University of Belgrade
Faculty of Organizational Sciences

XVI INTERNATIONAL SYMPOSIUM

2018 symorg

DOING BUSINESS IN THE DIGITAL AGE: CHALLENGES, APPROACHES AND SOLUTIONS

June 7 - 10, 2018
Congress center
Ratko Mitrović
ZLATIBOR, SERBIA

UNIVERSITY OF BELGRADE
FACULTY OF ORGANIZATIONAL SCIENCES

SYMORG 2018

Zlatibor, June 7-10, 2018

XVI INTERNATIONAL SYMPOSIUM

DOING BUSINESS IN THE DIGITAL AGE: CHALLENGES, APPROACHES AND SOLUTIONS

SYMPOSIUM PROCEEDINGS

Editors:
Nevenka Žarkić Joksimović, Ph.D.
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Zlatibor, 2018

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

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Barbara Simeunović, Ph.D., Minja Marinović

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

Year
2018

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

CIP - Каталогизација у публикацији -
Народна библиотека Србије, Београд

005:004(082)(0.034.2)
658:004(082)(0.034.2)
004.738.5:658(082)(0.034.2)

INTERNATIONAL symposium SymOrg 2018 (16 ; 2018 ; Zlatibor)
Symposium proceedings [Elektronski izvor] / XVI International symposium Doing Business in the Digital Age: challenges, approaches and solutions SymOrg 2018, Zlatibor, June 7-10, 2018 ; [organised by] Faculty of organizational sciences ; editors Nevenka Žarkić Joksimović, Sanja Marinković. - Belgrade : Faculty of organizational sciences, 2018 (Smederevo : Newpress). - 1 elektronski optički disk (CD-ROM) : tekst, slika ; 12 cm

Sistemski zahtevi: Nisu navedeni. - Nasl. sa naslovnog ekrana. - Tiraž30.

ISBN 978-86-7680-361-3
1. Fakultet organizacionih nauka (Beograd)
a) Бизнис - Информациона технологија - Зборници b) Електронско пословање - Зборници c) Предузећа - Пословање - Информациона технологија - Зборници
COBISS.SR-ID 265822732

FOREWORD

Symorg is a symposium traditionally organized and hosted by the Faculty of Organizational Sciences – University of Belgrade ever since 1989 with the aim of profoundly adding to the current body of knowledge in the fields of management and information systems.

We are pleased to present the *Proceedings of the XVI International Symposium of Organizational Sciences - Symorg2018* with the double-blind peer-reviewed papers presented at the Symposium. Following almost three decades of tradition in organizing this Symposium, participants had an opportunity to share and exchange their knowledge and experiences in a highly creative environment.

The main topic of this Symposium was the transformation of business affected by the digitalization. Accordingly, we named it 'Doing Business in the Digital Age: Challenges, Approaches and Solutions'. Simultaneously with 14 different tracks related to the main topic, the Symposium included four round tables, one project-related workshop and an undergraduate case study hackathon competition.

It seems that today more than ever before, we are witnessing major changes in business operations of many organizations. This Symposium aimed to provide the answers to a myriad of problems arising from new business models created by blurring the lines separating the digital and the physical world. As new disruptive technologies and ever-changing needs of important business stakeholders reshape the world of business, digital transformation becomes almost a necessity. Our ambition was to create new visions and catalyze this transformation.

The Proceedings are the result of an extraordinary effort made by the authors, reviewers, track moderators and the Symposium organizers. All the accepted papers in the Proceedings are organized in the following 14 sections:

- Leveraging Technology in Digital Business
- Management in the Digital Age
- Data Processing and Analytics in the Digital Age
- Organization and Business Models in the Digital Age
- Quality and Business Excellence
- Transformation of Financial Services
- Digital Trends in Marketing and Strategic Communications
- Technology Entrepreneurship and Ecosystem
- Entrepreneurship and SME in the Digital Age
- Creativity, Innovation and Intellectual Capital in the Digital Age
- Human Capital in the Digital Environment
- Digital Public Administration
- Operations Management for a Digital World
- Environmental and Social Impact of Digitalization.

We would also like to thank all the institutions, associations, keynote speakers and individuals who supported and enriched the Symposium, especially the Ministry of Education, Science and Technological Development, sponsors, delegates and volunteers.

Belgrade, May 30, 2018

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CONTENT

LEVERAGING TECHNOLOGY IN DIGITAL BUSINESS 2

Mirjana Stojanović
GENERAL DATA PROTECTION REGULATION: IMPACT AND IMPLICATIONS ON MOBILE OPERATORS 3

Bojana Savić
TELECOM CRM EVOLUTION IN THE DIGITAL AGE 11

Jovanka Vukmirović, Aleksandra Vukmirović, Milica Branković
POTENTIAL OF IMPLEMENTATION OF ICT IN MARKETING SECTOR – SERBIAN PERSPECTIVE 19

Nataša Paunović, Nenad Aničić
MOBILE APPLICATION DEVELOPMENT FOR INTEROPERABLE LOYALTY MANAGEMENT SYSTEM 25

Jelena Mihajlović-Milićević, Zorica Bogdanović, Marijana Despotović-Zrakić
SAFE AGILE FRAMEWORK IN E-BUSINESS PROJECT MANAGEMENT 32

Boban Davidović, Dušan Barać, Božidar Radenković
DESIGNING A COLLABORATIVE FILTERING RECOMMENDATION SYSTEM IN E-COMMERCE 39

Nemanja Bošković, Sandro Radovanović, Milija Suknović
OVERVIEW OF TRAVEL DEMAND FORECASTING METHODS USING SEARCH ENGINE QUERIES 46

Miloš Živadinović, Dejan Simić
FRAMEWORK FOR VERIFYING DOCUMENTS ON THE BLOCKCHAIN 51

Miloš Milić, Vojislav Stanojević, Siniša Vlajić
IMPROVING ROBERT C. MARTIN'S STABILITY SOFTWARE METRIC 58

Anđela Pejanović, Nenad Aničić
ANALYSIS OF DYNAMIC CONTENT RENDERING IN JAVASCRIPT TECHNOLOGIES 66

Tamara Naumović, Stevan Milovanović, Svetlana Mitrović
DEVELOPMENT OF AN E-RECRUITMENT PORTAL USING MEAN STACK TECHNOLOGIES 76

Ivan Jezdović, Aleksandar Ivković
DEVELOPMENT OF AN IOT SYSTEM FOR FIRE-FIGHTING IN SMART HOMES 84

Nikola Cvetković, Minja Marinović, Nemanja Spajić
DEVELOPMENT OF A SMART AGRICULTURE AUTOMATION SYSTEM BASED ON INTERNET OF THINGS AND USE OF RASPBERRY PI 90

Luka Petrović, Danijela Stojanović, Aleksandra Labus
DEVELOPMENT OF AN EDUCATIONAL GAME: AUGMENTED REALITY APPROACH TO EDUTAINMENT 96

Tamara Gajić, Marija Lukić
DEVELOPMENT OF VIRTUAL SIMULATIONS FOR THE NEEDS OF MILITARY EDUCATION 108

MANAGEMENT IN THE DIGITAL AGE 114

Bisera Andrić Gušavac, Neda Đorđević, Biljana Panić
BENEFITS OF THE APPLICATION OF NETWORK PLANNING TECHNIQUE FOR RIVER MLAVA WATER COURSE 115

Dragan Bjelica, Danijela Toljaga-Nikolić
IT PROJECT MANAGEMENT MATURITY AND PROJECT MANAGEMENT KNOWLEDGE 123

Milica Grujić, Nemanja Minić
PLANNING PROCESS IMPROVEMENT IN RELATION TO BETTER RESOURCE MANAGEMENT 129

Dragana Kragulj, Sandra Jednak, Miloš Parežanin
IMPLEMENTATION OF DESI METHODOLOGY AND DIGITAL PERFORMANCES OF EUROPEAN UNION MEMBER STATES 136

Tatjana Kuzmić, Marina Davidović
GEOGRAPHIC INFORMATION SYSTEM – ONE STEP FORWARD IN THE DIGITAL AGE 144

Tanja Milić
DOING BUSINESS IN THE DIGITAL ECONOMY: SWOT MATRIX ENHANCEMENT FOR HIGHER ORGANIZATIONAL PERFORMANCE 152

Luli Miloš, Dejan Petrović, Marko Mihić
STRATEGIC LEADERSHIP IMPACT ON NEW ORGANIZATIONAL CULTURE: EVIDENCE FROM A FAMILY-OWNED SME 159

Zorica Mitrović, Dragan Bjelica, Milica Pavićević
THE UNDERLYING THEORY OF PROJECT MANAGEMENT - A SYSTEMATIC REVIEW AND RESEARCH AGENDA 167

Milica Pavićević, Đorđe Marović, Zorica Mitrović
KEY COMPETENCIES DETERMINING MANAGERIAL SUCCESS: PRIVATE AND PUBLIC SECTOR MANAGER'S PERSPECTIVE 173

Snežana Popovčić-Avrić, Marijana Vidas-Bibanja
THE IMPORTANCE OF DIGITAL TRANSFORMATION FOR A SUCCESSFUL BUSINESS OPERATIONS 181

Anja Veselinović, Vladimir Obradović, Marija Todorović
THE MANAGEMENT OF DISASTERS IN FUNCTION OF THE ECONOMY COMPETITIVENESS 188

DATA PROCESSING AND ANALYTICS IN THE DIGITAL AGE 196

Tijana Dragojević, Jovana Svičević, Sandro Radovanović
CLASSIFICATION OF LIFE INSURANCE USERS USING DATA MINING 197

Marija Kuzmanović, Dragana Makajić-Nikolić
PREFERENCES OF WINE CONSUMERS TOWARDS LOCAL WINE BRANDS: CASE OF SERBIA 204

Milica Maričić, Milica Bulajić, Marina Dobrota
EASE OF DOING BUSINESS AND GROSS DOMESTIC PRODUCT: IS THERE A RELATIONSHIP? 213

Ivana Ivković, Vesna Rajić
CONFIDENCE INTERVALS FOR THE POPULATION STANDARD DEVIATION: SIMPLE RANDOM SAMPLING VS. RANKED SET SAMPLING 221

Nikola Cvetković, Nebojša Dragović, Aleksandar Đoković
FIELD STRESS DETECTION ALGORITHM USING REMOTE SENSING 229

Nikola Zornić, Aleksandar Marković

CRYPTOCURRENCY PRICE FORECASTING USING TIME SERIES AND MONTE CARLO MODELINGAND SIMULATION 236
Nikola Vojtek, Ana Poledica, Bratislav Petrović
STATISTICAL AND SOFT COMPUTING TECHNIQUES IN AIRLINE INDUSTRY – A LITERATURE REVIEW 244
Jovana Kuljanin, Milica Kalić, Manuel Renold
THE IMPACT OF LOW COST CARRIER ON COMPETITION IN LONG HAUL MARKET: LONDON - NEW YORK ROUTE 252
Strahinja Radaković, Milan Radojičić, Milica Maričić
MULTIVARIATE APPROACH TO MAKING SPONSORSHIP DECISIONS: THE CASE OF EUROPEAN FOOTBALL LEAGUES 260
Marko Prodanović, Damjan Rovinac, Stefan Radibratović
MEASURES OF DIGITALIZATION IN EUROPEAN ENTERPRISES: LINEAR REGRESSION MODEL 268
Višnja Istrat, Dajana Matović, Milko Palibrk
RESEARCH OF ASSOCIATION RULES AS DECISION MAKING TOOL FOR MANAGERS 274
Boris Delibašić, Sandro Radovanović, Miloš Jovanović
SKI LIFT TRANSPORTATIONS AS PREDICTORS FOR INJURY OCCURRENCE 279
Anja Bjelotomić, Aleksandar Rakićević, Ivana Dragović
DECISION TREE-BASED ALGORITHM FOR THE CLASSIFICATION OF MUSICAL INSTRUMENTS 284
Slaviša Arsić, Dragan Pamučar, Milija Suknović
DETERMINING THE WEIGHTS OF CRITERIAIN MENU EVALUATION USING BEST-WORST METHOD 292
Stefan Vujović, Danijel Mišulić, Sofija Krneta
ANALYSIS AND PREDICTIONOF VIEWSIN YOUTUBE INTERVIEWS 298
Matija Milekić, Aleksandar Rakićević, Pavle Milošević
NEURAL NETWORKS IN MARKET SENTIMENT ANALYSIS FOR AUTOMATED TRADING: THE CASE OF BITCOIN 305
Dušica Stepić
EXPERIMENTALCOMPARISON OF MULTI-LABEL LEARNING METHODS 313
Ivan Rakić, Željana Milošević, Slađan Babarogić
DATA MINING USING ORACLE DATA MINER AND ANALYTIC FUNCTIONS WITH HADOOP 320
Jelena Ljubenović, Ognjen Pantelić, Ana Pajić Simović
BIG DATA ANALYSIS IN SOCIAL MEDIA 329
Sofija Prokić, Jelena Ljubenović
QUERY PROCESSING ASPECT IN HETEROGENEOUS DBMS 336

ORGANIZATION AND BUSINESS MODELS IN THE DIGITAL AGE 347

Dušan Mežnar
RESTRUCTURING THE COMPANIES BY IMPLEMENTING PROCESS OF DIGITALIZATION 348
Bojan Jovanović, Momčilo Kujačić, Nikola Trubint
POSTAL OPERATORS IN A DIGITAL WORLD 354
Matjaž Roblek, Benjamin Urh
LINKING PROCESS COMPLEXITY INDICATORS AND PROCESS PERFORMANCE INDICATORS 360
Nina Đurica, Maja Đurica, Ivan Todorović
THE ROLE OF FACEBOOK IN BUSINESS MODELS ANDINCREASING COMPETITIVENESS OF HIGHER EDUCATION INSTITUTIONS 365
Tea Dabetić, Mladen Čudanov, Ondrej Jaško

MATRIX ORGANIZATIONAL STRUCTURE AND MULTI-SIDED PLATFORM BUSINESS MODEL IN DIGITAL MARKETING 371
Tihomir Spremo, Momir Lazarević
THE IMPORTANCE OF THE NETWORK ORGANIZATIONAL MODEL FOR BUSINESS OF COMPANIES IN THE REPUBLIC OF SRPSKA 379
Jovan Krivokapić, Miloš Jevtić, Stefan Komazec
CONSULTING APPROACHES TO THE ORGANIZATIONAL CHANGE PROCESS 387
Vuk Mirčetić
AUTHENTIC LEADERSHIP: CONCEPTUALIZING AND DEVELOPMENT 394

QUALITY AND BUSINESS EXCELLENCE 401

Ivana Mijatović, Biljana Tošić, Milan Jovanović
ACQUIRING THE KNOWLEDGE ABOUT STANDARDS IN THE DIGITAL ERA – CASE OF SMEs OPERATING IN SERBIA 402
Milan Dronjak
SMART STANDARDIZATION 408
Dragana Rošulj, Gordana Pejović
MODEL FOR APPLICATION OF THE BUSINESS CONTINUITY MANAGEMENT SYSTEM IN HIGHER EDUCATION INSTITUTIONS 414
Đorđe Lazić, Tamara Mitrović
INFLUENCE OF SOME ASPECTS OF DISTANCE LEARNING ON QUALITY OF STUDYING 422
Jovan Stokić, Aleksa Sekulović, Mladen Đurić
OVERVIEW AND FUTURE OF QUALITY MANAGEMENT CONCEPTS IN ADDITIONAL AIRLINE SERVICES IMPROVEMENT 430
Ana Čobrenović, Milica Rajković, Mladen Đurić
RISK MANAGEMENT INTEGRATION THROUGH ISO 9001:2015, ISO/IEC 27001:2013 AND ISO 22301:2012 STANDARD REQUIREMENTS 438
Dejan Hadži-Milosavljević, Jovan Filipović
THE SOFTWARE IMPLEMENTATION OF THE PROTECTION MEASURES OF INFORMATION IN THE BANKING INFORMATION SYSTEM 446
Gordana Pejović, Biljana Tošić, Jelena Ruso
BENCHMARKING AS THE QUALITY MANAGEMENT TOOL FOR THE EXCELLENCE ASSESSMENT OF MEDICINES REGULATORY AUTHORITIES IN EUROPE 456
Tamara Jakovljević
QUALITY OF LIFE AND DIGITAL TRANSFORMATION IN HEALTHCARE 463
Nedeljko Živković, Maja Glogovac, Ana Horvat
PUBLIC ADMINISTRATION QUALITY DETERMINED BY CUSTOMER-RELATED CAF MODEL 472

TRANSFORMATION OF FINANCIAL SERVICES 479

Vesna Bogojević Arsić, Milica Latinović
ALTERNATIVE ONLINE FINANCE: CROWDFUNDING AND ICO 480
Tijana Obradović, Milica Latinović, Veljko Dmitrović
HE WHO DARES WINS: NEUROFINANCE APPROACH TO FINANCIAL DECISION-MAKING 485
Milos Milosavljević, Nemanja Milanović, Nevenka Žarkić Joksimović
PLATFORM BANKING: EMPIRICAL EVIDENCE ON CUSTOMER EXPECTATIONS AND ACCEPTANCE 490

Milenko Radonić
PAYMENT PROCESSING IN WEB BASED ENVIRONMENTS: THE BENCHMARK OF THE WORLD'S LEADING PAYMENT PROCESSORS 496

Davor Vašiček, Josip Čičak, Ana Marija Sikirić
ACCOUNTING FOR EXPECTED CREDIT LOSSES – CROATIAN CASE 505

Nela Milošević, Slađana Barjaktarović Rakočević, Miloš Savić
SME FINANCIAL OPPORTUNITIES 510

DIGITAL TRENDS IN MARKETING AND COMMUNICATION 520

Slavica Cicvarić Kostić, Arsenije Ivanović, Milan Okanović
INFLUENCER MARKETING IN A SOCIAL MEDIA CONTEXT 521

Željko Dudić
ANALYSIS OF THE GLOBAL ELECTRONIC RETAIL MARKET 527

Slađana Đurić
CASE STUDY: AIRBNB SOCIAL MEDIA CAMPAIGN 533

Radmila Janičić
CHALLENGE OF HOLISTIC MARKETING IN ARTISTIC PROJECTS 542

Tijana Jugović, Milena Šćekić, Nino Ćorlić
INTEGRATION OF PERFORMANCE INDICATORS FOR DIGITAL AND TRADITIONAL ADVERTISING 547

Milica Kostić-Stanković, Valentina Vukmirović, Tatjana Cvetkovski
TENDENCIES OF CONTEMPORARY MARKETING COMMUNICATION IN DIGITAL ENVIRONMENT 553

Ana Langović, Milica Kostić-Stanković, Dejana Nikolić
SPECIFICS OF DIGITAL ASPECTS IN CREATIVE INDUSTRIES 562

Milica Matić, Gordana Jakić
CHANGING THE MARKETING TERMINOLOGY IN DIGITAL AGE 569

Marija Mićović, Branka Novčić Korać
BUILDING DIGITAL BRAND AWARENESS FOR KFC SERBIA 575

Sara Milošević, Branka Novčić Korać
CASE STUDY: DIGITAL STORYTELLING IN BRAND MANAGEMENT OF MOXY HOTELS 584

Miroslav Mitrović
INFLUENCE OF COMPUTING MODEL ON PUBLIC OPINION-DYMATICA, DIGITAL COMPUTING SYSTEM FOR MANAGEMENT OF PUBLIC OPINION 592

Dejana Nikolić, Slobodan Vasilić, Azra Tibo
INTEGRATION OF ONLINE AND OFFLINE COMMUNICATION ACTIVITIES IN EVENT MANAGEMENT 598

Milan Okanović, Tijana Smiljić, Slavica Cicvarić Kostić
THE ANALYSIS OF CONTENT USED IN POLITICAL CAMPAIGNS:DOES CONTEXT MATTER? 603

Selena Radović, Tamara Vlastelica
THE SYNERGY OF SALES PROMOTION AND ONLINE ADVERTISING IN AFFECTING FMCG CONSUMER BEHAVIOUR 609

Milica Slijepčević, Ivana Radojević
CURRENT TRENDS IN DIGITAL MARKETING COMMUNICATION 618

Milica Stevanović, Milica Tešić, Marija Jović
DIGITAL MARKETING STRATEGY FOR HEALTHY FOOD INDUSTRY 624

Miloš Subotić, Teodora Lolić, Darko Stefanović
MULTIPLE SWARMS ARTIFICIAL BEE COLONY ALGORITHM APLIED ON RETAIL SHELF SPACE ALOCATION PROBLEM 631

Jelena Veinović Stevanović

NEUROMARKETING IN ADVERTISING TODAY 638
Tamara Vlastelica, Tamara Veselinović
SEARCH ENGINE OPTIMIZATION STRATEGY IN PERSONAL ONLINE REPUTATION MANAGEMENT 641
Valentina Vukmirović, Zoran Tomić, Velimir Štavljanin
TENDENCIES IN DIGITAL MARKETING COMMUNICATION WITH SPECIAL OVERVIEW OF GENERATION Y MEMBERS IMPACT 648

TECHNOLOGY ENTREPRENEURSHIP AND ECOSYSTEM 657

Maja Levi Jakšić, Jovana Rakićević, Ondrej Jaško
COMPETITIVE INNOVATION AND ENTREPRENEURSHIP ECOSYSTEM FRAMEWORK 658
Jovana Rakićević, Maja Levi Jakšić, Nina Ukropina
THE ROLE OF SUPPORT ORGANIZATIONS IN TECHNOLOGY ENTREPRENEURSHIP ECOSYSTEM: CASE OF SERBIA 666
Aleksandar Vekić, Jelena Borocki, Angela Fajsi
CREATING ENTREPRENEURIAL ECOSYSTEM THROUGH UNIVERSITIES SPIN OFF AND STARTUP COMPANIES - EXAMPLE OF THE UNIVERSITY OF NOVI SAD 675
Milica Jovanović, Miloš Jevtić, Jasna Petković
THE ROLE OF CULTURE IN ENTREPRENEURIAL ECOSYSTEM: WHAT MATTERS MOST? 683
Goran Kutnjak, Dejan Miljenović, Ana Obradović
DIMENSIONING THE CONTEXT OF CORPORATE SOCIAL RESPONSIBILITY 692
Nikola Mehandžić, Sanja Marinković
APPLICATION OF BIOMETRIC TECHNOLOGY IN ELECTRONIC PAYMENT AUTHENTICATION 700

ENTREPRENEURSHIP AND SME IN THE DIGITAL AGE 719

Bojana Jeremić, Jasmina Omerbegović-Bijelović
MODEL OF FUNCTIONING OF INTERNAL ENTREPRENEURSHIP INPUBLIC ENTERPRISES OF THE REPUBLIC OF SERBIA 710
Marina Jeremić, Jasmina Omerbegović-Bijelović
AN APPROACH FOR MANAGING SMEs BASED ON KPIs IN STARTING PHASE OF COMPANY'S LIFE CYCLE 720
Nikola Atanasov, Predrag Mirković, Vladimir Marinković
PLANNING OF THE ACTIVITIES OF THE FAMILY FIRM SUCCESSOR PREPARING IN SERBIA 731
Mirjana Jeremić, Zoran Rakićević
RESOURCE MANAGEMENT QUALITY OF SME IN THE FIELD OF FASHION AND DECORATIVE FABRICS RETAIL 743
Bojan Živadinović, Nikola Atanasov
PROBLEMS WITH RESOURCES MANAGEMENT IN CATERER-SME IN THE DIGITAL AGE 751
Ivana Zdravković, Vesna Cakeljić, Jelena Krstić
EDUCATION PERFORMANCE INDICATORS FOR ENTREPRENEURSHIP IN THE SECONDARY SCHOOLS OF SERBIA AND IN THE WORLD 762
Nemanja Backović, Bojan Ilić, Vesna Milićević
BUSINESS ASPECTS OF PUBLIC-PRIVATE PARTNERSHIP IN DIGITAL ECONOMY ENVIRONMENT 771
Marko Miletić
INTRODUCTION OF THE NEW SERVICE ON SERBIAN TELECOMMUNICATION MARKET: VIRTUAL PHONE NUMBER 778

CREATIVITY, INNOVATION, AND INTELLECTUAL CAPITAL IN THE DIGITAL AGE 784

Biljana Stošić, Dragan Vasiljević, Radul Milutinović
THE ROLE OF INTELLECTUAL PROPERTY DIAGNOSIS IN INNOVATION PROCESS 785

Ognjen Žarić, Jelena Borocki, Aleksandar Vekić
THE ROLE OF HUMAN CAPITAL IN THE FUNCTION OF THE INNOVATION POTENTIAL OF THE REPUBLIC OF SERBIA 792

Maria Serena Angelini, Alessandro Gennaro, Simone Labella
DISCLOSURE ON INTELLECTUAL CAPITAL IN THE AGE OF INDUSTRY 4.0: EVIDENCE FROM ITALIAN CAPITAL MARKET 799

Biljana Bajić, Biljana Stošić
AGILE APPROACH IN INNOVATIVE MEDICINE DEVELOPMENT 807

Đuro Kutlača, Lazar Živković, Dušica Semenčenko
INNOVATION ACTIVITIES AND COMPETITIVENESS OF THE COMPUTER PROGRAMMING SECTOR IN SERBIA 816

Dijana Štrbac, Đuro Kutlača
INNOVATION ACTIVITY IN SERBIAN ENTERPRISES 823

Mirjana Miljanović, Ilinka Unković, Milimir Vasiljević
THE IMPORTANCE OF USING DIGITAL COMMUNICATIONS WITHIN CREATIVE INDUSTRY 831

William Proud, Vesna Damnjanović
THE EFFECTS OF BUSINESS CASE STUDY COMPETITIONS AS A TEACHING METHODAUTHENTIC LEADERSHIP: CONCEPTUALIZING AND DEVELOPMENT 837

HUMAN CAPITAL IN THE DIGITAL ENVIRONMENT 844

Bojana Sokolović, Ivana Katić
IMPORTANCE OF THE ORGANIZATIONAL CULTURE IN THE DIGITAL AGE BUSINESS 845

Željko Gajić, Zoran Jeftić, Ljupča Stojanović
ANALYSIS AND FORECASTING IN THE ERA OF BIG DATA 853

Željko Pešut
VIRTUAL IDENTITY ON SOCIAL NETWORKS – NEGATIVE ASPECTS 860

Stefan Ramljak, Milena Popović, Gordana Savić
THE EFFICIENCY OF HIGHER EDUCATION STUDENT MOBILITY PROGRAMMES IN EUROPE IN 2015 865

Dejana Pavlović, Vladimir Obradović, Marija Todorović
DISPARITIES AMONG YOUTH LABOUR IN SERBIA 872

Ivana Milinković, Ivana Kovačević
VIRTUAL VERSUS TRADITIONAL TEAMS: TEAM DYNAMICS AND TEAM MEMBERS NEED SATISFACTION IN A LEARNING ENVIRONMENT 879

Jasmina Žnidaršič, Miha Marič
RELATIONSHIP BETWEEN WORK-LIFE BALANCE AND WORK ENGAGEMENT AMONG HIGHER EDUCATION LECTURERS 887

Arturo Lavalle
FACING INDUSTRY 4.0 COMPETENCES DEMAND: THE IMPORTANCE OF TRAINING OF TRAINERS 895

Jovana Jovanović, Tatjana Ivanović
CHALLENGES FEMALE EXPATRIATES FACE ON INTERNATIONAL ASSIGNMENTS 903

Nikola Petrović, Jelena Anđelković Labrović, Mateja Sela
THE USE OF LEARNERS ENGAGEMENT DATA FOR REPORTING: CLUSTER ANALYSIS 908

DIGITAL PUBLIC ADMINISTRATION 915

Sašo Matas
EFFECTS OF THE USE OF ELECTRONIC AUCTIONS ON PUBLIC PROCUREMENT EFFICIENCY: CASE OF SLOVENIA 916

István Hoffman, Kristóf Balázs Cseh, Andrea Jugovics
E-ADMINISTRATION AND THE MUNICIPAL AUTHORITIES: THE CASE OF THE HUNGARIAN LARGE MUNICIPALITIES 924

Mária Murray Svidroňová, Nikoleta Muthová, Nikola Štefanišinová
INNOVATIVE WAYS OF CITIZEN PARTICIPATION IN SOLVING MARKET FAILURE 932

David Póč
PUBLIC POLICIES STRATEGIC MANAGEMENT AT THE REGIONAL LEVEL – MYTH OR REALITY? 941

Ivan Todorović, Stefan Komazec, Đorđe Krivokapić
KNOWLEDGE OF THE EUROPEAN UNION REGULATIONS ON PUBLIC PROCUREMENT AT THE LOCAL LEVEL IN SERBIA 949

Slađana Benković, Dejan Stanković
FINANCIAL MANAGEMENT CAPACITY BUILDING IN PUBLIC ADMINISTRATION BY UPGRADING KNOWLEDGE OF EMPLOYEES IN AREA OF INFORMATION-COMMUNICATION TECHNOLOGIES 956

Ernad Kahrović, Veljko Dmitrović, Zenaida Šabotić
PUBLIC MANAGEMENT: COMPARATIVE ANALYSIS OF THE APPLICATION OF THE PARTICIPATIVE BUDGET CONCEPT IN THE COUNTRIES OF THE FORMER YUGOSLAVIA 964

Miloš Milosavljević, Kristina Đurić, Jasmina Dlačić
THE EFFICIENCY OF ONLINE CONTENT IN POLITICAL CAMPAIGNS 973

Tatjana Stojadinović, Ilija Antović
DIGITAL TRANSFORMATION IN PHARMA INDUSTRY 980

Rajko Ković
THE ROLE OF OUTSOURCING IN IMPLEMENTATION OF PUBLIC-PRIVATE PARTNERSHIP CONCEPTS 988

OPERATIONS MANAGEMENT FOR A DIGITAL WORLD 995

Bojan Lalić, Darija Medvecki, Uglješa Marjanović
SERVICE MANAGEMENT IN MANUFACTURING: EVIDENCE FROM SERBIA 996

Dragan D. Milanović, Ilija Tabašević, Mirjana Misita
THE MANAGING OF THE TEMPERATURE MAPPING PROCESS OF THE WAREHOUSE 1002

Slobodan Morača, Marko Milosavljević, Angela Fajsi
VIRTUAL TEAMS: CONSTRAINS AND CHALLENGES 1010

Biljana Cvetić, Miloš Danilović, Oliver Ilić
AN APPROACH TO EVALUATING GOODNESS OF HEURISTIC SOLUTIONS IN MANUFACTURING CELL FORMATION 1014

Miljan Kalem, Danica Lečić-Cvetković
APPLICATION OF TYPIZATION AND STANDARDIZATION IN ACOMPANY FOR THE PRODUCTION OF PANEL FURNITURE 1021

Milena Stojković, Teodora Rajković, Danica Lečić-Cvetković
SAP APO APPLICATION IN THE PRODUCTION PROCESS FROM AUTOMOTIVE INDUSTRY 1029

Ivan Tomašević, Dragoslav Slović, Dragana Stojanović
EXPLORING THE LIMITS OF LEAN IMPLEMENTATION IN ENGINEER-TO-ORDER

ENVIRONMENT: CASE STUDY 1036
Ivona Jovanović, Ivan Tomašević, Barbara Simeunović
WASTE ELIMINATION IN CONTEXT OF WORKPLACE CLOSURE AND STABILIZATION AND LEAN PRODUCTION 1043
Danica Savičić, Teodora Rajković, Slađan Babarogić
INFORMATION AND COMMUNICATION TECHNOLOGIES AS SUPPORT FOR INVENTORY CONTROL IN THE AUTOMOTIVE INDUSTRY 1051
Lena Đorđević, Uroš Jeremić, Slobodan Antić
SPREADSHEET APPLICATION AND ALTERNATIVE DEVELOPMENT DIRECTIONS FOR A DIGITAL AGE 1059
Zoran Rakićević
THE S&OP: PRACTICAL AND ADVANCED MID-TERM PRODUCTION PLANNING 1066
Marija Unterberger, Dragana Šarac, Spasenija Ožegović
DEVELOPMENT OF A MODEL FOR DETERMINING THE NUMBER AND PLACEMENT OF ACCESS POINTS TOTHE PUBLIC POSTAL OPERATOR NETWORK 1074

ENVIRONMENTAL AND SOCIAL IMPACT OF DIGITALIZATION 1083

Nenad Badovinac
ANDROID APPLICATION FOR RECORDING SIGNED CONSENTS FROM GDPR REGULATION 1084
Nedeljka Živković
DIGITAL AGE AND SUSTAINABILITY OF THE ENVIRONMENT IN THE FIELD OF HIGHER EDUCATION 1089
Jovan Parušić , Uroš Šošević, Dejan Stojimirović
DIGITAL DISRUPTION OF AGRICULTURE 4.0 1097
Davorin Žnidarič, Marjan Senegačnik, Drago Vuk
ENVIRONMENTAL AND LOGISTIC ASPECTS OF INTRODUCTION OF ELECTRIC AUTOMOBILE 1104
Tijana Milanović , Gordana Mišev, Maja Milanović
E-WASTE MANAGEMENT: ENVIRONMENTAL AND SOCIAL IMPACTS 1113
Nikoleta Šarenac, Marko Ćirović, Nataša Petrović
ENVIRONMENTAL AWARENESS, ATTITUDES AND CAUSAL BEHAVIORAL PATTERNS: AN OVERVIEW WITH A GLANCE AT ENVIRONMENTAL IMPACTS OF DIGITAL ERA 1122
Nataša Plavša, Nataša Čačić, Jovana Pupovac
IMPLEMENTATION OF MODERN TECHNOLOGIES IN TRAFFIC AND THEIR CONTRIBUTION TO THE PROTECTION OF THE ENVIRONMENT 1129
Ismar Velić
INFLUENCE OF FOREIGN DIRECT INVESTMENTS ON THE ENVIRONMENT 1135
Nikola Vujanović
INVESTMENT IN RENEWABLE ENERGY SOURCES - ANALYSIS AND ASSESSMENT OF JUSTIFICATION 1143
Golub Marković
PAPER AND MUNICIPAL WASTE MANAGEMENT IN THE REPUBLIC OF SERBIA AND EU PRACTICES 1153

LEVERAGING TECHNOLOGY IN DIGITAL BUSINESS 2

Mirjana Stojanović
GENERAL DATA PROTECTION REGULATION: IMPACT AND IMPLICATIONS ON MOBILE OPERATORS 3

Bojana Savić
TELECOM CRM EVOLUTION IN THE DIGITAL AGE 11

Jovanka Vukmirović, Aleksandra Vukmirović, Milica Branković
POTENTIAL OF IMPLEMENTATION OF ICT IN MARKETING SECTOR – SERBIAN PERSPECTIVE 19

Nataša Paunović, Nenad Aničić
MOBILE APPLICATION DEVELOPMENT FOR INTEROPERABLE LOYALTY MANAGEMENT SYSTEM 25

Jelena Mihajlović-Milićević, Zorica Bogdanović, Marijana Despotović-Zrakić
SAFE AGILE FRAMEWORK IN E-BUSINESS PROJECT MANAGEMENT 32

Boban Davidović, Dušan Barać, Božidar Radenković
DESIGNING A COLLABORATIVE FILTERING RECOMMENDATION SYSTEM IN E-COMMERCE 39

Nemanja Bošković, Sandro Radovanović, Milija Suknović
OVERVIEW OF TRAVEL DEMAND FORECASTING METHODS USING SEARCH ENGINE QUERIES 46

Miloš Živadinović, Dejan Simić
FRAMEWORK FOR VERIFYING DOCUMENTS ON THE BLOCKCHAIN 51

Miloš Milić, Vojislav Stanojević, Siniša Vlajić
IMPROVING ROBERT C. MARTIN'S STABILITY SOFTWARE METRIC 58

Anđela Pejanović, Nenad Aničić
ANALYSIS OF DYNAMIC CONTENT RENDERING IN JAVASCRIPT TECHNOLOGIES 66

Tamara Naumović, Stevan Milovanović, Svetlana Mitrović
DEVELOPMENT OF AN E-RECRUITMENT PORTAL USING MEAN STACK TECHNOLOGIES 76

Ivan Jezdović, Aleksandar Ivković
DEVELOPMENT OF AN IOT SYSTEM FOR FIRE-FIGHTING IN SMART HOMES 84

Nikola Cvetković, Minja Marinović, Nemanja Spajić
DEVELOPMENT OF A SMART AGRICULTURE AUTOMATION SYSTEM BASED ON INTERNET OF THINGS AND USE OF RASPBERRY PI 90

Luka Petrović, Danijela Stojanović, Aleksandra Labus
DEVELOPMENT OF AN EDUCATIONAL GAME: AUGMENTED REALITY APPROACH TO EDUTAINMENT 96

Tamara Gajić, Marija Lukić
DEVELOPMENT OF VIRTUAL SIMULATIONS FOR THE NEEDS OF MILITARY EDUCATION 108

GENERAL DATA PROTECTION REGULATION: IMPACT AND IMPLICATIONS ON MOBILE OPERATORS

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Abstract: *The EU General Data Protection Regulation significantly expands the rights of the individuals related to the data privacy. At the same time, it defines the new obligations and responsibilities of the companies collecting and processing personal data. The goal of this paper is to provide the analysis of the new regulation in the context of mobile operators' business. It summarizes the main challenges and identifies the main steps for the practical implementation of the compliance. Finally, it emphasizes the potential for the different business benefits if the compliance to the new regulation is implemented in a correct way.*

Keywords*: GDPR, mobile operators, personal data, data privacy*

1. INTRODUCTION

Expansion of the digital services which has been happening last years in the different industries has led to the enormous amount of the data related to the users of those services, their habits, preferences, health, financial status, spending patterns and other personal information. For the digital services providers this set of data represents a potential for the highly personalized offering and consequently for a new business/new revenue. Furthermore, personal data became a tradeable asset in the digital economy ("new oil of Internet") and this emerging market of personal information raised a large number of economic, technical, social and ethical issues with particular concerns about privacy (Spiekermann, Acquisti, Böhme, & Hui, 2015).

After 4 years of debate, in April 2016, EU Parliament finally approved new General Data Protection Regulation. The EU General Data Protection Regulation (GDPR) replaces the Data Protection Directive 95/46/EC and was designed to harmonize data privacy laws across Europe, to protect and empower all EU citizens data privacy and to reshape the way organizations across the region approach data privacy ("Home Page of EU GDPR," n.d.). Enforcement date of the new regulation is 25th of May 2018. The GDPR expands the scope of data protection and the definition of personal data and every organization that collects and processes the data related to EU citizens must comply with it, no matter where they are based or where the data is stored.

This implies that organizations should adopt different internal measures that meet the principles of data protection by design and default (Tankard, 2016). Besides the technical/technological and organizational changes that are required, regulation related to the handling of personal data has its economic value and consequences (Acquisti, Taylor, & Wagman, 2016).

In the first part this paper provides a brief overview of the EU General Data Protection Regulation, reactions, and consequences that it has provoked and then focus particularly on the impact and implications that the GDPR has on mobile operators and their current and future business.

2. LEGAL FRAMEWORK

GDPR is intended to be a strong and coherent data protection framework in the EU, backed by strong enforcement, given the importance of creating the trust that will allow the digital economy to develop ("Regulation (EU) 2016/679 of the Euripean Parliament and of the Council,"n.d). Main actors which rights and obligations are defined by the regulation are the following:

- **Data Subjects** – Natural persons to whom apply the protection afforded by GDPR, in relation to the processing of their personal data
- **Data Controller** - A natural or legal person, public authority, agency, or other body which, alone or jointly with others, determines the purposes and means of the processing of personal data
- **Data Processor** - A natural or legal person, public authority, agency or other body which processes personal data on behalf of the controller ("Regulation (EU) 2016/679 of the Euripean Parliament and of the Council,"n.d).

The GDPR is applicable to:

- the processing of personal data by controllers and processors in the EU, regardless of whether the processing itself takes place in the EU or not
- the processing of personal data or monitoring of behaviour of data subjects in the EU regardless of whether as controller or processor is established in the EU or not.

Key principles and key changes comparing to the previous legislations addressing this matter are summarized in the rest of this chapter.

2.1. Rights of Data Subjects

In order to protect individuals and their personal data, GDPR defines the following ("Regulation (EU) 2016/679 of the Euripean Parliament and of the Council,"n.d):

Transparency and easier access to data (Right to access): Individuals must be allowed to get in an easy way the clear and understandable information on how their data is processed. This means that data subjects have the right to know which personal data concerning them is being collected and processed, where and for what purpose including the information about third parties to whom this data has been or will be disclosed. Furthermore, if requested, the controller shall provide a copy of the relevant personal data collected about the data subject, free of charge, in an electronic format. Controller may only charge for such a request in excessive cases.

Consent (Right to choose): Explicit consent of data subject's is required before processing of the sensitive data. Request for consent must contain the explanation of the purpose for data processing. Consent must be revocable and both giving and withdrawing the consent should be the data subject in an easy way. When the data subject is minor, parental approval is mandatory. The controller must be able to prove that the contest has been given.

Right to object: Data subject has the right to object to processing of his/her personal data on certain grounds, in addition to the right to object to processing for the purposes of profiling or direct marketing.

Right to change/rectify: Data subject has the right to update incomplete/incorrect details

Right to be forgotten: If an individual wants her/his data to be deleted, and if there is no legitimate basis for retaining and further processing it, the data must be erased.

Right to data portability: Individuals must be able to easily transfer the data between the different service providers (data processors/controllers).

Rights to be notified and compensated: Individuals must be notified in case of data breach which may have serious impact on them and have the right to be compensated for material and immaterial damages caused by non-compliant processing.

2.2. Accountability and obligations of the Data Processors and Data Controllers

While protecting and expanding the rights of the Data Subjects and increasing the level of control they have over their personal data, the new regulation is at the same time introducing direct obligations for the service providers in the role of data processors/data controllers, making them accountable for the GDPR-compliant way of working.

They have to implement appropriate technical and organizational measures to ensure that their products, services and internal business processes are designed following the data-protection principles (**Data protection by design)** and that by default, only personal data which are necessary for each specific purpose of the processing are collected, stored and processed (**Data protection by default)** ("Regulation (EU) 2016/679 of the Euripean Parliament and of the Council,"n.d).

Where a type of processing is likely to result in a high risk to the rights of data subjects (e.g. in case of particular new technologies or in case of automated processing which includes profiling), the controller shall, prior to the processing, carry out an assessment **(Data privacy impact assessment**) and undertake all the measures envisaged to address the risks, to ensure the protection of personal data and to demonstrate compliance to the GDPR ("Regulation (EU) 2016/679 of the Euripean Parliament and of the Council,"n.d).

Data processors/controllers are further obliged to maintain the records of all processing activities under their responsibility, to cooperate with supervisory authority and if a personal data breach occurs, to notify the

supervisory authority, not later than 72 hours after having become aware of it ("Regulation (EU) 2016/679 of the Euripean Parliament and of the Council,"n.d).

GDPR increases the power of the supervisory authority (regulator) and defines different corrective actions including penalties that regulator can apply towards data processors/controllers in case of non-compliance to the regulation. For serious infringements, a fine can go up to 20,000,000 EUR or up to 4% of the annual worldwide turnover of the preceding financial year, whichever is greater.

2.3. Reactions and interpretations

From one point of view, the GDPR is seen as the regulation that encourages digital transformation and represents a demand for effective data management practices and a holistic overview of all data held within a company which will enable a proactive cyber-security (Zerlang, 2017). From the others, some concepts are considered as already obsolete, inadequate, or controversial.

Concept that has been particularly commented is Data Protection/Privacy by Design. Two main remarks can be summarized as the following: it presents too abstract a framework to inform design; and it is often applied too late, i.e. after many critical design decisions have been already made in defining the business opportunity (Edwards, McAuley, & Diver, 2016).

Recommendations for the improvement goes from promoting a deeper understanding (R&D community, education, media, policy makers) and including privacy considerations in the standardisation process (Danezis et al., 2015) to the proposals to transform Privacy by Design approach to much wider Social Impact Assessment methodology with practical guidance to be applied at product/service concept stage as well as throughout the system's engineering (Edwards et al., 2016).

Conclusion that is common and indisputable is that the GDPR will force businesses to restore order to their operations and while it will deliver restrictions, it will also provide many benefits to businesses (Krystlik, 2017). In the process of achieving compliance, organisations will face many challenges, but at the same time many opportunities (Mansfield-Devine, 2016).

Remaining part of this paper analyse those challenges and opportunities in the case of mobile operator. (N.B. This analysis is limited to the data subjects using services of mobile operator and the protection of their privacy, not to the employees in the role of data subjects).

3. MOBILE OPERATORS AND PERSONAL DATA

Mobile network operator is a service provider of telecommunication services over wireless (mobile) network. In addition to the core telecommunication services as voice and data traffic, mobile operators are quite often including in their offer partner services (e.g. mobile payment of parking services).

Being in data controller/data processor role, mobile operator is collecting and processing huge amount of the data that according to the GDPR are considered as personal information. Besides two main identifiers, International Mobile Subscriber Identity (IMSI) and Mobile Subscriber ISDN Number (MSISDN), mobile users are associated with several others as name, physical address, personal ID, name of the company (in case of business users), etc. There are some other demographic data (age, gender...) that can be left voluntarily during the registration or interaction with the customer care, however most of personally identifiable information related to subscribers is collected or generated while providing the services.

One of the main relationships between the mobile operator and the end-user is billing relationship regardless the user's choice to pay before (prepaid) or after using the services (post-paid). Charging and billing data generated by corresponding network elements are very extensive and include different information about the call/message/data session as the time stamp, location and the mobile device used by end-user, called number, or visited site, streamed/downloaded content etc. In case of roaming there is an info about visited network, and consequently about the country visited by the end-user (data subject). To get better/cheaper rate plans, users often opt in for the packages which require explicit definition of the "favourite numbers", i.e. family, friends, community. Significant volume of the personal data can be generated during network monitoring activities or for statistical/analytical purposes.

Extensive set of collected data is mainly used for internal purposes: charging, billing, reporting, customer segmentation, campaign management, personalized offering, customer experience management, etc or unused at all. Disclosing of personal data to third parties might occur only in limited number of predefined

cases related to the legal obligations (e.g. lawful interception or emergency positioning) or in cases where subscriber has allowed/approved this either by opting in for partner services (e.g. mobile advertising) or by defining other subscriber(s) who can get a subset of his/her personal data (e.g. location).

During last years, users have become suspicious of the organizations that collect, store, and use their data. The primary concern of consumers is that organizations might sell their personal data to third parties without their consent. Decrease of trust happened in all segments, but it is much lower in communication services providers than in case of social media companies or digital disrupters (e.g. Uber). In emerging markets, communication services providers are still the most trusted organisations by consumers for handling personal data while in mature markets they are second to bank/credit cards companies (van den Dam, 2017).

3.1. GDPR compliance in case of mobile operators

The implementation of the GDPR indicates the need for various actions, planning, the assignment of new responsibilities and the acquisition of new expertise. The twelve aspects identified as the practical implications of the GDPR changes with the most relevance to all personal data intensive companies are summarized below (Tikkinen-Piri, Rohunen, & Markkula, 2017):

1. Specifying data needs and usage
2. Considering conditions for data processing in international context
3. Building privacy through data protection by design and default
4. Demonstrating compliance with GDPR requirements
5. Developing processes to deal with data breaches
6. Reckoning with sanctions for non-compliance
7. Designating a DPO (Data protection officer)
8. Providing information to data subjects
9. Obtaining consent on personal data usage
10. Ensuring individuals' right to be forgotten
11. Ensuring individuals' right to data portability
12. Maintaining documentation (Tikkinen-Piri et al., 2017).

Although mobile operators already follow much strict legislation than most of the other companies handling personal data, compliance to GDPR still imposes numerous challenges to them, mainly due to the number of systems manipulating subscribers' data and the diversity and complexity of the relations they have with the subscribers. Practical aspects of GDPR implementation specified above are hereafter analysed in the specific technical and business environment of the mobile operators and grouped within four action streams as outlined in the table below and explained in the following subchapters.

Table 1: GDPR implementation in case of mobile operators

Action Stream	Practical Aspects of GDPR implementation
New competence and new resources allocation	Designating a DPO, Developing processes to deal with data breach Reckoning with sanctions for non-compliance
Inventory of subscribers' personal data and subscribers' personal data handling processes	Specifying data needs and usage Demonstrating compliance with GDPR requirements Ensuring individuals' right to be forgotten Ensuring individuals' right to data portability Maintaining documentation
User interface and Consent management	Providing information to data subjects Obtaining consent on personal data usage Ensuring individuals' right to be forgotten Ensuring individuals' right to data portability Building privacy through data protection by design and default
Suppliers and partners management	Building privacy through data protection by design and default Considering conditions for data processing in international context

3.2. New competence and new resources allocation

First step in implementing GDPR compliance is to build and/or acquire the competence related to this matter. This is a prerequisite for performing data privacy impact assessment, the analysis of the gap between the current and GDPR-compliant implementation and to define new processes and procedures.

Procedures related to the possible data breaches must be defined, as the mobile operators have the obligation to notify regulators and the affected individuals (data subjects) about data breaches as early as

possible. All of this require a dedicated team responsible for defining data protection strategy and implementing measures and activities needed to ensure compliance with GDPR. A formal leading role for all data protection activities is the Data Protection Officer (DPO).

Besides the human resources, mobile operators must plan and allocate significant financial resources for the practical implementation of the GDPR and to calculate the financial risk exposure in case of non-compliance.

3.3. Inventory of subscribers' personal data and subscribers' personal data handling processes

In many of the current implementations, subscribers' personal data are collected, handled, and kept in separate silos (core network department, CRM/customer care, billing) without complete alignment between them, despite the existence of the centralized data warehouse system.

To be able to demonstrate GDPR compliance, operator must be able to prove that the subscribers' personal data are correctly handled, to verify that the processing flows are auditable at any time and to prevent loss of personal data, or loss of track of those personal data ("Enabling GDPR Compliance for Operators - TM Forum Project Charters Space - TM Forum Confluence," n.d.). To achieve this, operator must:

- identify the different platform and processes within those platforms which manipulate personal data
- identify the parties engaged into the processes
- identify the flows and directions
- identify the processes of each party
- define tools & processes to constantly keep updated those information for each platform ("Enabling GDPR Compliance for Operators - TM Forum Project Charters Space - TM Forum Confluence," n.d.).

Following the requirement for data minimisation, mobile operator must review and re-evaluate their current policies for the collection, generation, storage, processing, deletion, and disclosure to the third parties of the subscribers' personal data, to categorize the data that is collected and processed and to decide what is really needed for the business operations and for the lawful purposes. Personal data for which neither business nor legal justification cannot be found must be deleted. Important part of this process is to define the access policy to all the personally identifiable information/data that will remain and to separate the data set that is kept for legal purposes only in order to avoid that this information is accidentally processed in some other scenarios.

Making review and inventory of the subscribers' personal data, should also include review of the consents received so far. The way of performing customer segmentation or preparing personalized offering and targeting subscribers with them, should be revised in the context of GDPR clauses related to the profiling of data subjects.

Data model in this personal data inventory must be user-centric to secure that individuals' right to get a copy of his/her data or right to be forgotten and right to data portability can be satisfied in a correct and efficient way. Data model must include relationships between minors and parents/guardians.

3.4. User interface and consent management

Strict requirements related to the rights of individuals (data subjects) combined with variety of services from mobile operators' portfolio make the area of user interface and consent management the most demanding for the implementation of GDPR compliance.

The solution outlined by the global industry association (TM Forum) suggests the introduction of the Privacy Control Point which will provide ("Enabling GDPR Compliance for Operators - TM Forum Project Charters Space - TM Forum Confluence," n.d.)

User presentation - A central GDPR dashboard to support data transparency and clear and easy presentation of the personal data to the end user and interfaces to support inclusion of a dashboard in the existing (or new) omni-channel solution for the end-users' interaction.

Privacy and consent management – Individual user could have many services, including those that are not provided solely by the operator (i.e. partners' services). Consent requested and collected from the end-user must be at the individual service level and aligned with the user and service lifecycle.

Logging of all privacy related operations

API Access – controlled access to and exposure of subscribers personal data (including consents) either internally, i.e. within the operator's domain or externally, from/to partners domain ("Enabling GDPR Compliance for Operators - TM Forum Project Charters Space - TM Forum Confluence," n.d.).

Such an approach assumes the logical architecture based on "traditional" concepts, as APIs. Representative example is TMF644 Privacy management API which provides standardized mechanism for privacy profile types, privacy profiles and privacy agreements such as creation, update, retrieval, deletion and notification of events ("TMF644 Privacy Management API REST Specification R16.0.1 - TM Forum," n.d.).

The most challenging aspect of the scenario described above is to secure the data transparency and the right to withdraw the consent and/or erase the personal data in case of partner services. In the absence of a central logging facility that acts as a trusted third party, it can be extremely difficult to trace which partner organisations have accessed individual data sets (e.g. if partner further disclosed the data to another partner/3rd party) and to provide relevant information/response to an individual who requests information or action on his/her data.

Potential answer to this demand are solutions based on the latest file-distribution, blockchain and encryption technologies. In a purely decentralised peer-to-peer environment of equal partners, without requiring any centralised instance or further authorisation steps, the provider of data is empowered to trace the access to the data by partners in the distributed and shared data pool. This trace of access is without any doubt and cannot be denied (Roth, 2017).

Application of the blockchain technology in mobile network is still in a very early stage or "proof-of-concept" phase. To apply it in the live network and on commercially available services would be a crucial change and this would require close cooperation of the main industry players and regulators. However, the number of use cases in which mobile operator could benefit from the blockchain technology is constantly increasing (5G service enablement, IoT), thus this change might happen in the near future and the blockchain might become a long-term solution for the privacy and consent management.

3.5. Suppliers and partners management

Mobile operator is the primary contact point for the subscriber and from GDPR perspective accountable for proper handling of subscriber's personal data. However, the ecosystem in which mobile operator does the business, inevitably include different entities as suppliers and partners. There are different technical barriers which prevent operator to have the full control on how the subscribers' personal data are handled in the whole ecosystem (example given in the chapter 3.4), but from the legal perspective, operator can and should include GDPR related clauses and liabilities in all the agreements with the partners and suppliers.

Following the obligation for data protection by design and default, operators should include corresponding technical requirements in all requests for purchasing new equipment to ensure that the tools and support for privacy protection will be provided as a part of standard functionalities and not as customer specific adaptations/product customizations. This is especially valid for the new Business Support Systems (solutions that support customer-facing activities as billing, order management, customer relationship management, etc…) and Operations Support Systems (solutions that support back-office activities as operation of mobile network, provisioning and maintaining of customer services). Vendors/suppliers should have privacy impact assessment built into their product development lifecycle and should advise operators about the privacy impact of new technologies.

GDPR conditions for personal data transfers to a third country or an international organisation should be carefully evaluated in cases when companies acting as the providers of technical support or managed services to mobile operator, have their global service centres abroad. Before allowing export of any subscriber database or its part, that might be required as a part of operation and maintenance or troubleshooting processes, anonymisation or pseudonymisation of subscribers' personal data must be secured. (Pseudonymisation is the new concept introduced in GDPR, which refers to personal data processing in a way that the data cannot be attributed to a specific data subject without additional information ("Regulation (EU) 2016/679 of the Euripean Parliament and of the Council,"n.d).)

4. DISCUSSION

The EU General Data Protection Regulation demand from mobile operators to implement numerous technical, organizational, and procedural changes, to aquire new skills and to make significant financial investment. Still, it should be considered as a business opportunity, rather than a new obligation or a problem. If the GDPR related challenges are addressed by mobile operators in a proper way, this could bring them important business benefits summarized in the table below.

Table 2: Potential benefits of the GDPR implementation in case of mobile operators

Results of GDPR implementation (internal perspective)	**Potential business benefits**
Common user-centric data model	To simplify reporting and other business processes To reduce the risk of revenue leakage caused by misalignement between different subscriber databases
Removal of unnecessary data and of redundant data processing flows	To decrease operational costs
Clean inventory of subscribers' personal data Clear policies and procedures for handling subscriber data	To improve operational efficiency
Results of GDPR implementation (external perspective)	**Potential business benefits**
Demonstration of the GDPR compliance	To further strengthen the brend To improve customer satisfaction and loyalty To reduce churn and/or acquire new subscribers from the competitors To monetize the trust by developing and offering new digital services

4.1. Monetization of trust and new business opportunities

In the current circumstances, mobile operators worldwide are experiencing a decline in revenue from traditional services (voice and SMS) due to the increased usage of the communication services provided by OTT (Over-the-top) players like Skype, Viber, WhatsApp…By positioning themselves as the trusted communication services provider, mobile operators can justify the price of their services and further develop new digital business opportunities, including those in which they will offer to partners to leverage on their privacy protection infrastructure (e.g. privacy control point and corresponding API).

At the same time, telecommunications industry is preparing for the fifth generation (5G) of wireless technology which will significantly increase the speed and coverage and reduce the latency in mobile network. 5G is expected to play important role in the digitalization of the different industries, as manufacturing, automotive, agriculture, energy and utilities, public safety, healthcare, public transport, media, and entertainment etc. Evolution of mobile operator from the traditional provider of telco services to the digital enabler means that significant growth of IoT connections is expected, both in consumer and industrial segments. This opens the potential for the new revenue streams and at the same time, much broader concerns about privacy then in case of traditional telco services.

For the user centric and data centric 5G use cases to be accepted and to function as a viable business model, user trust in their data privacy is paramount (Khajuria & Skouby, 2017). As the protection of personal data will be very relevant for 5G adoption, all the efforts and investments that mobile operators make to achieve GDPR compliance could help them to monetize future 5G-enabled business opportunities.

5. CONCLUSION

This paper presents an overview of the new EU regulation related to the protection of personal data, with focus on implications it is going to have on the mobile operators and their business. It identifies the main steps to be done and even provides some ideas for implementation. Thus, it can be considered as a sort of guideline for the providers of telecommunications services who want to achieve GDPR compliance. Highlighted is the fact that the GDPR, if properly implemented, could bring several benefits to the mobile operators, and open the possibilities for improving their operations and capturing new revenue streams.

Possible future research associated to this topic can address the end-user expectations and concerns in terms of privacy in the 5G-enabled use cases and propose the way on how the mobile operators can respond to them sucessfuly.

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TELECOM CRM EVOLUTION IN THE DIGITAL AGE

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Abstract: *Telecommunication companies have great pressure for very fast adaption to new market conditions and new technologies in order to satisfy customers. Since customer became center of the telecom world, the topic processed in this paper is telecom customer relationship management in the digital era, challenges and possible solutions. This article shows analysis of market trends and common implementation of CRM systems in telecom companies and it gives an overview of key pain points in standard solutions. The purpose of the paper is to suggest a way for improvement CRM processes trough considering appropriate system architecture plan.*

Keywords*: customer relationship management, CRM, digital CRM, digital, telecommunication*

1. INTRODUCTION

Nowadays, telecommunication companies are part of an industry which grows very fast. Especially in the domain of mobile services where new technologies and products are changing the way of business, a way of communication, a way of living at all.

It is very clear by hart that there is more and more population using mobile phones and, in addition to that, statistics tell the same – at the end of 2017, there were around 5 billion mobile subscribers worldwide according to GSMA, with more than 50% subscribers using the mobile broadband network (3G/4G). Mobile data traffic, as the most important thing, today is based on broadband with really high speed. Even that will be changed soon by introducing 5G network. It has been expected that 5G will be commercially live in next few years and it will bring a situation where latency will be minimal or it will be no latency at all (for example, the surgeon would be able to run robotic glove in order to perform surgery on distance).

Telecommunication companies are in the middle of this storm and there is a big question for them: should this kind of company gives only connectivity to users and other companies or they can do something more. Everyone develops new strategies to take advantage of new potential customers and to have more than good customer retention program. Companies need to put a lot of effort on customer relationship management as a process, but also very important is to take care to have CRM tool which can fulfill all needs.

The goal of this paper is to analyze Serbian telecommunication market and to suggest a way for improvement CRM processes trough considering appropriate architecture. The more specific goal is to point out on weaknesses of common implementations of CRM tools and how new technologies can help.

2. CUSTOMER RELATIONSHIP MANAGEMENT

Customer relationship management (CRM) is an IT tool which allows the company to gather and analyze information about customers such as previous sales, answered and not answered calls to customer center, solved and not solved problems, active products and services (Nguyen, Sherif, & Newby, 2007). Collecting all this information has a purpose to keep the customer satisfied with current operator trough two simple steps (Ferdous & Rahaman, 2009):

- To use pattern and trends in order to offer the right product to the customer
- To create churn and behavioral prediction model

Facts which are listed in this paper point out that care about existing customers is the most important thing today. With proper care about existing customer, first of all, they will stay loyal to the operator and at the end will bring the revenue. The second one, through the word-of-mouth customers will recommend their operator to others. Living in the age of the Internet, word-of-mouth should not be neglected since all situations, good and bad, are spread through the network in seconds (Eunjin & Byungtae, 2005).

Revolution in IT brought us CRM tools where it is easy to define profitable and non-profitable subscribers, but not with the idea to let go non-profitable ones. Nowadays, customer retention programs are number one priority for mobile operators. CRM process and CRM tool should be modeled with special attention on a fact that today is social media age. Currently, technologies which make the difference in CRM are social media, especially social media free tools (Harrigan & Miles, 2014). A new way of CRM, digital CRM or e-CRM has a positive impact on customer loyalty which was researched by (Azila & Noor, 2011).

In probably all areas of industry, the center was moved from marketing and similar things to customer. The customer now is in the middle of all happenings. Empowering customers and putting them in the center has brought new challenges for customer relationship management (Lipiäinen, 2015).

Next chapters show detailed architecture common in the telecommunication industry, which reveals main pain points.

2.1. Traditional CRM

In telecommunication companies, there is one main split between systems: OSS and BSS. OSS or Operational Supporting Systems represents a group of systems and software that are used for managing firstly core network side, network infrastructure. On the other hand, BSS or Business Support Systems is a group of more IT systems with a role to support business processes and systems dealing with the customer directly. CRM tool usually belongs to Business System Support (BSS) stack. In BSS stack should count systems responsible for billing and charging, customer care, sales support, order fulfillment, dependent on implementation.

Till a few years ago in the industry of communication, it was considered that architecture should be billing centric. And it is true that for the majority of customers, things like rating, charging, invoicing was on the top of the list of priorities.

Traditional CRM in the past was a system which has only basic information about the customer and it was used as a kind of support to billing systems. There was no much attention to put information in one place and in a structured way, so agents on the first line can cope with every situation.

The following figure shows the very simplified architecture of BSS stack and role of CRM in it like it was common in last decade. Simplification in this view is necessary in order to focus on a problem pointed out in this paper.

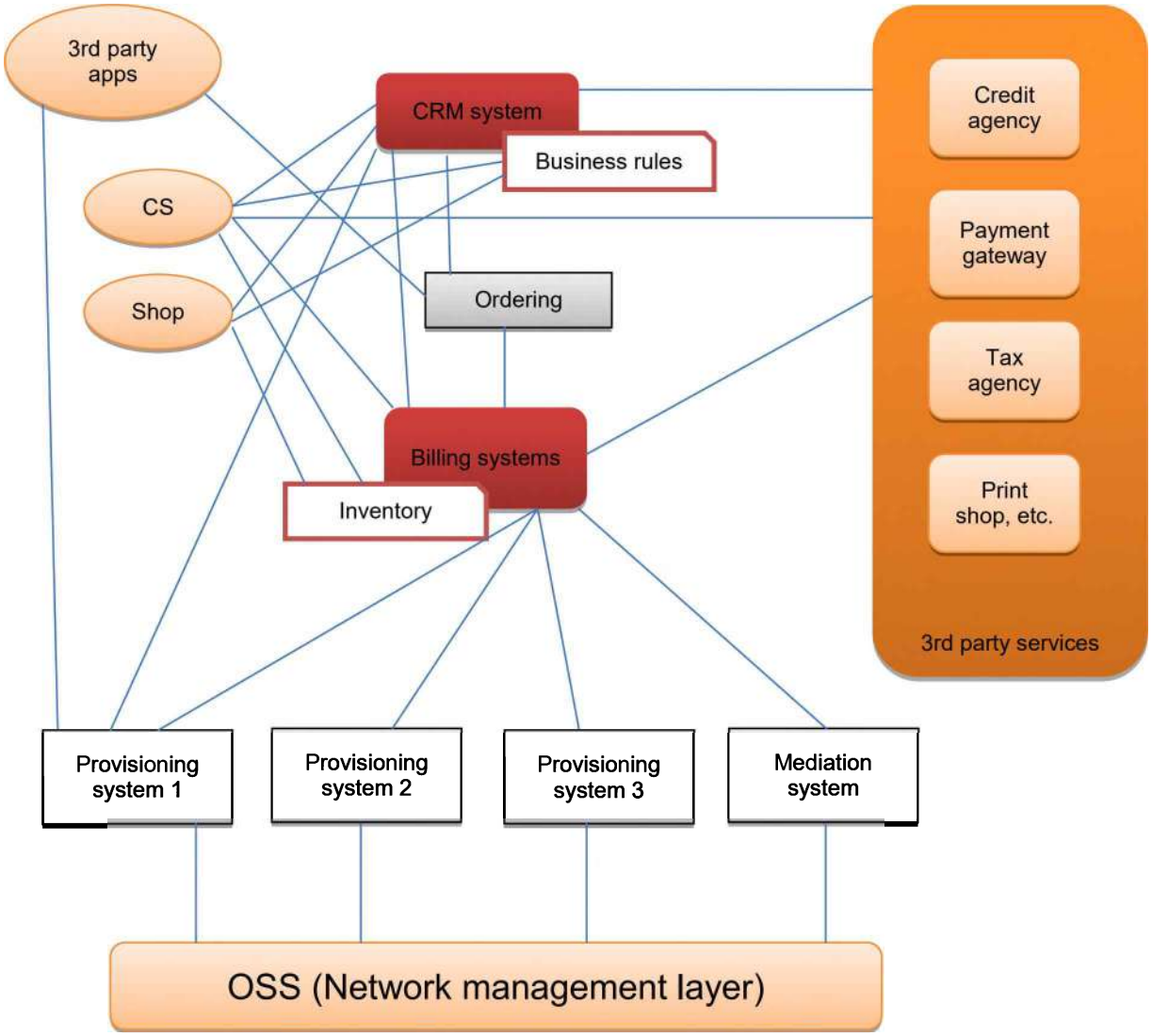

Figure 1: Presentation of simplified common traditional BSS architecture in TelCo

This kind of implementation was good in past years since customer need was to come to shop or call customer service and get information or activate services. But already some time this architecture is completely unsustainable since, firstly, there are more channels for interaction with the customer. Customer needs are higher but this set up is bad for few general reasons:

- High costs for maintaining
- No clear definition of which functionality belongs where
- Integration was done per case trough time which led to, so-called, spaghetti architecture
- Silo architecture is present meaning that each system functions for itself
- Processes are not and cannot be automated which means high manpower costs
- Double work is highly present, as well as duplication of systems, functionalities, and data
- Time to market is very low
- Bad customer experience and customer service

Also, there are more specific reasons why this architecture is not usable anymore. For example:

- Inventory is on billing system as the central point. That causes that billing systems need to be very responsive and scaled for a huge number of calls from external systems, like CRM
- Inventory can be synchronized back to CRM in order to lower pressure on the billing system, but in that case, there is no real-time information about customer actions or customer state at all
- Bad information modeling is present since each system has own database with same data but in a different form

The situation in a big and complex company, such are companies in the telecom industry, became that it is easier to drop off the whole stack of systems and build completely new ones. The idea of upgrading and adding new functionalities is a nightmare. Every new functionality, even a small change in one system

usually means changes on surrounding systems, too. But systems cost millions and there is no that company that can afford often replacement of these systems.

2.2. Digital CRM

The term "digital CRM" is actually a concept which is incorrectly formulated. There is no such thing as digital CRM. Everything is digital in modern systems. By this term, usually, it is considered content in digital form and a way of communication with customers and other stakeholders. CRM could be considered as a tool for the process of digitizing all gathered information about the customer (Nguyen et al., 2007). The majority of information today is on social networks. Successful social CRM implies that traditional CRM should be upgraded and extended in a way to cover social networks (Harrigan, Soutar, Choudhury, & Lowe, 2015).

The main goal for existing telecommunication companies should be to put the customer in the center and to adopt customer care in a way where all parts would be satisfied – company, employees and customers.

The worldwide market situation has been changed on several fronts:

- A new technology appears almost every day. Those technologies can help in daily business but it is not always true. In order to be competitive and innovative, companies need to afford themselves to put human resources in research and development of prototypes. Not every new thing is good, neither applicable to the business of the company.
- Customers want something more, something new. They want personalized approach and that everything can be done online and fast, for the start.
- Since the market is very saturated and there are no much more new things to offer in simple communication, companies need to figure out new revenue streams. Usually, those revenue streams are not core business, but telecommunication operators have a big advantage since they are ones who provide connectivity. This is a place where new technologies can find a place: IoT (smart homes), augmented reality, big data, machine learning. For example, a huge amount of information is collected in CRM and surrounding databases, so technology based on BigData is more than desirable to be used for creating such models which can help company itself or even be sold to a third party (statistical data, not data about the customer).
- Growing of new competitors is also an alive thing. Today MVNO (mobile virtual network operator) is a modern and profitable business without a lot of risks since it is completely virtualized. That operators don't have to invest in the most expensive thing – infrastructure.
- As it is mentioned in this paper, mobile data usage has constant grow. Also, new network capabilities are coming pretty fast for such kind of services. So, when LTE (4G) was introduced set of completely new products appeared. Now, 5G is ready to be launched.

All above is a reason why operator needs a new way of doing BSS. Since the customer is in the center of events today, customer relationship management could also be in the center of BSS architecture in a telecommunication company. Digital CRM implies that all channels used for an interaction are connected and integrated, so CRM can have all information: basic information about the customer, billing information, geolocation, active inventory, previous sales, information about complaints through all channels, etc. (Nguyen et al., 2007)

In previous years customers used a lot of channels for interaction. As it is stated by (Padam & Sridhar Marella, 2017): "As the Internet of Things is evolving and devices go online, completely new channels add data and interactions to CRM". The multichannel approach is necessary in order to track all customers' activities. Actually, not just multichannel, but omnichannel. Multichannel is different from omnichannel in one, but the thing which makes a difference. Multichannel is an approach where it is considered that customer use different channels for one activity, but those channels are not aware of activities through other ones. On the other hand, omnichannel is called a situation where all channels for customer integration are highly integrated. From the perspective of customer experience, it is mandatory for a company to have integrated solution because it is the only way to prevent misusing of systems and to provide perfect customer care.

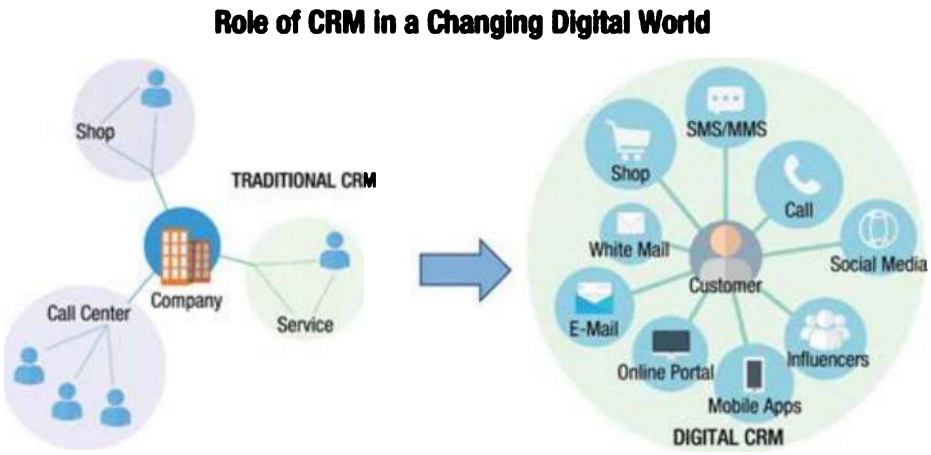

Figure 2: Role of CRM in a changing digital world (Padam & Sridhar Marella, 2017)

3. MARKET OVERVIEW

In Serbian market current situation is similar to the worlds with few deviations and market specifics. First of all, it is needed to show in which direction Serbian market goes and to recognize problems in order to be clear what kind of CRM is desired and why.

Serbian regulatory agency (RATEL) has been announced detailed report for the 2016 year. From the report few things dominate (RATEL, 2016):

- Total number of subscribers in a mobile network is on the same level in past 4 years and it's around 9.1 million
- Number of subscribers per 100 number of citizens is in stagnation but penetration is still huge: 128,52%
- Postpaid subscriber database is growing compared to prepaid
- The number of sent SMS and MMS is rapidly decreased
- Mobile data usage has constant growth
- Network coverage with LTE is better from year to year in case of all operators

Information from this report shows that Serbian market is obviously very saturated and there is no a lot of room for gaining new customers. Option for attracting new customers is only through the process of mobile number portability. So, operators need to convince the customer to give up on the previous one and to trust new operator. From the year of 2011 when MNP has been introduced in the market, a number of ported subscribers grows, which is shown on following graphs.

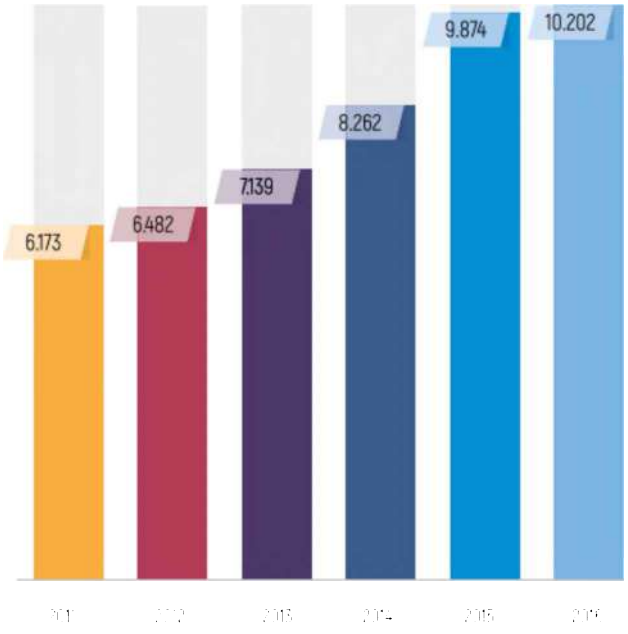

Figure 3: Average number of ported subscribers per month trough years (RATEL, 2016)

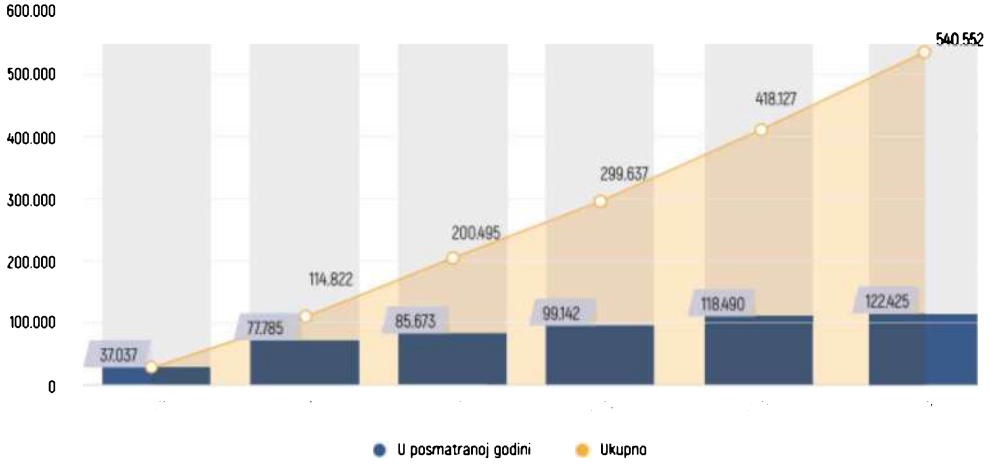

Figure 4: Ported subscribers per year and in total (RATEL, 2016)

Considering type and usage of customers that situation pretty follows modern West European markets. A number of postpaid subscribers grow compared to prepaid and finally, in the market from 2016, there is more postpaid than prepaid subscribers. Usage of voice traffic has been increasing due to the fact there are more postpaid subscriptions, but the usage of SMS and MMS is rapidly lowering. The main word in messaging part was taken over by applications based on internet usage (Viber, WhatsApp, Facebook Messenger, etc.). Today, life is unthinkable without applications which make us each day work much easier. For all of them, one thing has been in common: data usage. Figures tell how much data traffic has been increased in Serbian market:

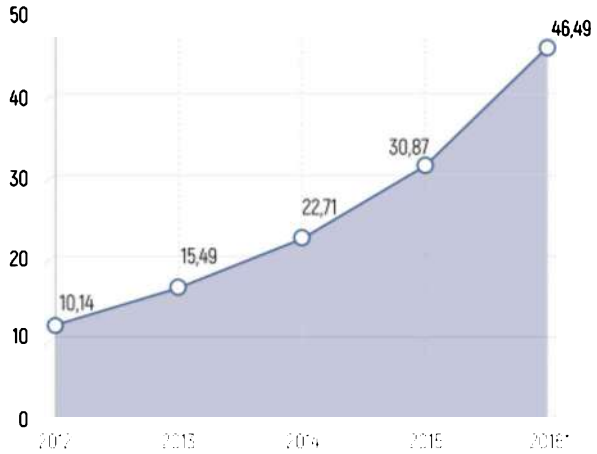

Figure 5: Amount of data transferred in million GB (GPRS+UMTS+LTE)

Those graphs and numbers show that customer care became the most important thing in contact with customers. It is very simple – in Serbian market there are no new customers. Already every third man in Serbia has two mobile numbers. The market is saturated and new customer can be reached only if he decides to leave current operator and sign the contract with new.

Need for good customer care and customer retention program puts CRM, as a process and as a tool, in the top of the list priorities in Serbia. And not just CRM, but CRM which can respond fast and with accurate data in every moment. It is crucial for communication with a customer that operator knows immediately about customer's action through any channel in order to afford appropriate support and answers to all possible questions.

The current implementation of CRM and whole BSS stack in Serbia is similar to the world's situation:

- No clear architecture design
- A lot of unnecessary interfaces causing spaghetti
- No automation of processes
- Time for launching products is too long
- No real-time data in CRM

4. PROPOSED CRM ARCHITECTURE

One of the possible architectural designs is shown in the following the figure.

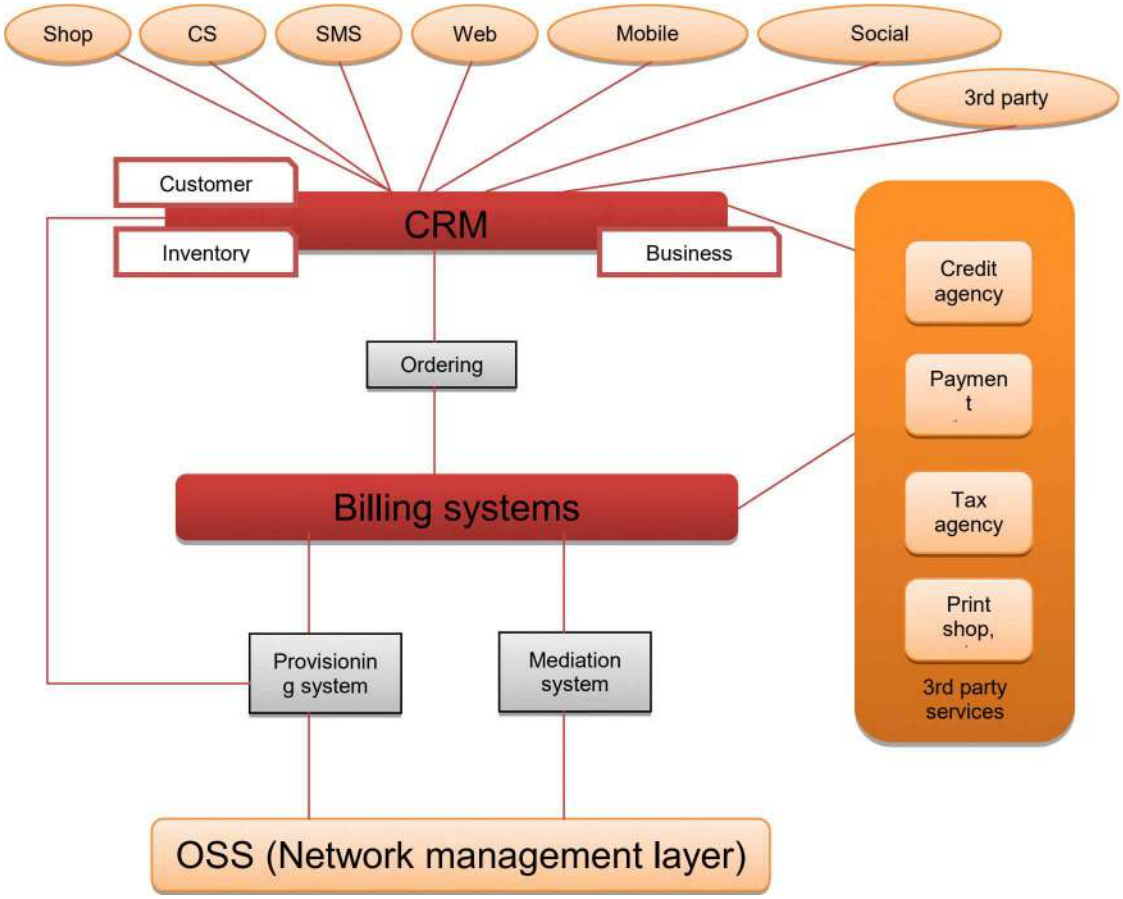

Figure 6: CRM centric architecture with omnichannel

Proposed architecture covers the most of pain points numbered in this paper. But, first of all, it is a way to answer on challenge how to cope with legacy systems. Idea is to put the right thing in a right place in order to let old BSS systems to do what they meant for. In shown case CRM is a place where all rules are implemented, CRM contains complete customer inventory and CRM is responsible for holding accurate customer data. This means that CRM is the only system which communicates with backend systems and all customer-facing systems should contact CRM in order to perform any action. No matter is it just check balance or activation of a new customer.

Good thing also is that introducing new solutions independent from the technology to BSS stack is possible and easy. That could satisfy a need for new revenue streams. If API which CRM expose is simple enough company can choose either to connect 3rd party apps or to create their own apps. Applications and channels mentioned in the previous figure are mandatory these days, but it should not be the end of story. Possibilities for creating new products with new technologies for one telecommunication operator are enormous.

The solution, of course, isn't perfect in all aspects. For this kind of implementation, it is very important to have stable and reliable CRM. Redundancy is mandatory as well as that system need to have more instances working in parallel, to be scaled in a good manner, to have great performances and very low response time. But even the most stable system sometimes goes down and no matter what backup processes need to be figured out. Backup solution by default brings disagreement in data so sync processes also need to be placed in order to support exceptions.

As it is already stated, today, in existing company, with all legacy systems, changing the way of business as proposed is not an easy job. It is very demanding to improve processes by changing systems with running a business as nothing happens. "In the online environment, the introduction and maintenance of CRM require a complex process of planning, analysis, strategy design and implementation" (Gurău, Ranchhod, & Hackney, 2003).

5. CONCLUSION

The assumption for a successful business is to have real-time communication and to manage interaction in a proper manner to all stakeholders (Despotović-Zrakić, Vasiljević, & Milinović, 2016). CRM is not a system which is important only for customer interaction but for all stakeholders, internal and external. Also, as (Lipiäinen, 2015) concludes: "CRM meant not only a technical solution to assist the customer process but also served as a modus operandi to take care of customers". It would be great for one company if one CRM system could be set up as a wrap up of customer and interfaces with the customer. It would result in all information in one place. The following figure summarizes story about differences and roles of CRM in traditional manner and CRM in the digital age.

Also, idea is that company should establish good and clean BSS environment where each system will be optimized for its main purpose. The way of implementation has to follow market standards and market trends in order to have systems in an environment where it is easy to introduce a new product or even a new system. For example, for establishing new systems in the environment it would be helpful to create so-called northbound and southbound gateways. These gateways should be placed with a strict definition of the interface, followed by good documentation. Northbound gateway to be set up for connection of user interfaces. On the other side, southbound gateway to be designed for modular connection to backend systems. That approach would be very useful since new system will connect with only one legacy point which is already connected with all necessary backend systems.

Time-to-market for telecommunication companies needs to be very fast since that part of the industry is one of the most dynamic ones. Beside that lean BSS architecture is needed, introducing of configurable product catalog is must have at this moment. That kind of product catalog would allow shorter time-to-market for new products and services and let employees have time for exploring new technologies.

This paper is completely focused on digitalization, but important thing that in the era of digital transformation, communication companies surely should not marginalize phone call toward customer service or to any other – it is still the primary way of communication.

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POTENTIAL OF IMPLEMENTATION OF ICT IN MARKETING SECTOR – SERBIAN PERSPECTIVE

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Abstract: *This paper discuses Serbia potential in the domain of information and communication technology application in contemporary business with an emphasis on marketing function. The conducted research about the use of information and communication technologies in the Republic of Serbia and desk analysis, proved presence of the basic preconditions for steps necessary for implementation of digital marketing concepts for the everyday business of companies in Serbia, regardless of whether they do online business or not.*

Keywords*: marketing, internet, information-communication technologies, Big Data, research*

1. INTRODUCTION

There is a large number of professional and popular papers that emphasize something that is already intuitively recognized - a great influence of information and communication technologies (ICT) in modern business, starting with Joseph A. Schumpeter: Preface to Business Cycles, 1939 edition (Schumpeter, 1939; Zysman, 2005; Schermerhorn, Hunt, & Osborn, R., 2005; Applegate, Austin & McFarlan, 2007; Lukić, 2015; Van Grembergen & De Haes, 2009; Vukmirović et al., 2016; Vukmirović, 2017).

Of course, Serbia as a candidate for EU membership and participating in negotiation process has also become influenced with the global economic flows. The indicators that show the level of technological development in Serbia are summarized through the following indicators (Digital Innovation Profile Serbia, 2018):

- ITU Global ICT Dev. Index 2017: rank 55 /176, score 6.61 /10
- Global Innovation Index 2017: rank 62 /127
- Innovation Efficiency Ratio: ratio 0.6; rank 67 /127
- Business Sophistication & Innovation: rank 110 & 95 /138
- Global Human Capital Report 2017: rank 60 /138

Main goal of the research presented in this paper is to determine the potential for the implementation of the modern ICT technologies in the Republic of Serbia. Research indicates the need for adopting the legal regulatory, specific lows and normative acts for implementation of data science technologies.

The results of the existing research indicate the significant potential that new technologies bring to the Serbian economy. Observed through the use of Internet technologies and social media, Serbian citizens are already using high-speed internet with the help of available technologies and services (primarily used to search information about goods and services and for reading online newspapers and magazines). There is a growing presence of both individuals and businesses on social media. The use of social networks such as Facebook and Twitter is steadily increasing in Serbia. When it comes to companies (enterprises) in the Republic of Serbia, research shows great interest and great dispersion in the use of ICT in everyday business (Kovačević, Pavlović, & Šutić, 2017).

The conclusions that we considered are based on the analysis of the existing research, primarily one about the use of information and communication technologies in the Republic of Serbia, which was conducted by the Statistical Office of the Republic of Serbia in 2017, according to Eurostat methodology, on the territory of the Republic of Serbia, on a sample of 2800 households/individuals and 1655 enterprises.

The reference period for most of the questions given to companies was January 2017, while some of those referred to the entire 2016. It is important to emphasize this fact considering the speed at which certain technological solutions are being implemented in everyday business. The analysis also used the results of studies of Digital Innovation Profile Serbia centric ICT innovation ecosystem snapshot National Expert Assessment conducted by the Innovation Division of the ITU Telecommunication Development Bureau.

Recommendations derived from this study for further development of the ICT sector are accepted and we await its implementation

2. MARKETING CONCEPT IN THE MODERN ERA

Decades back, the former small businesses that had few customers, produced only one type of product, and offered it on the market always in the same way. With the development of industry and technology, there was a need for expansion. In this endeavor to expand, there have been major problems in the market research. Companies have struggled for long to find an appropriate system for collecting information about their customers, products and services, and at the same time attempted to solve the problem of storing the information they collected. Even if they collected the necessary data, it took hours, days, and even months to process and analyzes them.

These problems are not limited to the field of production, the problem of analysis and data management is manifested in all spheres of today's business, such as medicine, astronomy, politics, etc. The big problem is that we are facing with an increasing number of data, of which only 20% are structured and stored in rational databases, while the rest of the data (documents, images, videos...) stays unstructured. Companies need to consider different types of data sources. Some of them are sensors on which machines generate specific data, while other sources of information are those generated by people, such as data from social networks or click-stream data from different websites. In addition, the continuous development of technologies and mobile devices leads us to new data sources.

Digital data from a rapidly growing number of new technological data sources, such as mobile devices, social media and other digital applications are flooding the world. The advancements in computational, storage and analytical technology, as the tools necessary to handle and use that flood of data are now becoming available and more economical (Radenković et al., 2017).

The combination of enormous volumes of digital data and technological advancement are creating the new Marketing Era – Era of Big Data in Marketing (Apilleti & Forno, 2014; Aquino, 2012; Arthur, 2013).

Big Data is data so large, varied and dynamic that it cannot be handled by conventional data processing technology. By using advanced technologies to combine and analyze this type of data, information can be made visible that was undiscoverable in the past. According to authors, such as Mayer-Schönberger and Cukier (2013), firms, government and science can significantly benefit from this revolutionary way of knowledge discovery.

The private and science sectors are starting to use new technologies such as Big Data in their everyday marketing activities. Big companies from retail, such as Walmart (Bryant, Katz, & Lazowska, 2008), Sears (Henschen, 2012), and Amazon (Kelly, 2013) are now using Big Data in an attempt to better understand the customers and their purchasing choices. Nowadays financial institutions are using Big Data to accurately predict behavior on the market and investment performance. Online companies like Google, eBay, Alphabet (Amazon) and Facebook have created their marketing models based on the huge volumes of digital data determined on individuals' behavior, sentiment, information requests and preferences.

Regardless of the problem of the unauthorized use of private data by third-party companies facing Facebook these days and issues related to unfair competition due to the dominant position in the market, these large companies have established rules that the rest (followers) have to follow or at least try to get out.

In addition, in view of generating a large number of diverse data, companies are facing the problem of storing and analyzing large amounts of data, collected from different sources, in different formats. When we have so many different types of data, it is impossible to manage the data in a traditional manner. Data management needs to be thought differently, and that is exactly why we believe we entered the Big Data Marketing Cycle. Big Data enables companies to collect, manage, process, and store large amounts of data at high speeds. Big Data is a combination of evolution of the technology from 50 years ago.

3. ICT POTENCIAL IN THE REPUBLIC OF SERBIA

According to the research entitled Use of Information and Communication Technologies in the Republic of Serbia, conducted by the Republic Statistical Office in 2017, in accordance with the Eurostat methodology, on the territory of the Republic of Serbia, on a sample of 2800 households / individuals and 1655 enterprises The reference period for most of the questions asked to companies was January 2017, while some issues were related to the entire 2016. This is important point, taking into account the speed at which certain technological solutions are implemented in every day's' business.

Profile of the Serbian household in the field of ICT applications: 90.5% of households own a mobile phone.

Serbia has some of the highest penetration rates for mobile services in the Balkans and a competitive mobile market with three competing operators. The fixed telephony market has been liberalized relatively late (in 2010). The penetration of fixed broadband access to the Internet is still relatively low compared to the European average. The FTTH (fiber to the home) Council in Europe has recognized Serbia for reaching a commendable penetration of FTTH levels in excess of 1% (Digital Innovation Profile Serbia (2018) - ICT centric innovation ecosystem snapshot National Expert Assessment, Innovation Division of the ITU Telecommunication Development Bureau). 68.1% of households in Serbia possessed at least one computer in 2017, which was an increase of 2.3% as compared to 2016 (Figure 1) (Kovacevic, Pavlovic, & Šutić, 2017).

Figure 1: Percentage of households in Serbia owning at least one computer, per year

Computer use in households varies depending on traditional demographic factors: territorial integrity, standards and education of the household head. The biggest gap in the presence of computers in households is present when the stratification is done according to household's monthly income. Households with above-average monthly income (over 600 euros) own a computer in over 95% of cases, while the shares of households with income lower than average (up to 300 Euros) is only 50%. This data indicates that potential consumers with higher purchasing power in Serbia are virtually completely online. It is similar with the penetration of the Internet in households, where it was noted that 68% of Serbian households have an internet connection in their homes (Figure 2).

Figure 2: Percentage of households in Serbia having an Internet connection, per year

As a reason they do not have internet access at home, the 70.0% of households said there was no need for the internet, 24.4% of households stated that equipment is expensive, while 22.8% of households said they lack the skills.

The method of accessing the Internet (types of connection) in households is shown in Figure 3. It is important to emphasize that 61.9% of households in Serbia have a broadband internet connection.
Also, there is a growing presence of mobile devices with access to Internet services, which is in line with global trends. That fact points out what is the direction for development of integrated marketing programs in these regions.

The habits of Internet users in Serbia are increasingly moving from information to communication - social media and making calls (voice and video), while, roughly a quarter of the online population uses internet technology for purchasing and little less than that for online banking.

The survey found that almost 20% of the internet population in Serbia finds a way to store an ever-increasing amount of data that they manipulate on a daily basis, either for private or business purposes, using cloud technologies (Google Drive, Dropbox, Windows Skydrive, iCloud).

When it comes to companies in Serbia, it is important to emphasize that 100% of companies use a computer in their business. In addition, 81.9% of enterprises use mobile broadband internet connection (3G or 4G) with usage of portable devices.

80.4% of companies operating in Serbia owned the website in 2017. (93.6% of the big size, 92.1% of medium-sized enterprises and 76.9% of small businesses own a website).

Observing B2B transactions in Serbia it can be concluded that:
- 41.4% of companies in 2016 ordered products / services via the Internet
- 23.8% of companies during 2016 received orders via the internet.

Social networks are increasingly present in everyday business in Serbia – 39.2% of companies used one of the social networks for their business needs.

Willingness to use open-source operating system has stagnated in recent years, and in 2017, 20% of the companies use open-source Linux operating system, which is at the level from 2013. It is interesting to note that large enterprises are leading in the use of open-source technologies in Serbia (41%). 9.3% of companies in Serbia use cloud-based services which are paid on the Internet.

4. FURTHER STEPS

These results indicate that there is no time for waiting- Serbian companies must take a step. Serbia's small core of highly-skilled and experienced IT development companies can generate growth and opportunity, helping Serbia's brands to become attractive to foreign investors, and inspiring other IT firms in the country. Major areas of strength for Serbian companies are financial services applications and industrial applications / process control. Serbia is starting to emerge as a distinct and positive brand in these areas (Digital Innovation Profile Serbia, 2018).

Figure 3: Innovation Journey Map – Serbia (Digital Innovation Profile Serbia, 2018)

If we begin with Innovation Journey Map – Serbia we see that the Innovation Journey Map sets out the work that needs to be done within the ecosystem in order to harness innovation on a transformative journey from pre-ideation to high growth. It describes each stakeholder's role (green), inadequate (yellow) and missing / weak (red).) Figure 3. We can conclude that the digitization of the Serbian language market place has taken great power. The fact that much has yet to be done just, still gives a chance for those businesses which have not been part of this process to catch their last chance to do so.

5. RECOMMENDATION FOR ACTION

Regardless of the limitations and perhaps disappointed expectations by some, Serbian companies had to welcome influx of new (big data and other) technologies.

Further Steps on micro level:
- Creating Strategic Documents - Big Data and AI Initiative,
- Open Data; Developing private-public-academic partnerships
- Education - education system - including dual education - not only for highly qualified

Further Steps on macro level:
- Companies cannot achieve all this alone. It is on the state to help them
- What has been done so far by the state (Digital Innovation Profile Serbia (2018)
- Connecting schools to AMRES (Academic Network of the Republic of Serbia)

The recently launched initiative 'Development of ICT infrastructure in education, science and cultural institutions' is in the process of connecting all schools in the country to the Academic Network. 1800 institutions in Serbia receive free and secure internet, active protection, and online support, including access to international electronic education services.

The 'Smart and Safe' platform, recently launched by the Ministry of Trade, Tourism and Telecommunications, aims to raise awareness of the importance of citizen engagement with the education system and the greater digital economy. The platform launches educational and promotional projects designed to support digital literacy, digital competencies and digital security culture throughout Serbian society.

The National contact center for the children safety on the internet, launched by the Ministry of Trade, Tourism and Telecommunications is based on regulations governing the protection and safety of children using new technology. This unique resource offers advices, help, information and research to children, parents, teachers and other relevant individuals in regard to online safety.

Digital Innovation Profile Serbia (2018), ICT centric innovation ecosystem snapshot National Expert Assessment, among the others states that the Republic of Serbia should support the ICT sector in its effort to succeed in this matter (Digital Innovation Profile Serbia 2018):
- Economic results and other data indicate the necessity for government's action in support of the ICT ecosystem with following:
- Establishing incentive structures as part of an environment designed to help ICT innovation converge with other technological innovations – with the clear objective of overall strengthening of the Serbian ecosystem.
- Affordable and accessible high-speed broadband is an important enabler for competitiveness across many areas including education, health, entertainment – and for general social cohesion. This places Serbia among countries that need to develop broadband infrastructure further and promote digital technologies in business.
- The primary objective of the Republic of Serbia is to achieve sustainable and dynamic economic development across technology and manufacturing in line with European Union targets, while able to withstand competition from its members. To achieve this, the government has adopted a number of strategies designed to boost ICT and progress towards a knowledge-based economy. The 'Strategy for the Development of Next Generation Networks (NGN) in the Republic of Serbia to 2023' has been drafted, which includes fibre as an essential element of the future infrastructure to meet growing demands for bandwidth.

6. CONCLUSION

Finally, it can be concluded that modern approach to marketing undoubtedly indicates that the development of marketing functions is directly correlated with the development of information and communication technologies, and that the results of the research indicate that this degree of dependency will increase even further. The perspectives of Serbia cannot be seen in a different way, which is also shown in the analysis of the research that has been synthesized in this paper, that further on points to the necessity of applying modern information ICT in everyday business and marketing. Internet and mobile technologies, Big Data and further development of artificial intelligence will accelerate the application of modern (not only informational) technologies in everyday business. This implementation has already encompassed all the spheres of a modern society, and not only in areas where expansion primary happened, such as social media. The boundary between online and traditional business (brick and mortar) is being lost increasingly. Amazon, for example, switched from e-business to other more profitable spheres of business, such as film production.

The car industry records show dramatic changes, which are not only characterized by the transition to a new motor fuel, but also by the basic service - switching from the purchase of cars as a vehicle to the future car that becomes a means of communication. Airbnb, Uber, Tesla and numerous successful start-up companies point out that business models based on new technologies dramatically change the traditional ways and philosophy of business. They have also accelerated development of infrastructure (Big data, cloud, mobile platforms and the use of business intelligence (BI), which, on the other hand, leads to the abolition of existing and creation of new, different jobs). Also, Crypto currencies change the basic operating premise of global economy.

This paper recommends the legal and strategic frame for the usage and implementation of data science technologies on institutional level and by private sector companies. Research has indicated the need for updating the education system in order of better implementation of e-business technologies such as Big Data, artificial intelligence and etc. Framework methodology for the development of Big Data concept for conducting research in the Republic of Serbia was presented.

By considering the objectives of the digital sector in Serbia (see (Digital Innovation Profile Serbia, 2018), it can be concluded that companies in this region have yet to capture a connection with the European average standards.

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MOBILE APPLICATION DEVELOPMENT FOR INTEROPERABLE LOYALTY MANAGEMENT SYSTEM

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Abstract: *This paper presents an approach for development of interoperable mobile loyalty application that resolves three aspects of interoperability: syntactic, semantic and technical. The main goal is to develop loyalty management system as an interoperable and digital system. This systemwill allow the development of different applications and enable communication with various loyalty programs provided by different companies. The case that is being considered is implementation of loyalty mobile application in Android OS. This application uses mobile application architectureas one of interoperability frameworks. This type of architecture helps to connect all participants in loyalty management system and makes dataexchanging process between themmuch easier. Some significant features are described in implementation of a loyalty application.*

Keywords:*interoperability, loyalty system, Mobileapplication architecture, Android, qr code*

1. INTRODUCTION

Loyalty system can be understood as a new business philosophyand a strategy, which allows getting new customers, retaining the trust of customers, personneland partners in the process of mutually beneficial cooperation based on participants' voluntary actions. The main idea through this cooperation process with customers, personnel and partners is to offer them product or service that will satisfy their needs (Jokinen, 2014). Existing loyalty systems are composed of different applications that are independently built (at different times, by different teams, using different technologies).There are problems in the exchange of data when moreapplications are in the interconnected relationship. Development of interoperable applications solves problems in exchanging data.

There are various software solutions for loyalty programs, which are integrated and which are not considering the aspect of interoperability. Related work (Software Advice, 2018) presents lists of software with customer loyalty programs,focusingon specific company. Our goal is to developthe loyalty management systemas an interoperable system. This system would allow the development of various applications and it would enable communication with different loyalty programs, provided by different companies.We also strive to be innovative and to reinforce technology in a modern way. To achieve this, we use mobile application architecture to innovate processes and business models.

The term "interoperability" is defined as the ability of two or more systems or components to exchange information and to use exchanged information (Benson & Grieve, 2016). In the context of businessapplications, interoperability is defined as the ability of a system or product to work unmodified with other system or product, without the need for special effortsfrom the user (Techtarget, 2018).

The interoperability is categorized in two basic categories: syntactic and semantic interoperability (ECOTECH, 2018.). If two or more systems are capable of communicating and exchanging data, they are exhibiting syntactic interoperability. Specified data formats and communication protocols are fundamental. XML, JSON or SQL standards are some of the tools of syntactic interoperability. This is also true for lower-level data formats, such as ensuring alphabetical characters are stored in a same variation of ASCII or a Unicode format (for English or international text) in allcommunicating systems. Semantic interoperability is the ability of two or more systems to exchange and automatically interpret the information, exchanged meaningfully and accurately, in order to produce useful results, defined by theusers of both systems. To achieve semantic interoperability, both sides must refer to a common information exchange reference model. (Ecotech, 2018.)

This paper represents the possible approach, through the example of the implementation of modern mobile architecture, to provide the answer to the question of the problem of interoperability. This work certainly would not be possible without defining a real problem, which has been mentioned in Section 2. Proposed approach and the mobile application architecture have been discussed in Section 3, while implementation of loyalty mobile application and most of the code excerpts with detailed picture have been given in Section 4 of the paper. Conclusion and potential further work are presented in Section 5.

2. DESCRIPTION OF THE PROBLEM

This section describes problems that need to be resolved,so we can achieve interoperability of applications.One of them is a problem of description of real system for loyality programs.

Nowdays, people use some loyalty program daily. In general, they get traditional paper or plastic card thatidentifies the card holder as a participant in a loyalty program. Unfortunately, people usually forget where they put their cards or they simply lose it.In addition, there are a lot of loyalty programs and people are participating in more loyality systems by different companies. As a result, they are losing interest in loyalty card programs.

Also, companies or facilitiesthat offer loyalty programs to their customers, don't have well-developed monitoring system and access controlfor customers and employees.

Therefore, there is a need to develop a loyalty applicationthat should be interoperable and distributed (Figure 2). Loyalty application would enable communication between customers andagents from central Loyalty Management systems. Also, it's necessary to provide communication between agents of different companiesthatcould cooperate together and provide some discounts or rewards for customers. This would require companies to agree with a form of cooperation or a contract that defines a discount or a reward. For customers, it is important to have more cards from different companies, that provide different loyalty programs. They want to have an insight into their own card transactions andthey want to be able to monitor history of their transactions.

Loyalty application should have some features such as: recording transactions,different rewards based on customer, partner, program, tier and product, web portals for administration, standard email and communications set up within the program (Simplicity, 2018).

There are three main entities in the loyalty system: customer, loyalty application and point-of-sale. Customer uses mobile device to accessloyalty application in order to see his different cards with stamps. Companies provide loyalty programs and define rewards and discounts for customers. Point of sale are places that execute giving stamps to customers. Point of sales can be distributed across different regions and they communicate to each other, if they belong to the same region. Gateways are agents that enable communication and synchronize data between central end points and point of sales.The loyalty application is connected through gateway and it exchanges data with point of sales.

The loyalty application should cover three aspects of interoperability on technical, syntactic and semantic level:

- Technical interoperability: At this level of interoperability, there are communication protocols for data exchange between the systems and through those the communication infrastructure for the exchange of bits and bytes happens. The basic networks and protocols are defined unequivocally.
- Syntactic Interoperability: If two or more systems are able to exchange data, they show syntactic interoperability. There are basically defined data formats and communication protocols. Examples of syntacticinteroperability are XML and JSON standards. Syntacticinteroperability is required for ensuring a higher level of interoperability.
- Semantic interoperability: Ensures that two or more computing systems are capable of exchanging information automatically, in a meaningful and precise way and to interpret shared information, so thatuseful results would be produced, in accordance with the requirements of end-users. To achieve semantic interoperability, both parties must respect the reference model for information exchange. During the exchange of information, the content requirement is definitely defined: a set of sent information, in terms of meaning, must be recognized and mapped into a set of information received (Kubicek, 2011).

3. PROPOSED APPROACH

There are several ways to achieve interoperability. Generally accepted ways to solve interoperability issues are: standards, interoperability frameworks, frameworks for the architecture of company information systems; semantic technologies based on ontologies, as well as the service orientation (Tu, Zacharewicz, & Chen, 2016).

Following steps, in order to solve interoperabilityproblems of applications,are:

- Need to define logical and physical design of information system. Logical design of an information system is an abstract representation of the data flows, inputs and outputs, while physical design relates to the actual input and output processes of the system.

- Using framework for interoperability. The interoperability framework can be defined as a set of standards and guidelines that describe the way in which organizations have agreed or should agree to cooperate together. The interoperability framework is not a static document, but over the time, it must adapt to changes in technologies, to standards and administrative requirements (EUROPEAN COMMISSION, 2017). Framework for interoperability is a part of the architecture of information systems and it deals with the integration and connection of elements. In this paper, focus will be on mobile application architecture, due to the need to make the application available for customers.
- Create interoperability gateway. The interoperability gateway is a channel designed to interface the Internet Protocol (IP) network with applications. Applications are connected to HTTP protocol and data can be interchanged.
- Mapping and data transformation. Data transformation is the process of converting data from one format (e.g. a database file, XML documentor Excel sheet) to another. Data transformation is necessary to ensure that data from one application or database is intelligible to other applications and databases, which is a critical feature for applications' integration. The first step of data transformation is data mapping. Data mapping determines the relationship between the data elements of two applications and establishes instructions for the way the data is transformed from the source application before it is being loaded into the target application. In other words, data mapping produces the critical metadata that is needed before the actual data conversion takes place (MuleSoft, 2018.).

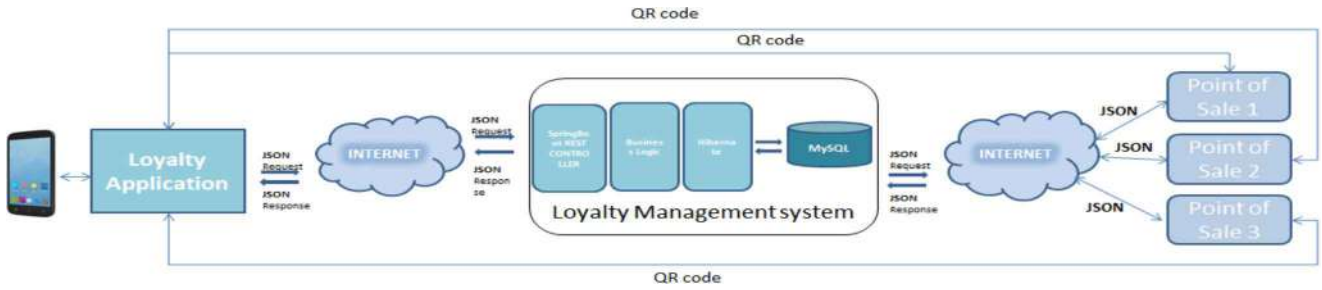

Figure 1: An approach proposed for mobile application development for interoperable loyalty management system

Based on mobile architecture, loyalty application should cover all loyalty programs provided by different companies. On the Figure 1, you can see a mobile application, connected with Loyalty Management system via IP gateway. In addition, the loyalty application communicates with point of sale through different qr codes. Point of sales have data for their own customers and they provide synchronization data with Loyalty Management system. Transformation of the data is released by using JSON format and REST service.Loyalty Management system is independent application which consists of business logic layer, REST API service and database layer. Database layercommunicates with MySQL database.

3.1 Mobile applicationarchitecture

Mobile application architecture is one of the aspecta of general architecture. The applications should be implemented in a syntactic, semantic and technical way that leads to interoperability improvements. Mobile application architecture is used as the main part of the interoperability framework and the focus will be on it. In the other hand, server architecture will be presented on abstract level, in order to show how mobile application architecture solves interoperability issues in technical, syntactic and semantic level, using interoperabilitygateway.

Mobile application architecture, consisted of application, application frameworks, libraries and kernel,is shown in Figure 2. Applications can be divided into two parts – native apps that provideOS and user apps. In the Figure 2, presented are the applications such as camera, contacts, e-mail and browser. The application framework provides many higher-level services to applications. This framework implements the concept that apps are constructed from reusable, interchangeable and replaceable components. This concept has been taken a step further in a sense that application is also able to publish its capabilities along with any corresponding data, so that they can be found and reused by other applications. The application framework includes the following services: Activity Manager which controls ll aspects of the application lifecycle; Window Manager handles screens; Content Providers allows applications to publish and share data with other applications; Notifications Manager allows applications to display alerts and notifications to the user; Location Manager provides access to the location services, allowing an application to receive updates about location changes (Techotopia 2016.). Libraries provide support for tasks such as string handling, networking, file manipulation. scanning, database access etc.They are specific for mobile development and they differ in the OS. Kernel OS provides a level of abstraction between the device hardware and it contains all the

essential hardware drivers, such ad camera, wi-fi, display etc. Also, the kernel handles all the things, such as networking and a vast array of device drivers, which resolves the issue of interfacing to peripheral hardware (Techotopia, 2016).

In the middle of the Figure 2, there is a gateway which connects mobile and server side. Gateway uses network connection standards such as HTTP protocol (Podila, 2013) and provides exchanging data at the technical level. On the bottom of the Figure 2, server that gets requests, transforms data,extracts data from database, makes and sends response to mobile application is represented. This way, itcovers interoperability issues on syntactic level byusing JSON data interchange format. On the both sides, a common model of designed information system is applied. This model represents agreement between all applications on terms, that they can semantically parse. That way, it resolves interoperability issues on semantic level.

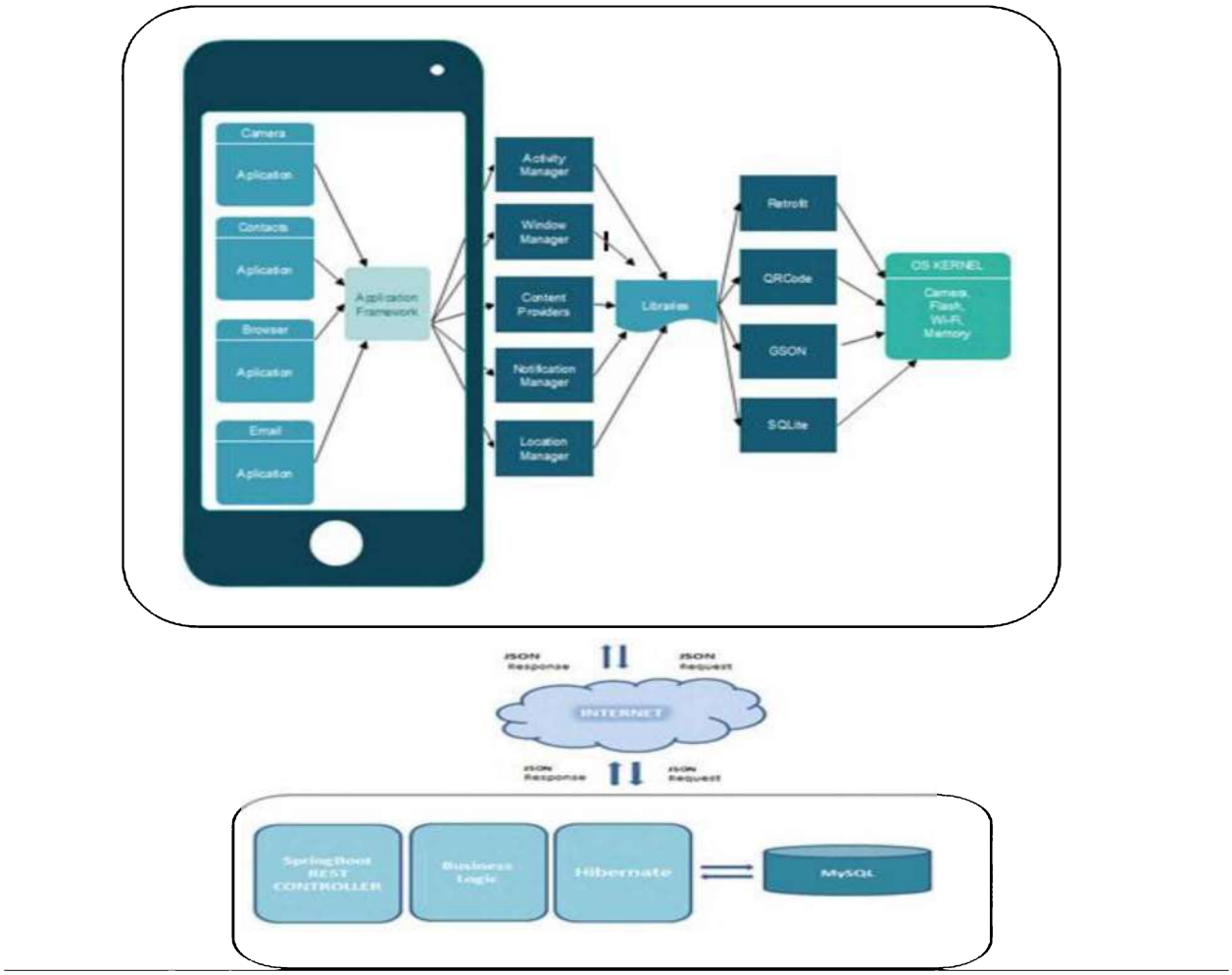

Figure 2: Mobile application architecture

4. IMPLEMENTATION OF LOYALTY MOBILE APPLICATION

In this section is demonstrated implementation of mobile loyalty application based on Android OS. The mobile application becomes an important software delivery model which integrates front-end user interfaces with back-end RESTful services (Ma, Li, Fan, Lee, & Hsueh, 2016).The loyalty applicationuses mobile application architecture as framework for interoperability. Logical and physical design was used to develop the methods and model for enhancing interoperability among applications. In general, it is needed to define standard model which will describe state and behavior of observing system.

Implementation of loyalty mobile application resolves interoperability issues of applications on technical, syntactic and semantic level. Figure 3 shows simple overview of the loyalty application in Android OS. The loyalty application is useful and simple solution that represents a digital platform, where every employee could have his own digital signature and where he could set his stamp on customer's account. This application helps digital transformation, which means conversion of analog physical objects, such us

traditional paper or plastic card, into digital objects on mobile device.The loyalty application is consisted of different loyalty programs provided by different companies. Customer with mobile device and installed app goes to some stores and when he scans QR code for the first time, he getsa ready card, with validated stamps by server.

On the Figure 3, Android user who scans QR Code is presented. The loyalty application uses QRCodeReaderView application as an internal project to provide scanning. This includes Camera API, which is specific for OS kernel. When user scans code, the value is taken and sent via Retrofit. Retrofit library provides API calls and processes requests and responses. Format for data exchange is JSON. On the server side is REST controller, which serves user and communicates with business logic layer. On business logic layer, the common model is defined, that has shared data dictionary and defined types of data. This model helpsthe transformationof data beetwen mobile application and server-based application. Hibernate layer communicates with MySQL database, excutes SQL queries and mapping properties.

When qr code is validated, server makes JSON response with stamp and sends customer's card as an object. This object is rendered by Picasso library and shown as card with stamp onthe customer's user interface.Customer has a lot of cards from different companies. Also, customer in app installed on his device can see histories of his rewards or discounts.

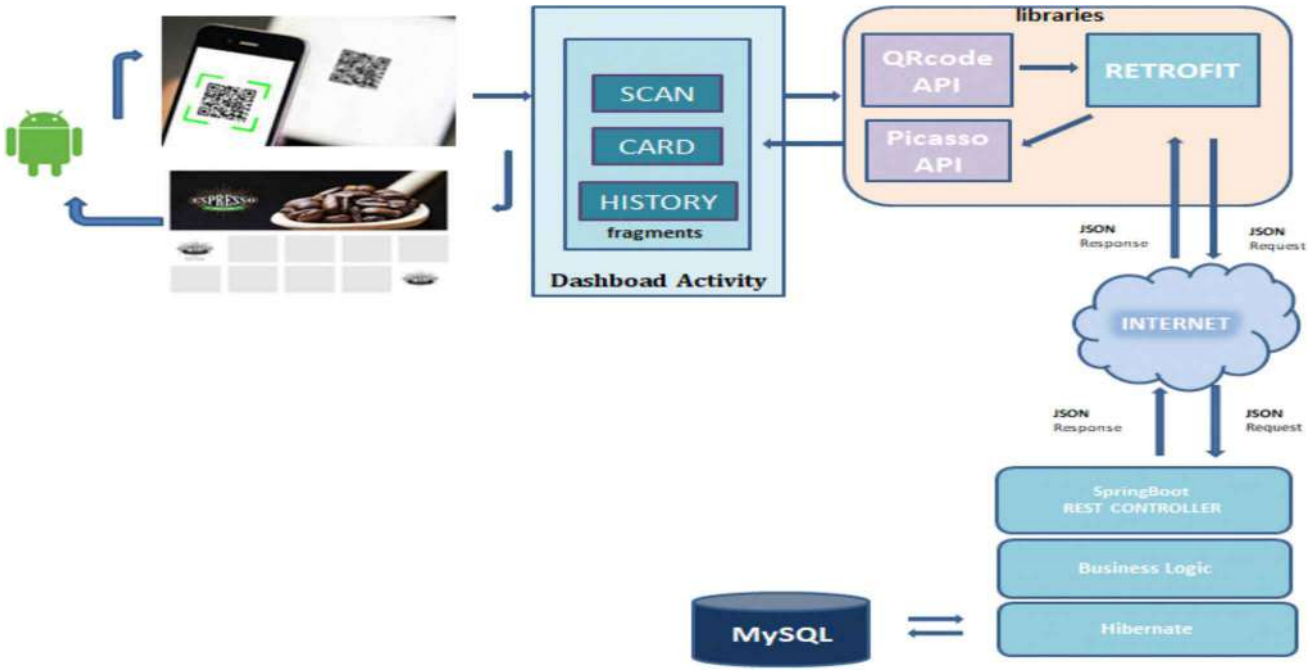

Figure 3: Loyalty application with main focus on mobile application architecture

4.1 Realization

The loyalty application is implemented in Android OS. When an application is created, build system automatically takes all the source files (.java and .XML), then applies the appropriate tool (for example, gets java class files and converts them to Dalvik Executable files with .dex extension) and groups all of them into one compressed file with APK extension. Significant part for developers is build.gradle (Module:app), which sets default configuration, such as minimal version of Android system on which the application can be installed, version name and code, build types. Build.gradle tool determinates and imports the dependent libraries such as Retrofit, Picasso, Card View etc.

The settings.gradle file is located in the root project directory and executed before any build.gradle and even before project's instances are created.The settings.gradle informs gradle which modules it should include when buildingthe app. In addition to the standard app module, qrcodereaderview module is also included.

```
include ':app','qrcodereaderview'
```

Below it will be explained how to interoperate these two modules in process of scanning qr codes.

- QRCodeReaderView class uses ZXING lib (Barcode Scanner) and integrates a QR decoder view. In this class, methods such as: start and stop camera using by CameraManager; set autofocus interval, set front or back camera and creating a qr code reader are implemented. Also, listener is specified and listens when qr code is read.

Public class QRCodeReaderView extends SurfaceView implements SurfaceHolder.Callback, Camera.PreviewCallback { public interface OnQRCodeReadListener { void onQRCodeRead(String text, PointF[] points); }

- In the ScanFragment (Figure 4) class of loyalty app, QRCodeReaderView is defined andOnQRCodeReadListener is implemented.
- QRCodeReaderView represents view for user's interface and it is defined in XML format. <com.dlazaro66.qrcodereaderview.QRCodeReaderViewandroid:layout_margin="10dp" android:id="@+id/qrdecoderview" android:layout_width="match_parent" android:layout_height="match_parent" /> This view in fragment is defined and binded using ButterKnife anotations @BindView(R.id.qrdecoderview)QRCodeReaderView qrCodeReaderView;
- OnQRCodeReadListener override onQRCodeRead method which gets value of scanned qr code. After that, given value is sent to server that will check it and validate it.

@Override public void onQRCodeRead(final String text, PointF[] points) { LawaApp.getApi().scanning(Constants.CLIENT_TYPE,LAWAPref.GENERAL.getPref().getString(Keys.UserK .ID), TimeUtils.writeDateAndTime(dateTimeNow), text.trim(), clientGroup, new Callback<List<Scan>>() {}}

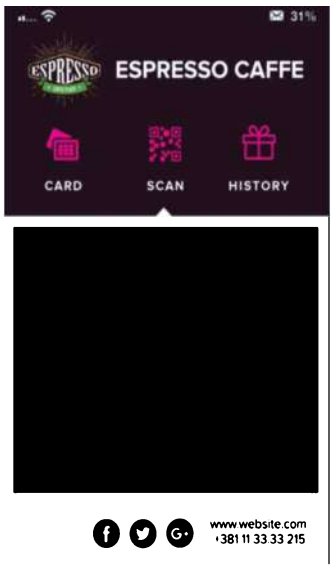

Figure 4: Screen fragment

5. CONCLUSION AND FUTURE WORK

This paper presents an approach for development of interoperable mobile loyalty application that resolves three aspects of interoperability: syntactic, semantic and technical. Proposed approach has several steps. First of all, it is necessary to pass through the logic and physical design of the IS to determine the state and behavior of the system that is being observed. The ultimate goal of design is to get a common standard model through which applications can communicate and share data.Following, to apply framework in this case of mobile architecture and to define gateway for transmition data. The last step is making decisions how tomap data between applications.

To verify proposed approach, an example of the mobile applicaton is presented. It is a loyalty application implemented in Android OS. The main focus is onmobile application architecture, but it also describes cooperation with server side. It is shown as an implementation of one functionality of mobile application: scanning qr codes. The loyalty application has also local database which synchronizes data with server when is in offline mode. In that case, it implements two gateways, one with loyalty application on mobile side and two with server side. This feature enables the user to use application without Internet. The development of application core took about two months, gathering materials and implementation took additional ten days, while the extra week was spent for fixing bugs and code optimization.

There are several ways for future development. In one of the following stages, it's planned to create a location service for getting current user's location, based on mobile application architecture which will be interoperable with loyalty application. Location service feature can offer customers discount and deals when they check in, walk into a store and scan their qr codes. Also, there is a concept of an application with recommendation service. For example, this app may recommend location of the store to customer, if he is near it and it can provide discount that way.

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SAFE AGILE FRAMEWORK IN E-BUSINESS PROJECT MANAGEMENT

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Abstract: *The aim of the paper is to explain the fundamental concept of Scaled Agile Framework (SAFe) and to help to understand which methodology should be used in project management in e-business. A large number of organizations has published and claimed to be "agile" or to plan to use the agile method, but there is some confusion regarding using of this concept. The main goal of the paper is to clarify what SAFe actually means and which necessary steps must be performed toward SAFe implementation. Also, this paper analysis risks which must be taken into account during the design and implementation of SAFe. The focus has been given on SAFE implementation in software projects. In conclusion, the benefits of implementation of SAFE in large organizations are described.*

Keywords*: Scaled Agile Framework, project management, Agile Release Train, agile methods, SAFE implementation, Scaled Agile, Inc.*

1. INTRODUCTION

The goals of the paper are to show the framework for scaling agile principles, its key elements and factors, to explain the benefits of managing projects in e-business using SAFe, and to clarify briefly the implementation of SAFe. Understanding the methodology such as SAFe, and its implementation in proper manner in e-business opens the plenty of possibilities and provides a foolproof opportunity for continuous success and maintaining competitiveness in the global market.

One of the first decisions we face when launching each project is "What development methodology should we use?". Agile methodologies have begun to develop 15 years ago. Agile is a specific type of rapid development and it is newer than the "traditional" waterfalls (Lotz, 2013).

A large number of organizations has published and claimed to be "agile" or to plan to use the agile methods. Agile software development has made a quiet revolution in project access and management. Due to the general trend of accepting optimization and reduction of activities which are not of a high priority and do not bring value, agile methods are most often well accepted by the senior management and the project team (Jovanović, 2017).

Implementation of agile methods significantly alleviates organizations to develop software for customized services and products in e-business. By using agile methods, organizations gain a competitive edge and the ability to adapt to current market trends. Furthermore, in this way the organizations can even improve their flexibility.

Scaled Agile Framework is an agile framework for project management. The product is made by Scaled Agile, Inc. In Scaled Agile Inc. SAFe development activities are based on the key belief that: "better systems and software make the world a better place." Their mission is to help those who build these systems through the development and publishing of the SAFe framework, as well as through the accompanying certification, training, and courses (“What Is SAFe?”, 2017).

SAFe aids e-businesses to deal with significant challenges in developing and delivering software designed for large-scale systems in the shortest implementation time. It is an online knowledge base with proven patterns for achieving success. SAFe synchronizes and provides synchronization, collaboration and delivery products for multiple Agile teams. Scalable and configurative, SAFe allows each organization to adapt it to its own business needs. SAFe is suitable to support small solutions which are used by 50 to 100 users, as well as complex systems with thousands of people. It describes the roles, responsibilities, artifacts, and activities necessary for the implementation of Lean-Agile development.

The main goal of the paper is to show the framework for scaling agile principles, its key elements and factors, to explain why it is important to manage projects in e-business using SAFe, and to briefly clarify the implementation of SAFe.

2. SAFE

The philosophy of SAFe is simple: the ultimate responsibility for the adoption, success and continuous improvement of the efficient and agile (Lean-Agile) development lies in existing managers and managers of the company. Only they can change and continuously improve the systems in which they all work. In order to achieve this, leaders must be trained and in parallel they become trainers themselves, with improved ways of thinking and working. Some of them need to offer a new leadership style, the one that really teaches, empowers and engages individuals and teams to achieve their greatest potential (Knaster & Leffingwell, 2016).

SAFe Lean-Agile Leaders are lifelong learners and teachers who assist teams in building better systems through understanding and exposing Lean-Agile thinking (Lean-Agile Mindset), SAFe principles and thinking about systems (Campbell-Pretty, 2016). Such leaders show the following behavior:

- Introduce and guide the changes
- Know the path
- Lifelong learning
- Develop people skills
- Inspire and align with the mission
- Minimize constraints
- Decentralize decision making
- Motivate workers to develop a constant need for learning

The Community of Practice (CoP) was formed within the framework of SAFe. It is an informal group of team members and other experts who work within a program or enterprise with a mission of sharing practical knowledge in one or more relevant areas. They regularly cooperate with the goal of sharing information and improving the skills and further they actively work on improving their knowledge from their domain ("Communities of Practice", 2017).

The entire work under this methodology is based on Core Values, which represent the basic beliefs of a person or organization. Basic values are the guiding principles that dictate behavior and action. Basic values can help people to recognize what is right and what is wrong, what to focus on. Moreover, they can support companies to determine whether they are on the right track and whether they fulfill their business goals. Lean-Agile set of views, Lean-Agile leaders, SAFe principles as well as the extensive advantages that Lean-Agile development provides to everyone, play important roles in defining what makes SAFe successful (Leffingwell, 2016).

Most of Lean's thoughts are presented in SAFe House of Lean. Lean's house is made up of six key constructions. "Roof" is the goal of achieving value; "pillars" support this goal by respect for people and culture, flow, innovation, and improvements. Lean-Agile Leadership provides the basis on which pillars and goal are built up. The details of Lean's house are shown in the Figure 1.

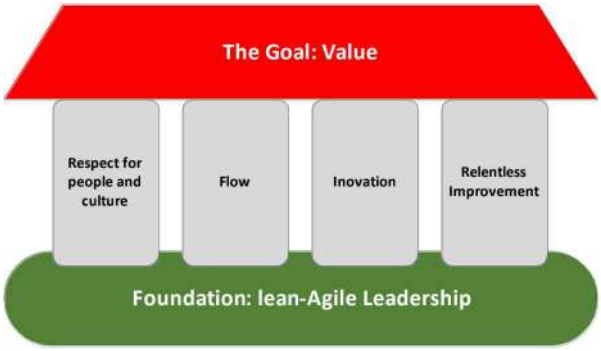

Figure 1: House of Lean

SAFe is based on series of unchangeable, basic Lean and Agile principles. These are the basic principles, basic truths and the economic fundamentals that set off roles and practices making SAFe so effective. These nine principles are:

- have an economic view i.e. observe the situation from the economic point of the view
- apply systematic thinking
- anticipate variability
- progress incrementally with fast integrated learning cycles
- evaluate the system objectively
- perform graphical presentation of the scope of work and its limitations

- cadence application, domain-level planning synchronization
- accelerate the internal motivation of members
- decentralize the decision-making system

2.1. SAFe Portfolio

All of the above mentioned principles have been used to present a broad range of development environments through four configurations that companies can adapt and implement in their business. Those are:

- Basic SAFe
- SAFe Portfolio
- Large Solution SAFe
- Full SAFe

The SAFe Portfolio has been most frequently applied. The SAFe Portfolio assists to align the execution of the portfolio with the company strategy by organizing agile development around the flow of values through one or more value streams. This provides business agility through principles, practices, portfolio strategy, as well as investment financing, agile program guide, and Lean management. The architecture of the SAFe portfolio consists of three levels: portfolio, program, and team (Figure 2).

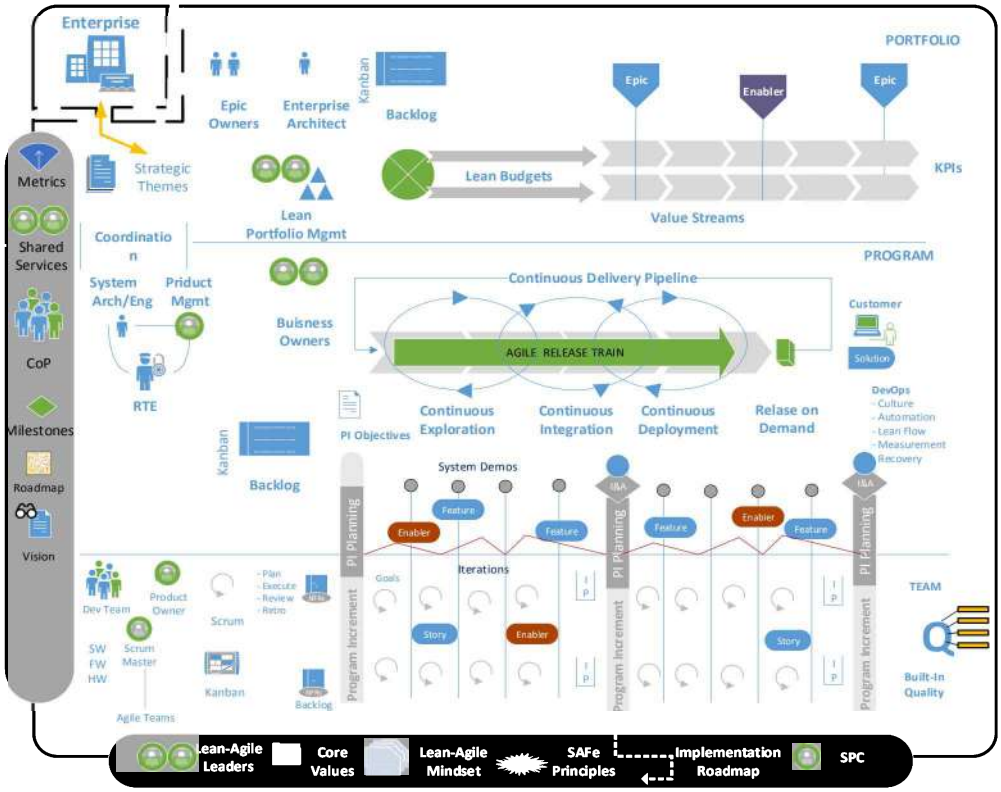

Figure 3: SAFe Portfolio

The PORTFOLIO level organizes and finances a set of value streams. The portfolio provides funds for solution development through Lean-Agile budgeting and the necessary coordination and management of value streams ("Portfolio Level", 2017). The portfolio level contains principles, practices, and roles needed to initiate and manage a set of development values. This defines financial assets and investments in value streams and their solutions. This level also provides Agile portfolio operations and Lean's management of people and resources needed to supply a solution. The portfolio level harmonizes the company's strategy with portfolio execution by organizing the Lean-Agile company around the flow of value through one or more value streams. By providing basic budgeting and necessary management mechanisms, it allows investment in solutions to guarantee a return on investment (ROI) in order to realize the strategic goals of the company.

The PROGRAM level contains the roles and activities necessary for continuous provisioning of the solution through the Agile Release Train (ART). At the program level, development teams, stakeholders, and other resources are dedicated to an important, ongoing mission to develop a solution. ART describes teams, roles,

and activities of the program level that gradually bring a continuous flow of values ("Program-Level", 2017). ART is a virtual organization formed to pass functional boundaries, to eliminate unnecessary handover steps, and to accelerate the achievement of value using the SAFe Lean-Agile principle in practice. Although called a programming level, ART is long lasting and hence (therefore) has a more persistent self-organization, structure, and mission than a traditional program. Usually, the program has a definite start and end date, as well as temporarily allocated resources.

The TEAM level contains roles, activities, events, and processes that Agile teams build and deliver in the context of the Agile Release Train (ART). All SAFe teams are part of ART, the primary level of the program level. The roles and functions of ART, including Release Train Engineers, product managers, system architects, engineering, system team, and common services facilitate all teams on the train. As a result, they are fully capable of defining, developing, testing and delivering working and tested systems in every iteration. Each Agile team is responsible for defining, building and testing Stories from their backlog team. Stories are short descriptions of small parts of desired functionality written in the user's language. By using a common cadence and synchronizing the iteration, teams are adjusted to a series of fixed length iterations to ensure that the entire system repeats itself. Teams use ScrumKSP or Kanban to deliver high-quality systems, which routinely produce a system demo every two weeks. This ensures that all ART teams create an integrated and tested system, which stakeholders can evaluate and respond to it to quick feedback. Each team has five to nine members and includes all the roles needed to build a quality increase in value in every iteration. The roles of ScrumKSP include a scrum master, a product owner, dedicated individual contributions, and all the experts on the subject for whom the team needs to deliver the value. The role of the Kanban team is less strictly defined, although many SAFe Kanban teams also implement ScrumKSP roles ("Team Level", 2017).

Before realizing the benefits of SAFe, organizations must adopt Lean-Agile way of thinking and understand and apply Lean-Agile principles, then identify value flows and Agile Release Trains (ART), implement Lean-Agile portfolio, build quality, and afterwards establish mechanisms for continuous delivery of values and DevOps. The Figure 3 shows the steps in the implementation of SAFe ("SAFe Implementation Roadmap", 2017).

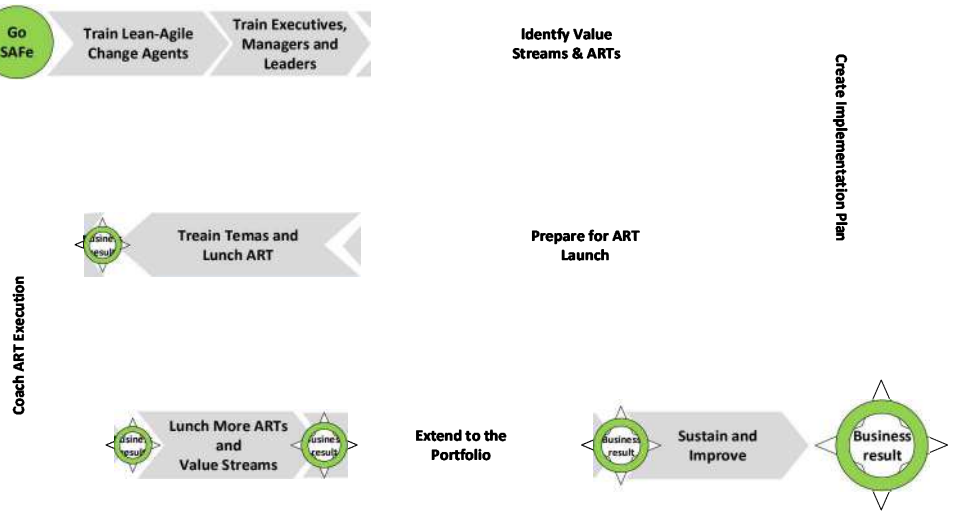

Figure 4: SAFe Implementation

Implementing of the changes, which are necessary to achieve Lean-Agile technology in an enterprise, is a significant challenge for most organizations. Implementation of Lean-Agile thinking and understanding, and applying Lean-Agile principles as well as effective implementation of SAFe in practice leads to e-business improvement. An appropriate culture must also be developed. Although SAFe knowledge is accessible to everyone, it does not define or prescribe the process of organizational change management, which is usually required for successful application-transformation. This is left to be determined by the company, because only the company knows its specific context, and the company must carry out the transformation.

Although there are no identical adoptions and it is rarely to have a perfectly sequential implementation step by step in any company, the best results are achieved if they follow a path similar to that one shown in Figure 3. Successful implementation includes the following 12 steps ("SAFe Implementation Roadmap", 2017):

- Achievement of the turning point
- Train Lean-Agile Change Agents
- Train executives, managers, and leaders
- Creation of the Lean-Agile Center of Excellence

- Identifying the flows of values and ART
- Creating an implementation plan
- Preparations for ART launch
- Training teams and launching ART
- Training of ART exercises
- Launching more ART and value streams
- Portfolio expansion
- Maintenance and improvement

Many companies have already gone through this path, and lessons learnt have become more and more available. Based on learning from hundreds of SAFe implementations, Scaled Agile, Inc. as the founder of SAFe, developed the basic implementation form SAFe 1-2-3 (Figure 4) for the successful adoption of SAFe. The form provides a simple roadmap, which helps to align with a common implementation strategy ("Implementing 1-2-3", 2016).

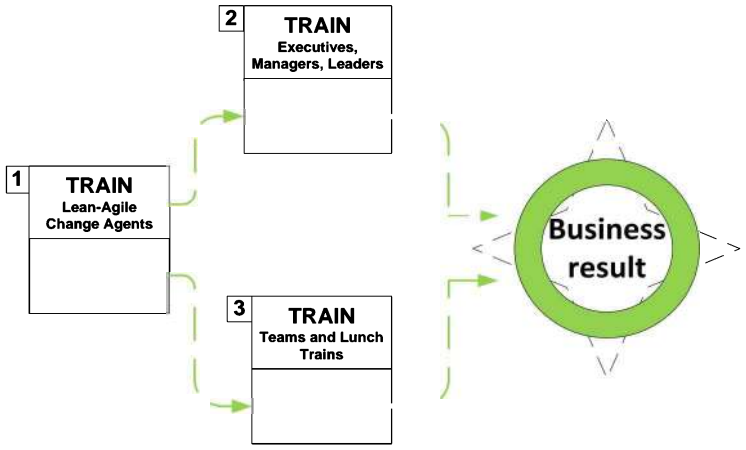

Figure 5: SAFe Implementation Strategy

3. SAFE RISK MANAGEMENT

The successful introduction of agile techniques at the project level is not the only challenge in this venture. Effective integration into e-business processes at a higher organizational level represents an additional risk in this process. The risk is part of our lives. In a rapidly developing world, the risks we need to manage develop rapidly too. They must be managed in order to minimize their threats and to maximize their potential.

Risk management involves understanding, analyzing and addressing risks in order to achieve the goals of organization. Therefore, risk management must be proportional to the complexity and to the type of organization ("MSF Risk Management Discipline", 2002).

The ideal solution for risk management at three levels introduced by SAFe, the level of a team, programs, and portfolios, does not exist. However, the categorization of risk is necessary for the proper treatment.

The majority of experts agree to manage risk at the code level at the team level during the Program of Increment Programming (Leffingwell, 2016). Higher-level risks (project or program) with potential to affect the entire Agile Release Train (ART) should be escalated to the level of the program. Teams do not have to analyze or to take into account the repeating risk, as all risks once occurred will be identified, listed, and planned to mitigate at the appropriate level. (Although there may be some risks at the portfolio level, managing them should be covered by managing the project portfolio of the organization or PPM).

A widely used risk mitigation tool within SAFe is ROAM board ("ROAM & Risk Management Under SAFe", 2017). It is utilized during PI planning to identify and analyze risks and problems. To ensure that all risks are covered, the aim of this technique is to Resolve, Own, Accept (by product management team), or to Mitigate (therefore acronym ROAM). Potential issues that are solved on the ROAM board at the team level are not transferred to the Program Panel at the program level. Reducing of the identified risks can follow the course similar to that in an agile project. The main advantage of using the ROAM table is that it ensures that all risks are covered - after a ROAM session; the work should be committed to solving all the identified problems in one way or another. Another advantage is that ROAM can simply be transferred to a shared online tool, facilitating collaboration between geographically distributed teams.

4. SAFE CHALLENGES

In the most companies, which are constantly innovative and expanding, the balance between costs and control, i.e., maintenance of high quality has to be provided. Enterprises usually have a complex structure necessary to produce a large number of products (and this number is constantly increasing). Without adjusting and increasing the number of employees, such required intensity or even imposed changes would lead to the collapse (Schwaber & Sutherland, 2016).
In these e-business oriented systems, the application of the SAFe methodology brings the necessary order, systematization and the results are always the best product delivered on time to the right place, to the right customer in the right quality and the right amount.

The SAFe methodology enables the use of a proven, public framework, with clearly defined roles and artifacts for applying the Lean and Agile methodology at the enterprises. SAFe's knowledge and tools are transparent and SAFe trainers are always available. The digitized program board allows process monitoring all the time and quick identifications on the control panel, i.e., whether progress is normal or unusual. Lean-Agile leaders point out managers to look at tasks or problems from a new perspective. Well-defined roles and terminology within SAFe are used as essential indicators for those new in the framework. If the changes are being implemented very quickly, they can represent a shock to employees. On the other hand, rapid integration has enabled people to participate in the Agile system. Employees are guided by trainers who consistently transmit the value of change, and help people accept their roles with a new way of working. It is important to establish an acceptable relationship between trainers and employees (Leffingwell, 2016). The implementation of SAFe increased transparency and visibility and as results, effectively identified errors, obstacles, weak tools and bad engineering habits are possible. Transparency is invaluable, everything is visible to everyone, communication and conversations are more valuable than monitoring indicators. SAFe forms a powerful community that keeps up with the ever-increasing growth rate of industry; it forms a system that can deliver more products without increasing the number of employees, and thus remains competitive.

Nevertheless, understanding and explaining agile methodology is not easy. Agility and speed of change leave the impression of a division of responses without one or more centralized authorities, which is a contradiction to the management methodologies that have been present throughout the business for decades, and not only in the IT industry.

However, this is not true. Agile methodologies offer more flexible and quicker workflows, methods that are easier to adapt to changes and new circumstances but require very strict precision, from the periods in which the divisions work to responsibilities between employees. They required the application of enormous knowledge and lifelong learning. Moreover, this kind of management is more complex than some of the previous ones. It requires greater involvement of all members of one system. It is particularly important to understand the application of these methodologies in e-business. One of the main forces of SAFe is - people. Before starting a professional life, human resources are formed at universities. Changes, speed, scalability, innovation, lifelong learning - all of these qualities in the 21st century have become an imperative. The question that arises is how to operate in such an environment? In addition, how to design young intellectuals to manage in turbulent and for sure challenging circumstances? These are the reasons why the education of young professionals should introduce learning about agile approaches. Moreover, the introduction of education on agile methodologies and their application is necessary, because it is an environment in which it will work.

5. CONCLUSION

The contribution of this paper is to systematize knowledge about SAFe, since it is a new framework, and that there is not much literature on this topic. The paper analyzes SAFe, highlighting the advantages of its application, but also its weakness. The main purpose of agile project management is to deliver products in a shorter period and to provide better quality for less money. This fits perfectly into the concept of e-business. By increasing the transparency and visibility of the company, it is easier to identify mistakes, obstacles, weak tools and bad engineering habits. Transparency is priceless and in SAFe everything is visible to everyone, and communication and conversations are more valuable than monitoring indicators. The Agile Manifesto says: "The most effective way of transmitting information within a development team is face-to-face communication." In SAFe, it leads to the next level with the planning of promotion programs, routine, “face to face” communication, with a standard agenda that includes a presentation of the business context and vision followed by a teamwork.

Agile should carry less risk than the traditional "waterfall" approach. It should help the project team in their joint work to do the job in the best way. Keys to success are contained in a communication, team dedication, strong leadership and good planning.

The results obtained with the use of SAFe are usually: 20 to 50% increase in productivity, more than 50% increases in quality and 30-75% is shortening the time of market entry (Yakyma, 2016). It also achieves a measurable increase in employee engagement and satisfaction of employers.

A representative example of the implementation of SAFe is Intel. Intel is one of the largest publicly released SAFe applications based on the number of ARTs. Intel has conducted training of 2000 employees within three months and by 2017. developed the Lean-Agile practice. Intel has built a strong community that speaks a common language. Intel's efforts are helping Lean-Agile to maintain a steady increase in the growth rate of the industry. Lean-Agile helps Intel to deliver more products without increasing the number of employees, so it can remain competitive and continue to follow the Moore's law.

From all written above, we can conclude that scaling is not easy, but it is worth the effort because the results are excellent.

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DESIGNING A COLLABORATIVE FILTERING RECOMMENDATION SYSTEM IN E-COMMERCE

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Abstract: *This paper discusses an approach for designing a collaborative filtering recommendation system within web stores. The main goal is to improve the level of conversion and increase customers attention and total sales by providing them with most relevant content and services. Data is collected from users activities within webshop: which products a user added, how many times the user entered the same product and total time spent on a product page. Based on collected user data it is possible to find most similar users and offer items that similar users were interested in. Further, we describe steps in designing recommendation system, architecture and possible application of the systems.*

Keywords: *Recommendation system, collaborative filtering, e-commerce*

1. INTRODUCTION

In modern e-commerce solutions, when it comes to optimization of conversion rate and increasing the customers' attention, only the most relevant content and services have to be delivered. Users expect to be provided with the exclusive content adapted to their needs and characteristics. However, this is quite complex and involves comprehensive approach including a variety of technologies, techniques, and concepts.

Accordingly, recommendation systems have been extremely important in last few years as they could be used in different areas, such as articles, social content, movies, books, news, and products as well. Recommendation systems have become an integral part of all the well-established online stores today. The main role of recommender systems is to search through a large volume of dynamically generated data in order to provide users with personalized content and services. They can especially be useful in e-commerce systems since the system is suggesting users which products user might be interested in and good recommendations can lead to a direct increase in sales.

This paper focuses on designing a recommendation system within an e-commerce solution, based on data collected through users' actions in a web store. The goal of the research is to investigate possibilities of using collaborative filtering techniques in order to improve conversion rate and results of content recommendation within web stores.

2. LITERATURE REVIEW

Recommendation systems have been in focus of many research papers. Most existing recommender systems use content-based or collaborative filtering methods or hybrid methods that combine both techniques (Aciar et al., 2007). The collaborative filtering approach to the recommendation is based on recommending items based on other similar users behavior (Balabanović & Shoham, 1997). Table 1 summarize approaches and examples from the literature.

All articles from Table 1 are based on using recommendation systems in different environments. Some of them are also based on e-commerce websites, but their main focus is data collected through sales and product ratings. Most of the researchers that use recommendation systems in e-commerce are focused on user data that is collected through sales or product reviews. This approach works well and it is already investigated. In this paper data collected from user actions on product pages are used. The benefit of this approach is that user actions from e-commerce websites are used, so there are much more data available for mining compared to a traditional approach, where only sales data or product reviews are tracked. It happens often that users browse through e-commerce websites and not buying on that website for various reasons (like for example price). But, those users can be used for collecting data and to learn more about visitors.

Table 1: Related literature overview

Context	Description
Book recommendation system (Tewari et al., 2014)	Combining features of content and collaborative filtering and association rule mining in order to recommend books to users.
Videos recommendation system (Deldjoo, et al. 2016)	Content-based recommender system for recommending videos based on extracted visual features of the video.
Recommendation systems in social networks (Wei et al., 2017)	Improving recommendation accuracy in a cold-start situation by using additional sources of information, such as friends relationships and user-generated tags.
Product recommendations from social networks data (Zhao et al., 2016)	Solution for a cold-start product recommendation, which aims to recommend products for e-commerce websites to users at social networking sites in "cold-start" situations.
Product recommendations theoretical approach (Wang & Zhang, 2013)	Proposed proportional modeling approach to the recommendation research field and a new opportunity model to explicitly incorporate time in an e-commerce recommender system.
Recommendation systems in B2C systems (Li & Karahanna, 2015)	Reviewing recommendation systems on B2C e-commerce systems. Identify gaps and future directions.
Personalized recommendations in B2C (Ji et al., 2004; Zhang & Jianxin, 2007)	Customer shopping model for B2C customers. Classification-based recommendation system for personalization in B2C e-commerce applications.
Recommendation systems effects on consumer beliefs / social context (Benlian et al., 2012; Weisberg, 2011)	Recommendation systems effects on effective and trusting dimensions of consumer beliefs. Relationship between past online purchases and purchasing intentions.
Recommendation system for e-commerce systems (Phi et al., 2016; Castro-Schez et al., 2011)	Focusing on the item-to-item and user-to-item recommenders.
Collaborative Filtering (Koren & Bell, 2015)	Improvements and recent progress of collaborative filtering methodology.
User-based collaborative filtering (Ma et al., 2015)	Revised the user-based collaborative filtering technique and proposed two recommendation approaches fusing user-generated tags and social relations.

3. DESIGNING A COLLABORATIVE FILTERING RECOMMENDATION SYSTEM IN E-COMMERCE

The goal of the research is to build an e-commerce recommendation system that uses users actions as the input. Further, the output of the system should be suggested products that the user is interested in. The recommendation system uses collaborative filtering where the system looks for similar users and based on that, the system recommends products that similar users were interested in.

Main user actions that were tracked are: which products user added, how many times the user entered the same product and total time spent on a product page.

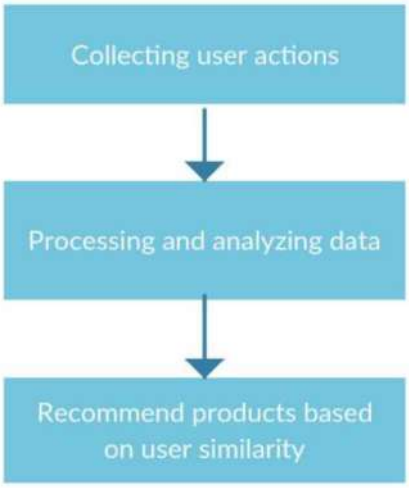

Figure 1: Recommendation system design

Figure 1. presents steps in the design of recommendation system: (i) collecting user actions, (ii) processing and analyzing data using Nearest Neighbors method, (iii) recommend products based on user similarity.

3.1. Collecting user actions

Collecting users actions data is a first step in building a recommendation system. Table 2 describes data collected from different users are shown. Part of the data is presented below in a way so it can be used for recommendation system.

Table 2: User behavior table

	User	Product	Time spent	Product clicks	Added to cart	Purchase
Case 0	1	1	38	2	1	1
Case 1	1	2	22	1	0	0
...	...	...	...	...	...	...
Case X	4	9	10	1	0	0

The fields represent collected user behavior data separated by the user, which is marked as a case. It is shown how many times each user clicked on a specific product and how much time the user spent on a product page. Also, it shows how many times each user added product to a cart and how many times user purchased a specific product.

3.2. Processing and analyzing data

Recommendation system method that is used is Nearest Neighbors. Nearest neighbor method principle is to find a predefined number of training samples closest in distance to the new point and predict the label from those. The distance is any metric measure - standard Euclidean distance is the most common choice. In this case ball, tree data structure is used, since that is optimized for a large amount of data comparing to K-dimensional Tree (Omohundro, 1985). A non-parametric procedure has been introduced by Fix and Hodges in pattern recognition literature as the voting k-nearest neighbor (k-NN) rule (Fix & Hodges, 1951). According to this rule, an unclassified sample is assigned to the class represented by a majority of its k nearest neighbors in the training set (Denoeux, 1995).

Using Nearest neighbor indices and distances for each record in object X (user behavior array) are printed. A part of the printout is shown on the following figure.

Table 3: Indices and distances for each element

Indices	Distances		
0 17 12	0.0	5.56776436	6.55743852
1 15 23	0.0	3.87298335	5.56776436
2 11 16	0.0	2.82842712	3.0
3 9 20	0.0	3.31662479	4.12310563
4 10 12	0.0	18.1934054	22.22611077
5 19 11	0.0	2.64575131	2.82842712
6 3 20	0.0	4.47213595	4.58257569
7 9 8	0.0	2.23606798	4.24264069
…			…
27 26 20	0.0	1.41421356	1.41421356

In the table above left column represents users ids in a list and right column represents how similar are those users. The nearest neighbor of each user is the user itself, at a distance of zero. The third and fourth elements are the elements with closest distances to the specific element. As we can see from the third row in the table above, user 1 is very similar to users 15 and 23. We can see in the fourth row that user 3 is also very similar to user 9.

When a new user comes to the e-commerce store, we have a situation of cold start problem. Many papers discuss on cold start items (items generated without knowledge about previous users' behavior). However, this is not within the scope of the paper.

3.3. Processing and analyzing data

Products are recommended to a current user based on calculation how similar is current user to other users that already visited e-commerce website. Accordingly, when a user *X* visits product *Y*, the system will take that as an input from user *X*. That input will be used to compare user *X* with other users in the system. The recommendation system is able to predict what other products user *X* might be interested in. Example recommendation that that system outputs like this: [7.68114575, 8.83176087, 9.53939201] -> [7, 9, 3].

The output that is shown above shows us how similar is user *X* with the other users in the system. As we can see in the example above a new user is the most similar with a user 7 (closest distance), a little less similar with a user 9 and after that to user 3.

Based on the example above, the system determines which users are similar to the current user and the system can choose products for the current user that similar users were interested in. If two users are similar and one of them added a product to the cart or purchased the item, we can also expect for the similar user to do the same. The recommendation system is showing all products that the most similar users purchased. If user *X* is the most similar to user 7 (as in the example above) then the recommendation system will show all items that user 7 purchased as recommended. In the current implementation, the recommendation system always uses only users who had made a purchase for comparison with other users (those users are the only ones that have a real value for the e-commerce system). The more data from users is collected, more correct a recommendation system will predict products that user *X* is interested in.

As mentioned above, this system can be implemented in a real-time e-commerce website. In order to implement there are few steps involved: (i) implement collecting user behavior data using JavaScript, (ii) send collected data to a web server, (iii) store data in the database, (v) fetch recommendations from recommendation system API call (v) render recommendations on the page. That is shown in the figure below.

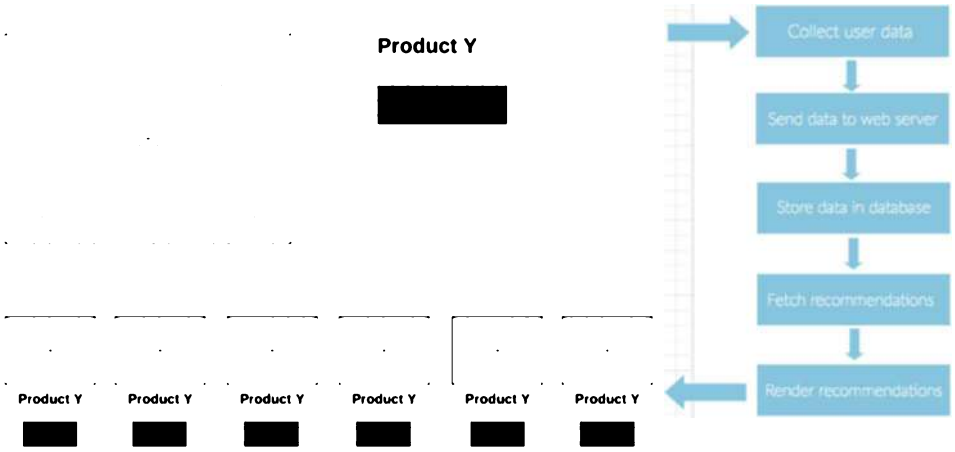

Figure 2: Recommendation system design

The developed system includes following software architecture elements: (i) HTML website, (ii) PHP server, (iii) database server and (iv) recommendation system server. HTML website is making a request to a PHP server (using JavaScript) and PHP server is getting user information from the database server. PHP server gets recommendations from recommendation system server. Communication between these entities is shown in Figure 3.

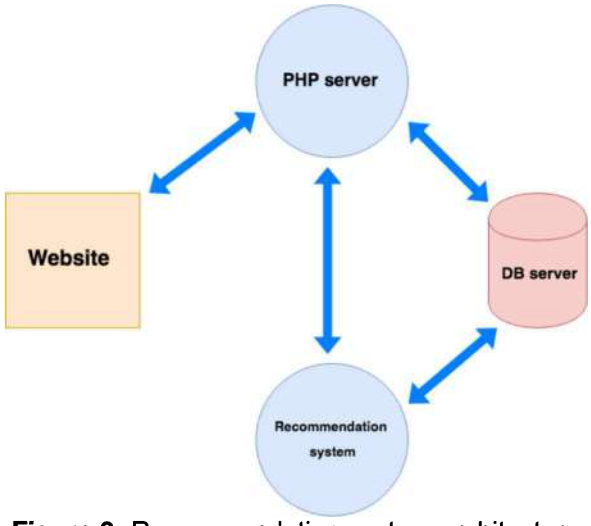

Figure 3: Recommendation system architecture

4. DISCUSSION

This system is different from the other recommenders in e-commerce systems (Benlian et al., 2012; Weisberg et al. 2011), because it tracks all data available from user behavior that can lead to better understanding what user might be interested in. The system main focus is not on using previous purchases from users. Instead, the main focus is on the helping user who hasn't yet made its purchase or new purchase is not related to old one. The scenario where the user purchases one item and comes again to purchase the similar item does not happen very often.

Nowadays, a lot of researchers integrate social media into e-commerce systems and use them for creating recommendations as users are enabled to log in using social media and like products with social buttons. In (Li et al., 2013) authors proposed a social recommender system that can generate personalized product recommendations based on preference similarity, recommendation trust, and social relations. Compared with traditional collaborative filtering approaches, advantages of the proposed mechanism is reflected in its comprehensive consideration of recommendation sources. This paper is not considering data from social networks. It is focused mainly on user behavior collected data.

Numerous studies have investigated recommendation systems as they play an important role in e-commerce websites since those systems increase sales and income for the shop owners. For example, (Lin, 2014) performed an empirical research that investigated to which extent recommendation systems increase sales within B2C platform in China market. He found out that user recommendations are more effective than system recommendations in driving product sales.

The main contribution of this paper is reflected in a proposed approach for recommendation systems in e-commerce websites focused on user behavior. Common recommendation systems for e-commerce websites use only sales as a parameter for recommending products. In implemented recommendation system complete user behavior is tracked. After finding a similarity between the current user and other users in the system, a recommendation system is able to predict in a real-time which products will be interesting for the current user.

We acknowledge that the proposed solution does have some limitations and can be improved. There are many different data that can be collected from a user behavior in order to find out how interested are users in the product, for example, user's social media interaction on pages. Also, product reviews and sales can be tracked together with users browsing data. In addition, time factor should be considered in users behavior, so only recent users actions should be considered. Below there is a list of advantages/disadvantages of the developed model:

Table 4: Advantages/disadvantages of the developed model

Advantages	Disadvantages
Real-time recommendations	Not considering the time factor
Focus on user behavior	Not considering social media interaction on pages
Does not require many data	Not considering product reviews and sales data
Recommendation based on similar users behaviour	Many user behavior data not tracked/mentioned
Ease of adding more user behavior parameters into the system	
Fast recommendations	

5. CONCLUSION

Recommendation systems are now used everywhere. All e-commerce platforms have some kind of recommended products lists. Most of those lists are purely based on product popularity, which actually represents a number of sales. Because of that, many e-commerce websites have a problem with products that used to be attractive to users, but they are not anymore. Those products are shown in popular products lists unless they are manually removed by e-commerce system administrator.

There are a lot of opportunities to add intelligence and personalization in every part of every system, creating experiences that seem like a friend that knows you, what you like, and what others like and understands what options are out there for you. Recommendations are discovery, offering surprise and delight with what they help uncover for you. Every interaction should be a recommendation (Wei, et al., 2017, Smith and Linden, 2017). Recommendation systems do not consider users behavior and how much time a user spends on the specific page and how many times the user enters pages. Also, it is important to know how many times user added product to the cart, even if a purchase was not been made. In the time when many retailers sell a large number of goods online, it is important to use recommendation systems that will help users navigate through the site and find what they look for.

The expected future of recommendation systems in e-commerce is to track complete users behavior and make some conclusions about the user. Based on that, recommend specific items to the user. Also, in the future, we will probably see increased usage of recommendation systems, not just for some products list as it is used now. In the future, complete e-commerce systems will be adjusted based on the users' behavior and expectations.

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OVERVIEW OF TRAVEL DEMAND FORECASTING METHODS USING SEARCH ENGINE QUERIES

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Abstract: *Travel demand was always very unpredictable, depending on many factors. Up until the emergence of several search engines, it was very difficult to forecast travel demand. Demand prediction is important to hotel management teams that can use produced information to adapt room prices and impact total revenue. Search engines Google and Baidu became an integral part of tourist research, as search queries about particular destination became key performance indicators. Since there are no available papers that cover all present methodologies for demand forecasting, this paper intents to fill this gap. This paper assesses relevant methods that use search queries for demand fluctuation prediction. Using econometric models such as ARMA, ADL, TVP and VAR, it is shown that there is a strong relationship between queries and actual demand. There are several hundreds of potential queries that can be used as input for the models, and picking those with highest predictive power is not easy. It is shown that search engine data has strong predictive power if appropriate queries are used as input for predictive models. Successful predictions will lead to better price management and in the end higher revenue for hotel businesses.*

Keywords*: demand forecasting, dynamic pricing, revenue management*

1. INTRODUCTION

The global travel industry gross bookings reached $1.6 trillion in 2017, making it one of the largest and fastest growing sectors in the world. Factoring in indirect economic contributions, travel and tourism now accounts for a staggering 10.2 percent of global GDP. This continuous growth that was seen from 2010. onwards, is underpinned by several key factors mutual for all global markets and many other factors bound locally. Although some industry experts are pointing out concerns about the high growth, trying to indicate cyclical history of the industry and potential downturn, there are more of those who are bullish on the industry. There are some key indicators of strong outlook on the travel industry that are not connected to the economic dynamics and point to the strong growth in the long run. Revenue management is one part of the hotel business that can be improved using available data and mathematical approaches that will yield improvement in the decision-making. In order to achieve improvements, we must first recognize other factors influencing total revenue.

The first and most important factor is the demand. Currently, very few hotel chains in the world use some sort of demand forecasting that helps them define the price for the future periods. There is high variability in demand in the short-term as well as long-term. There are many factors influencing demand level such as: economic environment, transportation availability, one-off events etc. If hotel management could predict the rise in demand in the next week, they could raise the price of available rooms and still sell them. There is surplus coming from this intelligent decision-making that can be captured. There are several papers dedicated to demand forecasting in travel (Yang et al., 2014; Bing et al., 2012). In the next chapter we will discuss some of the methods, their strengths, limitations and underlying assumptions.

Second important factor is the offer of the competitors. In travel and hospitality, there is a fixed amount of demand for a certain period. Customers are getting informed online and choose the place where they want to stay, based on the supply. A customer would naturally choose the cheaper option if the services of both options are identical. Hotel businesses must identify the characteristics they offer and find their respective competitors who offer same or similar services and compete with them for winning over customers. In the current environment, most businesses use traditional approaches to mapping out their competitors and occasionally following their actions. There is no standardized approach to dealing with changing prices of the competitors and making informed decisions based on them. The last argument creates motivation for future research.

There are several technological trends present in the hotel industry which was part of the research conducted in order to assess impact of technology on the industry. Research (Guttentag, 2013) was conducted on a new business model proposed by Airbnb, which is the first disruptive use of technology in the hotel industry. It represents an innovative accommodation product that has shifted perceptions of

hospitality throughout the hotel industry. While Airbnb remains a topic of significant attention within the sector, there is little understanding of the degree to which it is used as a hotel substitute, or how Airbnb guests view the service relative to hotels. This study offers important insight into these questions by showing that many Airbnb guests use the service in place of a hotel, and especially mid-range hotels. Secondly, IATA statistical report shows 10% increase in number of passengers carried by low-cost carriers in 2017. compared to 2016. Increase in all other price categories were below 5% for the same compared periods. Also, most of the traditional airline metrics such as Revenue passenger kilometres (RPK), Available Seat-Kilometres (ASK) and load factor, all show higher growth than other price categories. This indicates strong overall growth in low-cost segment of air flights. Thirdly, (De Pelsmacker, Tilburg, & Holthof, 2018) is a research on digital marketing efforts and results of over 200 hotels in Belgium. Authors focused on eCRM and concluded that online reviews, TripAdvisor profile nurturing, responsive digital footprint all affected room occupancy favorably. This indicates relevance of digital marketing and customer relationship management.

2. METHODOLOGY

Purpose of (Bing Pan et al., 2012) was to determine if search query volume was useful in forecasting demand for hotel rooms. The authors used search volume data on five related queries to predict demand for hotel rooms in a specific tourist city and employed three autoregressive moving-average (ARMA) family models and created their ARMAX counterparts involving Google search data to evaluate the usefulness of these data. The authors also evaluated three widely used econometric models – ADL, TVP, and VAR – for comparison.

ARMA models

ARMA model takes the form:

$$lny_t = \mu + \sum_{i=1}^{p} \varphi_i lny_{t-i} + \varepsilon_t + \sum_{i=1}^{q} \theta_i \varepsilon_{t-i} \quad (3)$$

AR model is a specific for of the (3) where q = 0:
:

$$lny_t = \mu + \sum_{i=1}^{p} \varphi_i lny_{t-i} + \varepsilon_t \quad (4)$$

ARIMA has the form:

$$\Delta^d lny_t = \mu + \sum_{i=1}^{p} \varphi_i \Delta^d lny_{t-i} + \varepsilon_t + \sum_{i=1}^{q} \theta_i \varepsilon_{t-i} \quad (5)$$

ADL model

ADL model regresses lagged depended variables to arrive a at current predicted value, models derived and used in this study has the form of:

$$lny_t = \mu + \sum_{i=1}^{p} \varphi_i lny_{t-i} + \sum_{i=1}^{5} \sum_{j=0}^{p} \alpha_{ij} ln\, x_{i,t-1} + \varepsilon_t \quad (6)$$

TVP model

TVP model used in this study established a relationship between the demand for hotel rooms and the Google search data. The model includes measurement and transition equations:

$$lny_t = \alpha_{0t} + \sum_{i=1}^{5} \alpha_{it} lnx_{it} + \varepsilon_t \quad (7)$$

$$\alpha_{jt} = \alpha_{j,t-1} + \mu_{jt} \text{ (j = 0,...,5)} \quad (8)$$

VAR model

VAR model differs from others in the sense that it treats variables and endogenous, which results in capturing the dynamic nature of demand. It is expressed as:

$$Y_t = C + \sum_{i=0}^{p} A_i Y_{t-i} + e_t \quad (9)$$

All three ARMAX models consistently outperformed their ARMA counterparts, validating the value of search volume data in facilitating the accurate prediction of demand for hotel rooms. The data used was composed of 5 different keywords labeled as room searches focusing on one city particularly. After the models were used, authors tested their accuracy using mean absolute percentage error (MAPE) and root mean square percentage error (RMSPE):

$$MAPE = \frac{1}{m}\sum_{t=1}^{m}\left(\frac{|\hat{y}_t - y_t|}{y_t}\right) \quad (10)$$

$$RMSPE = \sqrt{\frac{1}{m}\sum_{t=1}^{m}\left(\frac{\hat{y}_t - y_t}{y_t}\right)^2} \quad (11)$$

these two measures have been applied to evaluate the forecasting performance of tourism demand models (Song & Witt, 2006; Vu & Turner, 2006).

Authors made the point that web search improves predicting accuracy so in our own research we can assume relevancy of Google search data in some degree. Also, fellow colleagues developed a simple but powerful model that will be a starting point for further research, taking into account some of the limitations stated in their paper. Only 5 keywords were used in the model and since travel involves complicated decision-making, including more queries in the model would likely increase forecasting accuracy.

3. METHOD FOR CHOOSING QUERIES

Proceeding in our research on demand forecasting models, we came across interesting paper that had approach to forecasting which eliminated limitations of the 5 query approach (Yang et al., 2014) in their paper "Forecasting Chinese tourist volume with search engine data" had similar approach but they invested more effort into selecting relevant queries. Using iterative approach, they calculated the correlation coefficient between Hainan monthly visitor volumes and each of the search queries with different lag periods. Authors chose search queries that had correlation coefficient above the threshold of 0.76 arriving at 10 Google search queries and 25 Baidu queries. Threshold was set to optimize accuracy-parsimony trade-off. Using this approach, authors could identify an interesting pattern of Chinese tourists. Lags with significant correlations were in the range of 0-6 meaning tourists do not search for travel data more than 6 months before the trip. More detailed analysis showed that most Chinese visitors to Hainan first searched travel agent information, about six months before the trip. Then they searched for flight information four months before the trip, and finally one month before departure, they would look up weather and shopping opportunities. This confirmed the assumption that decision-making of travelers follow a pattern which was recognized using lags and search queries.

Yang, Pan, Evans, and Lu (2014) used co-integration analysis of search index and destination visitors. Using a shift and sum method, they created a composite index which they compared to destination visitor index.

$$logT_{t1} = c_0 + \beta_1 logT_{t1}(-12) + u_t \quad (12)$$

$$logT_{t1} = c_0 + \beta_1 logGl_{t1} + u_t \quad (13)$$

$$logT_{t1} = c_0 + \beta_1 logBl_{t1} + u_t \quad (14)$$

Formulas 12-14 represent a model where T_{t1} is predicted value, visitor volume estimate, Gl_{t1}, is search index from Google and Bl_{t1} is Baidu search index .

To conclude, (Yang et al., 2014) reviewed present models for predicting visitor volume, but most importantly contributed to the field in two ways. Firstly, it was proven that Local search engine Baidu has more predictive power in Chinese visitor forecasting than Google, which can be attributed to the cultural factors. The second contribution is the approach for selecting keywords that have highest predictive power. This approach lays the ground for future research in this field. In terms of application, the paper provides a new way of predicting tourist volumes for hotel managers and policy makers. There is another application of the model, where managers can use it to predict the increase in tourist volume and use this as the basis for benchmarking of their own performance, for example if the model shows 15% increase in volume and the certain unit has 5% increase, it shows weak performance. Authors stated this last application in their paper but there are some market factors which have significant power over variations. Model is not taking into account purchasing power, behavior and preferences of the customers, thus out of 15% of volume increase, there could be 12% coming from financially strong customers which are simply not using perhaps hostels, making 3% increase in hostel visitors volume justified.

As a next step, authors propose using tweets, blog posts, and social media posts to be used in the analysis. The combined power of several data sources could improve prediction accuracy which will lead to better tourism management. This will be taken as input for future research.

4. CONCLUSION

The travel industry is taking a big swing in recent years, increasing to 10.2 percent of global GDP in 2017. Growth is stable since 2010. and even though there are authors who alarm about industry's cyclical nature, there are more of those who have a positive outlook on the future years. This high growth combined with new technologies created every day and increased amount of data in all of the sectors of travel, are leading to increased interests in the development of new business practices and techniques that can affect some parts of core decision making and increase revenues and bottom-line. Even though many sectors of the travel industry are growing and showing endless possibilities for data scientists and data engineers, we focused on hotel businesses for one simple reason and that is, availability of domain knowledge through personal contacts. There are several identified trends in the hotel industry that are changing it significantly. This paper recognized several of them. Innovative business model of Airbnb, eCRM emergence and intense growth of low-cost airline flights which is driving low-cost lodging revenues. All these trends indicate high presence of tech-related innovations thus making future of the industry depending on technological development, which motivated us to investigate new ways of improving businesses in the travel industry using technology. Hotels have a simple business model to begin with, but a very complicated decision-making if there is an outreach for good revenue optimization. Since hotels are of fixed location, they are limited by the demand for lodging in their destination. Naturally, if hotels could predict future demand, they could modify their room prices (increase them) and still sell them. This can lead to increased revenue and overall profitability since cost factor is not affected by the price. There are several fields of application of intelligent systems and algorithms that improve hotel businesses. In the early 80s focus was on revenue optimization techniques which were based on stochastic models. Later, with more data present, the focus was shifted to forecasting models. With the rise of search engines such as Google and Baidu, foundations for extremely powerful models were laid. Several authors developed linear models that used search engine queries and analyze time-series data to arrive at fairly accurate forecasting models. In our assessment of such models, we focused firstly (Pan et al., 2012) who used ARMA, ARIMA, ARMAX and three econometric models ADL, TVP and VAR to test if search queries are improving model accuracy. Research showed that query data is improving model accuracy which leads to the conclusion that data provides fine information about the decision-making process of travelers. There were some limitations in this approach. Authors used only 5 queries as input for the model, which is just a part of all the queries used by travelers. Second paper we assessed (Yang et al., 2014) used a structured approach based on correlations testing to determine search queries relevant to predictions. Besides identifying key queries, authors could explain lags between queries and travel date and formulate logical decision-making of travelers. Base model for prediction was index based co-integration analysis which resulted in accurate predictions. Final contribution of this particular research is benchmarking application where management can compare predicted demand increase and actual sales increase for the period to arrive at the conclusion about their performance relative to the average. By assessing some of the models present, we have laid foundations for future research in the field of travel.

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FRAMEWORK FOR VERIFYING DOCUMENTS ON THE BLOCKCHAIN

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Abstract: *Tampered documents can cause irreparable damage to governments and businesses. It can be impossible to determine how the document has been tampered, opening up the whole system for large losses due to fraud. Mitigating document fraud and document tampering should be a top priority for any business system. We propose a framework which can be used to keep track of all document changes, while at the same time allowing verification of documents across a distributed system. This eliminates document fraud and document tampering by providing an easy way to perform document verification among all users of the framework. The framework is based on cryptographic hashes and blockchain for persistence. Each hash is mapped to a physical document stored inside a document repository. If a document's hash isn't present on the framework's blockchain, it has been tampered and can be disregarded. Our framework provides a starting point for enterprise document verification based on known blockchain principles and best cryptographic practices.*

Keywords*: blockchain, authenticity, verification, document management*

1. INTRODUCTION

Main benefit in the usage of paper documents was the ability to easily verify them and check to see if they have been tampered. Archival purposes were also much simpler due to the way documents could be replicated by hand or printing machines. In some occasions, it would be necessary to verify the authenticity of the copy. During the copying process, either by hand or by machine, it is easier to tamper the original document. The verification process was performed by an authorized body, either appointed by the government or by the company, depending on the document type. Documents were archived in physical locations, so that they could be retrieved and cross-referenced if needed.

With the advent of digital technologies, new ways to prove their authenticity needed to be created. Digital documents could no longer be easily verified and authenticated. The ability to tamper them even after they have been created has been improved with the usage of computers. One approach to solve this issue was to keep double copies of the documents – either both double digital, with one document kept at a secure location, or having paper copies of each digital copy. Either way can prove to be resource intensive, as well as not efficient or environmentally unfriendly. Archival of digital documents can also prove to be a problem, since digital storage devices can fail earlier than paper, destroying the archived data.

By the utilization of cryptographic hash functions which use the documents as input we can keep track of different document versions safely. A cryptographic hash function is a one-way transformation which produces data depending on the input (Menezes, van Oorschot, & Vanstone, 1996). Each document change produces a new hash, thus eliminating the tampering process without amending the original document. The framework is document agnostic, allowing to store any kind of documents which can be successfully verified using cryptographic hashes.

The process of amending original document allows us to perform changes on the original document while keeping track of its changes. Patches are signed off by authorized users before being committed to the database. Each authorized user contains an asymmetric cryptographic key pair (Menezes, van Oorschot, & Vanstone, 1996) which can be used for safe sign offs and identity verification. Signing them off allows us to keep track of document integrity throughout its lifecycle, while at the same time preventing future tampering in case of signing off without approved cryptographic keys.

Document and patch storage needs to be safe from tamper to prevent loss. In case of loss, no documents can be verified. Usage of blockchain combined with document repositories can minimize tamper and improve overall security of the document verification system.

Using the blockchain for storage of document and patch signatures provides a linear read-only access to previous records. Blockchain is a linear distributed database where entries (blocks) are added to it after a

consensus between blockchain users has been reached (Nakamoto, 2008). Benefits of linear access are fast access to the data and the ability to perform advanced analysis on the data, such as blockchain filtering and rotation (Zivadinovic, 2017).

Storing whole documents and their patches on the blockchain would prove to be cumbersome due to their size (Lunde, 2012). Because of performance issues, documents and patches are kept inside document repositories. Document repositories represent file storage devices where files representing documents and patches are stored (Green, 1993). Each one of them can be used as input to produce a hash value. The resulting hash value is used for future blockchain operations.

The framework shown in the following chapters should be treated as a proof of concept and a starting point for a complete implementation, not as a complete solution.

First two sections, "Existing document verification systems" and "Blockchain operations" are concerned with the overall review of current document verification blockchain solutions, as well as their core architecture.

The "Document verification framework structure" section applies the presented findings from previous two sections with the technical architecture and choices made during the development of this document verification system.

Use cases for the presented document verification system are presented in the fourth section. Two use cases are presented, one focused on citizen and government usage, while the second one is focused on company accountability and its inventory keeping of government regulated goods.

Last chapter, “Conclusion”, represents an overall impact of the presented system.

2. EXISTING DOCUMENT VERIFICATION SYSTEMS

One of the first works on the topic of blockchain and document verification is a paper written by Aravind Ramachandran and Dr. Murat Kantarcioglu (Ramachandran & Kantarcioglu, 2017) using Ethereum smart contracts (Wood) and Open Provenance Model (Moreau, Freire, Futrelle, McGrath, Myers, & Paulson) for tracking and correlating data. Their work is based on the interconnectivity between data for scientific research and keeping it safe from fraud, such as data fabrication. Results from this paper can be further refined and applied to all document management and document verification systems where we have documents consisting of multiple legs, such as multiple forms required for a single request.

Discovered document verification systems are mostly concerned with verifying identification documents. Governments of some countries, such as Australia (Government of Australia).One common thing between all reviewed document verification systems is that none of them openly provides the business process insights concerning verification. Another one worth mentioning is the Trudatum (Coinfirm Ltd., 2018) blockchain file verification service.

Gemalto offers its *Gemalto ID Verification* solution to perform document verification (Gemalto). Their system works with different types of user identification documents, such as passports, visas and ID cards. Document verification is performed upon a centralized database of templates. The procedure utilized by Gemalto is called *“Know Your Customer”* (KYC) to combat identity or financial fraud, as well as comply with international regulations. Its main usage is in government entities and large private companies (Gemalto).

Another company providing document verification is *Jumio* with its product *Netverify* Document Verification (Netverify). Similar to *Gemalto ID Verification*, *Jumio* provides the end user with the means to acquire and verify identification documents. *Netverify* Document Verification consists of the backend system and the mobile application utilizing different algorithms to perform data gathering from a document photograph. An additional benefit is masking of credit card numbers and other sensitive information, which is a prerequisite for PCI compliance (Jumio).

The Australian government provides a document verification system called *Document Verification Service* (Government of Australia) which allows different legal entities (such as companies) to check if the provided identification documents are valid and if there are additional government records connected to them. This system can only be used with Australian government issued documents and can provide several results concerning their status:

- Matched
- Not matched
- Document invalid or not electronically captured

Resulting data can be used by the legal entity to determine further identification methods, if needed.

Trudatum is a new software solution specifically made to work with files and documents. Their system works by leveraging the blockchain for file signing and verification. Trudatum is based on proprietary technology and at the time of writing, their services aren't available to the public, even though they have a successful pilot project behind them (Biggs, 2018).

3. BLOCKCHAIN OPERATIONS

Addition and modification operations represent the basis of the methodology used to form blocks of the blockchain. Even though the focus of this paper is on document verification, the presented operations are required to form a complete picture of the methodology used to verify documents on the blockchain.

Request acceptance by the blockchain means that the issued request has been propagated in full through the network utilizing the blockchain. The process of adding document hashes presents a fundamental step in the blockchain document verification methodology. Without it, we are unable to extend the blockchain with new document hash entries, thus being unable to verify the documents in question.

The process to add new document hashes to the blockchain is the following:
1. Create a document
2. Add it to the document repository
3. Generate its hash value
4. Send a request containing the necessary information to the blockchain endpoint
5. Parse the response from the blockchain endpoint

The request contains the public key of the author signing off the document and the document's hash value. On a successful response, we have confirmation that the document is now being tracked on the blockchain.

Modifying documents already tracked by the blockchain allows us to make amends to them. Amending documents is more space efficient since we track only the changes on the document, not the whole new document. When modifying, we use the blockchain to track the hash value of the patch which is applied to the document. A patch represents a set of changes needed to evolve a document from one state to another.

Tracking document patches on the blockchain is similar to adding document hashes:

1. Modify the document locally
2. Generate a patch from the changes
3. Generate its hash value
4. Add the patch to the repository
5. Send a request containing the necessary information to the blockchain endpoint
6. Parse the response from the blockchain endpoint

The request needed to publish a patch to the blockchain contains the public key of the author which signed off the patch, the hash value of a document we wish to patch, the hash value of the document with the previous patch applied (if it exists) and the hash value of the document with the latest patch we have applied.

If the system returns a successful response, the patch is now active and the parent document has been amended. Previous versions of the document in question are now invalid – only the document with the applied patches up to the last one is valid.

The list of patches which need to be applied to transform the document to the latest state can be extracted from the blockchain by following the parent references of requests. This process is called document restoration. It is possible in all cases of modification, except in the cases of deletion where all file formats, when empty, produce the same hashed value.

Deleting documents is the same as modifying them. In case of deletion, patch files contain the necessary data which is used to delete their content. The original document location on the repository is unchanged. Only its content becomes blank. Deleting the document from the repository is out of scope, but can be extended by adding checks for its presence.

When the document's content has been deleted, depending on the file format of the document, it can be possible to recreate it by following the blockchain backwards from the deletion patch.

Document verification, the core of this paper, is performed opposite of the process of adding document hashes to the blockchain:

1. Generate the hash value for a document you wish to verify
2. Send a verification request to the blockchain endpoint which contains the hash value
3. Parse the response from the blockchain endpoint

The parsed response can be either positive or negative. In case of a positive response, we have proof that the document we are verifying exists in the blockchain and that it hasn't been amended by patches.

4. DOCUMENT VERIFICATION FRAMEWORK STRUCTURE

The overall system consists of several components:

1. Blockchain
2. Blockchain endpoint
3. Document repository

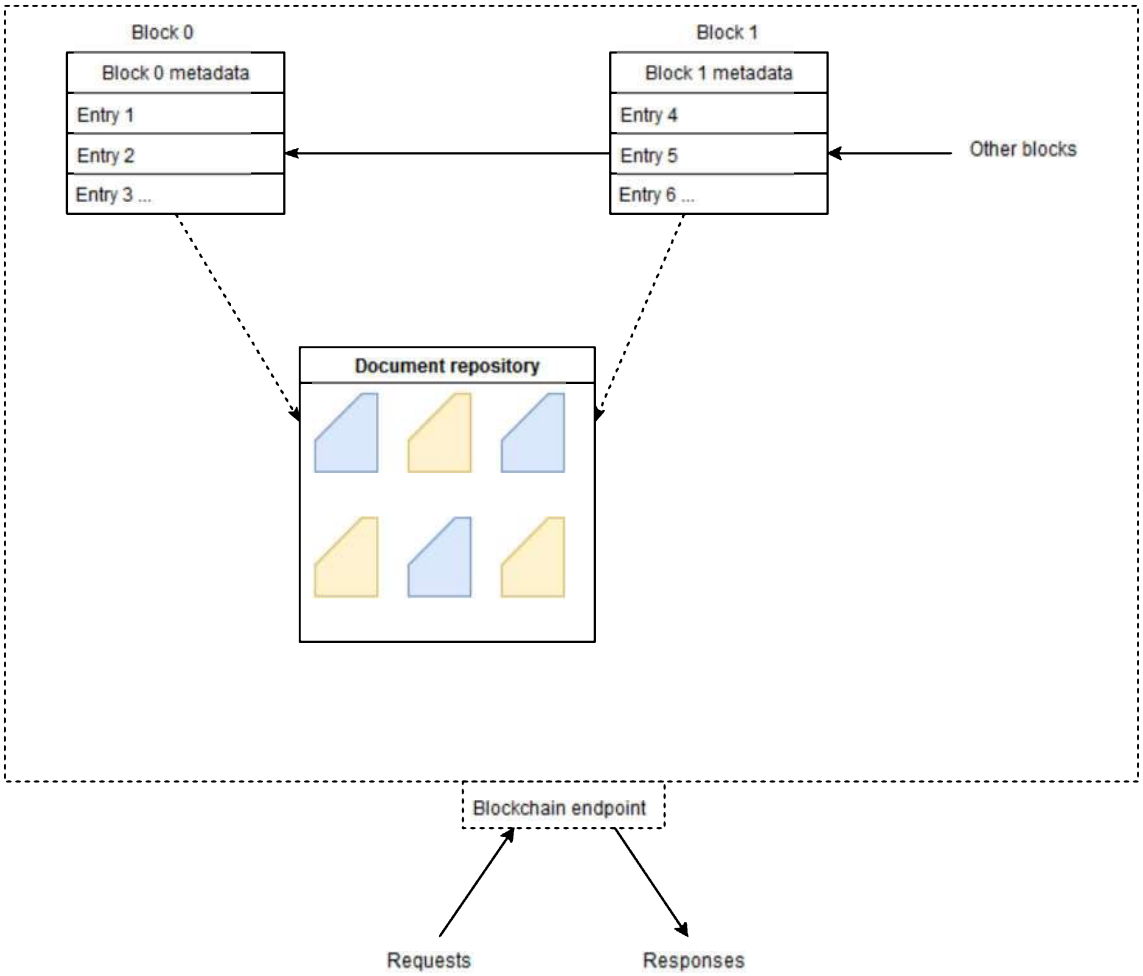

Diagram 1: Framework architecture

As mentioned in the introduction, blockchain is a linear distributed database where entries (blocks) are added to it after a consensus between blockchain users has been reached. Blockchain is distributed across multiple nodes. A node is a computer running an instance of the software used to manage the blockchain. All nodes have the same copies of the blockchain. Nodes are denoted by the blockchain itself, since they all contain copies of it.

Blockchain configuration is stored in the block metadata. The metadata represents an index into the blockchain, which allows search and filtering of data. Metadata is represented by the following data structure:

```
{
 id: 0,
 parent: null,
 time: ["2018-02-12T17:03:12+00:00","2018-02-12T18:03:12+00:00"]
 count: 3
}
```

Figure 1 : Block metadata format

Where *id* is the number of the block in the blockchain sequence, *parent* represents the previous block *id* in the blockchain, *time* represents an array of start and end time of entries which the block contains and *count* denotes the number of entries inside the current block.

In order to add new blocks and entries to the blockchain, majority of nodes needs to perform a consensus vote in order to determine whether the data will be added or not. The consensus vote depends on the consensus algorithm implemented, but for simplicity, we are assuming that the consensus is reached when 50% plus one node approve the addition of data. On successful consensus vote, the incoming request gets added to the current active block as an entry. The current active block is determined by the time period it represents.

Positive consensus vote is achieved when the incoming data to the node gets evaluated by the software used to manage the blockchain. The evaluation is done across different criteria, depending on the application. When evaluation has been completed, the resulting data is propagated across the network of nodes.

Backbone of the communication between nodes is handled by the blockchain endpoint. Blockchain endpoint is a set of network configurations and infrastructure connecting blockchain nodes between each other and allowing access to the blockchain from outside. The end user using the blockchain would need to access only the blockchain endpoint, without having knowledge of the internal structure. The request would get routed to all nodes of the system and wait for their response.

Document repository represent file storage devices where files representing documents and patches are stored**.** In the diagram above, blue files represent documents, while yellow files represent patches. Documents and patches do not need to alternate between each other, as shown in the picture. Entries contain references to the hash values of documents and patches.

Patches should conform to the *Unix diff* unified format (Free Software Foundation). This allows a standardized way to apply patches to documents, as well as makes the patches human readable for inspection.

Entries represent parsed requests which have been consented by the nodes and written into the blockchain. An example entry is shown below:

```
{
 author: "someOtherAuthor",
 previous: "hashOfDocument",
 current: "hashOfPatch"
}
```

Figure 2 : Entry format

Where the field *author* represents the sign-off public key of the author, *previous* points to the hash value of the last patch (if it exists) and *current* is the actual hash value of the document or patch.

The diagram below represents mapping between the document repository and the blockchain. It is visible that the entries inside the blockchain contain all the necessary data to identify and reference to documents inside the document repository.

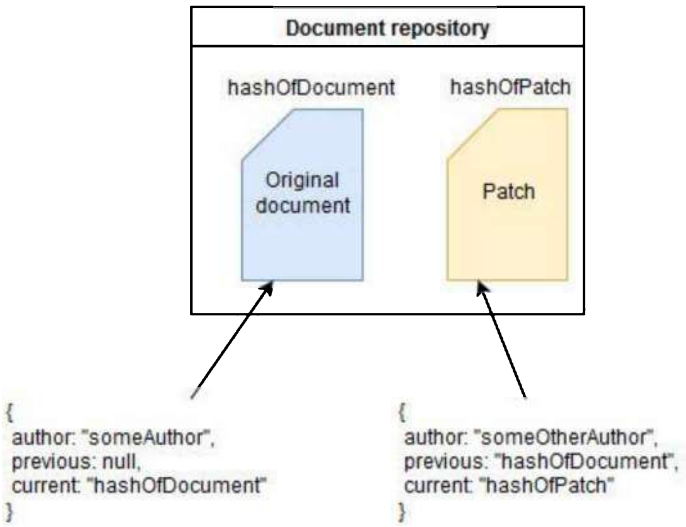

Diagram 2 : Blockchain and document repository mapping

Hash values used throughout this paper are assumed that they have been generated by the *SHA256* algorithm, while the cryptographic key pairs are assumed that they are based on the *RSA* cryptosystem with 2048 bit key length. The sign-off key is the public key of the key pair. Author verification is performed by choosing some data which is going to be used as the base line. Encrypting it by the private key in the entry and decrypting it by the author's private key should prove the public key's affiliation to the author – but only if the resulting decrypted data is the same as the input.

5. USE CASES

5.1. E-government

Having a distributed index of documents which cannot be tampered by any way without notifying the system of changes can prove to be the backbone of e-government. This would benefit both the citizens and the clerks of the country where its implemented.

The citizens would have an open way to check the validity of their documents by simply issuing the requests to the e-government blockchain and retrieving a positive or a negative response from the system.

On the government side, government procedures which monitor the blockchain can perform real-time updates when the documentation becomes expired. One concrete example is the driving license: in case of its expiration, the system would publish a patch request that invalidates the driving license in some way (such as setting a flag in the document). This, in turn, would amend the original driving license the citizen wants to verify, thus rendering it invalid – since it isn't the latest version inside the blockchain.

Another example is would be to check the status of your requests issued to the government (such as requests for granting citizenship). Querying the blockchain connected to e-government allows the request issuer to see how and where the request has been progressed.

When abstracted, requests are nothing more than regular documents which need to be approved or rejected due to some reason (e.g. missing additional documentation) by different entities. Each approval or rejection would be a patch to the original request, which can be read by the person which issued the original request.

In both examples the patches performed by the e-government cannot be changed in the future, without amending them across the whole blockchain. This means that the business process to handle document validity and to handle government requests cannot be modified by external modifications (e.g. by bribery) due to the distributed nature of the blockchain where a consensus on change needs to be reached (according to some consensus algorithm). In case of external modification, the system can be easily audited to determine where the anomaly has appeared.

5.2. Company accountability

The previous use case assumed that the blockchain is being hosted inside one entity (the government). It is also possible to host the blockchain both across companies and other entities, such as regulatory

committees. This would allow direct transparency into the subject matter without tampering. The condition to prevent tampering is selecting a consensus algorithm or having the critical number of blockchain nodes inside the company.

When the critical number of nodes belongs to the company (or the consensus algorithm is set in their favor), entities controlling the remainder cannot perform a takeover of the blockchain by issuing false data or denying incoming blockchain requests.

This node distribution can be useful for tracking government regulated goods (such as tobacco products or alcohol) between suppliers. Since the government has read-only access to the incoming blockchain requests, this removes the requirement of companies to produce reports concerning the sales and distribution of government regulated goods. An additional benefit is that the company's financial reports become easier to generate for the company. Furthermore, the government, since it has direct input into the current state of government regulated goods, can create more accurate tax rates and other regulation costs.

6. CONCLUSION

In this paper, we have proposed a framework which can be used for the development and research of document verification systems based on the blockchain. This system, by design, lowers the risk of document tampering and allows fast document verification. Documents are stored in document repositories, while their unique hashes are kept inside the blockchain. In order to add a document to the blockchain, a special request needs to be performed. Document modifications are performed by adding patches to the document repository and keeping track of their hash values inside the blockchain. When patches are added, the documents which are being amended need to be referenced. Verification is done by issuing a request containing the hash value of the document and receiving a positive or a negative response. Each request forms an entry inside a block. Each block delimits a specific time period. To perform any work on the blockchain, a consensus between nodes participating in the blockchain must be established.

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IMPROVING ROBERT C. MARTIN'S STABILITY SOFTWARE METRIC

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Abstract: *This paper discusses the problems of applying Robert C. Martin's Stability software metric when the influence of efferent or afferent couplings (C_e or C_a) on stability of a package is relativized. The problem of relativisation occurs in the cases when a package has (C_a=0 and C_e>0) or (C_a>0 and C_e=0). This problem has been defined by means of an overdetermined system of four equations containing two unknown variables and solved by applying the least squares method. The obtained solution allowed introduction of new stability software metric, we named BU Stability software metric. The new software stability metric improves Robert C.Martin's Stability software metric since it solves the problem of relativization of C_e and C_a. Finally, evaluation of BU Stability software metric is carried out to demonstrate that it cancels out the effect of relativization of C_e and C_a.*

Keywords*: Software quality, Software System, Afferent coupling, Efferent coupling, Software stability, Robert C. Martin's Stability software metric, BU Stability software metric*

1. INTRODUCTION

According to ISO/IEC 25010 (2011), software quality is one of the most important factor in the development of sustainable and reliable software systems. Pressman (2005) defines software quality as "an effective software process applied in a manner that creates a useful product that provides measurable value for those who produce it and those who use it". The benefits of the software quality are reflected in increased productivity of software development and maintenance and decreased cost and time-to-market.

The software quality attributes, such as maintainability, stability, reusability, extensibility, etc., are strongly related to software package dependency. Milic et al. (2017) points that software quality standard define the software quality attributes in terms of software metrics. According to Martin (2011, 2006), some of the well-known software metrics related to software package dependency are: Afferent coupling, Efferent coupling, Instability, Distance from the Main Sequence, and Package Dependence Cycles.

In this paper our attention is paid to Robert C. Martin's Stability software metric. Prior to pointing at the problems associated with the indicated metric, a brief explanation of the concept of software stability is given. The software stability, according to ISO 9126 (2001), "characterizes the sensitivity to change of a given system, i.e. the negative impact that may be caused by system changes". Yau and Collofello (1980, 1985) said that software stability is resistance to propagation of changes (ripple effect) that the software would have when it is modified. Meyer (1997) identifies this as modular continuity. Fayad and Altman (2001) points at the importance of identifying the areas in the project that are stable during the development of a software project. The Tang and Xuan (2012) paper that analyses dependency between component based software packages was very helpful for our understanding of software package dependency and its influence on software package stability. In the previous studies presented in Vlajic (2007, 2011), we have tried to define a formal basis for making stable and sustainable software systems, through explanation of the design patterns by the symmetry concepts and software entropy in the context of software maintenance.

This paper makes a critical analysis of Robert C. Martin's Stability software metric that quantitatively expresses the stability of a software package via Efferent and Afferent couplings (C_e and C_a). This metric exhibits deficiencies in two cases: a) the package has efferent but does not have afferent couplings (C_a=0 and C_e >0) and b) the package has afferent but does not have efferent couplings (C_a>0 and C_e=0). In the first case the influence of C_e on stability of the package is relativized, while in the second case the influence of C_a on stability of the package is relativized.

On the basis of these deficiencies, the problem has been defined by means of an overdetermined system of four equations having two unknown variables. It is well known that such systems, in general, do not have solutions. Therefore, there was a need to define 'solution' of such system. In that sense we have employed the least squares method, as presented in Nocedal and Wright (2006). The obtained solution made it possible for us to define a new software metric, called BU Stability software metric since it has been created at Belgrade University (BU), Faculty of Organizational Sciences, Department of Software Engineering.

The evaluation of the BU Stability software metric carried out at the end of the paper shows that this metric cancels out the effect of C_e and C_a relativization. BU Stability software metric will not impair Robert C. Martin's Stability software metric in the case when $C_e>0$ and $C_a>0$, in other words when there isn't problem of C_a and C_e relativization. Furthermore it is demonstrated in the cases when ($C_a=1$ and $C_e>0$) and ($C_a>0$ and $C_e=1$).

2. ROBERT C. MARTIN'S STABILITY SOFTWARE METRIC

The object-oriented Stability software metric, as described by Robert C. Martin (2011, 2006), is one of the most frequently used metrics for determination of package stability (component stability). By means of stability metric we obtain a quantitative measure of package stability which is significant for the maintenance, re-use and upgrade of the package. According to Robert C. Martin (2011, 2006), this metric has the following form:

$$I = \frac{Ce}{Ca + Ce}, \tag{1}$$

where I is mark for Instability.

Stability software metric is based on Afferent couplings (Ca) and Efferent couplings (Ce) among the classes of the considered package (whose stability is being measured) and classes that are outside of this package. More precisely speaking, Ca refers to the number of classes outside the considered package that depend on classes within this package. Ce refers to the number of classes inside this package that depend on classes outside this package. Stability metric has the range [0,1]. If I = 0, the package has maximum stability. If I = 1, the package has maximum instability.

3. PROBLEM

Let us assume that we have packages Px, Py, and Pz containing classes X_1, Y, and Z_1 respectively. Class X_1 depends on the class Y, while class Y depends on the class Z_1. The dependencies between classes determine dependencies between the packages. Thus Px depends on Py, while Py depends on Pz (Fig. 1). Instability of package Py is I=1/2=0.5, since Ce = 1 and Ca =1.

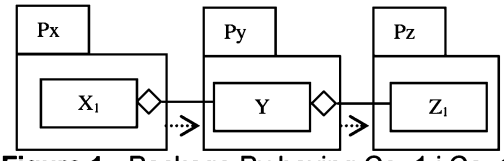

Figure 1: Package Py having Ce=1 i Ca=1

If a class Z_2 is added to package Pz, whereby class Y depends on class Z_2 (Fig. 2), then instability of package Py increases: I = 2/3=0.66, since Ce=2 and Ca=1.

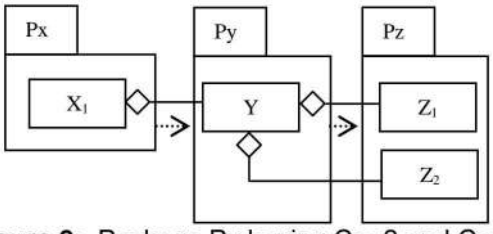

Figure 2: Package Py having Ce=2 and Ca=1

An increase of the number of classes (n) in package Pz would increase the instability of Py package. In an extreme case when n→∞, then I→1:

$$I = \lim_{n\to\infty} \frac{n}{1+n} = 1. \tag{2}$$

If in Fig. 1 class X_2 is added to package Px, whereby class X_2 depends on class Y, then instability of package Py decreases: I = 1/3 = 0.33, since Ce = 1 and Ca =2.
An increase of the number of classes (m) in package Px would decrease the instability of Py package. In an extreme case when m→∞, then I→0:

$$I = \lim_{m\to\infty} \frac{1}{m+1} = 0. \quad (3)$$

Stability of package Py, when (*Ca*=1 and *Ce*>0) and (*Ca*>0 and *Ce*=1), is presented in Table 1:

Table 1: Stability of package Py when (Ca=1 and Ce>0) and (Ca>0 and Ce=1)

Ca	***Ce***	***I= Ce/(Ca+Ce)***
1	*n*	→ 1
1	*n*-1	...
1	...	...
1	5	0.83
1	4	0.80
1	3	0.75
1	2	0.67
1	1	0.50
2	1	0.33
3	1	0.25
4	1	0.20
5	1	0.17
...	1	...
m-1	1	...
m	1	→ 0

We can conclude that increasing of Ce leads to increasing instability of package Py, while increasing of Ca leads to decreasing instability of package.

Deficiency of stability metric I is exhibited in two cases, addressed in Subsections 3.1 and 3.2.

3.1. Problem 1 – Relativization of Ce

In the first case, if the dependence between classes X_1 and Y disappears (*Ca*=0), see Fig. 1, instability of package Py becomes 1 (Fig. 3), since ***I***=1/(0+1).

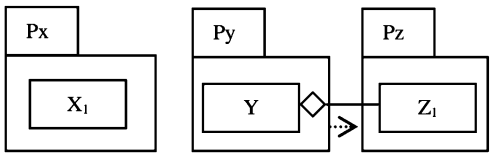

Figure 3: Package Py having *Ce*=1 and *Ca*=0

If class Z_2 is added to package Pz, instability of package Py remains 1 (***I***=2/(0+2)). We can conclude that the increasing Ce does not change instability of package Py which is always 1, since I=Ce/(0+Ce) for Ca=0.

We consider that deficiency of stability metric I is caused by Ce relativisation when Ca=0 and therefore should be removed from the metric.

The relativization of *Ce*, when *Ca*=0 is presented in Table 2:

Table 2: Relativization of Ce when Ca=0

Ca	***Ce***	***I= Ce/(Ca+Ce)***
0	1	1
0	2	1
0	3	1
0	4	1
0	5	1
0	...	1
0	*n*-1	1
0	*n*	1

3.2. Problem 2 – Relativization of Ca

In the second case, if the dependence between classes Y and Z_1 disappears (*Ce*=0), see Fig. 1, instability of package Py becomes 0 (Fig. 4), since ***I***=0/(1+0).

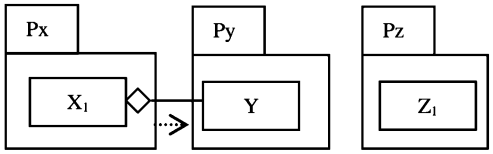

Figure 4: Package Py having *Ce*=0 and *Ca*=1

If class X_2 is added to package Px, instability of package Py remains 0 (***I***=0/(2+0)). We can conclude that the increasing Ca does not change instability of package Py which is always 0, since I=0/(Ca+0) for Ce=0.

We consider that deficiency of stability metric I is caused by Ca relativisation when Ce=0 and therefore should be removed from the metric.

The relativization of Ca, when Ce=0 is presented in Table 3:

Table 3: Relativization of Ca when Ce=0

Ca	***Ce***	***I= Ce/(Ca+Ce)***
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
...	0	0
m-1	0	0
m	0	0

We can summarize problems 1 and 2, i.e. the problems of relativization *Ce* and *Ca*, in Table 4:

Table 4: Stability of package Py when (*Ca*=0 and *Ce*>0) and (*Ca*>0 and *Ce*=0)

Ca	***Ce***	***I= Ce/(Ca+Ce)***
0	*n*	1
0	*n*-1	1
0	...	1
0	5	1
0	4	1
0	3	1
0	2	1
0	1	1
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
...	0	0
m-1	0	0
m	0	0

The problem of relativization Ce (when Ca=0) and Ca (when Ce=0) will be solved if we determine stability metric $I_r(\delta_1, \delta_2)$, i.e. variables δ_1 and δ_2 of I_r, so that stability metric $I_r(\delta_1, \delta_2)$ satisfies a condition (US_1): **1> ...> a> b> c> d> ...> 0**. This problem is presented in Table 5.

Stability metric I_r is denoted by letter ***I*** implying instability, and also by letter **r** implying relativization of *Ce* and *Ca*.

Table 5: The problem of relativization of *Ce* and *Ca* when (*Ca*=0 and *Ce*>0) and (*Ca*>0 and *Ce*=0)

Ca	***Ce***	***Ir*(δ_1, δ_2) = (Ce+ δ_1)/(Ca + Ce+δ_2)**
0	*n*	→ 1
0	...	...
0	2	$Ir_1(\delta_1, \delta_2) = a$
0	1	$Ir_2(\delta_1, \delta_2) = b$
1	0	$Ir_3(\delta_1, \delta_2) = c$
2	0	$Ir_4(\delta_1, \delta_2) = d$
...	0	...
m	0	→ 0

4. SOLUTION

The stability metric ***Ir*** can be represented by a system:

$$\begin{aligned} \mathbf{I_{r1}(\delta 1, \delta 2) = a,} \\ \mathbf{I_{r2}(\delta 1, \delta 2) = b,} \\ \mathbf{I_{r3}(\delta 1, \delta 2) = c,} \\ \mathbf{I_{r4}(\delta 1, \delta 2) = d,} \end{aligned} \tag{4}$$

where 1>a>b>c>d>0.

Taking into account values of Ce and Ca from Table 5, we obtain a system of four equations containing two unknowns:

$$\begin{aligned} (2+\delta_1)/(2+\delta_2) = a, \\ (1+\delta_1)/(1+\delta_2) = b, \\ \delta_1/(1+\delta_2) = c, \\ \delta_1/(2+\delta_2) = d, \end{aligned} \tag{5}$$

which can be written in the form:

$$\begin{aligned} \delta_1 - a\delta_2 - 2a + 2 = 0, \\ \delta_1 - b\delta_2 - b + 1 = 0, \\ \delta_1 - c\delta_2 - c = 0, \\ \delta_1 - d\delta_2 - 2d = 0. \end{aligned} \tag{6}$$

The overdetermined systems, like (6), in general have no solutions. Nevertheless, we introduce the concept of 'solution' of system (6) following the idea of the least squares method. As a solution of system (6) we will imply ordered pair ($\boldsymbol{\delta_1}$, $\boldsymbol{\delta_2}$) giving minimum function of square deviation.

$$\mathbf{F(\delta_1, \delta_2) = (\delta_1 - a\delta_2 - 2a + 2)^2 + (\delta_1 - b\delta_2 - b + 1)^2 + (\delta_1 - c\delta_2 - c)^2 + (\delta_1 - d\delta_2 - 2d)^2} \tag{7}$$

Such solution is obtained by solving the system of equations:

$$\begin{aligned} \frac{\partial F}{\partial \delta_1} = 0, \\ \frac{\partial F}{\partial \delta_2} = 0. \end{aligned} \tag{8}$$

In the present case, the system has form:

$$\begin{aligned} 2(\delta 1 - a\delta 2 - 2a + 2) + 2(\delta 1 - b\delta 2 - b + 1) + 2(\delta 1 - c\delta 2 - c) + 2(\delta 1 - d\delta 2 - 2d) = 0, \\ -2a(\delta 1 - a\delta 2 - 2a + 2) - 2b(\delta 1 - b\delta 2 - b + 1) - 2c(\delta 1 - c\delta 2 - c) - 2d(\delta 1 - d\delta 2 - 2d) = 0. \end{aligned} \tag{9}$$

This system can be simplified to a system:

$$\begin{aligned} 4\delta_1 - (a+b+c+d)\delta_2 = 2a+b+c+2d-3, \\ (a+b+c+d)\delta_1 - (a^2+b^2+c^2+d^2)\delta_2 = 2a^2+b^2+c^2+2d^2-2a-b, \end{aligned} \tag{10}$$

which is linear with respect to δ_1 and δ_2. The previously described system (10) will be illustrated by the case when, e.g. a = 0.6, b=0.55, c=0.45 and d=0.4. In this case system (10) is reduced to:

$$\begin{aligned} 2\delta_1 - \delta_2 = 0 \\ -2\delta_1 - 1.025\delta_2 = 0.205, \end{aligned} \tag{11}$$

whose solution is: $\boldsymbol{\delta_1 = 4.1}$, $\boldsymbol{\delta_2 = 8.2}$.
This solution represents solution of stability metric **Ir (4.1,8.2)**, which can be presented as:

$$Ir = \frac{Ce + 4.1}{Ca + Ce + 8.2}, or$$

$$Ir = \frac{Ce + \delta_1}{Ca + Ce + 2\delta_1}, for\ \delta_1 = 4.1. \quad (12)$$

If we introduce substitution:

$$Ce' = Ce+\delta_1, \quad (13)$$
$$Ca' = Ca+\delta_1,$$

Ir can be represented in the following form:

$$Ir = \frac{Ce'}{Ca'+Ce'}, \text{ with } Ce' = Ce+\delta_1,\ Ca' = Ca+\delta_1,\ \delta_1 = 4.1. \quad (14)$$

Software metric *Ir* improves the Stability software metric of Robert C. Martin, since it solves the problem of relativization of *Ce* (when *Ca*=0) and *Ca* (when *Ce*=0).

Remark: As we have seen, determination of variables δ_1 and δ_2 was dependent upon solvability of system (10). Now, we shall show that this system always has a solution for any set of values *a,b,c,* and *d* satisfying condition 1>*a*>*b*>*c*>*d*>0. Indeed, since determinant of the system is:
$D = (a+b+c+d)^2-4(a^2+b^2+c^2+d^2) = -[(a-b)^2+(a-c)^2+(a-d)^2+(b-c)^2+(b-d)^2+(c-d)^2]$,
obviously D≠0 for 1>a>b>c>d>0, thus system (10) has a unique solution in relation to $\boldsymbol{\delta_1}$ and $\boldsymbol{\delta_2}$.

5. EVALUATION

If software metric Ir is applied for obtained solution of the first problem (Fig. 5), where Ce is relativized, in the case when Y is related to Z_1 and the relation between X and Y does not exist, instability of package Py will be: Ir=5.1/9.2 ≈ 0.55.

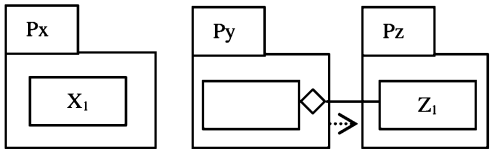

Figure 5: Package Py having *Ce*=1 and *Ca*=0

In the case when class Z_2 is added to package Pz, instability of package Py will be Ir=6.1/10.2 ≈ 0.6. With increasing of Ce, instability of package Py will keep increasing, converging towards 1. We consider that software metric Ir improves software metric I and cancels out the effect of Ce relativization, when Ca=0, since instability of package Py is increasing with increasing of Ce (Table 6).

Table 6: Cancelation of the effect of Ce relativization when Ca=0

Ca	Ce	Ca'	Ce'	Ir= Ce'/(Ca'+Ce')
0	*n*	4.1	*n*+4.1	→ 1
0	*n*-1	4.1	*n*+3.1	...
0	...	4.1	...	...
0	5	4.1	9.1	0.69
0	4	4.1	8.1	0.66
0	3	4.1	7.1	0.63
0	2	4.1	6.1	0.60
0	1	4.1	5.1	0.55

If software metric ***Ir*** is applied for obtaining solution of the second problem (Fig. 6), where *Ca* is relativized, in the case when X_1 is related to Y and relation between Y and Z_1 does not exist, instability of package Py will be: ***Ir*=**4.1/9.2 ≈ 0.44.

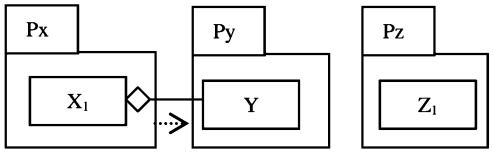

Figure 6: Package Py having *Ce*=0 and *Ca*=1

In the case when class X_2 is added to package Px, instability of package Py will be: ***Ir*=**4.1/10.2 ≈ 0.4. With increasing of Ca, instability of package Py will keep decreasing, converging towards 0. We consider that

software metric Ir improves software metric I and cancels out the effect of Ca relativization, when Ce=0, since instability of package Py is decreasing with increasing of Ca (Table 7).

Table 7: Cancelation of the effect of Ca relativization when Ce=0

Ca	Ce	Ca'	Ce'	Ir= Ce'/(Ca'+Ce')
1	0	5.1	4.1	0.45
2	0	6.1	4.1	0.40
3	0	7.1	4.1	0.37
4	0	8.1	4.1	0.34
5	0	9.1	4.1	0.31
...	0	...	4.1	...
m-1	0	*m*+3.1	4.1	...
m	0	*m*+4.1	4.1	→ 0

Software metric Ir represents a solution of the problem of Ca and Ce relativization and it can be presented as: $I_r = Ce'/(Ca'+Ce')$, with $Ce' = Ce+\delta_1$, $Ca' = Ca+\delta_1$, for $\delta_1 = 4.1$ (Table 8).

Table 8: Solution of the problem of *Ce* and *Ca* relativization when (*Ca*=0 and *Ce*>0) and (*Ca*>0 and *Ce*=0)

Ca	Ce	Ca'	Ce'	I	Ir
0	*n*	4.1	*n*+4.1	1	→ 1
0	*n*-1	4.1	*n*+3.1	1	...
0	...	4.1	...	1	...
0	5	4.1	9.1	1	0.69
0	4	4.1	8.1	1	0.66
0	3	4.1	7.1	1	0.63
0	2	4.1	6.1	1	0.60
0	1	4.1	5.1	1	0.55
1	0	5.1	4.1	0	0.45
2	0	6.1	4.1	0	0.40
3	0	7.1	4.1	0	0.37
4	0	8.1	4.1	0	0.34
5	0	9.1	4.1	0	0.31
...	0	...	4.1	0	...
m-1	0	*m*+3.1	4.1	0	...
m	0	*m*+4.1	4.1	0	→ 0

It should be stressed that software metric I_r will not disturb the existing software metric I in cases when *Ce*>0 and *Ca*>0, i.e. when the problem of relativization of *Ce* and *Ca* does not appear. In addition, e.g. when (*Ca*=1 and *Ce*>0) and (*Ca*>0 and *Ce*=1), the corresponding values of metrics I and I_r are decreasing (Table 9) from 1 towards 0.The ratio between the corresponding values in both metrics is maintained. This means that ratio $I(i)/I(i+1)$, i=1, 2, ..., r, remains the same as the ratio $Ir(i)/Ir(i+1)$. For example, if $i=p+2$, then $I(p+2)>I(p+3)$, 0.80>0.75; the same ratio remains for Ir, i.e. $Ir(p+2)>Ir(p+3)$ or 0.61>0.58.

Table 9: Stability of package Py when (*Ca*=1 and *Ce*>0) and (*Ca*>0 and *Ce*=1)

Row	Ca	Ce	Ca'	Ce'	I	Ir
1	1	*n*	5.1	*n*+4.1	→ 1	→ 1
2	1	*n*-1	5.1	*n*+3.1	...	...
...	1	...	5.1	...	...	...
p	1	...	5.1	...	...	...
p+1	1	5	5.1	9.1	0.83	0.64
p+2	1	4	5.1	8.1	0.80	0.61
p+3	1	3	5.1	7.1	0.75	0.58
p+4	1	2	5.1	6.1	0.67	0.54
p+5	1	1	5.1	5.1	0.50	0.50
p+6	2	1	6.1	5.1	0.33	0.46
p+7	3	1	7.1	5.1	0.25	0.42
p+8	4	1	8.1	5.1	0.20	0.39
p+9	5	1	9.1	5.1	0.17	0.36
...	...	1	...	5.1	...	...
r-1	*m*-1	1	*m*+3.1	5.1	...	...
r	*m*	1	*m*+4.1	5.1	→ 0	→ 0

6. CONCLUSION

We have improved Robert C. Martin's Stability software metric in the cases when the influence of the efferent and afferent couplings upon stability of a considered package is relativized. At first, Robert C. Martin's Stability software metric has been explained: $I = \frac{Ce}{Ca+Ce}$.

Then, the deficiency of this metric has been identified and illustrated. This deficiency occurs when a considered package has either no afferent or no efferent coupling (Ca=0 or Ce=0). If I stability metric has no afferent coupling (Ca=0) and has efferent coupling (Ce>0), then the efferent couplings is relativized. If I stability metric has no efferent coupling (Ce=0) and has afferent coupling (Ca>0), then the afferent copuplings is relativized.

The indicated problem has been represented by means of an overdetermined system of four equations containing two unknown variables and solved by applying the least squares method. The solution has been presented in terms of software metric I_r: $Ir = \frac{Ce'}{Ca'+Ce'}$, with $Ce' = Ce+\delta_1$, $Ca' = Ca+\delta_1$, $\delta_1 = 4.1$.

Software metric I_r improves software metric I because Ir solves the problem of relativization of Ce (when Ca=0) and Ca (when Ce=0), which was identified as a deficiency of software metric I. It was stressed that software metric I_r will not disturb software metric I in the cases when Ce>0 and Ca>0, i.e. when the problem of Ce and Ca relativization does not occur. This was demonstrated in the cases when (Ca=1 and Ce>0) and (Ca>0 and Ce=1). Since the obtained software metric has been created at **B**elgrade **U**niversity (**BU**) we named it "**BU Stablity software metric**".

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ANALYSIS OF DYNAMIC CONTENT RENDERING IN JAVASCRIPT TECHNOLOGIES

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Abstract: *In this paper we have described how a html content can be dynamically replaced using different libraries and frameworks. Practical example of dynamic content rendering was realized through jQuery, JsRender and Angular. Differences and similarities as well as advantages and disadvantages will be presented in the analysis where different aspects, such as load time, ease of maintenance, adjusting to changes must be taken into consideration. Analysis of selected libraries and frameworks was conducted in order to make a decision whether to use or not to use a framework.*

Keywords*: Dynamic content, JavaScript, jQuery, JsRender, Angular*

1. INTRODUCTION

JavaScript programming language is almost an inevitable part of nowadays web applications. Providing dynamic and interactive experience for the user has become an imperative. The number of JavaScript frameworks which help us achieve this, has increased considerably in the last few years. Choosing the appropriate framework has become a challenge. (Crockford, 2008)

Flexible and interactive applications that quickly respond to user requests have a lot of dynamic content. Rendering such content may take some time. In order to improve a web page's interactivity and usability the shortening of rendering time can be achieved by simply updating part of the page instead of the entire web page. There are various ways to do this and they will be presented in this paper. Analysis of these technologies is based on various factors such as load time, ease of maintenance, adjusting to changes. (Ambler & Cloud, 2015)

A brief overview of client and server-side rendering and importance of JavaScript in Web applications development is given in the second chapter. An example of dynamic content rendering is realized by using jQuery, JsRender and Angular. The solution of the same problem, in different ways, is shown by using each of them. Specifics for each technology are shown through snippets of code.

Many authors conducted a comparative analysis of JavaScript frameworks. A detailed study was conducted by Pano, Graziotin and Abrahamsson (v6. 2018) in order to identify and understand the factors that influence the choice of a JavaScript framework. According to them, actors leading to the adoption of a JavaScript Framework are customer, developer, team and team leader. Factors leading to the adoption are performance expectancy, effort expectancy, social influence, facilitating conditions and price value. (Pano, Graziotin, & Abrahamsson, 2018)

Analysis conducted in the fourth chapter is aimed at making a decision whether to use or not to use a framework considering dynamic content rendering. Conclusions and our vision of future work are described in the fifth chapter.

2. DYNAMIC CONTENT RENDERING

Unlike traditional web applications that mostly relied on server-side rendering, modern web applications generally involve client-side rendering. Server-side rendering implies that browser make a request to the server and gets rendered HTML. It is often necessary to render only a certain component on a page as opposed to loading of the entire page from server. This feature is one of the basic characteristics of Single-page applications. Impression of a “native” environment in the browser (like a desktop application), without page reloads in order to quickly respond to user actions. Remarkable user experience is just one of the advantages of this approach. Client-side rendering implies using JavaScript to render content in the browser. (Brikman, 2015)

"JavaScript is a programming language used primarily by Web browsers to create a dynamic and interactive experience for the user." (Flanagan, 2011) ECMAScript is the official name for JavaScript. In a common context JavaScript applies to a programming language, while ECMAScript applies to language specification. The current version of JavaScript is ECMAScript 8, from June 2017. (Rauschmayer, 2014) Unlike earlier, static, nowadays web pages mean more interactions, features like floating menus, add sound, display advertisements, animations, etc. Those features can be realized by different tools, and JavaScript is one of the most prominent ones. (Kiong, 2018)

Simple, multi-paradigm (scripting, object-oriented, imperative, functional) programming language, easy for learning – JavaScript has become an inevitable part of nowadays web applications. There are many JavaScript plugins, libraries and frameworks, and some of them are the subject of this paper.

2.1. jQuery

JQuery is defined as "fast, small, and feature-rich JavaScript library". (jQuery, 2018) Initial release of jQuery was on 2006, and since then until today stands for the most popular JavaScript library. (Miles, 2016)

The major components of jQuery:

- The DOM selection – methods which help finding elements in document object model
- DOM manipulation – manipulation methods that modify previously found elements
- Events – handling events as a precondition for creation a dynamic website
- Form – methods for easier sending information back to a server
- CSS and animation – methods for handling classes, locations and dimensions of elements
- Ajax - methods for exchanging data with a serve
- Helpers – to iterate over a collection, determine the type of object and many others (Miles, 2016)

One of the main ideas was to save coding time (no more writing plumbing code) and focuses on essential functionalities which can be seen in the JQuery's motto "write less, do more". (Miles, 2016)

2.2. JsRender

Described as "A lightweight, powerful and highly extensible templating engine", JsRender supersede jQuery Templates plugin. (JsRender, 2018) Optimized for high-performance rendering, without DOM dependency, JsRender is used for data-driven rendering of templates to strings. (JsRender, 2018)

JsViews platform adds data binding to JsRender templates and together provide fully-fledged MVVM platform for creation interactive single page applications and websites. JsRender can be used with or without jQuery. (JsRender, 2018)

Template can be defined from a string,

```
var template = $.templates("City: {{:city}}");
```

or in a script block as markup. (JsRender, 2018)

```
<script id="myTemplate" type="text/x-jsrender">
City: {{:city}}
</script>
```

With render function we can render a template as below.

```
var city = {city: "Belgrade"};
var html = template.render(city);
```

An array also can be passed, then template renders for each element in the array. (JsRender, 2018)

There are many tags in JsRender which enable iterate over arrays, over object's properties, conditional inclusion and other useful features.

2.3. Angular

Client-side web application as one of the models for modern applications tend to be more flexible and interactive with quickly responds to user requests. (Clow, 2018) One of the most popular frameworks for this

purpose is Angular. Defined as “a platform and framework for building client applications in HTML and TypeScript” (Architecture overview, 2018) Angular is one of the most popular JavaScript frameworks.

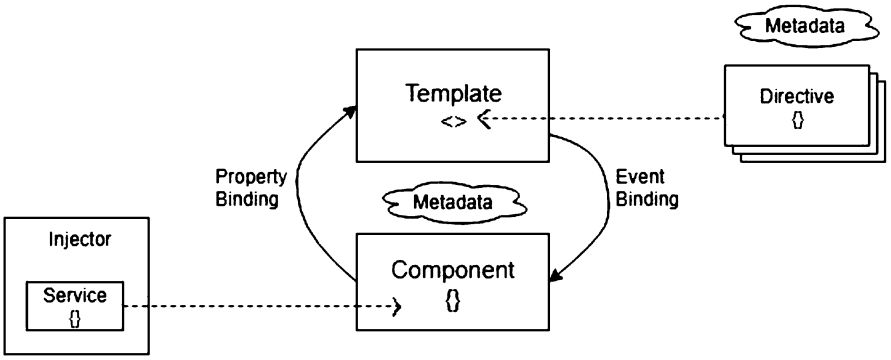

Figure 1: Architecture overview

Main building blocks of an Angular application and their relations are shown in Figure 1. NgModules as a fundamental building block provides a compilation context for components. Application is defined by a set of NgModules. Components define views and use services which provide specific functionality. In order to take advantage of lazy-loading NgModules loading on demand. Data and logic are located in classes defined by component associated with a HTML template. To modify HTML elements a template combines HTML with Angular markup. Two-way data binding is supported. For some data or logic which needs to be shared across components and not connected with a specific view, it is possible to create service class. Metadata are provided by @Injectable decorator that allows services to be injected into components as a dependency. (Architecture overview, 2018)

3. AN EXAMPLE OF DYNAMIC CONTENT RENDERING IN SELECTED TECHNOLOGIES

The HTML page has many interconnected components. Some of them change more often than others. In order to improve a web page's interactivity and usability it is possible to avoid rendering of the entire page, but only to render a certain component on a page. User interactions on one component can cause rendering of another component on the page. The related components affect one another, and their synchronization can be realized in several ways. Hiding, changing content are just some of the most common user interactions that will be presented.

Problem setting

It is necessary to create drop-down list whose elements are continents. After choosing a particular continent, a table with countries belonging to the selected continent should be displayed. Continent is determined by name and collection of countries, while a country is determined by name, capital and population.

At the beginning, the look of the component is shown in Figure 2.

Figure 2: The look of a component

After choosing a particular continent, a table with countries is displayed as is shown in Figure 3.

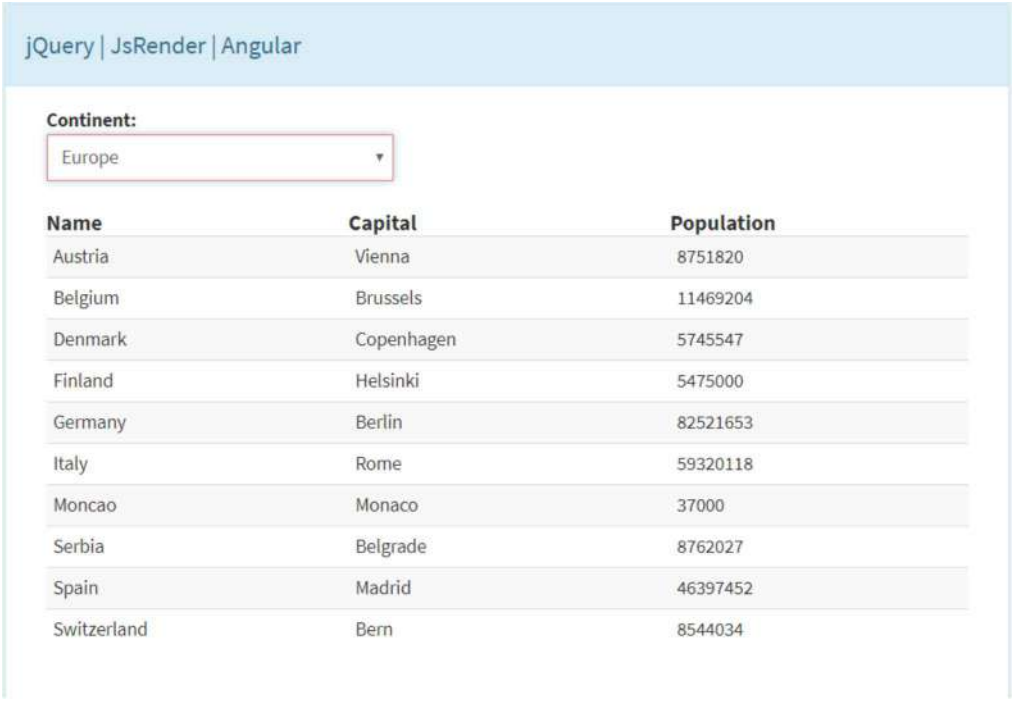

Figure 3: Displayed table with countries

Solution of the problem

3.1. jQuery

Bootstrap is used to stylish a HTML page.

```
<div class="panel-body">
    <div id="continent-container" class="container">
        <div class="row col-md-3">
            <label>Continent:</label>
            <select id="continent" class="form-control">
                <option id="-1" disabled selected>-- Select a Continent --</option>
            </select>
        </div>
    </div>

    <div id="countries-container" class="container col-md-12"> </div>
</div>
```

Drop-down list is created by select element. Initially there is only one option. The received data, continents, should be added as options. One of the ways is presented in code snippet below.

```
$.each(continents.continents, function (index, continent) {

    $("#continent").append($("<option>", { id: continent.continentId})
                   .text(continent.continentName));
});
```

The append() method was used. This method “insert content, specified by the parameter, to the end of each element in the set of matched elements”. (append, 2018) Prepend() method is similar, the difference is that content is inserted as a fist child.

After adding continents to drop-down list, it is necessary to define what happens by selecting a particular continent or in jQuery’s language define what happens on click on the continent element.

```
        var selectedContinentId = $(this).find('option:selected').attr('id');

        var selectedContinent = $.grep(continents.continents, function (continent) {
            return continent.continentId == selectedContinentId;
        })[0];
```

To find a selected continent, in order to find belonging countries, the method grep was used. This method "finds the elements of an array which satisfy a filter function". (jquery.grep, 2018)

```
if (selectedContinent != undefined && selectedContinent.countries.length > 0) {

   var $table = $('<table id="countries-table" class="table table-striped"></table>');
   var $tHead = $('<tr> <th> Name </th> <th> Capital </th> <th> Population </th> </tr>');
   var $tBody = $('<tbody></tbody>');

   $.each(selectedContinent.countries, function (index, country) {
      var $tr = $('<tr> <td>' + country.countryName + '</td> <td>' + country.capital +
                  '</td> <td>' + country.population + '</td>');
      $tBody.append($tr);
   });

   $table.prepend($('<br/>'));
   $table.append($tHead).append($tBody);
   $("#countries-container").append($table);
}
```

As shown in code snippet above, after defining table, table head and table body, for each country of a selected continent a new row is being created and added in table body. In the end, created table is added to countries-container.

3.2. JsRender

Panel body is almost identical as in the previous example, except that a select element initially has no options. The received data, continents, should be added as options. At the beginning the template was created.

```
<script id="continent-template" type="text/x-jsrender">

    <option id="-1" selected>-- Select a Continent --</option>
    {{for continents}}
    <option id="{{>#data.continentId}}">{{>#data.continentName}}</option>
    {{/for}}

</script>
```

After passing an array to JsRender, the template will be the same for every element in the array. Inner content in script will not be parsed as JavaScript by adding the text/x-jsrender attribute on the script. (Matthews & Gliser, 2015) To get the compiled template it was used $.templates() method with a jQuery selector. Next step is for render to obtain template according to the given data (continents), and get the HTML output as a string. In the end we inserted that output into the continent element. (JsRender, 2018) The previously described procedure is shown in code snippet below.

```
    var template = $.templates("#continent-template");
    var htmlOutput = template.render(continents);
    $("#continent").empty();
    $("#continent").html(htmlOutput);
```

As in the previous example, after adding continents to drop-down list, it is necessary to define what happens by selecting a particular continent. Finding a selected continent is identical as in the previous example. It is necessary to create a new template for countries.

```
<script id="country-template" type="text/x-jsrender">
    {{if countries.length > 0}}
    <br />
    <table class="table table-striped">
        <thead>

        </thead>
        <tbody>
            {{for countries}}
            <tr>
                <td>{{>#data.countryName}}</td>
                <td>{{>#data.capital}}</td>
                <td>{{>#data.population}}</td>
            </tr>
            {{/for}}
        </tbody>
        {{/if}}
    </table>
</script>
```

Countries of selected continent are given to template for rendering and output has been inserted into the countries container as shown below.

```
$("#countries-container").empty();

if (selectedContinent[0] != undefined) {
    var template = $.templates("#country-template");
    var htmlOutput = template.render(selectedContinent[0]);
    $("#countries-container").empty();
    $("#countries-container").html(htmlOutput);
}
```

3.3. Angular

Defining classes is the first step.

Continent class

```
export class Continent {
  constructor(public continentId: number, public continentName: string, public
          countries: Country[]) {
  }
}
```

Country class

```
export class Country {
  constructor(public countryId: number, public countryName: string, public capital:
              string, public population: number) {
  }
}
```

Panel body is similar to the previous examples.

```
<div id="continent-container" class="container">
  <div class="row col-md-3">
    <label>Continent:</label>
    <select id="continent" [(ngModel)]="selectedContinent" class="form-control">
      <option [ngValue]="null" disabled>-- Select a Continent --</option>
      <option *ngFor="let continent of continents"
              [ngValue]="continent">{{ continent.continentName }}
      </option>
    </select>
  </div>
</div>
```

Using the ngFor directive it is possible to iterate over continents collection. Current element is defined as continent. Each element of collection becomes an option which value is continent as object and text is continent's name. An example of two-way binding is given in [(ngModel)] = "selectedContinent". HTML element select is associated with selectedContinent variable from TypeScript component and the change on either side is reflected on the other. A HTML component is associated with TypeScript component.

```
export class AppComponent {

  public continents: Continent[];
  public selectedContinent: Continent;

  constructor() {
    this.continents = ...
    this.selectedContinent = null;
  }
}
```

The previously described connection between elements and properties is now clearer.
As in the previous example, after adding continents to drop-down list, it is necessary to define what happens by selecting a particular continent. Finding a selected continent is much simpler than in previous examples. If conditions defined by ngIf are met, access to the countries of a selected continent implies iteration through an array. Unlike previous examples where we had to find selected continent object in continents collection, now we just need to take selectedContinent variable and we can access the associated attributes. Previously explained two-way binding will provide up-to-date information at any time.

```
<br *ngIf="selectedContinent && selectedContinent.countries.length > 0"/>
<div id="countries-container" class="container col-md-12" *ngIf="selectedContinent
         && selectedContinent.countries.length > 0">
  <table class="table table-striped">
    <thead> ... </thead>
    <tbody>
    <tr *ngFor="let country of selectedContinent.countries">
      <td>{{ country.countryName }}</td> <td>{{ country.capital }}</td>
      <td>{{ country.population }}</td>
    </tr>
    </tbody>
  </table>
</div>
```

4. ANALYSIS OF DYNAMIC CONTENT REPLACEMENT IN SELECTED TECHNOLOGIES

Each framework is oriented towards the concrete problem, but all of them serve the same purpose - to make dynamic and interactive experience for the user. Frameworks give liberty to developers to focus on functionalities without taking too much care about the structure. The most frequent comparisons are ones in which frameworks are compared between each other. In order to make a decision whether to use or not to use a framework, some relevant factors can be closer examined as given below.

4.1. Based on load time aspect

Measuring page's loading time in used example, JsRender showed the best results. Not far behind JsRender is jQuery which took a little longer time to load, and following jQuery is Angular which showed the slowest results in this scenario. The difference in performance on the side of the user would be more obvious with the more complex example. The application usually contains lots of feature modules which are loaded all at once. Often there is no need for this, so lazy loading can help reducing the size of bundle when the app loads initially implies reducing loading time which improves user experience. Computer hardware specification is constantly improving and has better performances as well as browsers' JavaScript engines, so the concern about the speed is becoming a minor problem.

4.2 Based on ease of maintenance aspect

Today's applications have hundreds of lines of code in whose realization participate independent teams. Maintaining these applications is getting harder and harder. Developers often forget that it is not only important to write code that solves the problem, but also the one that is efficient. Maintaining a code is about finding better ways to resolve a problem. The code is usually maintained by someone who has not written it which slows down the process. Duplicated coding, divergence from coding standards and bad code structure are often the cause of severe and long-lasting maintenance which has a significant impact on the budget. Maintenance is much easier and faster in an Angular than in jQuery or JsRender. Automatically generated code that synchronizes the Model and the View is one of the benefits of using Angular. Based on this example it can be concluded that jQuery generates more lines of code than the other two. One of other flaws of jQuery is that a HTML element was built by string concatenation and the browser will still have to parse it. Also, jQuery code is not readable and maintainable as code in templates used in the JsRender, and especially in the Angular. It is easier to maintain JsRender code, but as it is most often combined with jQuery functions, that is what makes it more difficult to maintain a complete application.

4.3 Based on adjusting to changes aspect

In order to stay competitive, applications should adapt to constant changes and new challenges. Customer requests are often changed and companies must be ready to meet them, otherwise they could lose a competitive advantage. Depending on how the code is structured, changes will be more difficult or easier to apply. Let's consider the problem of calculating the average population of countries.

In jQuery that would mean adding a new html element by string concatenation and additional calling of append() method. The average is calculated by iteration through all the countries of the selected continent as is shown below.

```
var averagePopulation = ((selectedContinent.countries.map(function (country) {
                          return country.population; }).reduce(
                          function (sum, population) { return sum + population; })) /
                           selectedContinent.countries.length).toFixed(2);

var $tFoot = $('<tfoot><tr><th></th> <th> Average population </th> <th>' +
                averagePopulation + '</th> </tr></tfoot>');


$table.append($tHead).append($tBody).append($tFoot);
```

In Agular it is necessary to add *tfoot* element in html

```
<tfoot>
 <tr>
   <th></th>
   <th>Average population</th>
   <th>{{ averagePopulation() }}</th>
 </tr>
</tfoot>
```

and calculate average population in TypeScript.

```
averagePopulation(): string {
  return (this.selectedContinent.countries.reduce((sum, country) => sum +
          country.population, 0) / this.selectedContinent.countries.length).toFixed(2);
}
```

In JsRender example this would imply changing the template.

```
<script id="country-template" type="text/x-jsrender">
    {{* window.total = 0}}
    {{* window.length = 0}}
    {{if countries.length > 0}}
                ...
        {{for countries}}
        {{* total += data.population}}
        {{* length += 1}}
                ...
        {{/for}}
      </tbody>
      <tfoot>
        {{* window.average = (total/length).toFixed(2)}}
        <tr>
          <th></th> <th>Average population</th> <th>{{*: average}} </th>
        </tr>
      </tfoot>
      {{/if}}
    </table>
</script>
```

Angular proved to be the easiest to adjust, then JsRender, then jQuery.

5. CONCLUSIONS AND FUTURE WORK

From the conducted analysis and practical example, several conclusions can be outlined. Answer the question whether to use or not to use a framework depends on array of different but interconnected factors, analyzed in this paper. On the basis of previously mentioned facts, the question might arise why we do not always use Angular when it has been proved to be the best solution for most problems. When developing a lightweight application without too much user interaction and dynamics, Angular would be a costly solution. If the separate, static, pages are the basics of the site and intended to be presented to search engines Angular would not be a good solution. When discussing the choice, the time and the human (in terms of developer's knowledge) limitations should be considered. Finding a pattern which could help about this decision looks like a tough task. The user usually does not describe his needs precisely and constantly has additional requirements, most of which cannot be foreseen. There are always some requirements or functionalities that could be done in a better way in other technology. That is why technologies are often combined which most often leads to acceptable solution. However, combining technologies is not universal solution and it could cause additional issues which should be examined in detailed.

In order to make the right decision, it is necessary to look at all the constraints, to precisely determine what should be achieved, taking into consideration the variability in the future. Finding the intersection between mentioned constraints and possibilities that technology delivers is crucial for fining the optimal solution for a given problem.

For the purpose of this research jQuery, JsRender and Angular were considered. Next step would be to include more components in analysis, categorize them according to different types of requests and repeat the previous analysis.

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DEVELOPMENT OF AN E-RECRUITMENT PORTAL USING MEAN STACK TECHNOLOGIES

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Abstract: *This paper presents the development of an e-recruitment portal using MEAN stack technologies. The goals of the portal are job and internship advertising, easy and efficient search and e-recruitment. The developed portal is an aggregator of business proposals and intermediary in the process of e-recruitment. Students and workers looking for employment have the ability to send curriculum vitae via electronic applications. Valid applications collected via the portal are being forwarded to potential employers. Use of the developed model enhances the process of connecting employers with those who seek employment. Finally, the paper points out the specifics and advantages of using MEAN stack technologies for developing e-recruitment portals.*

Keywords*: E-business, electronic employment offers, e-recruitment, portal for e-recruitment, aggregator*

1. INTRODUCTION

Employers often face the need to find competent candidates who can meet hiring needs with their knowledge and skills. Many companies, for the purpose of employing suitable candidates, use the Internet as a mean of entering the e-market of labor. Anyone looking for a job, over the Internet, on e-market of labor, can easily obtain information about employment offers in their field of interest. Web portals play an important role in facilitating and accelerating mediation in the employment process. For people seeking an employment, the existence of “job search” portals is of high importance (Stevenson, 2008). Portals of this kind are mostly aggregators of employment offers of different companies. For the ones seeking a job, they provide an overview of job and internship offers (Mitrović, 2010).

E-market of labor provides job seekers with the ability of quick search of a large number of employment offers. Usually, companies in the employment process prefer collecting electronic business curriculum vitae (e-CV) through e-recruitment portals (Mitrović, 2011). In this way, job seekers can leave their biographies to potential employers. Web portals can be a medium for e-recruitment of candidates suitable for a job (Unadkat, 2012). The advantages of using a portal for e-recruitment are to quickly find and obtain job information, easy and simple communication between job seekers and employers, and the possibility of employment in remote locations (Radenković et al., 2015). Furthermore, portals for e-recruitment provide more information about companies and job offers and have an advanced possibility of matching candidates' skills and job requirements.

This paper presents an e-recruitment portal. The idea for creating this portal has emerged after observing the work of Association of students of information sciences FONIS, established in 2001. on the Faculty of Organizational Sciences. The main goal of this work is developing a unique aggregator web portal that will help connect companies with students and narrow the channel by which students get the employment information.

2. MODEL OF E-RECRUITMENT VIA WEB PORTAL

2.1. E-recruitment

Before we explain the model of e-recruitment and its use, let’s revise the e-recruitment as a term. E-recruiting stands for the use of internet for attracting, recruiting, and retaining job seekers and employees and also individuals who are content in their current position (these are called "passive candidates"). Also known as Internet recruiting, virtual recruiting and online recruitment.

E-recruitment emerged as an idea in late ’90s, early 2000s with exponential growth of at home Internet usage and proliferation of dot-coms, as Betsey Stevenson explains (Stevenson, 2006). In July, 2000 Alan Kruger wrote “The Internet is rapidly changing the way workers search for jobs and employers recruit

workers. The resulting speed and ease of filling jobs have significant implications for unemployment, pay and productivity". He further concludes that those who lack access to Internet job market may suffer restricted job opportunities (Kruger, 2000).

To fully comprehend the meaning of e-recruitment let's look at the definition Lievens and Harris provide:" any method of attracting applicants to apply for a job that relies heavily on the Internet" (Lievens & Harris, 2003). This summarize the whole idea behind e-recruitment. The means, methods, approaches of this type of recruitment constantly evolve and expand, so in this paper we will focus and web portal model of e-recruitment.

2.2. Web portal as a model of e-recruitment

Model of e-recruitment via web portals represents a unique access point for e-recruitment, job seeking, information and services such as job application, FAQ, statistics, etc. The user gets access to complete their applications without the need of individual access to each of the services. The content of the portal is dynamic, updated often with search possibility.

Given the circumstances that portal models are based on attracting a great number of users by offering free content, revenue models are often based on one or combination of following models:

- Advertising. A great number of users allow the portal to sell ad space.
- Membership. Even though users get the content for free, it is possible to charge membership on certain extra content.
- Partnership programs. Users can be directed to partners websites and create income for the portal.

Beside admin users who manage the system, end users of the portal are companies and students. Because of that, the portal allows different usage possibilities. Admin users can to sign-in, manage records about the companies, job and internship ads, and applications. Admin users have a privileged access to the system, which allows them to manipulate the data within. Under the term manipulate, we consider the ability to create company profiles, keeping and managing records about applications for a certain company, as well as the processing of the applications, creating and keeping records about ads created for the company and their further management.

To a company, the portal allows logging into the system, where it shows all the records of the company, including created ads and submitted applications. Company users are allowed to create and moderate existing ads, but ads can only be submitted for admin approval.

A student is a guest user of the portal and doesn't have the possibility of logging in, because the idea of the portal is to ease the access to the given information. Portal allows guest users to see published ads with all of the provided information, perform a search with certain criteria and submit the application. As the student doesn't have their own account, further notifications and information are given through e-mail service, to the e-mail address provided in the application.

For the purpose of filtering employment information, the proposed e-recruitment portal has the following main functionalities (Figure 1):

- User sign-in
- Creating company profile
- Creating employment ads
- Editing employment ads
- Deleting employment ads
- Search of employment ads
- Creating job application
- Deleting job application
- Processing job application
- Search of job application

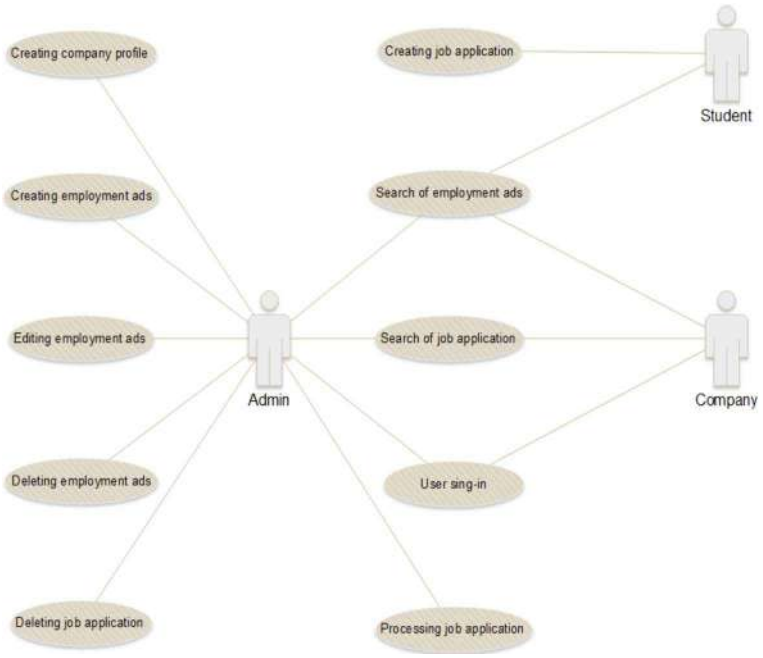

Figure 1: Use case diagram

3. E-RECRUITMENT PORTAL ARCHITECTURE

E-recruitment portal has been created using MEAN Stack technologies (Haviv, 2014): MongoDB as a database, Express.js as the Node.js (Internet 1) framework for backend and Angular as frontend of the application. MEAN Stack represents significant change in standard architecture – from relational databases to NoSQL (Strauch, 2009), from MVC oriented architectures to client single-page applications (Đorđević, 2015). E-recruitment portal architecture is shown in Figure 2.

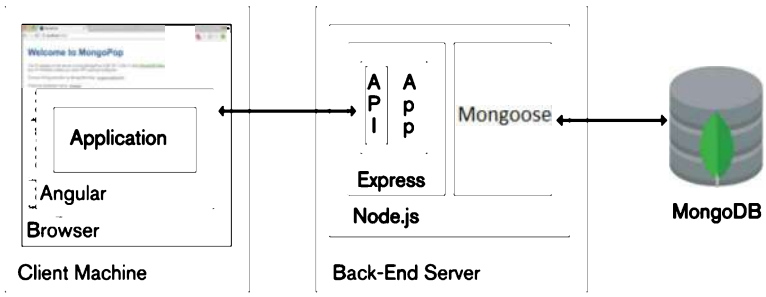

Figure 2: E-recruitment portal architecture

In the first section (on the left), the client part of the portal is shown, whose main components have been developed in Angular. It contains all UI components, all services needed for data display and sending data to the server. Server part (in the middle), is based on Node.js server, which listens to all HTTP requests. The backend of the portal consists of Node.js implemented using the Express.js framework, crucial for creating API of the portal, then Mongoose (Rahić, 2017), MongoDB tool for object modeling (MongoDB Architecture Guide, 2017), used for creating all object models used through the portal. The last part of the portal is MongoDB. It contains all collections populated by BSON documents needed for proper functioning of the portal. Collections used for implementation of this portal are (Figure 3):

1. Collection of internship ads
2. Collection of categories
3. Collection of subcategories
4. Collection of internship applications
5. Collection of users
6. Collection of messages

```
1  show collections

0.028 s   Show Profile Info

1  kategorijas
2  messages
3  potkategorijas
4  praksas
5  prijavas
6  users
```

Figure 3: List of database collections

MongoDB represents JSON documents in a binary-encoded format called BSON behind the scenes (Holmes, 2015). BSON extends the JSON model to provide additional data types, ordered fields, and to be efficient for encoding and decoding within different languages. The MongoDB BSON implementation is lightweight, fast and highly traversable. Like JSON, MongoDB's BSON implementation supports embedding objects and arrays within other objects and arrays (Leite, 2015). MongoDB can even 'reach inside' BSON objects to build indexes and match objects against query expressions on both top-level and nested BSON keys .This means that MongoDB gives users the ease of use and flexibility of JSON documents together with the speed and richness of a lightweight binary format (Internet 3; MDN, 2017). Documents are built with a name or key and value pairs. An example of one document is shown in Figure 4.


```
{
    "_id" : ObjectId("59a7dd80d8f9ba07d4f8766d"),
    "naziv" : "Angular Developer",
    "kompanija" : "Namics",
    "opis" : "Potreban nam je junior\n\nDodji i zaposli kod nas
        .\n\nOvo su ocekivanja i taskovi:\n- Writing a scalable
        app that deploys on multiple environments and has
        different themes and feature sets for different clients
        .\n- Monitoring process statuses of hundreds of cloud
        instances\n- Browsing through huge genomic datasets and
        multi-gigabyte files\n- Developing graph composition
        tools for web and desktop\n- Developing platform
        management components for bioinformatics data\n- Writing
        our own UI components",
    "pozicija" : "Junior",
    "kategorija" : "JS",
    "__v" : NumberInt("2"),
    "prijavas" : [
        ObjectId("59b000b25ac884378cc40df8"),
        ObjectId("59bef5299d32f9516872159c")
    ],
    "tagovi" : [ ]
}
```


Figure 4: Document example

4. IMPLEMENTATION OF AN E-RECRUITMENT PORTAL

4.1. Main page

The home page consists of a navigation menu, which contains a path to other parts of the application, and lists of ad practices and jobs. The main page for the guest user is shown in Figure 5 and for the administrator in Figure 6.

Figure 5: Main page for the guest user

Figure 6: Main page for the administrator user

The guest user is able to search jobs using the filter shown below the navigation menu. Filters represent the categories of published jobs. Categories are set by entering ad data. A guest user is allowed to sign in to ad,

while admin or user with standard access is not. Clicking on the Login button will open the registration form within the ad itself.

The job application contains mandatory fields such as name, surname, e-mail, and link to e-CV and other optional fields that extend the application. By clicking on the button, the user sends an application for the job. The Sign in button is disabled until all mandatory fields are entered. After successfully completing the login form and clicking the Login button on the ad, the user gets a notification in the pop-up window.

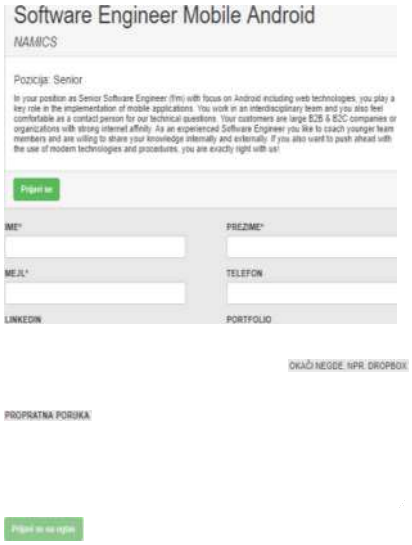

Figure 7: Job application form

4.2. Custom CMS

In order to administrator log in into the system, email address and password are required. This form is not available through the navigation menu, in order to prevent the abuse of the portal. After a successful login, the admin is redirected to the home page. The admin console page consists of a special navigation menu that contains a path to the ad management page, a login management page, a page for creating new users, and a logout page (Figure 8).

Figure 8: Appearance of a navigation user with an administrator access

4.2.1. Ad management

The ad management page consists of two parts: forms for adding new and editing existing ads, and a list of all published ads (Figure 9).

Figure 9: The ad management page

By filling out the form and clicking the Save button, the user adds a new ad to the database. All form fields are required. Fields Tags and Categories allow a search of ads. By selecting technologies in the Category field, a menu with predefined tags opens, which the user can mark (Figure 10). The Save button is disabled until all the fields are filled, which partly optimizes the validation of the form.

After successfully saving the chosen options, the user receives a notice in the form of a pop-up window. Within the ad list, each ad has the Edit and Delete option in the bottom right corner. By clicking Edit link, the form is filled in with existing ad data and editing of ads is allowed. If the user wants to delete the ad, they need to click on the Delete link, after which a pop-up window will appear where the user needs to confirm the deletion of the ad. The user is prevented from deleting ads in case that some users had applied for that ad.

Figure 10: A menu with predefined tags

4.2.2. Application management

By selecting Login in the navigation menu, the login management page will be shown. This form contains a list of all submitted ads (Figure 11). Admin user is allowed to view and delete applications. Changing the login is not possible, in order to prevent the abuse of the platform.

Figure 11: Login management page

Each application to the ad contains information entered through the application form and the name of the ad for which the application is filled in. To the administrator, an overview of all applications has been provided, while company users are allowed to review applications related only to their company. If the user wants to delete the application from the system, it is necessary to click on Delete in the Application header. After the user selects the option to delete, a pop-up window appears in order for the user to confirm the deletion.

4.2.3. User management

Only administrators can create new users (Figure 12). All form fields for creating a new user are required. The Submit button is disabled until all fields are filled properly.

Figure 12: The page for creating new users

5. CONCLUSION

This paper presents an e-recruitment portal developed using MEAN stack technologies. The contribution of the paper is twofold. Firstly, an e-recruitment portal for advertising jobs and internships specifically to student population can make their search easier and quicker. The existence of multiple job portals and multiple channels for advertising internships make the process of finding a suitable one hard and time-consuming. Developing a portal as a service of a student organization is suitable because the students can find a suitable job or internship through a single channel. Secondly, this paper presents a case study of the usage of MEAN stack technologies for developing web portals. The choice of technologies allows an easy and rapid application development while creating a scalable and flexible application that can easily adapt to future changes.

In further development, it is planned to create a section Company in which it would be possible to search for companies ads that have created profiles on the portal. There will be an improved section of statistics in which companies can see statistics related to practices, such as the number of views, the number of applications and other. Furthermore, section Questions will show all guest users' questions for specific ad.

In order to reduce manual processing of job applications, an e-mail service will enable direct sending of job applications to companies.

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DEVELOPMENT OF AN IOT SYSTEM FOR FIRE-FIGHTING IN SMART HOMES

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***Abstract**: This paper shows an example of an IoT system for fire-fighting in smart homes. As support to this system, web application for tracking of sensors detection and warnings is shown. The devices that register smoke and flame and inform fire departments are implemented. The web application should enable early detection of fire and extinguish early fire while informing the house owner of the situation via SMS or via GSM call. All data is followed in real time through web application which is used by fire department. Aim of this system is to detect and prevent fire disasters in real time.*

***Keywords:** Internet of things, smart homes, home security, fire protection, fire-fighting*

1. INTRODUCTION

The term Internet of Things (IoT) was reportedly coined by Kevin Ashton, more than 15 years ago. The new world of IoT is creating widespread connectivity which includes devices such as cameras, toasters, garage doors, environmental and security systems inside homes and business through remote control of different sensors such as temperature, light, motion and detection (The Internet of Things and the fire service, 2017). The IoT offers promising solutions to convert conventional systems into modern ones. The technology is based on wireless sensor network, actuators, GPS and mobile devices and units. IoT is a global network of devices which communicate among each other, have their identities, physical attributes, intelligent interface and are integrated into the information network (Vujovic, 2015).

Smart home technologies (SHTs) comprise sensors, monitors, interfaces, appliances and devices networked together to enable automation and remote control of the domestic environment (Cook, 2012). Controllable appliances and devices include heating and hot water systems (boilers, radiators), lighting, windows, curtains, garage doors, fridges, TVs, and washing machines (Robles & Kim, 2010). Control functionality of these devices is provided by software on computing devices (smartphones, tablets, PCs) or through dedicated hardware interfaces (e.g. wall-mounted controls). Global consumer research carried out in seven countries worldwide, including UK and Germany, suggests a high level of market support. Over half of consumers surveyed expressed a general interest in smart homes, and 50% believe SHTs will have an impact on their lives over the next few years (GFK, 2016). Market forecasts project over half a million households in Germany will have smart appliances or devices by 2019, driven by widespread adoption of smart phones. However actual levels of uptake of smart home technologies are still low, and smart product sales are dominated by internet-connected TVs (Harms, 2015). Market growth mostly depend on users who are perceiving potential benefits and acceptable levels of risks. Smart home technologies can greatly improve energy management, security, safety, enhanced leisure and entertainment services and personal independence through healthcare provision and assisted living. (Chan et al., 2009; Nyborg & Røpke 2011). The most significant barrier to adoption of SHTs is upfront cost, privacy, security of data, reliability and interoperability of different technologies. Also there could be a social impact such as increased laziness in domestic life.

The Internet of Things (IoT) has led much of the world becoming smarter and more connected. Fire protection is among the various areas that can realize the true benefits of Internet of Things. Fire prevention and fire safety equipment are undergoing a massive revolution thanks to the Internet of Things. Internet of Things devices are connected to low power wide area or cellular networks to enhance prevention, increase response time and keep the first firefighters on the scene safe. The National Fire Protection Agency reports that 1.170.000 fires took place only in the U.S. during 2017, which resulted in 2.430 civilian deaths and $11.8 billion in property damage. Despite improved safety equipment and training, the greatest danger that firefighters face are the unknown factors they must deal with on the scene. Many departments already employ smart technology, such as thermal cameras. IoT goes even one step further, it enables leaders on the ground to see what is happening on the scene while tracking every team member's location in real time. IoT can integrate with existing alarms, personal safety devices and fire suit technology with only minor adjustments. Tracking technology keeps firefighters safer by reporting each member's exact location directly

to the shift commander, but these devices don't work using GPS technology because of its low reliability inside a concrete or steel structure. Lightweight RFID based trackers are used instead. By using the exact location and thermal cameras commander can map the area and offer guidance for other team members (Firefighting with IoT, 2017).

The model of firefighting system in smart homes is developed that should enable early prevention of loss caused by the fire and smoke. A web app should enable monitoring in real time, reducing the response time and automatically extinguishing small fires. With complete implementation of the system it should reduce costs, increase efficiency regarding the intervention, increase security inside home and improve living conditions overall.

2. LITERATURE OVERVIEW

The fire service and other emergency first responders are currently benefiting from enhanced-existing but also from newly-developed technologies. Firefighters are operating in the sensor rich environment that is creating great amount of potentially useful data. The "smart" firefighter is going to be able to fully exploit selected data and to perform work tasks in a highly effective and efficient manner (Sundmaeker, Guillemin, & Friess, 2010).

Firefighting safety field has made remarkable progress in recent years in the building of information network, and has many results in application, and part of application patterns have taken shape in terms of IoT. The overall society has great expectation and demand pressure to the improvement of Fire IoT management level, and provided a great market potential for its application.
The modern firefighting system is based on wireless sensor network in combination with Internet of Things. Due to modern and advanced technology the system minimizes the losses caused by fire. There is significant variety of information accessible by fire brigades and great potential lies within Internet of Things. The Fire Protection Research Foundation's executive director Casey Grant says "Real-time information will greatly assist emergency responder situational awareness, which is especially critical during an event when time is precious" (Xin & Quanyi, 2010).

Fire automatic alarming systems are very popular nowadays. These systems are widely used in most civil and industrial buildings in China. With only one additional internet interface and one management software in a single building, fire detection can be realized. Distant monitoring systems (DMS) are the link for to the buildings with the alarming system. Distant monitoring systems are based on modern communication network and allow real-time monitoring of all information. This is just the beginning of such systems which can be technically improved further. This improvement has been achieved by the rapid development of "Golden Shield" firefighting teams in China, by taking advantage of public security private network and specialized communication network. Progress in automatic office work, sharing and using of firefighting information as well as rapid response of firefighting teams have been achieved (Vijayalakshimi & Murugananad, 2017).

Fire protection management consists of 4 main parts:

1. Regulations - all public and some civilian buildings must have fire safety regulations in case of emergency.
2. Supervision - supervision management contains archives of fire management, fire safety inspection, fire control inspection and so on.
3. Response capacity of fire emergency - it contains response plan establishment, full-time firemen and voluntary fire brigade formation and response plan drills. Comprehensive fire emergency response plan can not only do a lot of help to assist commanders while giving commands, making decisions and deployment but also to ensure the fire officers and soldiers get familiar with environment immediately and deploy rationally.
4. Publicity and education training - building should have fire safety bulletin boards in the striking place, which disseminate fire hazards and the measures to be taken when the fire breaks out. Regular fire safety training should be organized to ensure that all occupants know the emergency evacuation process. (Ying-conga &Jingb, 2013)

Only two companies today successfully sell and implement smart IoT solutions. ZigBee and Aeris solutions are the leaders in IoT fire prevention systems. Aeris offers comprehensive solution meant to enhance security in emergency situation, and mostly prevent firefighting staff from injures or even death. The most important capabilities of Aeris' products are team members tracking in real time using the most advanced technology that is fireproof, light to carry into the scene and extremely reliable. Robotic response is another capability. These robots may be able in some cases to arrive on the scene faster than humans. They are supplied with oxygen and sensors to help and identify victims inside the fire and are able to map and clear

the rooms before the firefighters arrive on the scene. The main downsides of Aeris are price. These systems are too expensive and they still involve a lot of human interaction to function properly (Gao, 2016).
ZigBee technology made a revolution in fire prevention. They made five systems that can work independently or together as a single unit. It involves fire control room as an intermediary between the building and fire department. Since the fire breaks out, thermal monitoring system sends a fire signal into the fire control room of the building and activates ZigBee's hydrant extinguishing system to extinguish the early fire. When the control room confirms the disaster, a fire signal is sent to the fire department. Where ZigBee's IoT terminal is used to find the shortest route to the fire scene.

The five systems of ZigBee are as follows:
1. Thermal imaging fire monitoring system
2. ZigBee IoT alarm system
3. Wireless ZigBee fire hydrant monitoring and related technology
4. Mobile terminal information sharing system
5. ZigBee IoT terminals and radio frequency positioning rescue technology (Jang & Gao, 2010).

Downside of such a system is its price, even as a single system. It requires a lot of human involvement, it is not customizable enough, and it can only be implemented in the early phase of building construction, otherwise costs can be as triple as normal.

The requirements for the firefighting system monitoring developed in this paper are as follows:
- Sensors for gathering information on the scene
- Database server for real-time tracking
- Automation of extinguishing process
- Fire department and firefighting personnel

3. MODEL OF IOT SYSTEM FOR FIRE-FIGHTING IN SMART HOMES

This paper presents a system that allows early detection of fire, alarming the fire department and activating the countermeasures. The system consists of a smoke detection sensor, a temperature sensor, a flame detection sensor, a relay, a solenoid valve, GSM module, Arduino microcontroller and a Raspberry Pi microcomputer. In the case of smoke detection, the fire department is alarmed through the web application and the location and smoke pollution information is sent to the screen of the brigade in charge. In addition to informing the fire department, using the GSM module, a mobile call is placed to the smart home owner. If the situation gets worse and early fire and smoke turn into real fire, the flame detector sends a signal to the control unit that activates the relay which activates a solenoid valve. Valve brings water to sprinklers in order to extinguish fire and prevent severe damage to the smart home.

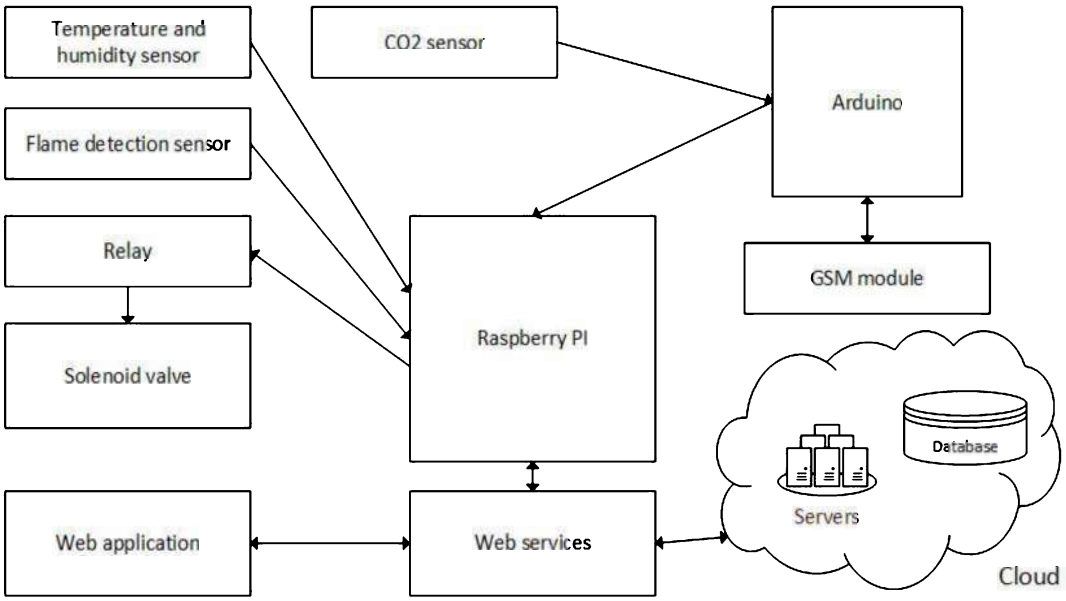

Figure 1: Model of fire fighting system in smart homes based on Internet of Things

When such events happen all information is sent to fire departments in order to improve the service and better prioritise emergency situations in the future. All necessary data is passed through a web application.

Using this kind of model it is very easy to determine levels of CO2 in the air or detect flame. This information is crucial to take next steps to protect the household and its residents. The use of this model allows complete automation of fire extinguishing. Additional information is provided by the temperature sensor and the humidity sensor. These sensors can be very useful in early detection of a fire.

Data is sent via web services to the server and it is stored in non-relational MongoDB database. MongoDB is an open-source database management system based on documents. It is classified as a NoSQL database that avoids the traditional structure of relational database-based databases. The basic structure consists of JSON documents with dynamic schema, or BSON format (binary JSON). Sensibility of the flame detection sensor is set to maximal, so it would detect any light in the room.

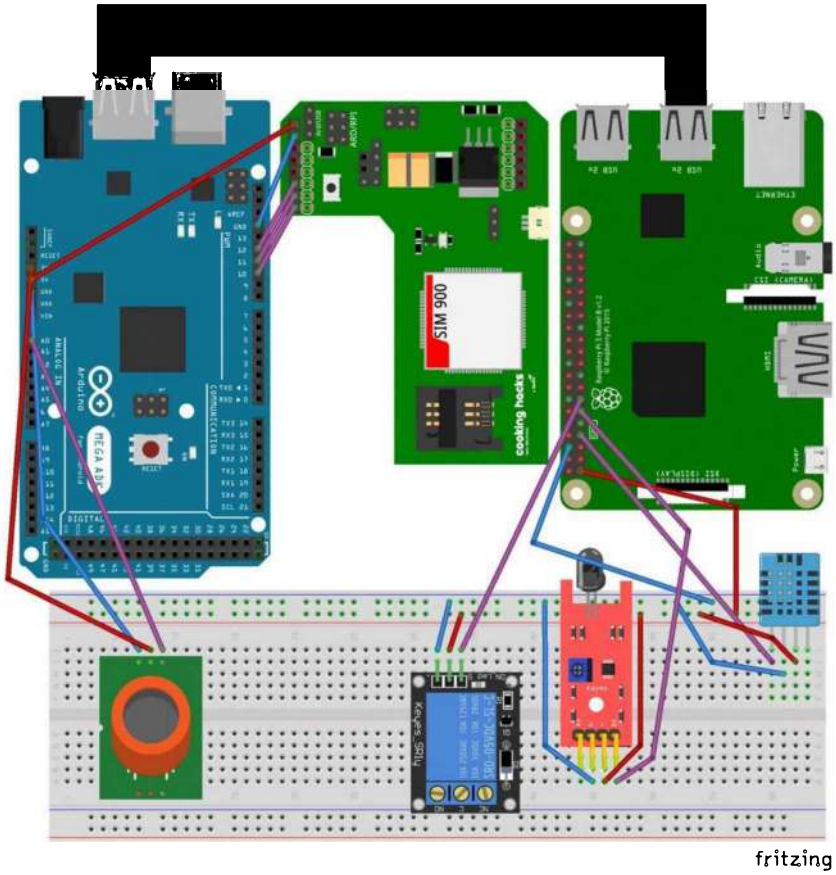

Figure 2: Physical connection of devices

On the figure 2 are shown Raspberry Pi microcomputer and Arduino microcontroller connected with sensors and actuators. Blue 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. Purple 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 CO2 sensor. Temperature and humidity sensor, relay and flame detection sensor are connected to Raspberry Pi while GSM module is connected to Arduino. Because of big amount of data the non-relational database is used and it is located on the cloud.

4. DEVELOPMENT OF WEB APPLICATION FOR FIRE-FIGHTING SYSTEM

In order to implement such system in regular household few requirements have to be met. Whole house has to be covered with stable Wi-Fi connection, constant power and water supply. In addition to this requirements, the house owner should have mobile phone with GSM and SMS capabilities.

This paper presents a web application that allows firefighters in the control centre to monitor the state of carbon monoxide in smart homes. The web application is developed by using Bootstrap framework. Application logic on server side is developed in PHP programming language. Parts of the application logic which are executed on the client's side are developed using JavaScript. AJAX is used for data insight in real time. All communication with web server takes place through sending and receiving HTTP requests that carry data in JSON format.

Along with carbon monoxide information, in case of emergency, application shows CO2 level, address and option to send fire fighting vehicles to the location. Location is visualised, using Google maps as it is shown on Figure 3. Based on location, system calculates ETA by checking the location of the nearest emergency vehicle.

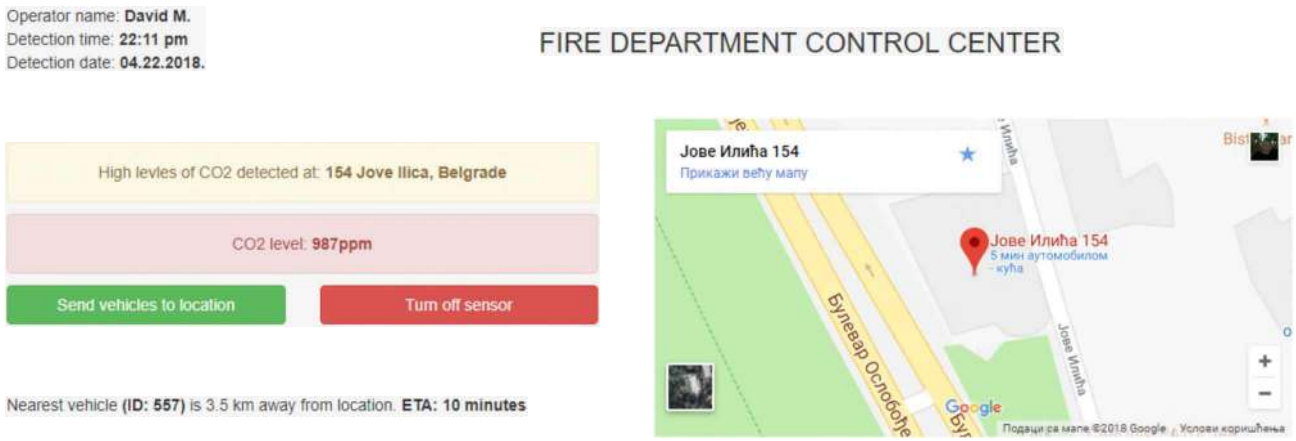

Figure 3: Fire department web application

At the same time while sending the information to the fire department, the system, uses GSM module which is connected to the Arduino and calls home owner to inform the about potential fire disaster.
As an alternative to web application it is possible to develop mobile application. Within mobile application user would have an insight to the data from the sensors inside the smart home, with some additional functions like push notifications.

Figure 4: Call initiated via GSM module

5. CONCLUSION

In this paper, development of an IoT system for fire-fighting in smart homes is shown. System 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 firefighting system in smart homes was presented.

Main advantages of this solution are simplicity, low cost of equipment and possibility of implementation in other smart environments like smart buildings, offices and storages. Important advantage of this solution compared to other solutions is versatility. This system can easily be implemented into civilian homes without a need for major construction works. 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 better recognition of early fire.

One of disadvantages of this system is that it requires advanced technical knowledge needed for implementation. In order for system to work with optimal performance participation of the city administration is needed to enable communication between smart homes and emergency services.

While other solutions mostly relays on human involvement and low automation, system shown in this paper overcomes these difficulties by using solenoid valve which is connected to water source. Solenoid valve is able to send water to sprinklers and quickly extinguish early fire, which makes it completely automated system.

Real-time data is shown inside the fire department which includes temperature, gas level, and data gathered from flame detector. This way quick intervention of fire brigade is always provided to those who need it.

This system can be improved by analysing all the collected data from sensors. Analysing large amounts of data in real time and using machine learning can allow the fire department to detect the fire before it actually starts. This new approach gives a reliable solution that can permit to detect fires risks, in order to avoid severe damage of this disaster, when it happens. Application of IoT in fire monitoring is an excellent solution that leads to smart city development.

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DEVELOPMENT OF A SMART AGRICULTURE AUTOMATION SYSTEM BASED ON INTERNET OF THINGS AND USE OF RASPBERRY PI

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Abstract: *Smart agriculture is overtaking traditional ways of food production. Modern life dictates very fast rhythm and there is not enough time for dealing with house jobs and managing a home garden. With help of Raspberry PI and Internet of Things (IoT) this becomes reality. This paper presents implementation of Raspberry PI device with the use of IoT in home conditions as well as a design of the smart agriculture system which is divided into software and hardware part. Smart sensors are also a part of proposed solution. Their usage is giving a big advantage in food production and monitoring. Temperature and humidity data are available in every moment which gives the opportunity for proper and timely reaction. Proposed implementation is given in order to provide a standard solution for creating a smart agriculture system for home use.*

Keywords*: Raspberry Pi, Internet of Things, smart agriculture, automation, monitoring*

1. INTRODUCTION

New technologies are being developed on daily basis and its usage is growing and progressing. Similar changes and innovations can be noted in food production too. If food supply is looked, it is evident that today's offer of food is quite diverse and abundant, but at the same time the risk of the unknown effects of food consumption has risen. These unknown risk factors have led to the idea of using new technologies in the process of producing and growing food in homes with none or minimum effort. As the awareness of people's health has increased in recent decades, most people began to take care of their nutrition. Although the supply of various foods is high, today, in most cases, consumers do not know what they are actually buying and whether the food is contaminated with some harmful ingredients that could endanger their lives. One of the solutions to this problem is that people produce organic food that is part of everyday nutrition for themselves. Although this process requires a lot of time, the development of IoT and connected computers and various sensors, allows that most of the process of growing the plants can be automated, whilst saving a large amount of time. One type of computer that uses its application in diverse number of spheres, because of its compatibility and price is Raspberry Pi.

This paper describe implementation of Raspberry Pi computer with the use of IoT and smart sensors in home gardens. Connecting and programming a smart agriculture system is not so hard and provides a lot of benefits for their owners. The number of these systems will be increasing over time.

Paper is organized as follows. After the introduction, Section 2 is devoted to literature review and description of used hardware and technologies. Section 3 refers to use of Raspberry Pi in general, and especially in smart agriculture. Design of the smart agriculture system which include main objectives, hardware and software architecture of the system will be presented in the Section 4. Implementation of the presented smart agriculture system will be explained in the Section 5. The conclusions and directions for further research are given in Section 6.

2. LITERATURE REVIEW

"Internet of Things" represents an inter-networking of various physical objects, vehicles, buildings and other devices with embedded electronics, software, sensors and connectivity that allow objects to collect and share data (Brown, 2016). IoT allows objects on the network to be viewed and controlled remotely, with the aim to create a more direct integration of the computer system and the physical world (Harvard Business Review, 2016; Vermesan & Friess, 2013). In this way, with the reduction of human intervention, greater efficiency is achieved, along with the accuracy and economic benefit. The whole structure of Internet of things, in order to do a simpler analysis and design, can be divided into three parts or levels: hardware, infrastructure, applications and services. The first and lowest IoT part is hardware for connection of physical devices. Only those devices that are connected can share information and learn from experience. The goal of this part is to build devices and systems with built-in computer functionality and intelligence for proactive

thinking and behavior. Infrastructure as the second IoT part allows devices to connect to a wireless or some other computer network. This connection should enable an environment for development of IoT applications through channels for information and device information management and decentralized management channels. The third and highest IoT part are applications and services for obtaining data from the device, processing and delivery. Improvement of this applications and services is necessary for development of smart environments and the meaningful application of IoT in different areas. (Radenkovic et al, 2017)

In recent years, the development of information and communication technology (ICT) resulted in the emergence of two important concepts that affect the world around us: Internet-of-Things (IoT) and Cloud computing (Ashton, 2009; Evans, 2011; Mell & Grance, 2011). Innovations have improved capabilities to precisely monitor environmental conditions and to make proper actions according to received data. In last few decades, people are becoming unnecessary for more and more things everyday. Machines, robots and computers with the use of modern technologies are present in every branch of the ecomony.

The literature concerning issues related to automation of home gardens and use of Raspberry Pi is extensive. One of the first papers that present the use of wireless sensors and use of new technologies in agriculture is presented by Wang et al, (2006). Wireless Sensor Networks (WSN) are widely used in monitoring and predicting of data in agriculture business. WSN system construction and its implementation in agriculture for growing a roses is presented by Rodriquez et al, (2017). Detailed description of nanostructured (bio) sensors for smart agriculture is presented by Antonacci et al, (2018). Authors (Schumann-Bölsche & Schön, 2015) are considering applying of Raspberry Pi and sensor technology to some parts in Africa in order to help and improve their humanitarian logistics. Precision agriculture application with a cost effective and standardized sensing system for remote monitoring and disease monitoring is presented by Sawant et al (2017). A case study for a private IoT enabled platform for research in precision agriculture and ecological monitoring domains is presented by Popovic et al, (2017). Authors (Mohanraj et al, 2016) proposed the advantages of using new technologies in Indian agricultural sector, which enables the rural farmers to replace some of the conventional techniques. Large field monitoring was unthinkable until recently. Automation of large field monitoring with the use of sensors and Raspberry Pi is presented by Balamurugan and Satheesh (2017). In order to get a desired quality of wine, Morais et al, (2018) designed, developed and implemented monitoring system in order to measure wine temperature, pH, redox potential and wine's dissolved oxygen. One of the review papers that offers IoT applications in agriculture is presented by Talavera et al, (2017).

In literature, can be found a lot of papers with implementation of such infrastructure in various fields. One of them is application of IoT with the use of Raspberry Pi for creating a renewable energy monitoring system (Pereira et al, 2018). On the other hand, Perumal et al, (2017) used Raspberry Pi for monitoring building system. Building monitoring system is consisting of monitoring power consumption, temperature, light and humidity. Some authors (Vujovic & Maksimovic, 2015) suggested use of IoT and Raspberry Pi for automation of homes and buildings in order to discover fire. Also, one of the implementation is done in biometrics (Shah and Haradi, 2016).

3. RASPBERRY PI IN SMART AGRICULTURE

Raspberry Pi is a single-board computer, with the size of a credit card, developed in the United Kingdom with the intention of promoting basic computer skills and sciences in schools and developing countries. Although primarily developed for educational purposes, due to its portability and the ability to interact with the outside world, Raspberry Pi became very popular and began to be used for various purposes. A large number of developers and applications use Raspberry Pi for home automation. These developers are trying to modify the Raspberry Pi and make it a very affordable solution for monitoring energy and its consumption. Due to the relatively low cost of this computer, Raspberry PI has become a popular and economical solution, in contrast to more expensive commercial solutions (Rao and Uma, 2015). As Raspberry Pi is popular in a large number of different spheres, it has found its application in agriculture as well. A great deal of significance has been contributed by a huge number of sensors, such as temperature, humidity, soil moisture sensors and many others that can make a big contribution to the improvement and automation of agriculture.

"Smart agriculture" based on IoT technologies enables farmers and manufacturers to reduce investment time and increase productivity by controlling the quantity of fertilizers, controlling irrigation, regulating temperature, etc. In IoT based smart agriculture, a system is built for monitoring the crop field with the help of sensors and automating the irrigation system. The farmers can monitor the field conditions from anywhere. IoT based smart farming is highly efficient when it is compared with the conventional approaches.

The application of smart IoT based agriculture doesn`t have to target just large agricultural corporations, but also can be new starter for rising trends, such as organic production, family farming and many others. When it comes to environmental issues, smart IoT based agriculture can provide great benefits including more efficient water use as well as optimization of inputs and treatments.

4. SMART AGRICULTURE SYSTEM DESIGN

The impression is that people have recently raised their awareness about healthy eating habits, but still they are not sure whether healthy foods that are marketed are actually "healthy". In this case, the only solution is the independent production, where it can be known for sure the origin of the food. One of the difficulties for that scenario is the necessary time to dedicate for something like that. Solution to this problem is a smart agriculture system, which will automate process of monitoring the condition of crops, collecting and process data, together with the automation of individual processes such as irrigation. The goals that automated smart agriculture system needs to fulfill are:

- Management of the agricultural land without electricity,
- Automated soil irrigation,
- Preservation of temperature and humidity data on soil

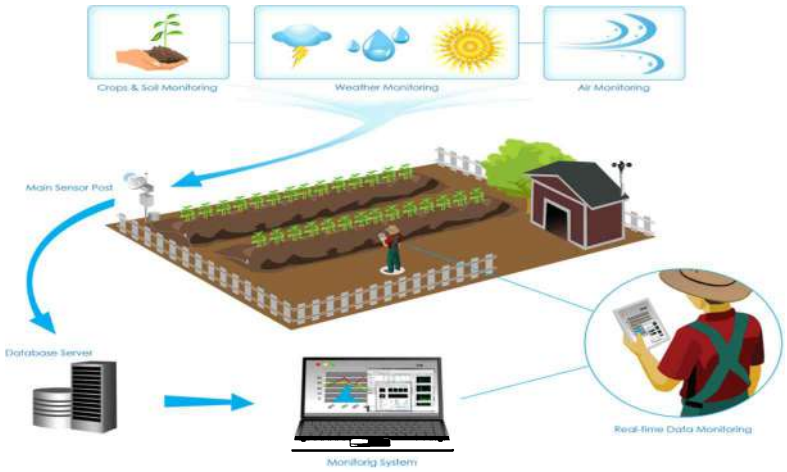

Figure 1: IoT system for smart home gardening

In order to accomplish these goals, it is necessary to use different types of smart sensors along with Raspberry Pi. Smart sensors are devices which interact with physical environment. Received environment inputs then use built in computer resources of sensor to perform some of the predefined functions at the moment of input detection. The collected data is first processed and then forwarded. As the basic integral element of Internet of Things, smart sensors manage to improve the accuracy of collected data from the environment and make this process automated. Smart sensors, combined with other components such as amplifiers, converters and analog filters are used for control and monitoring mechanisms in different environments. Management of the garden without electricity is enabled by using a solar panel that is connected to a battery which is a power source in smart agriculture system. In this way, it is enabled to install this system in places without the possibility of connection to the electricity. As timely watering is one of the most important processes for breeding the plants, drop by drop watering system is the one that has proven to be very efficient. This system is used in most cases. The name "drop by drop" tells us that it is a system that pours every plant equally. Electro valve is a valve in which water flow can be regulated with use of electricity. Also, this system can be used for feeding the plant, if a tank from which irrigation water is used supplies certain fertilizers that promote the growth and health of the plant. In order to track the humidity and soil temperature, it is necessary to integrate smart sensors.

Smart agriculture system design can be divided into hardware and software part. The hardware part represents the infrastructure that consists of inter-connected physical devices, such as source of energy, which is in this case a battery powered by a solar panel, pipes for soil irrigation, smart sensors for measuring humidity and temperature of soil as well as automatic irrigation valve and Raspberry Pi as the main device in the system. All parts of the smart system are connected to the Raspberry Pi with its GPIO pins for collection of inputs. When the infrastructure is set up and connected, in order to allow for the collection and processing of data from all devices of the system, it is necessary to program Raspberry Pi. By developing an APIs for collecting data from different devices, it is possible to undertake certain actions in automation process. The

SIM card implemented in the Raspberry Pi is used to manage the system from remote devices such as home computer or a mobile phone.

5. SMART AGRICULTURE SYSTEM IMPLEMENTATION

Implementation of smart agriculture system is main goal of this paper. The implementation can be divided into several steps, such as preparing the ground, setting up energy sources, setting smart sensors and linking them to Raspberry Pi, as well as programming it in order to collect and process data.

In the first step, it is necessary to prepare the arable surface by installing the pipes for automated water irrigation. In length, with a meter distance between them, pipes are implemented. The arranged pipes are connected with the water source, precisely one hundred litres barrel. On the connection with the barrel, 12V electric valves are installed. Their purpose is to regulate the soil irrigation and automate it using Raspberry Pi. In order to secure the power source, solar panel is placed at the appropriate place to collect solar energy. The solar panel is then connected via controller to the 12V and 100Ah battery that is a power source of the smart agriculture system. The sensor for measuring the temperature and humidity of the air is set to the meter from the ground level, while the sensors that measure the condition of the earth, are placed directly into the soil, closer to the plants, in order to have accurate information. Humidity and temperature sensors are an indispensable item for keeping records and analyses for some future ventures that can comprise a larger amount of plants. The DHT11 sensor is digital sensor for measuring temperature and humidity. SparkFun Soil Moisture Sensor is the analogue sensor for measuring soil moisture. DS18B20 is digital waterproof sensor for measuring soil temperature. All of these sensors are connected to Raspberry Pi by cable and "breadboard", while they are connected to the battery to receive a power source.

Figure 2: Sensors for implementation an IoT in smart agriculture

When everything is set up and properly connected to Raspberry Pi, it is necessary to "program" Raspberry so that the data is collected and processed and so that can later help in undertaking certain actions. The mentioned data is collected with the use of GPIO pins. Each sensor has at least three outputs, such as electricity, grounding and data output. The last one (data output) is used for connection to the mentioned GPIO pins of Raspberry, which can enable quickly data collection and processing by the Raspberry. Since the Linux operating system is used on Raspberry Pi, the python programming language and the Flask framework for routing are used in order to enable the server to collect and process data from a Raspberry. This server contains five methods:

- get_temperature
- get_humidity
- get_soil_temperature
- get_soil_moisture
- do_irrigation

get temperature is a method that returns the current temperature in the json format {'current temperature': 20}. get humidity is a method that returns the current air humidity in the json format {'current humidity': 49}. get_soil_temperature is a method that returns the current soil temperature in the json format {'current_soil_temperature': 29}. get_soil_moisture is a method that returns true or false depending on whether the earth is moist or not. do irrigation is a method that takes time in minutes as the input parameter for irrigation of plants.

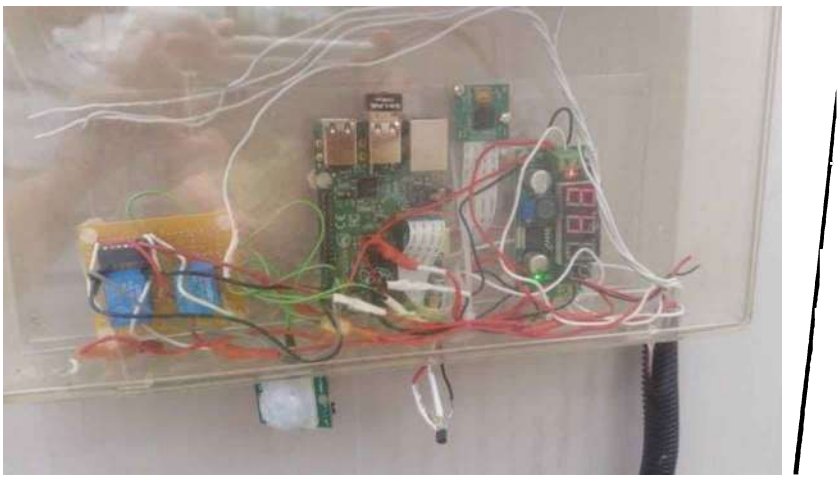

Figure 3: Connection of Raspberry Pi with sensors and controllers

For further management of the smart garden, it is necessary to install an application in order to get information's about the current vegetable state and plants in generally. This application is not something that should be complicated, instead of simple, transparent and easy for use application. It can be "One page" application that gives all the necessary information in one place, so it can be helpful with making conclusions on what is happening and eventually to help with prevention of some possible losses. This application will have two tasks:

- to provide real time information on temperature and humidity of soil at any time, as well as a button for regulation of irrigation that can be either automatic or manual (automatic means that whenever the land is dry system for irrigation is turned on for 10 minutes)
- to store collected data for temperature and humidity of soil in the database on every half hour, so it can be used for further analysis and preparation of bigger projects.

Also, it is possible to ensure that the collected information's are sent as a SMS.

6. CONCLUSION

Monitoring of temperature and humidity of air and soil with the use of IoT is definitely the future for either home gardens or for bigger projects and farms. Necessary actions in case of a deviation from normal values are covered. It is evident that Raspberry Pi is bringing so much advantage in smart agriculture and producing of organic food in home conditions for personal use. The same technology can be applied to large-scale gardens in which organic foods can be produced in order to find their place on stalls across markets and green markets. Implementation of smart agriculture system with the use of Raspberry Pi and IoT is presented for personal and home use. Evaluation and comparison between traditional production and technology monitored production as well as possible advantages of using blockchain technology are set as a goal for further research.

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DEVELOPMENT OF AN EDUCATIONAL GAME: AUGMENTED REALITY APPROACH TO EDUTAINMENT

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Abstract: *In this paper, the authors examine the problems, capabilities, and benefits of implementing augmented reality technologies in higher education and integrating them into formal e-learning in the form of edutainment. The main goal is to design and develop an educational interactive game that features augmented reality and would enrich the teaching process with interesting content as well as motivate students and stimulate their acquisition of knowledge. The developed game is based on current internet mobile technologies, with AR aspects realized through the use of the Vuforia platform, and is implemented as a part of a smart classroom. It includes a web application for teachers to create tasks, small parts of the curriculum that are being tested, a mobile application that students use to interact with the game and solve tasks, an augmented reality module that supports distance learning and a component for integration with Moodle LMS. This paper will focus on the AR aspects of the game and the benefits that can be gained with its use in education. The game has been implemented within the educational process at Faculty of Organizational Sciences, University of Belgrade*

Keywords: *Augmented Reality, Internet of things, game-based learning, edutainment.*

1. INTRODUCTION

The educational process is ever changing and evolves over time. This progress stems a requirement to fulfill the needs of the students that change over time (Education, 2011). With the coming of the digital age and the daily innovations which represent it, it has never been harder or more important to redesign current methods of teaching and formulate a new approach that will accommodate a society living on the thin line between the real and digital worlds (Bowen, 2015). There is a need for modern education in all age groups with special focus on children starting their education as they are a generation born into the modern world and are introduced to many forms of technology since birth (Yelland, 2006). Technologies of augmented reality in education are increasingly being used and show great potential and contribution to the teaching process from the pedagogical aspect.

Many innovations in education come from the constant rapid development of Informational and Communicational technologies, especially Internet (Gyorgy, Suciu, Alexandru, & Militaru, 2014; Labus, Despotović-Zrakić, Radenković, Bogdanović, & Radenković, 2015). The effects of implementing internet technologies in e-learning have been a focus of many studies (Means, Toyama, Murphy, & Baki, 2013).

There are numerous articles and research papers with incorporating smart technologies or new methods in education as their focus of attention but a lot of them approach the subject matter from a purely theoretical view (Cook & Das, 2004) while other works don't always demonstrate the full integration of game-based learning in conventional education systems (De La Guía, Lozano, & Penichet, 2013; Kipper, 2013; Shen, Wu, & Lee, 2014). In this research, we try to contribute to filling this gap by developing a game within a smart learning environment and that aims to enhance the user's perception by utilizing the power and popularity of augmented reality.

2. LITERATURE REVIEW

A. Augmented reality

Augmented reality is a technology that has an astounding number of applications such as business, medicine, gaming and other forms of entertainment and education (Liou, Yang, Chen, & Tarng, 2017). Using AR in educational games leads to hybrid games, games in which digital and physical objects can interact with one another (Mircea et al., 2011). It is a new medium, combining a multitude of different computer aspects to offer a unique approach to continuous and implicit user control (Lee, 2012). This approach can enhance the quality and speed of training by providing a different view into the subject matter (Kamphuis,

Barsom, Schijven, & Christoph, 2014). An example of this is the use of AR in medical training (Gu & Duh, 2011). By switching from 2D images to 3D models generated by smart devices, medical students can better grasp the concept of many elements in their field of study like anatomy. Advances in mobile devices and their graphics processing and rendering increases the gaming potential of mobile phones . By combining mobile 3D game engines with Augmented Reality technologies it is possible to create a platform that is capable of enriching our reality any time any place. One such example is described in (Sherstyuk, Vincent, Berg, & Treskunov, 2011). In this example, authors describe the process of interacting with a 3D model of a patient. Thanks to mobile technologies, the model is not only rendered in 3D it is also responsive and fully functional. In this way, many hardware limitations of physical tools are circumvented and students are capable of gaining practical knowledge in a far greater capacity.

Currently, most of the innovative approaches to education are implemented as part of higher education. This is because universities have the necessary technologies and skilled personnel that are not only capable of conducting such classes but also willing to research new approaches to teaching (Begg, Dewhurst, & Macleod, 2005). That being said, it isn't restricted to universities as there are attempts to do the same on a high school level (Papastergiou, n.d.).

B. Educational games

Studies have shown that there is a great need for a better way to provide education. Due to rising demand for highly educated people, educational institutions cannot provide the necessary supply. This leads to creating more efficient means of teaching that can speed up the process and increase its quality (Savander-Ranne, Lunden, & Kolari, 2008). Many studies have shown that alternative and modern approaches to teaching yield better results (Stojanovic, Bogdanovic, Nedeljkovic, 2016). Some of the techniques that have been recently looked into are the use of modern technologies in the form of teaching tools and the use of edutainment in the teaching process (Knežević, Despotović-Zrakić, Labus, Jezdović, Ivković, 2016). Educational games find themselves used in research papers more and more and their potential is heavily discussed. They are interesting to students and possess the ability to motivate them beyond normal lecture capacity. This makes researchers explore their beneficial influence on the learning process (Petrović, Jezdović, Bogdanović, & Despotović-Zrakić, 2017). Use of games to facilitate learning is not a new concept and was used for a long time. The first form of such games is physical games. These games use physical objects to bring knowledge to students (Zagal, Rick, & Hsi, 2006). Since then, educational games have come far. Innovations in technology have created new forms of games that follow the trends and maintain their appeal to a younger audience, with the latest trend being mobile and AR games (Gros, 2007). Using video games in a teaching environment is nothing new (Alshanbari, 2013). Studies have shown that playing video and computer games can have a positive effect on players' cognitive abilities like decision making, speed thinking and reaction speed (Prensky, 2003). Another aspect of gaming that can be used to facilitate better learning is competitiveness. The competitive side of gaming leads to better motivation and a greater amount of effort being poured into performing actions whether they are of educational character or not (Burguillo, 2010). They also help focus attention to a single point which can be used for a more effective transfer of knowledge, with lesser losses of information due to "white noise" of distracting happenings all around us (Griffiths, 2002). In psychology, the greatest form of this is called "flow" and it describes a state of full immersion into an activity that focuses all of a person's concentration into a single goal (Csikszentmihalyi, 1975b, 1975a). When used in conjunction with gaming and "flow", education can be an interesting, motivational, immersive and above all else a productive activity, for example, a goal-driven educational game (Kiili, 2005). Using new technologies to change traditional types of games and adapt them to new trends makes them more interesting to newer generations and increases their effects (Petrović, Stojanović, Labus, Bogdanović, & Despotović-Zrakić, n.d.)**Error! Reference source not found.**. With the development of 3D games, we can see a rise in their popularity over the 2D type (Koops, Verheul, Tiesma, de Boer, & Koeweiden, 2016).

There are several parameters that can be used to evaluate the quality of an educational game (Aslan & Balci, 2015):
- Acceptability: the level of completion of the learning goals;
- Challenge: the level of motivation;
- Clarity: the level of understanding;
- Interactivity: the level of interaction between the student and the game;
- Reward: it enables the student's satisfaction after the completion of goals.

C. Internet of Things

Internet of things has found itself being used for various purposes, like traffic, data analysis and for our purposes the most important one of all – education. There can be many implementations of IoT in education but the most often example is in universities.

Many classrooms today are connected to the Internet and have the advanced technological equipment, such as tablets or interactive boards. This type of classroom is called the smart classroom (Song, Zhong, Li, Du, & Nie, 2014). These classrooms are equipped with all kinds of tools and technologies necessary to provide an enhanced learning experience that builds on top of the classical face to face model with a virtual, off-site approach by providing a flexible and inspirational environment (Mikulecký, 2012). These classrooms are the ideal place to implement educational games as they meet the necessary technological requirements (Xiliang, Xin, Yafei, & Mengkun, n.d.). By relying on the recent internet and mobile technological boom, limitations of smart environments are pushed even further. Using smartphones, as they are currently the equivalent of a pocket-sized computer- a fact that was unimaginable even as recent as 10 years ago, learning can happen everywhere, physical presence can become a thing of the past (Suo, Miyata, Morikawa, Ishida, & Shi, 2009).

3. DESIGN

A. Project requirements

The goal of our study was to create a tool that would transform the antiquated teaching mechanics into an exciting and immersive experience as well as monitor the effects it has on the student's motivation and knowledge acquisition. During our research, we have explored the processes of envisioning and designing methods to bring our idea into fruition as well and developing hardware and software components based on current technological standards that are necessary for implementation into a real environment. Based on its potential in education, augmented reality technologies have been chosen as a core of the solution. The result was an educational game based on AR that test's the players' knowledge on a given subject in a fun and inviting manner and monitors their progress and achieved results. The game aims to motivate students to embrace learning as a positive influence in their life by presenting it as a challenge set on a medium that the user is already accustomed to.

B. Game concept

The concept of the game revolves around the process of giving the correct answers to given questions. What differs in comparison to a standardized test is the way in which the examinees not only solve the problems but also the method of submitting their answers. By designing questions in an interactive way that forces the students to apply their acquired knowledge in a practical manner that is both fun and educational, tests can be taken to a new level. One approach to this is creating workstations or polygons for each assignment and distributing them to remote locations. This creates a goal-driven approach or in game terms manifests the illusion of "quests". Polygons can consist of any number of elements, from simple images to be used with AR modules to IoT infrastructures that demonstrate some core features of smart objects. Another approach might be through a computer or in recent times mobile education, with apps instead of pen and paper. This too can test both the theoretical knowledge i.e. quizzes or simulate some real-world situation for the student to manage. Our approach was a mixture of aforementioned solutions joined together, a model that is composed of a server which represents the core of the system and many distributed platforms made for solving each task in a different way, but obeying the standards of the central unit and integrating into it.

C. Architecture

The architecture of the developed system is shown in figure 1. The system is split into core and distributed elements with a middleware to connect them much like a bridge would. Among the core elements, we have a virtual machine to house the central web server. The server host many items that are integral to the system such as an administrative tool in the form of a web application that is used by a teacher to administer the whole testing and grading process. The most important part of this tool is to create the logical form of assignments that are presented to students during testing as well as serving as building schemas for their physical representation. Other components that make the central server their home are the main database used for storing all transactions and the many web services used by all of the system's various components. It is the services that are the gateway between the centralized core and the distributed network of participants and locations. The most important tool from the aspect of the player is the controller. Representing the middleware, the controller serves as a means of communication between the player and a black box that is the game. It is present in the form of a mobile application on a smart device such as a phone or tablet. Using its User Interface it can collect input from the user and has integrated features to connect to the APIs of the server and physical data of the environment. The last segment of the system is a collection of the many distributed locations, mostly smart environments adapted for the purpose of solving at least one task. Communication between components is realized through the use of web services, RFID tags (Miglino, Ferdinando, Fuccio, Rega, & Ricci, 2014), and QR codes (Kan, Teng, & Chen, 2011). User management and grading are interconnected with Moodle LMS.

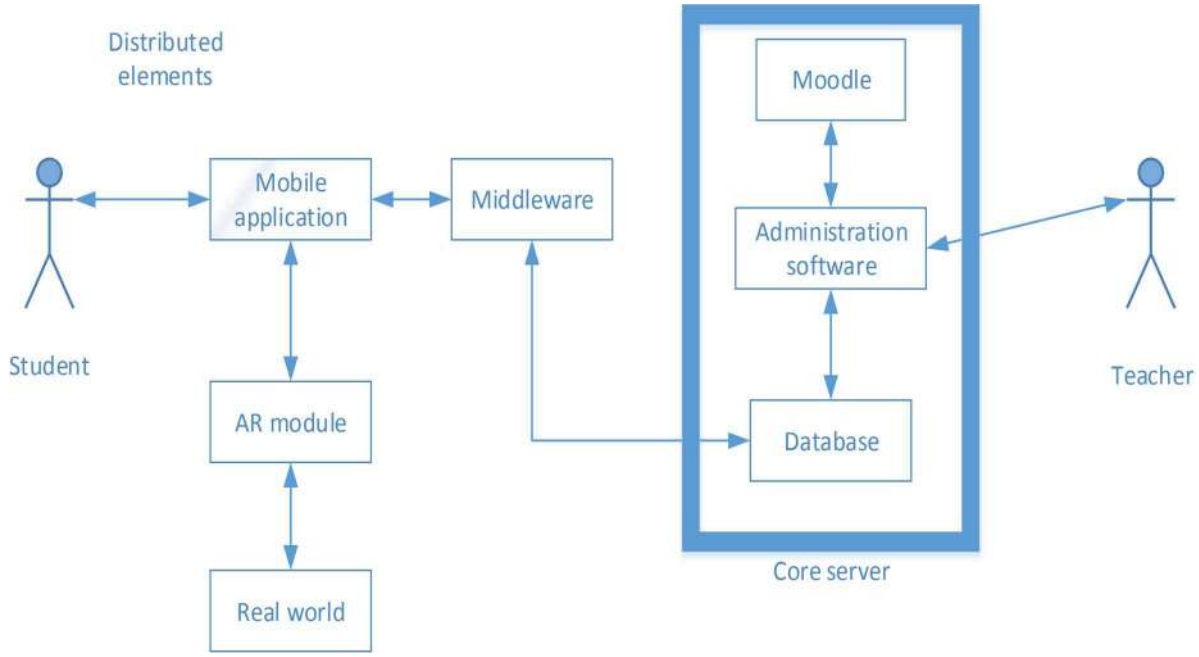

Figure 1: The architecture of the game

Mobile application

The mobile application is the player's gateway into the complex system of the game. It is the only way to interact with the physical objects necessary to solve tasks as well as the only interface that receives tasks from the server. In order to accommodate a wide range of task types, it uses task metadata to adapt to the current type and generate only the capabilities necessary at the moment (Simić, Despotović-Zrakić, Labus, Radenković, Bogdanović, 2015). It does this by being split into modules that are used as building blocks to form a whole during the loading of a new task, as seen in figure 2. The application can be divided into two parts, the Vuforia part, that enables the use of augmented reality, and the Android part that facilitates everything else.

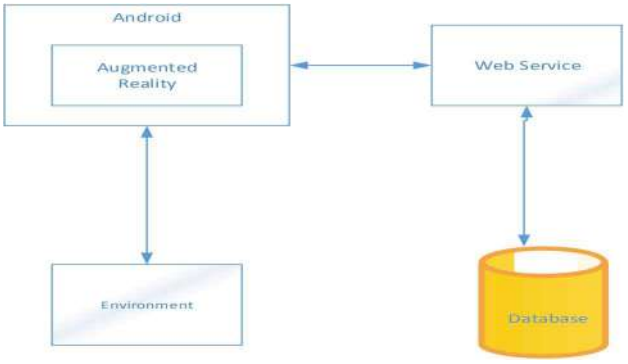

Figure 2: Mobile application structure

Augmented reality module is used to enhance the user's view of the real world and it does so by interacting with a camera view and analyzing every frame, trying to find a designated image within it. If an image is recognized 3D elements are overlaid over it. There are three types of AR modes available:

- Cloud Recognition which holds all target images as well as metadata files in a cloud server. This mode recognizes a target and reads the accompanying metadata file. This file contains names and positions of 3D models that should be rendered.
- Virtual Button which recognizes only a single target but in exchange supports user interaction. On successful target recognition, first of a list of 3D models is rendered as well as 2 buttons, left and right. When hovering underneath a button, the displayed model is changed either to the left or right of the list position of the previously displayed model.
- Explore which works similarly as Cloud Recognition in that its targets and metafiles are stored in the cloud. The main difference lies in views rendered on recognition. Unlike the first type, Explore only has 1 model available, a text panel and title and text that are displayed inside it are contained in metadata text files.

To successfully implement the game, it is necessary to prepare an environment for it. At the very least it is needed to prepare a location for all the image targets present. If there is a need to also collect data from the environment in some way, this environment includes workstations on multiple locations and equipment for students (Petrović, Jezdović, Stojanović, Bogdanović, & Despotović-Zrakić, 2017).

Workstations are equipment present on site for each task. If the task is envisioned to be solved with the aid of external factors and devices, then all the necessary hardware and software must be set. Since the game is played in multiple locations, they are scattered throughout the envisioned playing field.

Location of each task can be anywhere, in the classroom, in the faculty building, or outside. For example, a task can be related to measuring the temperature, and the equipment can be placed in a classroom. Or, a task can be related to plant watering, so the workstation will be placed in the garden.

Administration software

The administrative tool is used by teachers to organize tests (playing of the game), to create new tasks or modify existing ones, review achieved results for a given student and grade them. By using this tool, we prepare data that is available to other parts of the system through our web services. In figure 3 we can see the screen used for reviewing achieved results.

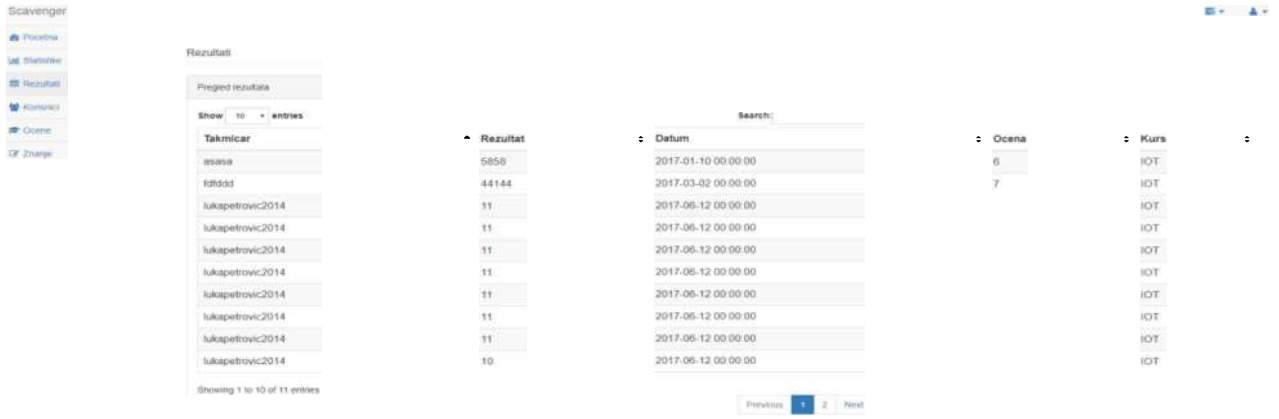

Figure 3: Results overview screen

Moodle integration

In both the mobile and web tools authentication is done via Moodle. By entering credentials a call to a public Moodle API is made with a request for authentication tokens. Only after confirmation of identities has taken place users can begin their work. Another call to the Moodle service is activated after the game ends. The client application sends the achieved results to the server for professors to grade with the help of the web application. After the grades have been set, they are set as Moodle assignment scores.

D. Game scenario

The test is split into groups of 1 or more assignments, let's call them subjects. The students, or in this context players, are given a mission to clear as many subjects as they possibly can within the time limit. They are given assignments in sequential and random order with questions from all subjects mashed together. To complete the subject, students are required to correctly answer exactly 1 assignment from that subject's subset. Once an answer is submitted its validity is put to the test. A correct one will award the player full points for that question as well as mark the subject solved. Any subject that is marked as solved will no longer be among the possible questions for that student. On the other hand, if the answer was not correct, there is no change and players are given the next task. There is no direct penalty for solving a task incorrectly as it might be received and correctly solved at a later point in the game, however, the time required to redo it decreases the acquired points at the end of the game (as the remaining time is part of the grade). New tasks are generated from a collection of all assignments from the unsolved subjects so in the case of a wrong answer the user can get that same question, another question from the previously tested subject or a question from a completely different subject. A potential penalty occurs if the player cannot correctly finish a task even after multiple attempts. In this scenario, not only is the utilized time deducted from the score, so are the points that each completed task brings.

To begin the game, students have to go to the predefined start location and acquire a player controller that is already configured. After imputing their credentials and successfully logging in to their Moodle account, they proceed to choose the option to begin testing. After starting the game, the timer begins the countdown. By

getting random tasks, students are sent to different locations and their paths diverge from the start. Next is the process of solving tasks one by one in a similar fashion until a task from each group is solved or time runs out. Each assignment has information that it presents to the player by displaying it in the controller at the moment it has been received. Among the info present is the location which the player has to go to, the question which needs to be answered as well as metadata needed to generate all the necessary components. Metadata is used to generate user interfaces that the player sees, such as the way of inputting the solution (keyboard, RFID tag, QR code) or interfaces for connecting to the environment (AR, IOT…) After arriving at the specified location, students proceed to interact with the environment in a way defined in the text of the task and its metadata. Productive interaction will yield data necessary to complete a task prove mastery over the subject. Each task is also scored according to the difficulty of completion. Completing harder tasks rewards more points but it may cost more time. The final score of the test is determined by the number of subjects closed, difficulty points of each task and the remaining time. As previously stated, the game is played in iterations, which is shown in figure 4.

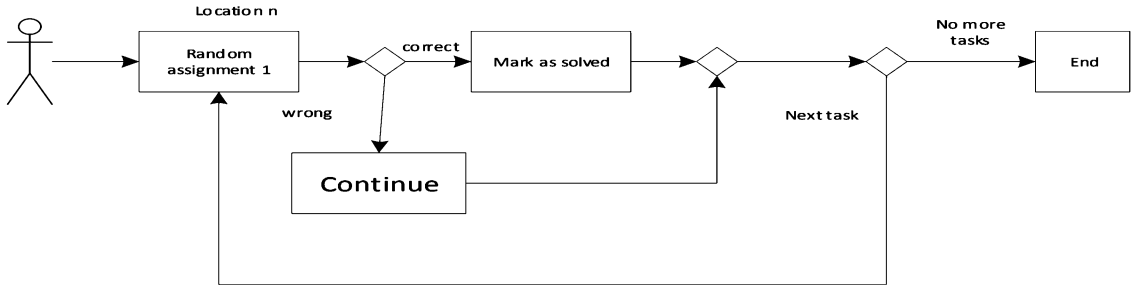

Figure 4: The game scenario

Since not all tasks are of the same difficulty, they cannot be graded in the same way, so the final score is calculated based on the remaining time and the sum difficulty level of each successfully completed task. The detailed game process is displayed in figure 5.

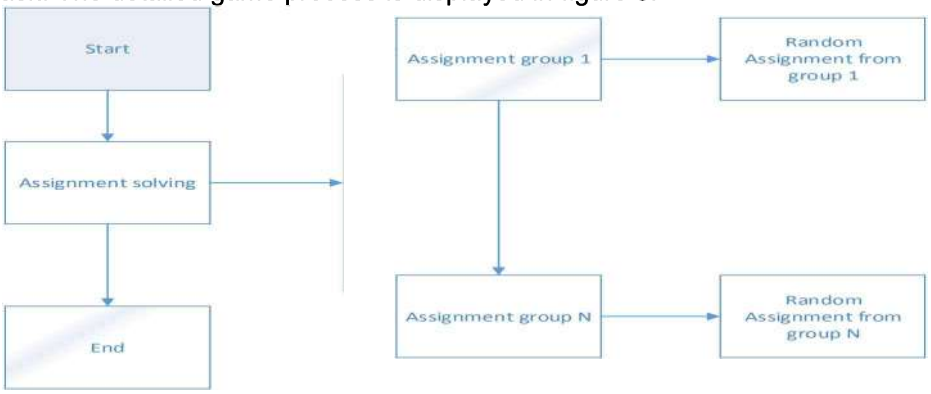

Figure 5: Task overview

Throughout the game, the student can review the solved assignments. After completion of all the assignments, or after the time has elapsed, the score that student achieved is calculated, shown to the student, and inserted into the administration application and Moodle.

An extra feature of the game is a hint option. Tasks are equipped with messages meant to point the student in the right direction in case there is trouble coming up with an answer. To use the help or not is up to the players themselves. Solving tasks awards grade points that make the final grade but there is another use for them. By collecting enough points a special button is made available. By pressing it students sacrifice points that have been used in the button but gain help on a complicated problem. Choosing this option lowers their final result but possibly awards another closed subject.

E. Assignments

A schema of an assignment is shown in figure 6. The displayed assignment is from the AR type. The student is required to scan the environment with the AR camera provided as part of the handheld device and recognize elements that are generated in the view. Based on his conclusions he reaches the answer and submits an answer.

Figure 6: AR Assignment workflow schema

As an example, an AR assignment called Diagram completion will be presented. After arriving at the designated location, multiple pairs of IoT platform diagrams and QR codes will be present. A question can be seen on the first of multiple available screens of the mobile application and its text will tell the player how to activate the AR features of the game and that he needs to scan the diagrams and find the complete one. After reading the instructions and navigating to the AR screen players choose one of three available AR modes (see figure 7) and aim the camera at the first diagram and on-screen multiple 3D models of IoT elements will show up in different locations.

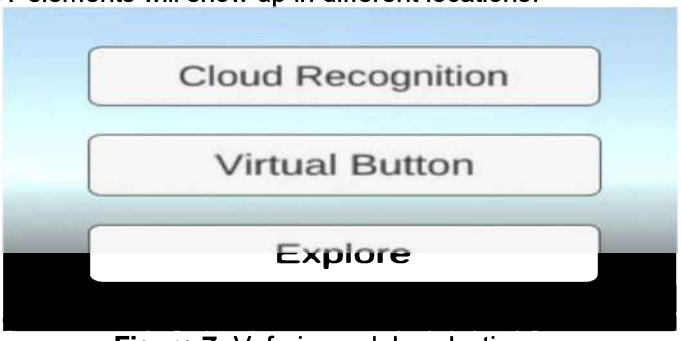

Figure 7: Vuforia module selection

Each diagram is missing at least one key component. Students need to find a diagram that when combined whose missing components are present in its 3D render. Such a combination of diagram and models is considered complete and is the correct one. Submission of the solution is done by navigating to the next application screen and pressing the button to scan the QR code paired with the previously selected diagram. QR tags hold codes for solving tasks. Tags paired with correct answers will match the assignment codes and mark the assignment as completed during check-up while all others will fail to match. Navigation through the application windows is done by swiping left and right on the device screen. Based on the task metadata, the mobile application will generate only the needed windows (figure 8). Generally, there are 3 windows present, the information window that holds the text of the question and necessary instructions as well as the location while the other two windows are dynamic and represent the widow for solving and the solution input window respectively. In the showcased example AR camera has been used for the former, while for the latter a QR code scanner was generated.

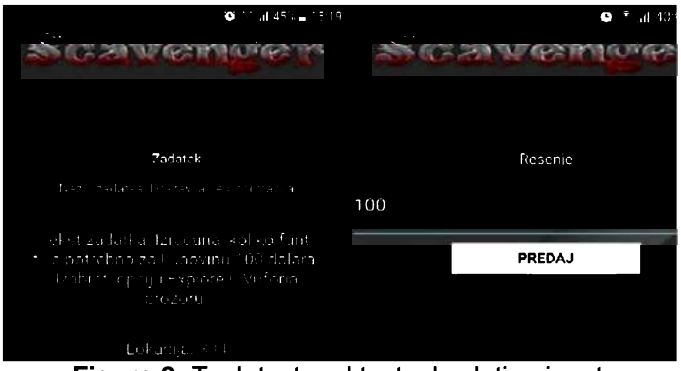

Figure 8: Task text and textual solution input

Another example of an AR task is named Model recognition. This task also tests the knowledge of the IoT models but is of lesser difficulty. The goal is to simply find the item that was specified in the text.

The process is the same as in the previously described example with small differences. Firstly there is only one diagram present on location, with a multitude of QR tags marked with numbers. After opening the AR window, 3 models will show up on screen, an IoT object and 2 buttons to change the center object. By using the primary model as number 1 and increasing the enumeration of every next model to the right of it by 1, or decreasing it by going left we can get the answer. We number models until we reach the required one and scan the QR code marked with that same number. In both examples, it is possible to look at the augmented reality from all sides and angles but it is also possible to rotate and scale models by interacting with the screen. This feature makes it easier to see details if necessary.

Figure 9: Vuforia task example

4. RESULTS

For the evaluation of the developed game, a pilot testing was organized at the Faculty of Organizational Sciences, University of Belgrade, within the Department of Electronic Commerce (e-lab) during the Summer School attended by undergraduate 4th-year students. The goal was to test the efficiency of using the developed game while learning about the Augmented Reality technologies. The research was conducted in accordance with the code of professional ethics. All students willingly agreed to contribute to this research.

The research involved 7 students who attended the Internet of things course. After using the application, students filled in a poll in which they gave their opinion on the way each task was solved. The questionnaire had 10 questions and the students could demonstrate their opinion on the offered five-step scale from "I completely agree" to "I completely disagree".

Each student received a mobile phone on which a mobile application was installed. Their tasks were to launch the application, log in to the Moodle system, and press the button in the displayed menu - launch the game. The system then selected one of the tasks randomly. If the student does not solve the exact task, they have the ability to re-test within a given time again. After the expiration of the time or after solving all the tasks, it was necessary to press the button "finish the game". Two of the offered tasks were Vuforia type.

The student had the task of reading the text on the screen of the mobile phone, then going to the assigned location from the task. Within the application, it was needed to move the screen to the right and click on the scan, then select the option specified in the text of the task and position the device so that the image is visible on the camera. The students needed to select a 3D model that matched the task's solution, double-click the "back" button, move the screen to the right and click on the scan. The device had to be positioned to see the QR code corresponding to the selected model. The last step was to move the application screen to the right, enter the read message into the displayed field, and click "Submit". Finally, students who participated in the research-filled in the questionnaire, answering questions about the application itself. In the given survey, students expressed their opinions on the application, but also answered questions that were related to satisfaction in solving each of the three questions asked.

A. Knowledge test results

The table shows the opinions of students related to the use of the extended reality application while solving the tasks set.

Regarding whether tasks were easier to solve by using the application, 71.43 percent of students said they fully agreed with the view that it was easier to solve the task with the application, while the other 28.57 percent of students replied that they could not decide.

No one answered that they partially or completely disagree that their tasks are easier to solve using the application.

Table 1: Questionnaire data

Question	% Strongly agree (score = 5)	% Agree (score = 4)	% Neutral (score = 3)	% Do not agree (score = 2)	% Strongly disagree (score = 1)	Mean score	Standard deviation
The task is easier to solve with using the application.	71.43	0.00	28.57	0.00	0.00	4.36	0.82
The task is easy to learn.	85.57	14.29	0.00	0.00	0.00	4.71	0.49
It's boring for me to solve this task like this.	14.29	14.29	28.57	14.29	28.57	2.64	1.29
I had the feeling of controlling the situation while solving the task.	42.86	57.14	0.00	0.00	0.00	4.36	0.54
Too bad that there were no more tasks of this type.	42.86	28.57	28.57	0.00	0.00	4.14	0.78
There was enough time to solve this task.	71.43	28.57	0.00	0.00	0.00	4.64	0.54
There was insufficient time to solve this task.	42.86	0.00	28.57	14.29	14.29	3.43	1.40
There was too much time to solve this task.	14.29	14.29	14.29	42.86	14.29	2.43	1.21
I prefer the classic test for solving this type of task.	14.29	14.29	14.29	28.57	28.57	2.43	1.33
The task is more fun to solve with the application	85.57	14.29	0.00	0.00	0.00	4.71	0.34

When asked if the tasks were easy to learn, 85.71 percent of students replied that they fully agreed, and one student partially agreed. Students in a percentage of 85.71 percent agree that it is more fun for them to solve tasks using the application, and as much as 42.86 percent think it is a pity that there were no more tasks of this type. When asked if they have a sense of controlling events while solving tasks, 57.14 percent of students agree in part and 42.86 percent of students fully agree. Students' indecisiveness is evident over time in solving tasks. We see that 42.86 percent think that there was insufficient time to solve the tasks, while in the same percentage; the students think that there was too much time to solve the tasks. It is believed that this way of solving tasks for students is new and, depending on their readiness and skills in the use of new technologies, their position on this issue varies. A certain number of students, 28.57 percent cannot decide and put their opinion in a large number of questions. This means that although they agreed that the given application was useful, they were not convinced that it fits their needs.

B. Opinions about the application

After completing the coursework, students expressed their opinion on the most sensitive and most negative aspects of the application.
As the most positive aspects, they stated:

- Ease and simplicity,
- Interactivity,
- Interest,
- Facilitates learning and
- Virtualization.

According to the answers, the most negative aspects were:

- QR code is not being scanned,
- The application can crash,
- Slowness,
- Taking a lot of device storage space.

In the further stage of the research work, and the development of applications of expanded creativity for educational purposes, the answers of students who could not decide when it comes to needs and expectations, save time, easier tasks, in particular with the aim of improving the application as well as more successful and more efficient educational process.

5. CONCLUSION

The evaluation was conducted during practical lessons with undergraduate students in the course of the Internet of Things. Testing was done with a small group of students. The results showed that the application of augmented reality, used in conjunction with the game model, has the potential for implementation, that students considered it useful and fun, and that it contributes to their knowledge, as well as the quick and easy overcoming of the subject material. It also provided guidelines and suggestions for improving the application of augmented reality in widespread use in the educational process. In addition to improving the technical aspects of the system, the future work will be directed towards the development of a larger number of tasks, further integration with Moodle and complete technical and educational assessment of the system.

ACKNOWLEDGMENT

Authors are thankful to the Ministry of education, science and technological development, grant no 174031.

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DEVELOPMENT OF VIRTUAL SIMULATIONS FOR THE NEEDS OF MILITARY EDUCATION

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Abstract: *The analysis of contemporary systems for creating virtual simulations, difference between classical games and those supported by simulations, problems encountered by creators of scenarios, as well as the application of virtual simulations for the needs of military education are presented in this paper. The specific system for creating VBS3 virtual simulations shall be presented in the paper. Its comparing with commercial games has been done. Also, the advantages and disadvantages of these systems have been given. Its modular structure, as well as creating and using the user defined modules (script files) will be especially emphasized. The realization of the entire scenario with solving concrete problems will be discussed too. The end of the paper brings a brief description of the mode of system utilization, as well as the system evaluation, which is necessary for further implementation of this system in military training.*

Keywords*: virtual simulations, military education, VBS3, serious game, e-learning, edutainment*

1. INTRODUCTION

The Ministry of Defense and Serbian Army are trying to provide high-quality education and further advanced training for their members. Besides traditional education attention has been paid to electronic education and application of virtual simulations in the educational process.

During the last decades one of the biggest changes is an increasing use of computer games and virtual simulations (Hainey, Baxter, Boyle, Moreno-Ger, & Connolly, 2013). For this reason, it is necessary to perceive the benefits of learning compared to playing games and whether this complies with the theory of learning (Lindgren & Schwartz, 2009). In this paper we will present the specific system for creating virtual simulationsVBS3. We will also present an evaluation of the proposed solution.

2. PRESENTATION OF VBS3 ARCHITECTURE AND DESIGN

Commercial games are primarily designed for entertainment. The value of applied or serious games is in the education and training (Minhua & Oikonomou, 2016). Playing games is not bad if they have been designed on the basis of simulations and when they contain educational value (Tobias, Fletcher, Wind, 2011). In this section we will explain the software use and classification of virtual simulations in the army environment.

The classification based on complexity, methodology being used and objects level have been generally accepted in computer simulations, as follows (Šimić, 2012):

- Live Simulations – real environment, soldiers or blank ammunition.
- Virtual Simulations – developed and designed by programmers or a team of experts in complex software environment.
- Constructive Simulations – the most complicated, designed for the training, as well as for the training of personnel and commanders of integrated tactical structures.

VBS3 (Virtual Battlespace 3) is interactive, commercial-off-the-shelf (COST – software which is on sale), 3D training system providing the environment for creating an enormous number of the spectra of simulations for military training, can also serve for research purposes. It is based on modern 3D gaming technology. The emergence of VBS3 brings improved performances and multicast system is introduced, which enables the adapting of participants to the multiplayer operating mode, prevents delays occurring at server loading, improves performances in the local network. The commanding and managing system has been super structured by the ORBAT mode enabling a hierarchy in commanding (VBS3 v3.2 User Guide, 2014).

VBS3 is a flexible, open-platform simulation software providing programmers a broad spectrum of possibilities in creating the training scenario. Open-platform enables the link of the external applications with the VBS through API (Application Programming Interface) module. The architecture of the VBS system is

shown in Figure 1, where its modular structure can be seen precisely. The system itself is in connection with the database with which it performs data exchange and registration.

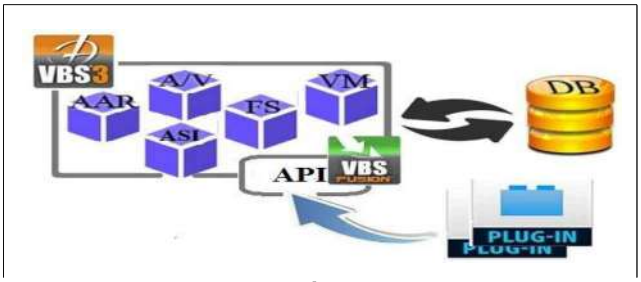

Figure 1: VBS Architecture

We shall demonstrate the differences between commercial games and virtual simulations on the example of the VBS software and one of the classics in the world of video games, Call of Duty (CoD). VBS brings the possibility of independent creating of the scenario. One of the essential characteristics of the VBS software is the possibility of analysis and evaluation of previously completed simulation exercise, while in the world of games this does not exist.

In addition to system defined there are also user defined modules represented by scripts (organized in the so-called sqf files) written in special VBS3 script language. Controls and data, written in the script, are converted into script files through the conversion module. Then, through conversion module, it is converted into the data type understandable to the user. When starting any scenario, the script file will be compiled each time. The number of user defined modules is not limited. Selecting other modules is carried out through initialized modules by using a special macro – controls execVM, call or preprocessFile. In the example, set forth in the paper, three user defined modules have been created in the scenario, the initializational and the module of synthetic units status (AI – Artificial intelligence) and real player control mode.

Starting of VBS3 can be carried out in two modules: user and administrator modules. Administrator module enables a complete access to audio, video and other advanced settings and has a complex interface. In the user mode the settings are very restricted, interface simplified, and RTE (Real Time Editor) is not available, because it is intended for simulation managing and control (VBS3 Manuals Version 17.1.0 , 2017).

3. PRESENTATION OF THE SCENARIO

The presented scenario is the research of the possibilities of training of the infantry squad in surmounting obstacles, coordination, management and commanding, as well as the implementation of the basic tactical training in the environment simulating reality. For the implementation of the scenario a terrain has been chosen, the geographical-topographical characteristics of which mostly corresponded to real characteristics the participants in the training can encounter. As far as time is concerned, the scenario can be divided in two parts: introductory and main part. In the introductory part of the scenario the participants have no control over their units, it serves to participants to be informed about the situation, concrete tasks, understand their roles in a team and that players who encountered such type of software for the first time get familiar with the controls serving for controlling the units. A special script has been made in the introductory part for creating and controlling objects, saved in a special file (blufor. sqf). The realization of the introductory part starts with creating two groups. The group located in the expectation region (Group B) and support groups (Group A). Figure 2 shows the view of the scenario map.

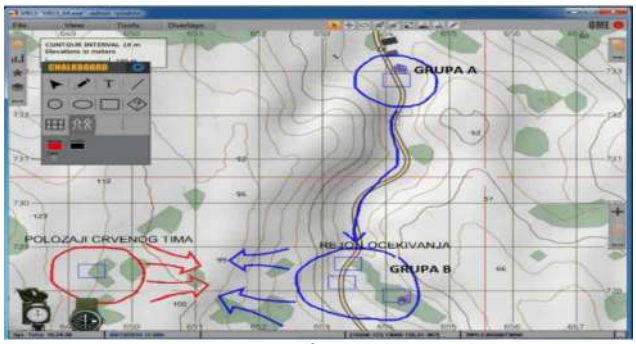

Figure 2: View of the scenario map

In the expectation region the task of Group B is to wait for the arrival of the support group. The central part of the introductory part is on Group A that should get on a combat vehicle and reach Group B in order that a squad is formed which would, from the expectation region, go in order to carry out tasks. After the arrival of Group A and forming of a squad, real participants take over control over their units and start performing the tasks. Practically, this is the transition phase in which human intelligence takes over partial control from the artificial intelligence. The main part of the scenario begins here, in which two tasks are carried out. The first task is destroying mine-explosive device (MED) located on a road, by means of a sniper rifle. The second task is occupying defined point on a map where fortified enemy forces are located. In the example, we created a mine-explosive device and a vehicle.

Practically, a trigger of defined type is created (empty detector), which is positioned on the corresponding coordinates on a map with determining the reaction zone. The function executed at its activation is in the last code line – in the concrete example, 5 soldiers are getting off a vehicle. From that moment players gain control over their units, and the text of the tasks, that a squad should perform, is written on the screen, and the titleText control is used for that. For creating enemy forces, a special module has been designed – script file opfor.sqf. For creating the units, the function createUnit is used. A unit can represent an individual soldier or their group. Furthermore, a unit can be controlled by participants, or by the VBS (AI Unit Control - Artificial Intelligence) and in that case, it is completely independent.

Besides creating units, it is necessary to adapt their conduct by using the control setCombatMode. There are five levels of training graded from the lowest to the highest, "blue", "green", "white", "yellow" and "red". Practically, it has been concluded, during the research, that for the enemy the level "white" is optimal for the confortation with the level of the participant of the simulation. The level "white" means that AI units will not open fire except in the case of an immediate danger and they will react defensively if attacked. Setting (adjusting) the level of training is performed individually for each unit, as presented in the paper, 7 enemy AI soldiers set on the "white" level. Combat mode "red" means the offensive responding of a unit – immediately after finding the enemy. This does not mean that the fire will be opened beyond weapon range, but the undertaken combat actions will be with the aim of destroying the enemy (concealed movement, taking cover, watching, aiming). Mode "yellow" enables a unit to attack the enemy if it is in the action zone, whereby units retain the disposition (formation). Mode "blue" means that units will never attack the enemy. From all stated, one can draw a conclusion concerning the "white" mode as the most convenient for the needs of unit training.

4. EVALUATION OF THE SUGGESTED SOLUTION

An increasing use of simulations and games in the education and training puts a question to us as to what do we gain by that, and what do we lose (Roman & Brown, 2008)? We get the answer by developing the methods for evaluation of the software on which education is performed, in order to perceive its possibilities, limitations, as well as the effect on learning (Hainey, Baxter, Boyle, Moreno-Ger, & Connolly, 2013). The main idea in this section is to present our method for evaluation, by measuring time in different situations.

On the tactical level, in order to carry out the drill successfully, we must know the potentials of the units we have at disposal. The time required for a unit in the simulation to pass a defined distance depends on many factors, such as: terrain configuration, equipment carried, characteristics of a terrain, as well as on the endurance of units. Artificial intelligence, implemented in the VBS3 software, enables the control of these variables, their effect on the simulation, in order to approximate virtual behaviour to a real one as much as possible. Figure 3 shows the dependence of time on the way of movement and distance on a plain terrain. Measuring for movements has been performed: marching (normal walk), running and crawling. In the VBS3 this dependence is expressed by the fatigue variable. Fatigue is the least when walking (marching), while the greatest is when running.

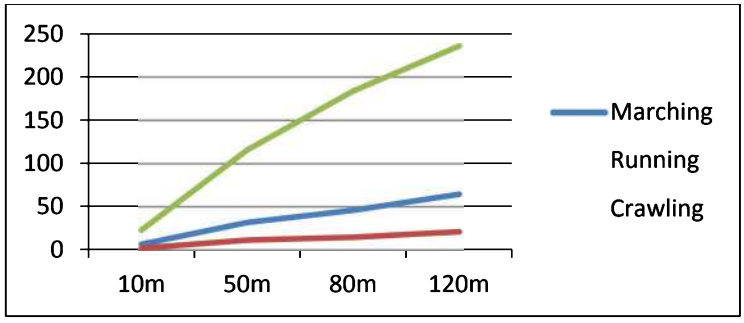

Figure 3: Movement of units on a plain terrain

Measuring has been also performed on a hill terrain. Results are shown on the following diagram (Figure 4), and based on them the effect of fatigue indicators on unit performances can be seen. As a section is increasing (becoming bigger), we can see the exponential increase in time, necessary to pass a section. A unit moving by running uphill has a drastic change of the fatigue indicator.

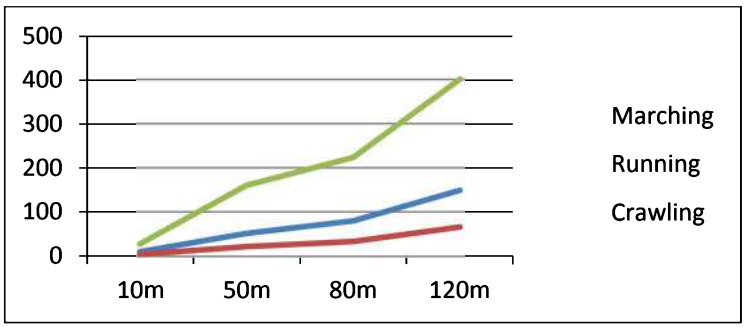

Figure 4: Movement of units on hill terrain

In addition to basic, there are also specific movements being modeled in the system. Table 1 shows the dependence of time for a crew, getting on a vehicle, on soldiers distance from a vehicle. The complete crew of a combat vehicle took part in measuring.

Table 1: Time of unit getting on a vehicle

	Directly in front of a vehicle	**10m**	**100m**
Time [sec.]	4,80	7,69	22,90

In the implementation of the scenario it is necessary to establish the time it takes AI units to react from different action zones to the participant (the so-called blue) team. This information is closely connected with the level of training of AI units. In high training states (red and yellow) the time that has passed from noticing a unit up to opening fire is very little and participants who are not trained sufficiently and have no experience in the use of software, have no chances against them. Downward trends for the blue and green level tells that on the distances of 250m, namely, 300m, AI units become completely passive relative to the enemy. Table 2 shows the time it takes, as from the moment of noticing, an average trained player to neutralize the enemy soldier on various distances. Comparing these data with the data for AI units, it is evident that the reaction of an average player is approximate to the ''white'' level of training.

Table 2: The time it takes a player to neutralize the enemy

	100m	**200m**	**250m**	**300m**
Time [sec.]	3,00	5,50	6,60	8,10

This means that either the participants' level of training should reach the level required for the given scenario (preparing for the drill – exercise), or when creating the scenario, one should realize the possibilities of change in the level of enemy training (AI units) in compliance with the current participants' level of training.

5. CONCLUSION

Efficient, modern and rational army presumes the employment of highly qualified and skilled personnel. Computer simulations enrich the educational process, stimulate the staff and train the personnel (Šimić, Gajić, & Vukadinović, 2018).

The use of the VBS platform in research and education enables the experimentation with minimum costs of resources, improvement of education quality by better application for the training on the terrain (transition of theoretical to practical knowledge by transfer of experience from the virtual to real environment). As an argumentation, only a part of a typical military scenario is presented in the paper. However, virtual simulations have not exclusively a military purpose, but they can be also applied in the training for preventing and control of extraordinary events (state of emergency) and natural disasters, anti-terrorist combat, conversion, negotiating in various cultural environments and situations, protection and supervision of entry and exit from security susceptible areas and similarly. Also, an advantage is that conditions, not occurring at all or seldom in the real world, can be simulated.

The Military Academy, in addition to theoretical knowledge, also provides practical knowledge to attendees. We must not disregard the traditional form of education. The opinion of many people is that this form of education should remain the basic and enrich the educational process by means of contemporary

technologies (Dillenbourg & Fischer, 2007).E-education opens new prospects and privileges for all participants in the education. E-learning means the development of a new educational system. In the conditions of fast technological possibilities and changeable market conditions, the educational system should provide better educational opportunities without increasing financial resources. The Ministry of Defense and Serbian Army aim at responding to this challenge by the development of various e-learning programs, including the possibility of application of virtual simulations in the educational process.

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MANAGEMENT IN THE DIGITAL AGE 114

Bisera Andrić Gušavac, Neda Đorđević, Biljana Panić
BENEFITS OF THE APPLICATION OF NETWORK PLANNING TECHNIQUE FOR RIVER MLAVA WATER COURSE 115

Dragan Bjelica, Danijela Toljaga-Nikolić
IT PROJECT MANAGEMENT MATURITY AND PROJECT MANAGEMENT KNOWLEDGE 123

Milica Grujić, Nemanja Minić
PLANNING PROCESS IMPROVEMENT IN RELATION TO BETTER RESOURCE MANAGEMENT 129

Dragana Kragulj, Sandra Jednak, Miloš Parežanin
IMPLEMENTATION OF DESI METHODOLOGY AND DIGITAL PERFORMANCES OF EUROPEAN UNION MEMBER STATES 136

Tatjana Kuzmić, Marina Davidović
GEOGRAPHIC INFORMATION SYSTEM – ONE STEP FORWARD IN THE DIGITAL AGE 144

Tanja Milić
DOING BUSINESS IN THE DIGITAL ECONOMY: SWOT MATRIX ENHANCEMENT FOR HIGHER ORGANIZATIONAL PERFORMANCE 152

Luli Miloš, Dejan Petrović, Marko Mihić
STRATEGIC LEADERSHIP IMPACT ON NEW ORGANIZATIONAL CULTURE: EVIDENCE FROM A FAMILY-OWNED SME 159

Zorica Mitrović, Dragan Bjelica, Milica Pavićević
THE UNDERLYING THEORY OF PROJECT MANAGEMENT - A SYSTEMATIC REVIEW AND RESEARCH AGENDA 167

Milica Pavićević, Đorđe Marović, Zorica Mitrović
KEY COMPETENCIES DETERMINING MANAGERIAL SUCCESS: PRIVATE AND PUBLIC SECTOR MANAGER'S PERSPECTIVE 173

Snežana Popovčić-Avrić, Marijana Vidas-Bibanja
THE IMPORTANCE OF DIGITAL TRANSFORMATION FOR A SUCCESSFUL BUSINESS OPERATIONS 181

Anja Veselinović, Vladimir Obradović, Marija Todorović
THE MANAGEMENT OF DISASTERS IN FUNCTION OF THE ECONOMY COMPETITIVENESS 188

BENEFITS OF THE APPLICATION OF NETWORK PLANNING TECHNIQUE FOR RIVER MLAVA WATER COURSE

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Abstract: *The purpose of this paper is to raise the level of knowledge and awareness on the importance of a systematic approachto planning and project management in a real business environment, regardless of the type of activity, or type of problem being solved. The real problem of regulating the Old Mlava riverbed is analyzed in the paper. The problem was solved and optimized, and a comparative analysis with real fieldwork was made, using the Network Planning Technique (NPT) in MS Project software package. The results obtained from the MS Project were compared with the results of already realized field work.*

Keywords*: Regulation of the Water Course, Floods, Network Planning Technique (NPT), Software Package MS Project*

1. INTRODUCTION

As the number of people continuously rises as well as their needs, the pressure on water and food resources in the environment is much stronger. Human activity is one of the main causes of water resources pollution. These activities lead to a fast increase of ecological problems, natural resources and an environment in which humans live and act (Andrić Gušavac et al., 2016).

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 are in a balance with its capacity, which is necessary for its regeneration. Its significance is reflected in the fact that water is the essential precondition for life of humans, animals, plants, etc. Because of that, it is important to continuously implement various measures to protect water quality which involves uncertain information, multiple and often conflicting objectives, and limited resources (Andrić Gušavac et al., 2016).

Floods are a constant threat to life and property. As increasing human activity downstream of rivers results in greater flood damage, the floods themselves, in turn, are also increasing in size and frequency due to human activities in the upstream section of the river system. An increasing trend in extreme flood events can be observed in many countries around the world (Dutta et al., 2006). The potentially flooded area in Serbia with a 100-year return period is 15,198.07 km2 (17.2% of total area). Serbia is mostly threatened by the floods of small to medium-size torrential rivers mostly in late spring (from May to the end of June), a period characterized by intensive rainfalls of a few-hour duration (Dragićević et al. 2013).

To avoid flood hazards from leading to catastrophic disasters, a thorough risk analysis should be performed. Flood risk management is the process of managing an existing flood risk situation. It consists of the planning and development of a system to reduce the flood risk. Flood risk management takes place on three different levels of action:

- operational level, associated with operating an existing project system;
- project planning level, implemented when a new version or a revision of an existing project is planned;
- project design level, embedded into the second level, describes the process of reaching an optimal solution for the project (Plate, 2002).

To obtain optimal solutions for project planning, it is necessary to analyze the performance of alternative plans with regard to a reduction of risk for various possible scenarios (Dutta et al., 2006).
Among natural disasters, with serious risks for people and their activities, floods have been the most common in terms of frequency, their threat level and the damage they cause; accordingly, they deserve special attention. Even though in most of the cases, the floods are caused by natural factors, we can see that the human factor contributes more and more to the effects of the disasters (Ceobanu & Grozavu, 2009).

A major role in catastrophic floods in Serbia is played by cyclones in the Sava and Danube river valleys. Flood analyses show that inundation mostly occurs in late spring and early summer, i.e. in the periods when cyclones are the most frequent. Apart from the mentioned causes, it should be pointed out that the formation of floods in Serbia is also influenced by a rather high density of watercourses (747 m/km2), intense erosion processes and the presence of the lower courses of large international rivers in its territory. Torrent floods are rather frequent, particularly in the basin of the South Morava and they are caused by the unregulated water regimes of hill watercourses. The last two types of floods have also been recorded in the territory of Serbia; some of them had catastrophic consequences. The greatest floods in Serbia were those of 1965 and 2006 and they were the most severe ones in Serbia during the 1960 – 2010 period. At that time, water levels on many rivers reached the absolute maximum values (Gavrilović et al., 2012).

Project management is the application of skills, resources and techniques to plan, monitor and control the project to achieve its goals (Jovanović, 1999). It requires the balancing of contradictory requirements about time, price and quality. Project management is a process that implements: project planning; monitoring the realization of the project, with certain plan adjustments; analyzing, evaluating and reporting on results (Krčevinac et al, 2006). Planning is of key importance for project management. The project plan is a document that determines specific techniques, resources and series of activities needed to achieve the project objectives (Krčevinac et al, 2006). In addition to planning, activities of organizing, guiding and control planning are closely related. For project realization planning, a set of methods has been developed, known as Network Planning Techniques (NPTs). NPT is a set of methods used to plan, monitor and control project implementation (Krčevinac et al, 2006). Phases within the NPT are: structure analysis, time analysis, cost analysis and resource allocation (Martić et al, 2007).

In the late ’50s and early ’60s of the 20th century in the USA, methods for planning and tracking projects, called Critical Path Method - CPM and Program Evaluation and Review Technique - PERT, were independently developed. Based on techniques of these methods, the Precedence Diagramming Method - PDM was developed. Network Planning Technology (NPT) has found its application in all segments of planning.

This research paper presents the use of NPT to solve the vital problem that the city of Požarevac faced in 2014 due to the unregulated Mlava River bed, when floods occurred in some municipalities.

The planned approach required that problem had to be perceived, not only from the purely technical aspect, but also from the aspect of level of economic possibilities of local self-government and technological possibilities of the local construction company, i.e. that, from relatively modest sources of financing, the problem was solved in the optimal time frame and avoid further floods caused by autumn high water levels.

One of the major issues for knowledge management in a project environment is the poor project success analysis and the lack of proper documentation on the results of the previous projects. Knowledge management in a project environment is an insufficiently explored topic in project management (Todorović et al., 2015).

So far, some software has been developed that enable monitoring of activities and project control. Project Management software is a program that enables summarizing project data, data management, CPM analysis, multiple calendars, reports, networking, simultaneous monitoring of multiple projects, “what if“ analysis, graphic presentation, planning and balancing of resources, and cost analysis (Kerzner, 2003). The common features of this kind of software are: support for project management; an environment that allows users to communicate, easy insight into the tasks and updating them; a large number of users; etc. (Jevtić, 2009).
For this work, Microsoft Project has been used to control the project activities, scheduling, costs, and communication of team members. MS Project also provides, in cooperation with other Office package programs, higher productivity, reporting, templates and user-oriented tools.

Using MS Project has enabled planning accuracy within one day. An insight was obtained on the necessary daily engagement of labor, mechanic equipment and materials for installation in control facilities. As it was a real world project, it was possible to visually get acquainted with the location and technology of performance, collect information about the contractor and gain insight into the significance of the project for the city of Požarevac and the local population. During the work on this project, the technology of carrying out the works, all working processes and technological units, as well as the complete planning system in solving the real world problem in the field of construction profession are all in detail familiarized with.

2. PROBLEM DESCRIPTION

By the ‘70s of the last century, two parallel water courses flowed through the municipalities of Požarevac and Malo Crniće:

1. "Mogila" as the main flow
2. "Old Mlava" as a secondary flow.

In the period between 1975. and 1978. defensive embankments were built, which controlled the Mlava River, i.e. the main flow of Mogila was regulated. The secondary flow of Old Mlava remains unregulated and, as such, at higher water levels, endangers, to a greater or lesser extent, the muncipalities through which it flows.

In the municipality of Malo Crniće, the old Mlava riverbed is well-set and organised and represents a part of the drainage system all the way to the town of Salakovac, which borders with the muncipality of Požarevac. From Salakovac to river conjuction, the secondary flow is unregulated and not capable of accepting and evacuating large amounts of water from the upstream part of the basin, i.e. from the drainage system. This practically means the flood of downstream riversides from Salakovac to conjuction, that is, any bigger quantity of water, and the Old Mlava riverbed can not take on without the spillway into the coastal area.

For the aforementioned reasons, the catastrophic floods that occurred in May 2014. have caused great material damage. After analyzing the current hydrological situation, it was concluded that the Old Mlava basin (in unfavorable events such as strong and long-lasting rain and snow melting at the end of winter) will present a permanent danger for flooding of land through which it flows through its upper stream. Due to the listed reasons, in 2015, JVP Srbijavode has elaborated a study entitled "Regulation of the old riverbed of the Mlava River", according to which the regulation would take place in two main phases (Elaborat, 2015):

- Phase I: Includes the work on the construction of protective and regulating facilities on the water stream of the 2nd line of Stara Mlava (cleaning of riverbeds, construction of hydro-technical structures, demolition of superfluous non-functional objects and bringing the system into functional state).
- Phase II: Includes works on securing the flow profile of the Stara Mlava watercourse between Djerdap embankment and the village of Bubušinac.

Figure1: Canal before the works have started (Elaborat, 2015)

3. PROBLEM SOLVING USING NPT

In the study "Regulation of the Mlava Old Riverbed ", the graphical and numerical data given is used in this paper as input elements for the application of the Network Planning Technique in solving specific problems. The project design and work calculations have been used to a greater extent for the creation of a list of activities with minor corrections (Elaborat, 2015).

Before the final listing of the activities, consultations were carried out with engineers from the company AD Vodoprivreda from Požarevac. This company won this job in public tender in December 2015 which, on behalf of the local authority of the City of Požarevac, was carried out by the Public Enterprise "Directorate for the Construction of the City of Požarevac", and the authors of this paper were given direct insight into the complete construction problem.

According to the experts' advice from the contractor and supervisory team, structure analysis was done. Based on the flow diagram of the technological process (Figure 3), a logical arrangement was established between the activities. Logical and technological dependencies were determined; first between the projected phases (I and II), and then the dependence between the individual stages of phase I. After this analysis, there has been significant displacement of certain phase stagesabout the design and the projection of works.

For the final starting analysis, the following concept was adopted:

Phase I:
- Phase I preparatory work: 4 activities and 1 milestone activity
- The main works of phase I that consist of 6 stages in the new order:
  - **I.6.** Excavation of the canal and construction of an inflow building in the pumping station CS "Srećno" on the surface mine Drmno: 16 activities and 1 milestone activity
  - **I.3.** Seeding of the Djerdap embankment and construction of reinforced-concrete pipe drain(1500mm in diameter) with the floodgate: 10 activities and 1 milestone activity
  - **I.4.** Securing the functionality of a double pipe drain(1000mm in diameter each) on the relation Bradarac - Rukumija: 4 activities and 1 milestone activity
  - **I.5.** Securing the functionality of a double pipe drain(1000mm in diameter each) on the relation Bradarac - Drmno: 4 activities and 1 milestone activity
  - **I.1.** Removal of a non-functional doublepipe drain on the right embankment of the Mlava River (1000mm in diameter each) at a distance of km 0 + 035: 6 activities and 1 milestone activity
  - **I.2.** Removal of a non-functional double pipe drain on the right embankment of the Mlava River (1000mm in diameter each) at a distance of km 1 + 289: 6 activities and 1 milestone activity
  - Other works and phases: 2 activities and 1 milestone activity

Phase II:
- Phase II preparatory work: 4 activities and 1 milestone activity
- Main works of phase II
  - **II.1.** Extinction of the Mlava River: 3 activities and 1 milestone activity
  - Other Phase II works: 2 activities and 1 milestone activity

To define and analyze the activities more easily, Technological Process Maps (TPM) were made. Figure 3 shows the technological process map for AB drain on the relation Bradarac - Drmno and the dismantling of the drain on the left embankment of the Mlava River. Locations of the work phases are presented in figure 2.

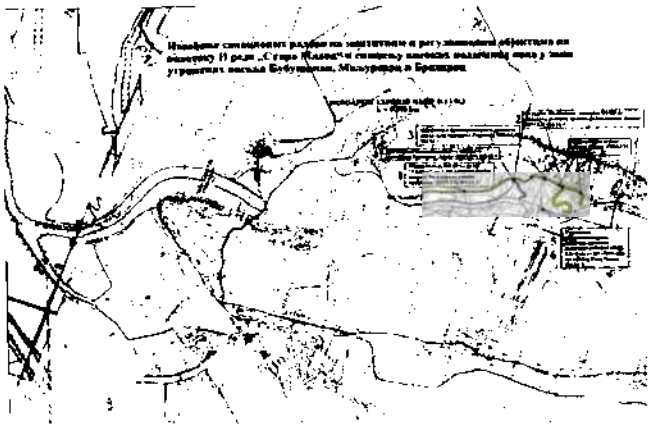

Figure 2: Old Mlava - work locations of phase I and II (Elaborat, 2015)

After defining all the activities and making the technological process maps, the analysis of each activity started. This analysis determined the following parameters: the required amount of work for each activity, the contracted cost of the works, the necessary resources for the execution of each activity, the practical performance of the construction machines, the number of machines that will be involved in the realization of the activity, and after that the minimum duration of the activity and duration of the activity is calculated.

To solve the problem, Microsoft Project 2010 was used. The working hour's calendar was adopted to work on one shift, lasting 10 hours. Working hours start from 7:00, and end at 17:00. All Saturdays are work days, only Sundays, state and religious holidays are adopted as non-working days. This ten-hour work is characteristic for the construction industry, with so-called redistribution of working time on an annual basis.

Outside the construction season (November - March period), the working hours are shortened to 8 hours and five work days a week. Works are completely stopped in the winter when weather conditions make it impossible to work outdoors.

A contract for the execution of works had been concluded between JP "Directorate for the Construction of the City of Požarevac" and AD "Vodoprivreda". The contracted construction period was 140 working days, and the works of both contracted phases had to be completed by the end of August 2016.

The realization of the project started on Monday, April 20th, 2016 according to the adopted calendar of working hours until the completion of the works. The analysis results were 105 working days and the closing date of 20.08.2016. (after optimization).

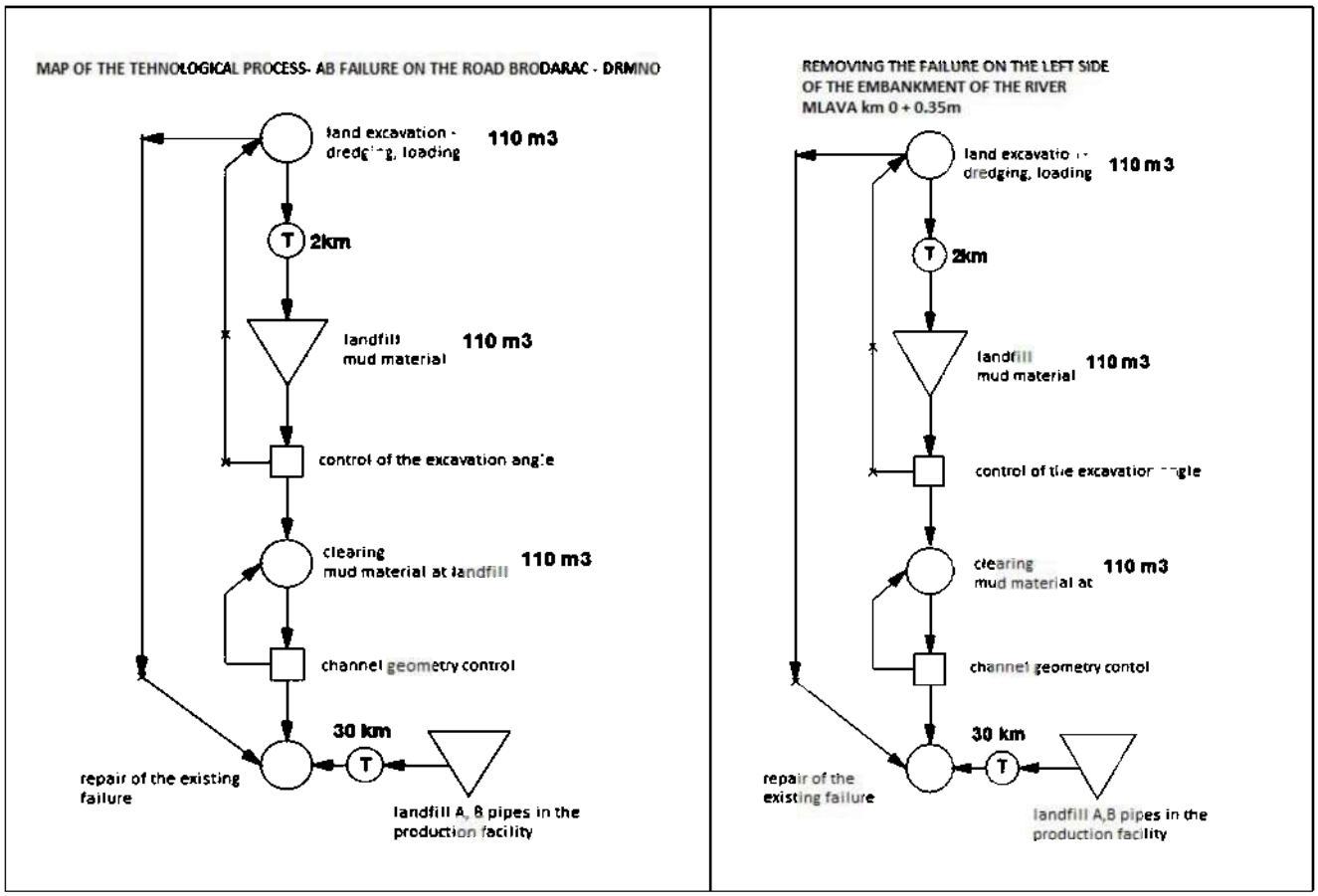

Figure 3: Technological Process Map

For each activity, the resources needed for its implementation are specified: material, mechanization and labour (workers) and its price. The price lists were taken from the price list of the contractor AD Vodoprivreda from Požarevac, and from the information provided by the Serbian Chamber of Commerce under the title "Recommendation on the performance of the Serbian operator on the foreign market".

The adopted price list used in the preparation of this project was created by a combination of:

- Recommendations of the Serbian Chamber of Commerce about the appearance of Serbian construction companies on the foreign market.
- Official price list of water company "Vodoprivreda" a.d. from Pozarevac.

4. RESULTS

The application of Microsoft Project gives facility managers a clear and precise picture of the activities to be given special attention. Their realization should be without delay, so that the necessary resources would be on the construction site, according to the defined dates for the start of the activity. The required workforce and materials should be timely utilized to continuously carry out the activity without any waiting or delays.

During the development of this paper, an analysis was made for several different input parameters; the first variant had the following parameters:

- Beginning of works 15.03.2016.
- The construction time was 135 working days.
- Completion of works 20.08.2016.

These are the parameters by which the contractor based his business strategy for the realization of this project and based on them received a Gantt chart and a network diagram.

Network plan and Gantt chart for river Mlava water course are presented in figure 4. Activities that are on the critical path of the project are presented in red. Duration of each activity, strat and finish, together with total and free slack are presented in the plan.

ID	Task Name	Duration	Start	Finish	Total Slack	Free Slack	Predece
0	**RIVER MLAVA WATER COURSE**	**.17 day**	**/ed 20/4/1**	**Fri 2/9/16**	**0 da...**	**0 days**	
1	1 Geodetic works	4 days	Wed 20/4/16	Sat 23/4/16	0 days	0 days	
2	2 Cutting trees with motor tester and leavi	4 days	Mon 25/4/16	Thu 28/4/16	0 days	0 days	1
3	3 Digging	4 days	Mon 25/4/16	Thu 28/4/16	0 days	0 days	1
4	4 Cleaning of weeds and weeds	3 days	Fri 29/4/16	Mon 2/5/16	0 days	0 days	3,2
5	**5 PHASE I PREPARATION**	0 days	Mon 2/5/16	Mon 2/5/16	106 ...	106 d...	4
6	6 Exclude a channel profile with a rejection to the side	13 days	Tue 3/5/16	Tue 17/5/16	0 days	0 days	4
7	7 Transportation and unloading of excavated materials with trucks up to 1	9 days	Tue 3/5/16	Thu 12/5/16	4 days	4 days	4
8	8 Making the channel shore by a bulldoze	7 days	Wed 18/5/16	Wed 25/5/16	1 day	1 day	6
9	9 Expanding and planning excavated material by landfill	8 days	Wed 18/5/16	Thu 26/5/16	0 days	0 days	6,7
10	10 Procurement, transport and installation of gravel into buffer layers and bedding for the construction of the slopes under the roads crossing the canal, with	4 days	Fri 27/5/16	Tue 31/5/16	0 days	0 days	8,9
11	11 Procurement, manufacture, installation and disassembly of one-sided formwork (d = 24mm) for the failure walls	4 days	Wed 1/6/16	Sat 4/6/16	0 days	0 days	10
12	12 Supply, cutting, bending and mounting of smooth armor for failures. Ø12mm	3.2 days	Wed 15/6/16	Sat 18/6/16	48 days	0 days	11,14
13	13 Installation, transport and installation of MB30 concrete without formwork and reinforcement (transport up to 30km).	4 days	Mon 20/6/16	Thu 23/6/16	48 days	0 days	12,14
14	14 Procurement, transport and installation of AB pipe Ø1000 in length	0.8 days	Mon 6/6/16	Tue 14/6/16	0 days	0 days	11
15	15 Excavation of earthen material for the construction of an elongated building	3 days	Wed 15/6/16	Fri 17/6/16	0 days	0 days	14,6
16	16 Transport and unloading of earthen mat	3 days	Sat 18/6/16	Tue 21/6/16	56 d...	1 day	15
17	17 Preparation of transport and installation of concrete MB30 for the construction of the frontal wall of the	1 day	Fri 24/6/16	Fri 24/6/16	48 days	0 days	13,19
18	18 Procurement, manufacture, installation and dismantling of double-sided formwork for the construction of the front wall	2 days	Sat 18/6/16	Mon 20/6/16	49 days	0 days	11,15
19	19 Supply, cutting, bending and installation of mesh reinforcement for the	1 day	Tue 21/6/16	Tue 21/6/16	49 days	0 days	12,18
20	20 Production of a concrete construction of a ductile concrete channel	1.6 days	Sat 25/6/16	Mon 27/6/16	48 days	0 days	21,17
21	21 Supply, cutting, bending and installation of mesh reinforcement for	2 days	Wed 22/6/16	Thu 23/6/16	49 days	1 day	19
22	22 DIGGING CHANNEL ON SURFACE MINE "DRMNO"	0 days	Mon 27/6/16	Mon 27/6/16	48 days	0 days	20
23	23 Excavation of ground material on the lo	4 days	Sat 18/6/16	Wed 22/6/16	0 days	0 days	15
24	24 Transport from borrowing and unloading excavated material on the route	4 days	Thu 23/6/16	Mon 27/6/16	55 days	1 day	16,23
25	25 Procurement, manufacture, installation and dismantling of double-sided formwork for concrete structures (failure)	2 days	Thu 23/6/16	Fri 24/6/16	54 days	0 days	18,23
26	26 Procurement, cutting, bending and installation of smooth reinforcement.	2 days	Sat 25/6/16	Mon 27/6/16	54 days	0 days	21,25
27	27 Installation, transport and installation of concrete MB30	1 day	Tue 28/6/16	Tue 28/6/16	57 days	3 days	26,20
28	28 Procurement, transport and installation of the tabletop constitution.	0.8 days	Tue 28/6/16	Tue 28/6/16	54 days	0 days	23,26,2
29	29 Procurement, transport and installation of AB pipe Ø1500, length 1.00m	3 days	Thu 23/6/16	Sat 25/6/16	0 days	0 days	14,23
30	30 Installation of earth material in the emb	1 day	Wed 29/6/16	Wed 29/6/16	54 d...	0 days	8,24,29
31	31 Humming the slopes and crown emban	1 day	Thu 30/6/16	Thu 30/6/16	54 d...	0 days	30
32	32 Sealing the embankment surface	1 day	Fri 1/7/16	Fri 1/7/16	54 d...	0 days	31
33	33 CONSTRUCTION OF THE DERDAP "SLEPOG NASIPA" AND CONSTRUCTION OF THE PROFILE Ø1500 WITH	0 days	Fri 1/7/16	Fri 1/7/16	54 days	9 days	32,27
34	34 Excavation of the canal profile (sweeping) with the truck loading truck	1 day	Mon 27/6/16	Mon 27/6/16	0 days	0 days	29
35	35 Transporting trucks and unloading of spilled material at the landfill	1 day	Tue 28/6/16	Tue 28/6/16	0 days	0 days	34
36	36 Removing the muddy material by the	1 day	Wed 29/6/1	Wed 29/6/1	0 days	0 days	35
37	37 Repair of the tubular failure, bringing it into functional state	1 day	Thu 30/6/16	Thu 30/6/16	0 days	0 days	36
38	38 CHARACTERISTICS OF THE FUNCTIONALITY OF TUBE PROFILE 2 x Ø1000 ON THE BRADARAC ROAD -	0 days	Thu 30/6/16	Thu 30/6/16	55 days	10 days	37
39	39 Excavation of the canal profile (sweeping) with the truck loading truck	1 day	Fri 1/7/16	Fri 1/7/16	1 day	1 day	37
40	40 Transporting trucks and unloading of spilled material at the landfill	1 day	Fri 1/7/16	Fri 1/7/16	0 days	0 days	37
41	41 Removing the muddy material by the	1 day	Sat 2/7/16	Sat 2/7/16	0 days	0 days	36,37,4
42	42 Repair of the tubular failure, bringing it into functional state	1 day	Mon 4/7/16	Mon 4/7/16	0 days	0 days	41,39
43	43 CHECKING THE FUNCTIONALITY OF PIPE DRAIN 2 x Ø1000 ON THE ROAD	0 days	Mon 4/7/16	Mon 4/7/16	48 days	0 days	42,41
44	44 Demolition of drain	1 day	Tue 5/7/16	Tue 5/7/16	45 d...	0 days	42
45	45 Excavation of ground material on the	1 day	Wed 6/7/16	Wed 6/7/16	45 d...	0 days	44
46	46 Transport from borrowing and unloading of earthen material on the	1 day	Wed 6/7/16	Wed 6/7/16	47 days	0 days	44
47	47 Installation of earth material in the embankment	1 day	Thu 7/7/16	Thu 7/7/16	47 days	0 days	46
48	48 Humming the slopes and crown emb	1 day	Fri 8/7/16	Fri 8/7/16	47 d...	0 days	47
49	49 Sealing the embankment surface	1 day	Sat 9/7/16	Sat 9/7/16	47 d...	0 days	48
50	50 REMOVAL OF A NON-FUNCTIONAL DRAIN ON THE LEFT COAST OF THE MLAVA RIVER 2 x Ø1000 NA 0 + 035	0 days	Sat 9/7/16	Sat 9/7/16	47 days	2 days	49
51	51 Demolition of the omission and part of the embankment	1 day	Thu 7/7/16	Thu 7/7/16	45 days	0 days	45
52	52 Excavation of ground material on the	1 day	Fri 8/7/16	Fri 8/7/16	48 d...	48 days	51
53	53 Transport from borrowing and unloading of earthen material on the	1 day	Fri 8/7/16	Fri 8/7/16	45 days	0 days	51
54	54 Installation of earth material in the embankment	1 day	Sat 9/7/16	Sat 9/7/16	45 days	0 days	53
55	55 Humming the slopes and crown emb	1 day	Mon 11/7/1	Mon 11/7/1	45 d...	0 days	54
56	56 Sealing the embankment surface	1 day	Tue 12/7/16	Tue 12/7/16	45 d...	0 days	55
57	57 REMOVAL OF THE NONFUNCTIONAL TEMPERATURE RIGHT TO THE LEFT COVER OF THE MLAVA RIVER 2 x Ø1000	0 days	Tue 12/7/16	Tue 12/7/16	45 days	0 days	56
58	58 Editing of the construction site of ph	4 days	Tue 5/7/16	Fri 8/7/16	48 d...	3 days	43
59	59 Creation of the Elaborate of the derived state. Phase 1	10 days	Tue 28/6/16	Fri 8/7/16	48 days	3 days	22
60	60 OTHER PAPERS OF THE PHASE 1	0 days	Tue 12/7/16	Tue 12/7/16	45 d...	45 days	59,57,5
61	61 Phase 2 geodetic works	6 days	Tue 5/7/16	Mon 11/7/1	0 days	0 days	42
62	62 Cutting the trees with a motor tester and leaving it aside. Phase 2	4 days	Tue 12/7/16	Fri 15/7/16	0 days	0 days	61
63	63 Digging Phase 2	7 days	Sat 16/7/16	Sat 23/7/16	0 days	0 days	62
64	64 Cleaning of weeds and weeds	4 days	Mon 25/7/1	Thu 28/7/16	0 days	0 days	63,62
65	65 PREPARATION WORKS Phase II	0 days	Thu 28/7/16	Thu 28/7/16	31 d...	31 days	64
66	66 Excavation of the canal profile with a truck loading truck	18 days	Fri 29/7/16	Thu 18/8/16	0 days	0 days	64
67	67 Transport and unloading of excavated material by trucks	13 days	Fri 29/7/16	Fri 12/8/16	5 days	5 days	64
68	68 Expanding and planning excavated material along the excavated canal	9 days	Fri 19/8/16	Mon 29/8/16	0 days	0 days	66,67
69	69 EXTRACTION OF THE RIVER STARS OLI	0 days	Mon 29/8/1	Mon 29/8/1	4 days	4 days	68
70	70 Phase II site construction site constru	4 days	Tue 30/8/16	Fri 2/9/16	0 days	0 days	68
71	71 Creation of the Elaborate of the derived state. Phase II	8 days	Fri 19/8/16	Sat 27/8/16	5 days	5 days	66
72	72 OTHER WORKS OF THE PHASE II	0 days	Fri 2/9/16	Fri 2/9/16	0 days	0 days	71,70,6

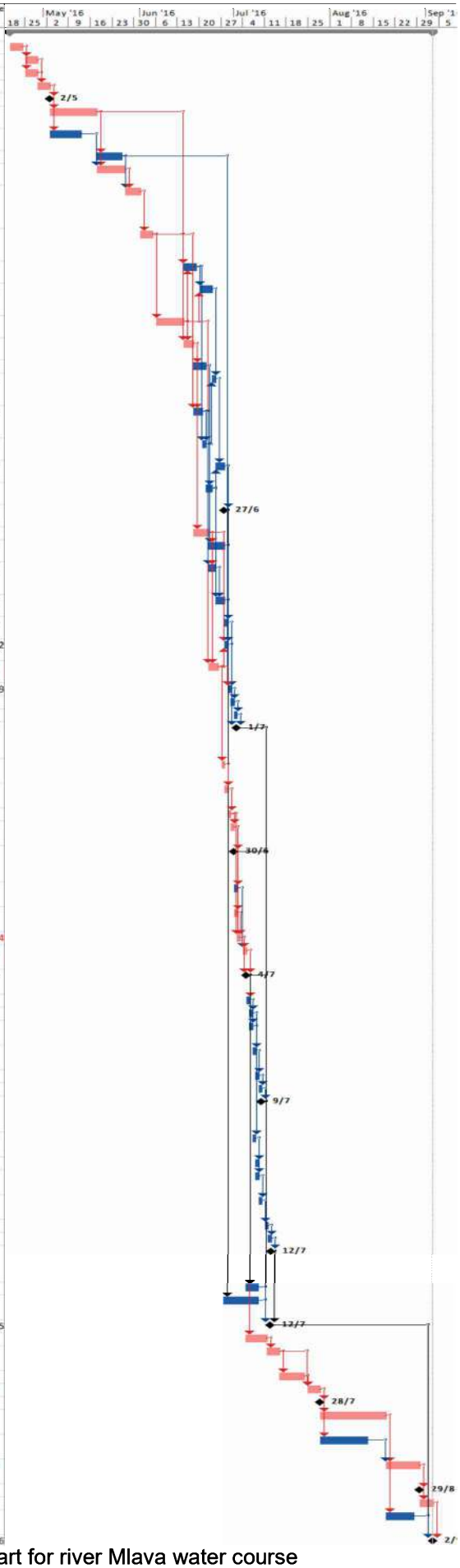

Figure 4: Network plan and Gantt chart for river Mlava water course

The first benefit from the application of network planning technique was already obtained in the analysis of the obtained Gantt chart and network diagram, where was realised that there were more possibilities for optimisation, that is, shortening the duration of the whole project. The parallelization of works has been intensified, and since the work route is geographically linear, simultaneous execution of works on several locations has been adopted, taking into account that none of the more crucial resources is exceeded.

The second benefit is seen in the resource analysis. The limiting condition for optimization was the maximum utilization of the resources of the contractor, that is, to avoid the additional recruitment of a subcontractor. Within the limits of existing resources, adopted building technologies and logical dependencies, the relationships between activities have been optimized, with the emphasis on maximum parallelization. This approach has provided a "more dynamic" mode of work execution, which manifests itself with a significant reduction in the duration of the project, from the initial 135 days to the new 117 days. By shortening the deadline, the contractor got the opportunity to postpone the beginning of works for April 20th, 2016. (30-day postpone). By moving the start of the works, earlier start of preparatory works in production facilities wasmade possible. March is the last winter month and belongs to climatically variable months, with more rainy days. By avoiding works in March, that is, by moving the beginning to April, the negative effects of working in the rain and the wet terrain were eliminated. This increases the performance of both machinery and workers and reduces the risk of stagnation due to rain, which ultimately increases the likelihood of completing the work within the planned time.

New project parameters received:
- The start of the project implementation is on Monday, April 20th, 2016.
- Completion of the project is 2.09.2016.
- Estimated working time 117 work days.
- The entire project has 72 (11 milestones) activities.
- No resources are exceeded.
- It was not necessary to perform additional dislocations of the resources used.

5. CONCLUSION

This paper shows the application of the network planning technique to solve the real construction problem of "Regulating the Old Mlava riverbed".

The technical aspect of the regulation of the Old Mlava riverbed was studied, the hydrological reasons for the occurrence of floods were explained and a list of technical measures, which had to be done on the terrain, was described. The technical characteristics of the new canalwere given, as well as the cross-sectional drawings of the channels in variants with earth and concrete coating. In the shortest terms, the basic theoretical possibilities on the network planning technique are presented. Possible links between activities are described, the terms of the critical path and time reserves are explained, and the formulas for calculating the start and end of the activity are given. To better understand the method of calculating the time by the method back and forth, a short example of 8 activities was made in the paper.

The real problem of "Regulating the Old Mlava riverbed" was analyzed according to the NPT method. From the first to the last activity, the design work premise was subjected to precise analysis step by step.It should be noted that in the process of drafting this work, engineers from the company of the contractor were involved, and in cooperation with them, thanks to their experience and suggestions, an analysis of the structure were made.In parallel with the structureanalysis, flow diagrams for the individual phases of the work were also analyzed. The duration of the activity was also calculated and the activities that preceded the observed activity were defined.The paper also defined how the MS Project software package was used, explaining the input of pre-prepared project and activity data.

From the above, it can be concluded that the application of the NPT method is possible in a wider range of diverse activities, and especially suitable for application in the field of construction. It was also concluded that NPT provides daily monitoring, control of project execution, as well as possible corrections in case of occurrence of some unforeseen circumstances that would cause a delay in realization.

This work has imposed a recommendation for all construction companies that NPT should be applied to anyproject of great importance.It may be necessary to launch an initiative to change the legislation, that is, in each project a section showing the NPT for that particular facility should also be included.

Field work was performed by company management experience, without taking into account more serious analysis of both technology and organization, without knowledge of the critical path and the accumulation of

certain resources. The company, both the contractor and the investor, need to improve the current understanding of planning and reduce it to the right frame, to avoid “spontaneous” planning. This type of planning often leads to exceeding the agreed deadline, increases the construction costs and reduces the profit of the contractor. Good planning identifies potential risks and takes measures to either neutralize or minimize them and propose optimization measures.

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IT PROJECT MANAGEMENT MATURITY AND PROJECT MANAGEMENT KNOWLEDGE

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Abstract: *The purpose of this paper is to analyze various knowledge management factors in managing IT projects in order to achieve a higher level of organizational maturity. This paper presents an analysis of knowledge management processes according to CRISP-DM methodology by the clients, IT specialists and project managers of IT projects. The research presented in the paper was implemented in 154 different organizations in the Republic of Serbia. The internal and external perception of organizational maturity is taken into consideration. There are 6 clusters, specific for different contemplations of project contractors, project managers and IT specialists. The results of the study revealed that the knowledge management processes fluctuate from the initial to higher maturity stages. In addition, the agile approach and project management office establishing are immanent for higher levels of maturity. Theoretical and practical implications are discussed in the paper.*

Keywords*: IT, project, maturity, knowledge, process, cluster*

1. INTRODUCTION

In the last decade, maturity models have become a popular tool for analyzing the current state of organizations. Although on the one hand they are perceived as a promotional tool, on the other hand they are very useful in the process of lessons learned collection. The system for collecting and evaluating knowledge is certainly also important for reaching higher levels of maturity, and hence the main motive in this work is reflected through linking the field of knowledge management and project manmagement maturity model. Niazi et al. (2016) analyzed global software development projects in order to map project management success factors to 10 project management knowledge areas according to PMBOK 5. The main conclusions from their research are related to human resource knowledge area. On the other hand, the generic application of knowledge and best practices does not fulfill the specific requirements of the projects (Sage et al, 2010). In previous releases of PMBOK, such as the fourth edition with nine functional areas, it has been noticed that knowledge in these areas is directly related to the success of project management (Abdul et al, 2014). Project practitioners recognized the link with the academic community in response to specific practices, in order to connect a systematic approach to knowledge acquisition on projects which is indirectly linked to a systemically and scientifically validated approach (Konstantinou, 2015).

Transferring knowledge from individual projects to the portfolio and programs occurs as a result of organizational project management and the achieved level of maturity (Görög, 2011). This situation is imanent for the IT industry, and therefore all the tendencies should be directed towards effective planning, collecting and sharing knowledge through projects, as well as through programs and portfolios. Kopečková & Máchal (2016) emphasize differentiation between knowledge and skills of project managers, which affects the utilization of full potential and capacity of the organization.

A large number of research on reaching higher levels of maturity highlighted by the knowledge management system directly outlines the role of the project management office. In this context, PMO appears as the main transmitter of knowledge in the field. However, in cluster analysis Müller et al. (2013) did not find a positive link between PMO members and project participants. There is an intent to explain the knowledge management process and identify important factors that affect the degree of maturity of an organization. Sohanvar et al. (2014) recognized that creating and collecting knowledge is more important than knowledge sharing and reusing. The knowledge distribution are mainly related with the transfer of individual and tacit knowledge focussing more on interpersonal and individual learning, than on organisational learning (Aerts et al, 2017). Project managers, or team leaders on software projects can learn from the agile effort and lessons learned, and therefor they have to find a method to use resources and processes, which are available at the moment (Bogojevic, 2017).

2. MATURITY ANALYSIS

The most common way to represent the level of maturity is reflected through five levels, which according to Carcary (2011) have the following characteristics:

1. Initial - At the first level of maturity there is a lack of formal efficiency of practices and processes in IT management structures. The effectiveness of the practice is based on ad hoc and informal successes of individuals;
2. Basic - At the second level of maturity, a formal management structure is established, with a basic understanding of the IT function, but without considering the entire business;
3. Medium - The third level of maturity implies that IT structures and management approaches are coordinated both in the company and with stakeholders, on the basis of which formal metrics and reporting system are set up;
4. Advanced - The fourth level of maturity is characterized by consistent and coordinated approaches that contribute to continual improvements above the industrial average;
5. Optimized - The fifth level of maturity includes the definition of policies, procedures and standards for achieving maximum possible efficiency, which is firmly linked to internal and external stakeholders. At this level, the organization is recognized as an industrial leader.

3. IT PROJECT MANAGEMENT MATURITY ORIENTED MODELS

3.1. Information Technology Capability Maturity Framework

IT-CMF (Information Technology Capability Maturity Framework) framework for assessing the maturity of key IT competencies was created in 2008 by the Institute for Innovation Evaluation. This framework consists of four integrated IT strategies and 34 competencies, which are grouped according to strategies. The assessment of maturity is based on a set of questionnaires or interviews carried out by an expert team (Innovation Value Institute, 2016).

Carcary and Zlydareva (2014) link IT-CMF with a strategic model of maturity of the organization, with the goal of recognizing strategic competencies in the field of IT in the organization. Curley and Kenneally (2011) point out that traditional metrics in the field of IT projects have a negative effect on business performance, while IT CMF components influence the correct definition of business value improvement.

3.2. COBIT Maturity Model

The IT Governance Institute (ITGI) was established in 1998 to promote international thinking and standards in the management and control of IT systems. ITGI has designed and created a publication called CobiT (Control Objectives for Information and Related Technology) 4.1. as an educational tool for senior management, IT management and controllers. Maturity level within the CobiT model have been created as a hierarchically structured set of levels with corresponding requirements for achieving maturity, where the fulfillment of requirements at lower levels goes to multiple levels of maturity.

CobiT model does not have a tendency to accurately measure the level of maturity or to certify an organization that has reached that level of maturity. With CobiT, the maturity of an organization is seen as a maturity profile within each level that has been reached, ie, it looks at the possible levels of maturity for IT processes at each level. For example, some processes can be well defined, even if they are incomplete. In this case, it can not be said that the processes given are not defined at all (Alfaraj & Qin, 2011). Using the maturity model developed for each of the 34 CobiT IT processes, the company's management can identify:

- Realized company performance - where the company is today;
- Current status of the branch - comparison with norms in the branch;
- Organizational goals for improvements - where the organization would like to be;
- Planned development path;

3.3. Project Maturity Model

In order to develop a framework for understanding, defining and planning improvements within the project management function, Consultant Interthink from Canada created in 1993 the PM2 maturity model (Project Maturity Model). It was originally used as a benchmarking tool for processes, structures and abilities in over 550 companies around the world. The development of the model itself was based on the CMM model and the Trillium model of estimation of maturity. In 1997, Interthink published a survey on organizational project management titled "Organizational Project Management - Basic Research".

The organization is evaluated within 12 areas divided into two groups. The first group consists of elements related to the life cycle of project management: program initiation, project initiation, project planning, scheduling and budgeting, project management, project monitoring and project reporting. The second group of elements refers to the structure, framework and environment of the organization: risk management, technology, organization, environment and resource management. The PM2 model of maturity uses a five-step maturity scale (Interthink Consulting, 2001).

3.4. PRINCE2 Maturity Model

The PRINCE2 maturity model (P2MM) is based on the P3M3 and CMM maturity models. It is owned by Axelos. This model is used by organizations that are project management oriented and which use PRINCE2 methodology. P2MM uses the five-degree maturity framework previously explained. P2MM consists of three individual models:

- Portfolio Management Maturity
- Program Management Maturity
- Project Management Maturity Model

P2MM focuses on the seven key perspectives of the process, which include the models' analysis. The flexibility of this model lies in the fact that the application of this model can refer individually to a project, program, or portfolio. This can influence the better understanding of certain parameters in all aspects. For example, risk management or resource management can be seen from the point of view of the project, but also from the point of view of the program or portfolio. The level of maturity is sometimes not the same for these three aspects. The areas assessed within these three segments are: control, benefit management, financial management, stakeholder analysis, risk management, organizational management, resource management (Office of Government Commerce, 2009). The maturity analysis is done through the P2MM self-assessment questionnaire, in which they can participate (Axelos, 2013).

4. METHODOLOGY

The research involved 154 organizations in the Republic of Serbia, which have a defined IT component within the business strategy. In 75% of cases, organizations use an agile approach, where the greatest focus is on project performance (Figure 1). On the other hand, with comparative analysis of methodologies and knowledge management areas, it is noticeable that the hybrid approach yields the best results (Figure 2). The cluster analysis shows the characteristics of observations in relation to the dependent variable knowledge management, which includes the following subcomponents: understanding the general context of the business environment, understanding business data, preparing data for analysis, modeling, evaluating and applying knowledge and the lessons learned. Six clusters are presented, for 154 organizations, using the k-means algorithm.

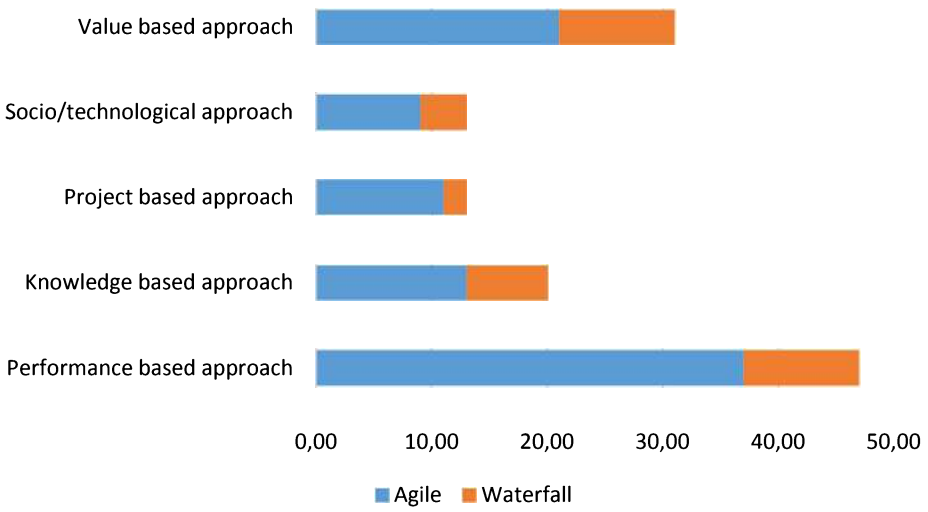


Figure 1. IT project approach and methodology - comparative analysis

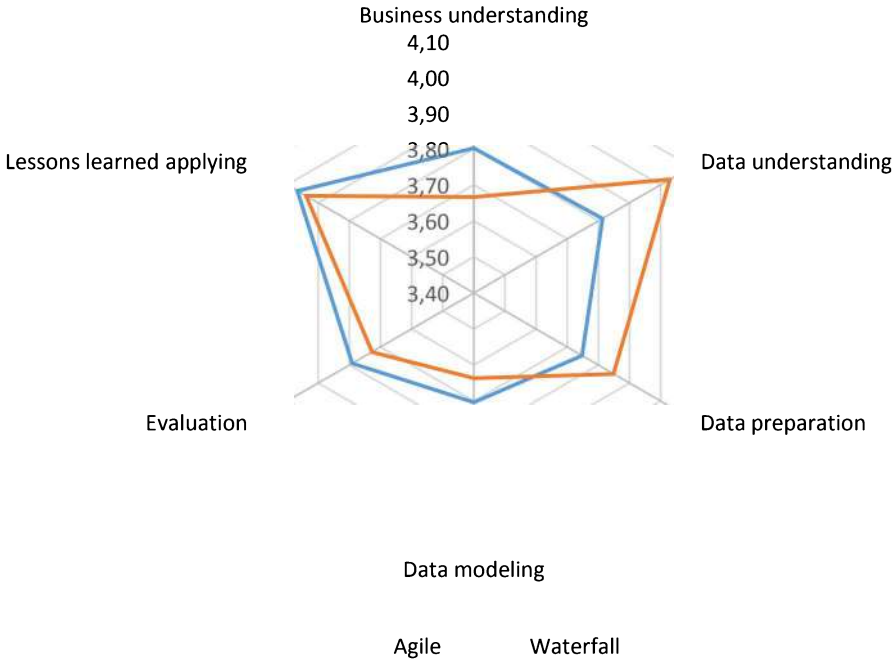


Figure 2. Knowledge management areas and methodology - comparative analysis

5. RESEARCH RESULTS

The first cluster is consisted of 34 organizations, of which 55.8% are at the at the first level, 5.88% at the second level, 11.76% at the third level, 20, 59% on the fourth level and 5.88% on the fifth level. The values of the dependent variables (understanding the general context of the business environment, understanding business data, preparing data for analysis, modeling, evaluating and applying knowledge, and the lessons learned) are unfavourably evaluated in comparison with other clusters. Organizations in this cluster mainly apply a traditional approach to IT projects, whose value is generally less than 50,000 euros and lasts up to six months. The number of end users, in most cases, is more than 20, and projects that are implemented in the public sector belong to the following categories: information systems, software and engineering, systems oriented to people and networks. Organizations in this cluster do not prefer the establishment of a project management office and mainly implement projects in education and IT.

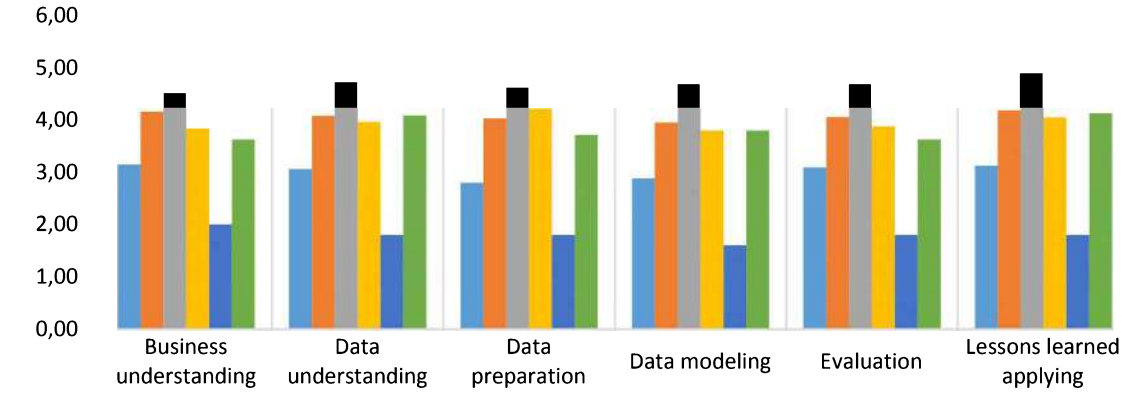
The second cluster consists of 39 organizations, of which 51.28% are at the at the first level, 15.38 at the second level, 12.82% at the third level, 17.95 % on the fourth level and 2.56% on the fifth level. Values of dependent variables (understanding the general context of the business environment, understanding business data, preparing data for analysis, modeling, evaluating and applying knowledge and keeping the lessons learned) are highly valued compared to other clusters. Organizations in this cluster mostly apply an agile approach to IT projects, whose value is generally less than 100,000 euros and the duration is up to 36 months. The number of end users, in most cases, is greater than 20, and projects that are implemented in the private sector belong to all categories of IT projects. Organizations in this cluster partially prefer the establishment of a project management unit and mainly implement projects in the following industries: creative industry, telecommunications, banking, insurance and investment services, trade and information technology.

The third cluster consists of 29 organizations, of which 62,07% are at the first maturity level, then respectively, 24,14% at the fourth level and 13,79% at the fifth level. Values of dependent variables (understanding of the general context of the business environment, understanding of business data, preparation of data for analysis, modeling, evaluation and application of knowledge and keeping the lessons learned) are highly evaluated compared to other clusters. Organizations in this cluster mainly apply agile approach to IT projects, whose value is generally less than 100,000 euros and the project duration is more than three months. The number of end users, in most cases, is more than 20, and projects implemented in the private sector belong to categories: information systems, software and engineering, systems oriented to people, applied computer systems and hardware. Organizations in this cluster do not prefer the establishment of a project management office and most often belong to organizations in the following industries: telecommunications and information technology.

The fourth cluster is consisted of 24 organizations, of which 50% are at the first maturity level, then respectively, 4,17% at the second level, 20,83% at the third level, 16,67% at the fourth level and 8,33% on the fifth level. Values of dependent variables (understanding the general context of the business environment, understanding business data, preparing data for analysis, modeling, evaluating and applying knowledge and keeping the lessons learned) are highly valued compared to other clusters. Organizations in this cluster predominantly apply agile approach to IT projects. The number of end users, in most cases, is greater than 20, and the projects that are implemented belong to the following categories: software and engineering, information systems, socially and professionally linked areas and applied computer systems.

The fifth cluster consists five organizations, of which 100% are at the first level of maturity. Values of dependent variables (understanding the general context of the business environment, understanding business data, preparing data for analysis, modeling, evaluating and applying knowledge and keeping the lessons learned) are low in comparison with other clusters. Organizations in this cluster mainly apply a hybrid approach to IT projects, whose value is generally less than 100,000 euros and the duration is shorter than 12 months. The number of end users, in most cases, is over 20, and the projects that are implemented belong to the categories: software and engineering, information systems and mathematical software and analyzes. Organizations in this cluster partially prefer the establishment of a project management office and mainly implement projects in banking, insurance and investment services and trade.

The sixth cluster consists 24 organizations, of which 37.15% are at the first level, 4.17% at the second level, 20.83% at the third level, 33, 33% on the fourth level and 4,17% on the fifth level. Values of dependent variables (understanding the general context of the business environment, understanding business data, preparing data for analysis, modeling, evaluating and applying knowledge and keeping the lessons learned) are highly valued compared to other clusters. Organizations in this cluster predominantly apply traditional approach to IT projects, the duration of which is up to 36 months. The number of end users, in most cases, is more than 20, and projects that are implemented in the private and public sectors belong to categories: software and engineering, information systems and computer systems of the organization - architecture and others. Organizations in this cluster prefer to establish a project management office and implement projects in all industrial branches (Figure 3).



	Business understanding	Data understanding	Data preparation	Data modeling	Evaluation	Lessons learned applying
Cluster	3,15	3,06	2,79	2,88	3,09	3,12
Cluster	4,15	4,08	4,03	3,95	4,05	4,18
Cluster	4,52	4,72	4,62	4,69	4,69	4,90
Cluster	3,83	3,96	4,21	3,79	3,88	4,04
Cluster	2,00	1,80	1,80	1,60	1,80	1,80
Cluster	3,63	4,08	3,71	3,79	3,63	4,12

Figure 3: Cluster analysis on sub-components of dependent variable - knowledge management

6. CONCLUSION

The significance of this research is supported by the fact that an increasing number of companies have defined IT component in their strategy. Also, IT industry is the largest export-oriented industry in Serbia, and therefore the application of knowledge management is justified. It often happens that higher level of knowledge and higher level of maturity are connected with the establishment of a project management office, which is a guide to organizations in the application of lessons learned and best practices implementation. At initial maturity level, the organizational focus is on understanding the general context of the business

environment, while at higher maturity level this aspect is implied in knowledge management. With the increase in maturity, there is a growing trend in understanding business data, as well as the importance of using the modeling and evaluation process. All levels of maturity include a high degree of application of knowledge and keeping the lessons learned because the development of the company is reflected in the number of mistakes it makes in relation to the previous period.

ACKNOWLEDGEMENT

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.

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PLANNING PROCESS IMPROVEMENT IN RELATION TO BETTER RESOURCE MANAGEMENT

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Abstract: *Resource management requires incremental and occasionally radical improvements so as to maintain and increase the level of efficiency and effectiveness. There are a number of methods to improve the resource management process, and this paper analyzes the possibility of the improvement by means of better planning. Theoretically, various business and resource management planning improvement models have been developed, of which the one designed by the Deloitte consulting company can be singled out. The model is composed of a series of recommendations for the planning improvement grouped in two parts and represented in the form of a question: what an organization can do and what an organization can do better. The planning improvement and resource management ought to be considered as part of a wider organization improvement process.The aim of the paper is to present the basis and the advantages of the model as well as the possibilities for its improvement.*

Keywords: *business planning, resource management, organizational changes, organizational value.*

1. INTRODUCTION

Business planning includes the estimation of the future business conditions, the estimation of the effects of future conditions on an organization, the development and implementation of the strategies as a response to the changes of surrounding conditions, as well as the estimation of the outcome of the planned strategies. Since planning is basic for every business activity, we can state with certainty that efficient and effective resource management depends on good planning to a great degree. Significant acceleration of all business flows in modern conditions requires much more sophisticated planning methods, but on the other hand, modern information technologies make it possible for sometimes almost unimaginable things to become reality.

In recent years, companies from all branches of industry have begun introducing new digital technologies into business, by means of which they find new ways to solve various business challenges. By using digital platforms in the planning process, companies are provided with efficient and sustainable processes for problem solving, which means that improved data collecting, processing and vizualization techniques are of a great benefit to employees dealing with business planning issues. Modern business planning techniques have become available owing to cloud technologies that enable new approaches to the planning process as well as faster and easier prediction of certain scenarios, which is not the case with conventional information systems of companies (Matt, Hess, & Benlian, 2015). Modern technologies significantly facilitate the business planning process, as well as the business strategy planning itself, which enables a company to remain competitive on the market (DalleMule & Davenport, 2017). The resources in modern conditions are becoming more and more digital, i.e. non-material resources are increasingly taking over primacy. Previously, data were a key resource in only some parts of the organization - for example, in finance and accounting, and today they have become the central part of each organization (Braganza, Brooks, Nepalski, Ali, & Moro, 2017).

In a study published in the *McKinsey Quarterly* magazine in which around 800 managers took part, only 45% percent of the participants claimed to have been satisfied with the strategic planning process within their organization, while 79% of the participants responded affirmatively to the question whether the process formalization leads to the strategic planning improvement. These data suggest that there are significant issues when planning in a number of organizations, but that there is also awareness of the necessity for the improvements. Theoretically, various models for planning improvement have been developed. For instance, if we take into consideration the approach that has been based on the increase of satisfaction among employees by means of strategic planning, we can single out the following recommendations: *to identify and analyze the key issues, to create the right teams (gather people who develop and realize a strategy), to adjust the planning circles to the needs of every organizational unit* (it is not necessary to develop strategic plans every 12 or 18 months), *to establish the system for strategic performance tracking* and *to integrate the human resource systems into a strategic planning* (to link the managers' compensation to the new initiative progress) (Dye & Sibony, 2007).

The paper will analyze the model for the company value increase developed by the *Deloitte*[1]consulting company, with the focus on the improvement of the process of planning in the resource management. The model represents a comprehensive demonstration of a number of ways in which the organization can be improved by the key fields (income, expense, resource, processes, etc.), with all directions being grouped into two fields: *what an organization can do* and *what an organization can do better*. The first part of the model refers to the activities that an organization is currently performing, and which can improve the planning process, while the second part refers to the activities that an organization can do better than with the existing method. Certain activities have been referred to individually within the model, but are represented together in the paper due to their connection, but also due to the limited space for analysis. The possibilities of planning process improvement according to certain fields are represented below.

2. WHAT AN ORGANIZATION CAN DO

There are a lot of ideas that can make an organization better and the key parts of the model will be presented below together with examples of successful implementation of proposed solutions with concrete benefits. The complete list of recommendations can be found on the link in the references section.

Emphasize the planning based on a scenario – The scenario-based planning is "a method for thinking creatively about uncertain future". This approach is essentially based on considering more future variations that include plenty of uncertainties and risks in the system, i.e. focusing on the estimation of more than one possible outcome. According to the approach stated by Peterson, Cumming and Carpenter (2003), the key parts of the scenario-based planning are *the central problem identification, estimation, the identification of alternatives, scenario development, scenario testing* and *policy screening.* Certain scenarios have the goal to manage the uncertainties, while the goal of some is to discover them. The *Shell* Company used this method as early as in the 70s to deal successfully with the oil embargo and also realized the major investments in oil wells, but this method today has additionally been improved and popularized (Peterson, Cumming, & Carpenter, 2003). In most cases, in the business planning process, too much unnecessary data are used, where time is wasted on the data processing and the prediction of the outcomes of different scenarios, which means that management has no significant benefit from these activities. Modern information technologies enable digitization and automation of business planning processes, whereby planning is defined as a process that is in accordance with the requirements and needs of the company management, automated scenario planning systems and modern systems for modeling processes. Such an enhanced process can support various calculations, measurements, simulations, and predictions of different scenarios and their outcomes (Pollack, 2010; Matt, Hess, & Benlian, 2015; Phadnis, Caplice, & Sheffi, 2016).

Harmonize the partial business strategies (consumer, product, marketing, sales, service, logistics and realization, HR, technology and other strategies) – There are numerous problems that may arise in an organization, but also there are many examples of companies that managed to achieve significant results by means of the business strategy harmonization. For instance, in *Cisco Systems*, the annual sales have increased from 1.2 billion dollars in 1994 to 13 billion dollars in 1999, and within the same period the company realized 41 acquisitions. The secret to this success lies in a well-planned, flexible, harmonized and successfully implemented strategy, where the strategy for human resource management shall be emphasized in particular (Geer, 2003). Also, digitization as a modern trend requires organizational and technological adjustment. To survive on the market, organizations should develop a digital strategy aligned with other partial strategies. This is a prerequisite for digital competition with other organizations (Ross, Beath, & Seba, 2017). The need for partial strategy harmonization seems clear and sensible, but in practice, it is often omitted, i.e. there is the silo effect both in planning and in the realization, the business plans are merely copied from the previous year and alike. To harmonize business strategies means to establish their most important cause and effect relations (to establish the way in which minor changes in one element may cause the significant changes in another – similar to the *butterfly effect* in physics.

Consider the possibility of a merger, an acquisition or disinvestment – Both merging and separating organizations/organizational units lead to major changes in the structure of all kinds of resources. The companies with the same business activity, but also the companies which are related in the value chain, are merged. Mergers, acquisitions and disinvestment may, in certain situations, lead to similar, both positive and negative results – in some situations, disinvestment is by large a better option than additional investment, a merge or an acquisition (although in practice it is often treated as a defensive strategy), whereas in other situations, acquisitions or merges are a better solution. The example of one of the largest integrations as a consequence of successful planning is the acquisition of *Mannesmann* by *Vodafone Airtouch PLC* in 1999,

the value of which was 183 billion dollars (Carayan, Swenson, & Neff, 2002), whereas in Serbia it is the acquisition of *Mobtel* by *Telenor* for 1.53 billion dollars.

Improve the integration of short-term and long-term planning – In practice, more attention is often paid to short-term plans (a well-known saying "in the long run, we are all dead") rather than to long-term planning for a number of reasons: the future is difficult to be forecast, organizations lack in time to deal with all forecasts of uncertain future, insufficient knowledge of the strategic planning techniques and methods, etc. The future is certainly unpredictable, but as Peter Drucker stated: "the best way to forecast the future is to create it". These two planning methods are closely related and conditioned – short-term planning creates the basis for the realization of long-term goals, whereas the well-established long term goals facilitate the process of short-term planning. The external development is defined as the joining of businesses, most frequently in the form of strategic M&A (merge and acquisition) or strategic alliances. Research has shown that there is a significant correlation between the growth and diversification, based on the merge of companies, in terms of long-term business planning (Rajnoha, Štefko, Merková, & Dobrovič, 2016).

3. WHAT AN ORGANIZATON CAN DO BETTER

Improve the process of identification and estimation of industrial and market trends – This aspect implies the consideration of new needs, analysis of potential markets, analysis of required resources for satisfying the identified needs, chances, risks and methods for entering new markets etc. In the process of planning, the following must also be determined: the changes of consumers'/users' needs on the existing markets and possible response of organizations in terms of non-profitable products withdrawal (the products that no longer satisfy the market needs), discovering new marketing and sales canals for the existing products and the placement of new products that will in near or remote future become the initiator for the organization growth and development (Paley, 2004; Porter & Heppelmann, 2015). The industrial and market trends are composed of certain *sub trends* whose relations and conditionality must also be taken into consideration. Apart from the trend and sub trend identification, it is also essential to determine what is, or what might be their effect on the organization profitability (Becker & Freeman, 2006). It is not easy to estimate and plan the response to the changes of industrial and market trends, but it needs to be done so that the organization may survive.

Improve the identification of chances and threats –Strengths and *weaknesses* are first of all the internal elements of analysis, whereas *possibilities* and *chances* are its external elements. The internal strengths and weaknesses include advantages and disadvantages in terms of business performance of a company, its current operations, available technology, relations among its organizational units, etc. The external chances and threats refer to the analysis of main competitors' performances, new technologies and legal regulations. Therefore, it ought to be determined what makes an organization or a product/service better or worse than the others and how these advantages shall be used, i.e. how the weaknesses shall be eliminated (Paley, 2004; Al-Turki, 2011).

Improve the ability of the strategy development at the organizational and business unit levels – The organizational strategy and resource management strategy planning and development ought to comprise the widest possible part of an organization, with the harmonization at all levels of planning being the most important issue. According to one approach, there are five strategy development styles – *command, symbolic, rational, transactive* and *generative. Command style* refers to the situation in which several top managers control the strategy development. The strategy development in accordance with the mission and vision represents *symbolic style.Transactive style* refers to additional improvement of employees and their bringing together with the aim of the best possible strategy development, i.e. it refers to the stimulation of the employees' engagement. *Generative style* implies experimenting, i.e. risk-taking by employees (White, Conant, & Echambadi, 2003). The strategy development at the organizational and business unit levels is the key step in the realization of higher goals and without the clear idea, the activities for business performance improvement, it may become a mere waste of time (Steiner, 2010).

Improve the harmonization between budget and capital programs with strategic priorities – First, the strategic priorities need to be clearly determined, and then the resources shall be directed to their realization to the fullest possible extent. Planning is often being exclusively related to finances and budget of an organization, even though it refers to a much wider term. Efficient budgeting implies setting realistic goals, which motivate the management and other employees to act towards their realization. Simultaneously, budgeting, by its nature, implies relying on a standard expense concept. Furthermore, the conditions may be static, if the environment is stable, but more often than not, they should be flexible, i.e. adjustable to possible changes in business conditions (new goals, new technical-technological solutions, process improvement, etc.) (Carayan, Swenson, & Neff, 2002).

Improve the process of identification, estimation and realization of opportunities for disinvestment, mergers and acquisitions – Certain rules that ought to be followed in the realization of the above-stated activities must be determined within the process of planning. Some of these rules are: proper selection of organizations or parts of organizations that will be the subject of the mentioned organizational changes, a thorough analysis of the target organization/organizational units (profitability, market share, product portfolio, competitiveness, etc.), consideration of the compatibility of the companies that are to be merged/split up (business, financial, social, organizational and other aspects following the merge/separation), the possibility of organizational structure harmonization, culture, the possibility of keeping the best quality staff and alike (Campbell, Stonehouse, & Houston, 2002). If the fact that a merge, an acquisition or disinvestments represent major organizational changes is taken into consideration, then it is evident that the role of business planning in their realization is also significant.

Improve the process of transfer (communication) of strategic directions and priorities to all stakeholders – A good plan shall successfully be communicated to all participants on whom its successful implementation depends. Poor communication or its complete absence frequently leads to failure to realize excellent business plans. All participants (employees and managers) need to have the idea about the goals and strategies of an organization, as well as about their individual role in their achievement (e.g. what are or what shall be the strategic resources of an organization, how the values are created, how they are managed, i.e. how they are used, improved and kept, etc.) (Paley, 2004). One example of a company that has achieved good business results by, inter alia, successfully communicating the strategic message to its employees is *Atlantic Grupa* from Croatia.

Improve the ability of new business development and spin-off – In order to remain competitive on the market, organizations must plan and develop new businesses. New business implies the development of new products or services that can be sold, rented or make profit through the sale of licenses (Carayan, Swenson, & Neff, 2002). It ought to be emphasized, though, that the innovations themselves are not a guarantee of success, but need to be sustained by adjusting other organizational units. *Business models* for which, without any thorough analysis, can be said to depict the value creation logic within an organization (the business models shall not be confused with strategies here) play a major role in the new business creation. Business models comprise and connect all most important elements of an organization that affect the value creation. Therefore, by new business planning, the business models that support innovations, create values and are difficult to be imitated ought also to be created (Teece, 2010). New business, including the one which has been created by using resources, can cause major changes – an organization may change the branch in which it operates, significantly increase its profitability, create entirely new markets, but also it may collapse.

Direct resources to the priority projects – The business venture priority hierarchy ought to be established by planning so that the major part of resources is invested in the most profitable projects independent of their type. The resources (apart from the free ones) may also be the ones that have been unlocked by, for instance, the sale of the excess equipment, land, the reduction of the number of employees and alike (Campbell, Stonehouse, & Houston, 2002). Also, resource management and especially strategic resource management and the application of its basic concepts can have a large and positive role in the project management process (Papke-Shields & Boyer-Wright, 2017). In Serbia, there are many companies that could unlock the locked resources and to invest them in the priority projects. For instance, the restructuring plan of the Public Enterprise *Srbijagas* provides the reduction of the number of employees through the so-called natural wastage (retirement or voluntary resignation, accompanied by the loss of these jobs without providing replacement) or through the stimulative termination of employment with severance payment. In practice, the plan has not yet been realized, but the savings that can thus be gained are not significant given the height and the structure of the income and expenses of this public enterprise. Following the reduction of expenses and the release of resources, the next step ought to be the development of new projects and the identification of priorities.

Improve the monitoring of current and potential regulations/laws and lobbying effectiveness – The monitoring and estimation of the impact of new and existing laws/regulations are the basis for the response planning and organization adjustment method. Certain “minor“articles in a law noticed and interpreted in the proper way may provide significant benefits to an organization and vice versa (e.g. in the area of tax law). Legal aspect is one of the key external factors that are to be taken into consideration when planning. For that purpose, numerous environment analysis techniques that also include the legal aspect (e.g. the BPLEST analysis) have been developed. *Lobbying* implies the engagement of specialized people responsible for the development of positive business relations between an organization and political or state-owned institutions and organizations. Lobbying can be both internal and external – internal refers to the connection with and the effect on the law creators, whereas external refers to the indirect effect by winning the influential individuals or by financial support. Mainly large enterprises deal with the planning of these activities due to enormous

funds they have available, the potential significant benefits they may obtain, but also the losses that may lead into a crisis or (in certain cases) the collapse of an organization. (Kelleher Richter & Samphantharak, 2009) Former politicians and diplomats are mainly the ones who are engaged in lobbying – e.g. Gerhard Schröder is lobbying for the gas line below the Baltic Sea, Joschka Fischer for the competing *Nabuko* gas line project from Turkey to Austria, *BMW*, *Siemens*, etc.

Improve the estimation of internal and market organizational unit value– In order to increase its value, an organization first needs to know the value of each of the resources it possesses and altogether and how that value will change in the future – if it is assumed that the value of one part will decrease in the future, the possibility of its sale might be taken into consideration. And vice versa, if it is estimated that the value will increase, the sale might be delayed. Provided that the market value is higher than the internal one, the organization is considered to be operating well and to have the future. And vice versa, in case that the market value is lower than the internal one, the organization is considered to be operating poorly. (Paley, 2004) The value of both certain organizational units and the organization as a whole needs to be determined as precisely as possible in the process of planning. A similar principle can also be applied here as in other business fields – the value of an organization and its parts shall be neither underestimated nor overestimated.

Improve the analysis of internal and external risks in business planning – The risk analysis is a systematic process for identification and estimation of events that might affect the goal realization. These events can be identified both in internal and the external environment of an organization. The risks exist but also arise when these events, for some reason, are not in harmony with the goals of an organization. The risk management analysis and planning imply their identification, the estimation of the effect volume and the response to each of the risks. When analyzing and estimating, it is essential to take two aspects into consideration: individual risks and their impact on the company goal realization as well as the general risk factors that might indicate a lower or a higher level of risk. For this purpose, different modeling methods are being used. For instance, the models based on the estimation of possibility measure the possibility and the volume of the impact on events, whereas the models which are not based on the estimation of possibility are used in case there are not sufficient available data (Atkinson & Jourdan, 2008; Brinckmann, Grichnik, & Kapsa, 2010).

Improve the analysis and planning of tax benefits – The tax planning and management is one of the possibilities to generate savings on the expenditure side – in case the company legally avoids paying a tax, it directly opens up the possibility of allocating those savings to other activities. It is understood that the resource structure, i.e. the participation of the resources subject to taxes and those that are tax-free, directly determine whether an organization will or will not obtain the tax benefits. The tax planning and management shall be integrated into the strategy of an organization and is by all means one of the most important elements in the analysis of competing advantage of an organization (Carayan, Swenson, & Neff, 2002).

Improve the process of the recruitment, development and succession planning of managers – Many organizations have major problems with developing leaders and massively losing talented people. Some of the recommendations for preventing such situations are: defining key competencies for leadership roles in the organization, rigorous assessment of a candidate's potentials, creating growth maps and giving real opportunities for employees' growth and development. It is important to emphasize that ideal candidates do not have to meet all conditions, but only those crucial (Fernández-Aráoz, Roscoe, & Aramaki, 2017). The improvement of these fields directly affects the possibility of crisis as the consequence of the departure of a manager for whom there is no adequate replacement ("successor"). Certain companies, e.g. *General Electric*, develop their educational centers for the training of managers, even though numerous universities have similar programs. Likewise, there are certain companies that directly cooperate with universities, that being the consequence (or the cause) of the development of programs that suit the specific needs of an organization, e.g. *Royal Air Force* and *Cranfield University* in Great Britain, *Ford Motor Company* and *University of Michigan* and *Cranfield School of Management* (Jackson, Farndal, & Kakabadse, 2003).

Improve the leadership and management skills of the employees holding senior posts – Companies indirectly invest in the increase of productivity and product and service quality, and thus in the development and the increase of the value of an organization as a whole by planning the development of managerial skills, i.e. by the training of managers. It ought to be emphasized that the key part of this process is the selection of right people (the identification of the employees with significant managerial and leadership capacity) as well as the right trainings (the identification of relevant or "tailor-made" programs) (Geer, 2003). This aspect of business planning improvement (closely related to the one stated above) is one of the most important aspects since people represent the most valuable resource of any organization.

4. CONCLUSION

Organizations ought to know which resources they possess, what their value is, whether they are strategic or not, how to create values, how to use and renew them, which new resources should be obtained, etc. Modern conditions complicate the process of resource management planning, but on the other hand, they also enable almost unimaginable situations. By summarizing all of the above theoretical aspects and examples, we can point out that the presented model leads to significant improvements:

- Harmonization of all parts of the planning process – short-term, long-term, planning through multiple scenarios, etc.
- Harmonization of strategies at all organizational levels
- Focusing on tracking significant market trends, chances, opportunities and threats
- Focusing on key parts of an organization in which better planning can generate significant benefits
- Better analysis and prioritization of projects
- Better communication of planning activities etc.

What can be noticed from all of the mentioned examples is that it is not necessary to apply all parts of the model, but only those that most closely correspond to a particular organization (logically, the organization that needs all of these improvements has serious issues). Parts of the model are related, and often the improvement of one automatically leads to the improvement of the other, although in some cases an organization has to opt for only one option. Another quality of this model is that it provides a great deal of the final list of possible improvements and represents a guideline for managers to overcome a crisis as well as to analyze the mentioned areas in regular circumstances. The result of all these efforts would be to increase the value of the organization in every sense of the word, in other words, to heal or to create a healthier organization. Each part of the model can be analyzed in detail as a separate entity which indicates the complexity of the model but also, on the other hand, the potential multiplied benefits it provides.

The paper includes only part of an integral model for the organization value improvement which its authors believe to consider the largest number of the planning process aspects. The key model parts can be singled out in one sentence: in order to plan and manage the resources successfully, it is most important to harmonize planning at all organizational levels, in all time frames (short-term and long-term), to track and, if possible, create trends, to set priorities and to sustain their realization by means of all resources available.

Following the description of possible improvements, it can be concluded that the success of all activities stated above depends on successful planning, while planning itself represents only the first, though possibly the most important, part of the resource management process. Planning improvement shall lead to the resource management process improvement, but also to the improvement of other related fields. The model shall be considered integrally and in the context of other organizational changes. The future research ought to include both quantitative and qualitative analyses of the success rate of the organization value increase model application, with special focus on the industrial branches in which the model generates the best results. We believe that In Serbia there is considerable space for the application of the described model. Applying the model to one or more of the domestic organizations and measuring results of its implementation will be the next step in the analysis of this area.

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IMPLEMENTATION OF DESI METHODOLOGY AND DIGITAL PERFORMANCES OF EUROPEAN UNION MEMBER STATES

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Abstract: *Implementation of DESI methodology for evaluation of the digital performances of the European Union member states is considered in the paper. DESI enables us to classify all the member states into three clusters. Denmark, Finland and Sweden are at the top regarding the DESI value. These states are leaders also at the global level regarding digital performances. Greece, Bulgaria and Romania have the lowest achievements. The results of implementing digitalization are modest at the level of the European Union as the whole and they should be improved. Digitalization may improve significantly the competitiveness of a country in the global market. However, this is valid only for countries that already have the well-established information-communication infrastructure. The composite index enables countries to understand weaknesses in the implementation of the digital economy according to individual indicators.*

Keywords*: Digital Economy, Digital Economy and Society Index – DESI, European Union, Economic Development, Competitiveness*

1. INTRODUCTION

Globalization, development and implementation of information-communication technologies (ICT) have changed the way of doing business and have caused transformation of economy and society. Digital economy studies how technologies influence the accomplishment of economic performances. It is based on information-communication, i.e. digital technologies. Economic activity is performed between different entities by ICT. ICTs have developed through time so that digital economy of the '90s was based on the Internet, intranets and private networks with additional value, computers, software and other aspects of ICT. Since 2010, it is based on the internet of things, mobile and smart telephones, tablets, laptops, cloud computing, digital platforms, big data, data analytics and robotics technologies (OECD, 2015). There are three definitions of the digital economy according to Bukht and Heeks (2017). The first one is that digital economy is generally digital sector, i.e. ICT sector that produces digital goods and services. The second one is that digital economy produces a part of the economic output that is accomplished by digital technologies with a business model based on digital goods and services. The third definition is the broadest and it refers to the implementation of ICT in all fields of the economy. The digital economy is growing seven times faster than other economies (European Commission, 2014), creates 5% of the global GDP and 3% of the global employment (Bukht & Heeks, 2017). The digital economy is closely connected with the knowledge-based economy where knowledge and innovation are the basis of the economic development, with the strong and necessary support of the ICT. Since the nineties of the 20th century until today, economists analyze countries that have revived their economies and have accomplished significant rates of development due to new technologies.

This paper discusses the application of the DESI methodology and the ranking of EU member states in the implementation of the digital economy. The following sections explain the strategies of the European Union that have contributed to the development of the digital economy. The third section of this paper examines the impact of the digital economy on economic development. The fourth section describes the DESI methodology. In the fifth section of this paper, countries ranking was done using the DESI methodology. The last section of this paper is a conclusion.

2. EUROPEAN UNION STRATEGIES IN DIGITAL ECONOMY DEVELOPMENT

During the nineties of the 20th century, the transformation of the American economy was based on the information-communication technologies (ICT). The ICTs were present in economic processes and influenced the economic efficiency in different ways and in different sectors. The American economy accomplished good economic performances by gradual adoption and their implementation, as well as structural changes. This trend of economic development, based on the influence of the ICT, attracted the attention of other economies. In order to accomplish the economic growth, greater competitiveness, economic performances and to reduce the existing gap between the European and the American economy, the European Union (EU) decided to transform own economy and increase the role of ICT in the

accomplishment of the goals. Therefore, the EU creates so-called electronic Europe (eEurope) and implements the Lisbon strategy.

The aim of the Lisbon Strategy (2000-2010) was to make the EU the most competitive economy and the knowledge-based economy. As a part of the Lisbon Strategy, so-called eEurope – an information society for all was launched. It was a political initiative to ensure that the EU benefits from the transformations to the information society, i.e. digital economy and knowledge-based economy (Europe 2020 Monitoring Platform, 2000). In December 1999, the European Commission initiated the creation of the eEurope. The Lisbon European Council approved it in March 2000. The conditions necessary for achievement of an information society are: 1) providing access to every citizen, home, school, company and administration to *online* services, creating the digital era; 2) creating digital literacy in Europe, supported by ICT and 3) providing information society for all social layers (eEurope Initiative, 2000). In order to achieve the objectives, the European Commission adopted the Action Plan – eEurope 2002. The basic actions of the Plan were stimulating a cheaper, faster and more secure Internet and its use, as well as promoting investments of humane and financial character. After eEurope 2002, the Plan eEurope 2005 was adopted. Targets of this Plan were the development of broadband access at competitive prices, providing more security and protection of networks and broader and better use of IT by state administration, i.e. eGovernment (EUR-Lex, 2005).

In June 2005, the new strategy i2010 was adopted – European information society for growth and employment in 2010. This strategy refers to the information society and media, with the following priorities: 1) to end establishing of a Single European Information Space, encouraging an open, competitive internal market for information society and media; 2) to promote innovation and investment in research into the ICT field; 3) to create the European information society that provides better public services and better quality of life (EUR-Lex, 2009). The EU managed to create 18 million new jobs with this strategy before the beginning of the economic crisis (European Commission, 2009).

In March 2010, the European Commission brought a *new strategy – the Europe 2020 strategy*, with the task to continue fulfillment of the Lisbon Strategy goals and the exit of the European economy from the economic crisis (Europe 2020, 2010). According to the strategy, the EU should exit from the crisis by a smart, sustainable and inclusive growth (European Commission, 2010). Seven pillars of the Europe 2020 support the Strategy goals. Achieving smart growth is set by the Digital Agenda, one of the seven pillars of the Strategy. The Digital Agenda proposes better using of the ICT in order to speed up innovation, economic growth and progress. The main objective of the Agenda is creating and development of the digital single market (Europe 2020, 2015). The Digital Single Market strategy was adopted in May 2015. The Digital Single Market should "ensure access to online activities for individuals and businesses under conditions of fair competition, consumer and data protection, removing geo-blocking and copyright issues" (Digital Single Market, 2018). The Strategy has three pillars: 1) Access – better access for consumers and businesses to digital goods and services across Europe; 2) Environment – creating conditions and planning levels for digital networks and innovative services; 3) Economy and Society – maximizing the growth of the digital economy. The Digital Single Market gives access to the market of over 500 million people. Completing the Strategy can contribute EUR 415 billion per year to the European economy, creating hundreds of thousands new jobs and transforming the public services (Digital Single Market, 2018). The EU digital economy grows at the annual rate of 12%, there are 7 million jobs in the European ICT sector, the expectation is that demand for jobs in the ICT sector will be 16 million (European Commission, 2014). In May 2017, the Commission published a mid-term review of the Digital Single Market Strategy. This publication has given the review and evaluation of the progress in the implementation of the Strategy. The achievements of the Digital Single Market are: reduction of price for electronic communication and abolishing roaming charges, better Internet connectivity, introducing more rigorous rules on data protection and privacy and the EU rules on cybersecurity that will be implemented from May 2018, creating conditions for digital networks and services, promoting digital skills and high-performance computing, digitalization of industry and services, as well as modernization of public services (European Parliament, 2018). In order to achieve the set goals, it is necessary to invest in artificial intelligence, blockchain, eHealth and innovation (European Commission, 2018). Value of the EU data economy was more than 285 billion Euros in 2015, which was 1.94% of the EU GDP. The value of the EU digital economy may increase to 739 billion Euro until 2020 and make 4% of the EU GDP (Digital Single Market, 2018). Due to the referred possibility, as well as in order to provide a fair, open and safe digital environment, future actions are directed to the EU data economy, cybersecurity for the property protection and online platforms.

3. INFLUENCE OF DIGITAL ECONOMY TO ECONOMIC DEVELOPMENT

Digitalization changes the traditional business and has a great potential for increasing the economic development of countries and creation of a healthy social-economic environment. Primarily, some key advantages are in connecting individuals and companies, as well as increasing the internationalization of

business. High influence is also on reducing transaction costs and stock expenses. However, this may have a bad influence on competence, considering that there are companies with insufficient capacities to use these advantages. (Goldfarb et al., 2015; Arsic, 2018). Some authors emphasize the benefits of digitalization for environment protection. Implementation of new technologies and new production methods instead of the traditional industrial production result in positive effects on ecology and quality of life (Khan et al., 2015; Seele & Lock, 2017; Missalla et al., 2018). Special importance is given to the development of entrepreneurship, especially in the sector of services and software making. Low financial investments and highly skilled employees characterize such the type of entrepreneurship (Sussan & Acs, 2017). Likewise, it is considered also that innovations and diffusion of knowledge are introduced in this manner (Bilen-Katić & Radovanović, 2014; Nambisan, 2017).

The research conducted in the EU Member States has shown also the negative side of the implementation of the digital economy. Namely, the results have shown that there was a great difference between the member states in the digital infrastructure, especially in the states with a lower level of economic development. This results in the even greater gap in the economic development in the digital era. Linguistic barriers and distrust between business partners are also mentioned as limitations (Evangelista, et al., 2014).

The greatest controversy is about the topic how the digital economy influences the unemployment. Good and bad sides are often indicated. On one hand, new jobs are created, business in some fields is simplified considerably while productivity is increased (Brynjolfsson & McAfee, 2012). On the other hand, some jobs in new business models lose their significance. The need for certain skills is reduced and retraining for the new skills required by the digital economy is aggravated (Harrison & Budworth, 2015; Quinton et al., 2017).

4. METHODOLOGY

Gross Domestic Product (GDP) and GDP *per capita* represent the traditional indicators of economic activity of a country and quality of life of its citizens. GDP enables monitoring of economy trends in a country in different periods. This macroeconomic aggregate enables distinguishing economic differences between regions and countries (Tvrdon & Skokan, 2011). Increase or decrease of total social production in a country is analyzed on basis periodic series, which is very important for economic planning and evaluation of the adequacy of economic policy measures of a country. However, there is a considerable number of disadvantages in using GDP as the measure of the welfare of a macroeconomics (Samuelson and Nordhaus, 2000; Mishaelson et al., 2009; Kragulj, 2016). GDP does not perceive the goals of production and the quality of economic growth. GDP does not inform on the quality of life, i.e. it does not provide the insight into the non-material needs, about the free time, about the quality of the environment, etc. A great shortage of GDP is that it provides no information on economic disparity (Kragulj, 2016; Jednak et al., 2018). Therefore, economists invest great efforts in finding a broader measure of economic activity. It is necessary regarding the complexity and multidimensionality of the development phenomenon that comprises different aspects of life: economic, technological, social, environmental, cultural, institutional, etc.

Evaluation of the level of economic and social development can be given by analytic observation of the development components and their decomposing to indicators. Since the key development components are at the same time just the first step in defining the level of development, it is necessary to establish determinable measures that will provide a quantitative picture of the development process. Economic, i.e. sustainable development is a complex social process. It has become clear that one indicator is not enough for the evaluation of the condition and the level of development of one economy in the contemporary economic conditions and the process of digitalization, but several indicators should be implemented. Just the complexity and the multidimensionality of the development phenomenon make the use of aggregate indexes, comprising of individual weighting indicators, especially attractive in this domain. Of course, there are still a great number of questions imposed. If several indicators are necessary, how these should be chosen? Which indicators should be chosen in order to get the adequate picture regarding the goal of the research? Are the chosen indicators analog to the measured phenomena? Can replacement of indicators, i.e. introducing the ones and eliminating the others, considerably change the picture of observation? (Kragulj, 2016). In addition, the series of other questions is possible to ask. Therefore, the methodology of research and analysis is of great importance for the achievement of the goal that we seek.

There are many different socio-economic indicators for measuring economic development formed by international institutions, as the United Nations, the World Bank, the European Commission, the Organization for Economic Cooperation and Development (OECD), etc. The modern age is a digital age. Expansion of the information-communication technologies has had the key impact on functioning and development of society, economy and business, as well as on macroeconomic and microeconomic performances. A digital economy based on digital technologies opens numerous possibilities, challenges, but also risks at macro and micro

plan. Therefore, a relatively new composite index will be presented in the paper, so-called Digital and Society Index (DESI).

The Digital Economy and Society Index – DESI was first published in 2014 by the European Commission with the basic goal to present and measure the results of the European Union Digital Agenda. The European Commission publishes this composite index, ranking the states of the European Union according to the achieved level of economic and social digitalization, once a year. Therefore, the indicators for this index exist for 2014, 2015, 2016 and 2017 and it is possible to monitor the progress of the EU states in the process of the economy and society digitalization in a period, but also of the European Union as the whole. Likewise, since it is a composite index, it is possible to identify the spheres and fields in which the EU Member States should accomplish better results. Regarding the structure of this index, it comprises of 5 dimensions, 12 sub-dimensions and 31 indicators, which is illustrated in Table 1 (DG CONNECT, DESI 2017).

The Connectivity dimension, with the weight coefficient w = 25%, is composed of four sub-dimensions that are of key interest for connectivity with the Internet. *The Human Capital dimension*, with the weight coefficient also w = 25%, is composed of two sub-dimensions that emphasize the necessity of developing digital skills, both basic and advanced, which would enable broader use of digital products and services, as well as their faster development. *The Use of Internet dimension,* with the weight coefficient w = 15%, is composed of three sub-dimensions that show the possibilities and skills of citizens to be included in various online activities and using different online contents (from music to eCommerce). *The Integration of Digital Technology dimension,* with weight coefficient w = 20%, is composed of two sub-dimensions that show in which extent the process of digitalization in the business sector has been implemented through the use of e.g. Cloud, Big Data or the Internet of Things, which significantly influence the improvement of the business efficiency and the increase of competitiveness. T*he Digital Public Services dimension,* with weight coefficient w = 15%, is composed of one single sub-dimension, showing the use of digital technology in public administration, i.e. the use of electronic systems in the interaction of business and citizens with the public sector. Weights are allocated for both sub-dimensions and individual indicators (DG CONNECT, DESI 2017).

Table 1: Structure of the Composite Index of Digital Economy and Society (DESI)

Dimension	Sub-dimension	Indicator
Connnectivity	Fixed Broadband	Fixed Broadband Coverage Fixed Broadband Take-up
	Mobile Broadband	Mobile Broadband Take-up 4G Coverage Spectrum
	Speed	NGA Coverage Subscrptions to Fast Broadband
	Affordabillity	Fixed Broadband Price
Digital Skills	Basic Skills and Usage	Internet Users At Least Basic Digital Skills
	Advanced Skills and Development	ICT Specialists STEM Graduates
Use of Internet	Content	News Music, Videos and Games Video on Demand
	Communication	Video Call Social Networks
	Transactions	Banking Shopping
Integration of Digital Technology	Business Digitisation	Electronic Information Sharing RFID Social Media eInvoices Cloud
	eCommerce	SMEs Selling Online eCommerce Turnover Selling Online Cross-border
Digital Public Services	eGovernment	eGovernment Users Pre-filled Forms Online Services Completion Open Data

Source: DG CONNECT – DESI, 2017, p.6

With the aim to form DESI, normalization of indicators has been performed by an implementation of a min-max method with a linear projection on the scale between 0 and 1 (greater value on the scale is better) and with predefined values of minimal and maximal indicators. These values were introduced in order to make possible to compare indicators during the years, as well as in order to analyze their trend (Petrović and Bojković, 2017; DG CONNECT, DESI 2017).

5. RESULTS AND DISCUSSION

DESI enables also a comparative analysis of the member states within the achieved level of economy and society digitalization and their grouping into the most successful states and vice versa. DESI shows that the different EU Member States do not progress with the same speed. In 2017, Scandinavian states had the greatest DESI (Denmark, Finland, Sweden), while Bulgaria and Romania were at the rear. The average value of the index for the EU was 0.52. DESI in Denmark was 0.71, while in Romania its value was 0.29 (Figure 1).

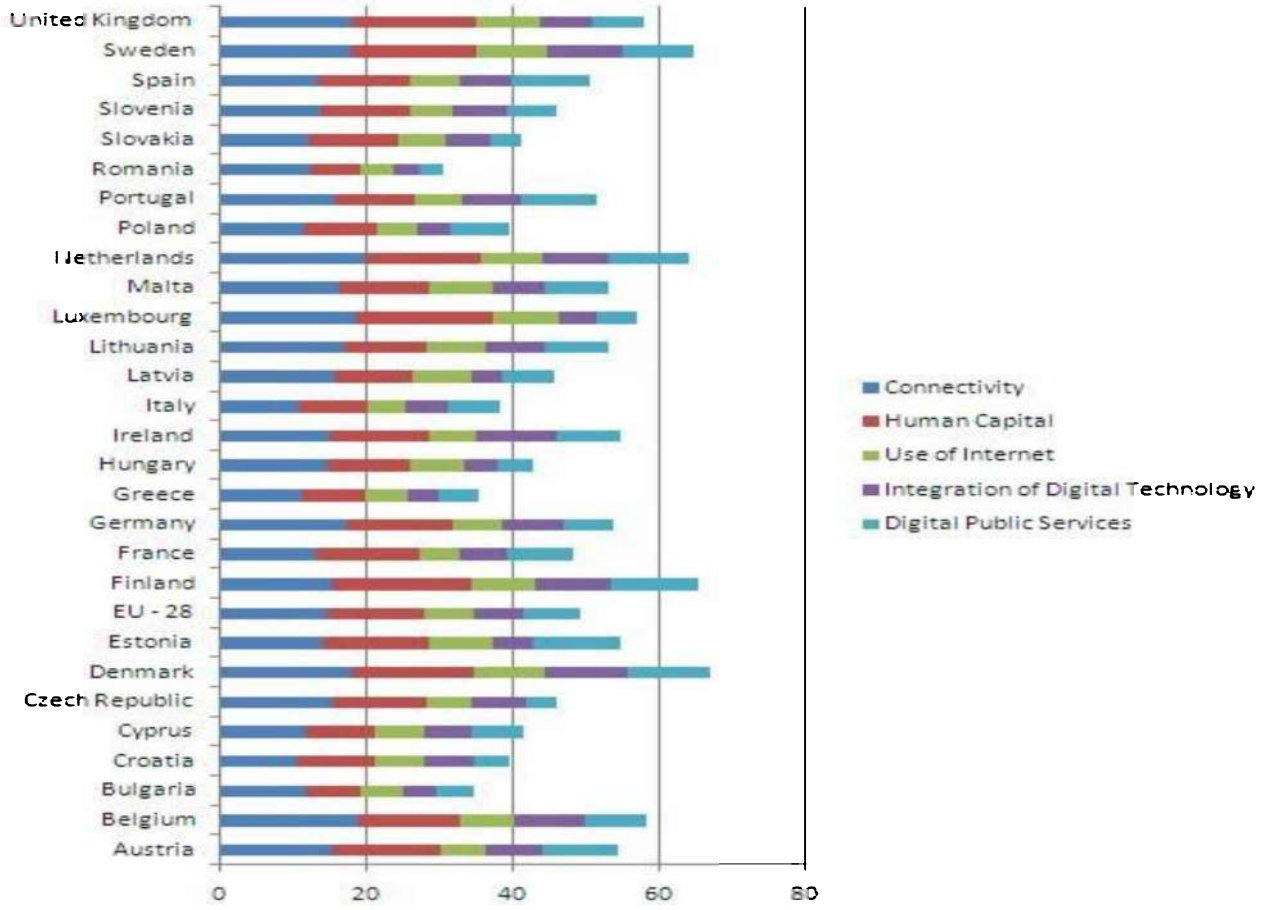

Figure 1: Digital Economy and Society Index, Source: European Commission, 2017

On basis of DESI value, it is possible to perform grouping into the three clusters. The first cluster comprises the states with high performances according to the DESI Value: Denmark, Finland, Sweden, Holland, Luxemburg, Belgium, Great Britain, Ireland and Estonia. The second cluster comprises of the states with middle performances. The value of DESI score for these states is similar to the average value for the whole EU. The second cluster comprises Austria, Germany, Malta, Lithuania, Spain, Portugal, France, Slovenia, Czech Republic and Latvia. The third cluster comprises the states with the worst DESI score: Slovakia, Hungary, Poland, Croatia, Italy, Greece, Bulgaria and Romania.

Figure 2 shows the growth of DESI in the period 2014-2017, where the year 2014 is taken as the base. On basis of this index, the European Union as the whole advances: DESI for 2014 was 0.43, for 2015 was 0.46, while in 2016 it was 0.49. In 2016, Slovakia and Slovenia advanced the most (more than 0.04, unlike the average for the EU of 0.028). On the other hand, low growth was recorded in Latvia, Germany and Portugal (below 0.02). The rank of states in the observed period changed very little, mostly for one position and only in case of some states. The states with the highest and the lowest DESI have kept their positions in the observed period.

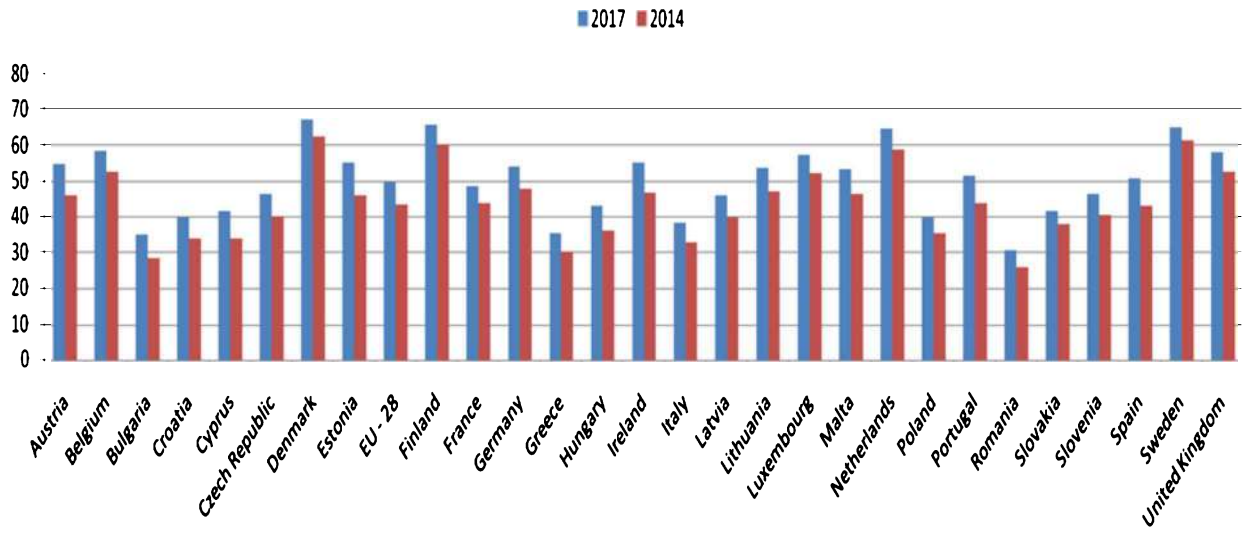

Figure 2: Digital Economy and Society Index – growth 2014-2017, Source: European Commission, 2017

Observed by main dimensions DESI score gives a better insight into the rankings. On *Connectivity dimension,* the highest score in 2017 was obtained by the Netherlands (0.82) followed by Luxembourg (0.79), Belgium (0.78) and Denmark (0.76). Poland (0.52), Bulgaria (0.52), Greece (0.48) and Croatia (0.45) had the weakest performance regarding *Connectivity dimension*. For the observed period 2014-2017, these four countries are leaders by this dimension, while Italy and Cyprus were also at the forefront. Regarding the *Human Capital dimension* Finland (0,76), Luxembourg (0.73), United Kingdom (0.71), Sweden (0,69) and Denmark (0,67) obtained the highest scores in 2017, while Greece (0.35), Bulgaria (0.30) and Romania (0.28) got the lowest ones. These countries are at the top and bottom of the whole observed period 2014-2017. Regarding the *Use of Internet dimension* Denmark (0.72), Sweden (0.71), Luxembourg (0.64) and the Netherlands (0.62) obtained the highest scores in 2017. On this dimension, Poland (0.40), Bulgaria (0.38), Italy (0.36) and Romania (0,29) are at the bottom of the list. These countries are at the forefront for the entire observed period, while Denmark, Sweden and Finland are the leaders regarding the Use of Internet. As for *Integration of Digital Technology dimension* in 2017, businesses are the most advanced in Denmark (0.62), Ireland (0.56) and Finland (0.56), and the least developed in Latvia (0.23), Bulgaria (0.22), Poland (0.21) and Romania (0.19). Similar results were apparent for the whole period 2014-2017. European leaders in *Digital Public Services* are Estonia, Finland and the Netherlands, while Romania, Hungary and Croatia are lagging behind. In 2017, Estonia achieved 0.84 for this dimension, while in Romania it was 0.27. The average value for the EU was 0.55.

In order to provide an international compatibility, digital performances of the EU Member States have been compared with 15 states that were not the members. The International Digital Economy and Society Index (I-DESI) was created for that purpose in 2016. The referred index differs from DESI according to its components. The reason is that certain indicators are not available for the states outside the European Union. The following states have been taken for the comparison: Australia, Brazil, Canada, China, USA, Island, Israel, Japan, South Korea, Mexico, New Zealand, Norway, Russia, Turkey and Switzerland. The comparison was performed both with the EU Member States and with the average values for the complete EU. The leading states in the EU regarding the digital performances, Denmark, Sweden and Finland are global leaders also regarding the I-DESI score. These three states are followed by Japan, USA and South Korea. However, if the average values are taken for the EU as the whole, the values are below the average at global level measured by I-DESI methodology (European Commission, 2017).

6. CONCLUSION

DESI methodology has a great importance in monitoring digital performances of states. Its further development and harmonization of indicators through I-DESI might be in the future a global indicator for monitoring the level of digitalization development in certain states. The advantage of this composite index is that it comprises a broad spectrum of different indicators. In this way, states can get a clear insight in which spheres of the digital economy they are lagging.

It is noticeable that the leading industrial states of the European Union like Germany and France are lagging in implementation of digital economy behind the Scandinavian states. Italy is even in the last cluster

regarding the DESI. Due to the implementation of the digital economy, Baltic states have improved significantly their international competitive position. States candidates for the accession to the European Union are not included in DESI methodology. The problem is also that statistical offices of certain states do not monitor all the indicators that are the components of this index. It is necessary that these states improve their information-communication capacities in the next period in order to keep on successfully one day with other member states. Bulgaria, Romania and Croatia, as the last associated states, have not managed to do that, while the Baltic states based their competitive advantage just on the digital economy.

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GEOGRAPHIC INFORMATION SYSTEM – ONE STEP FORWARD IN THE DIGITAL AGE

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Abstract: *In recent years information technology has grown very rapidly. In the context of GIS, free/open source concept and three-dimensional implementation have also increasingly developed in recent years. The usage of these types of softwares is rapidly growing, so this paper describes the wide range of applications of GIS. It describes the major characteristics of GIS, as well as the reasons for the application of GIS in the analysis, modelling and display characteristics. The paper is focused on application of geoinformation technologies in mapping and managing in urban planning. Hence, in the paper are given examples of some GIS tools that can be used to manage data, no matter how big they are or what's their type.*

Keywords*: application, components, GIS, maps, data management*

1. INTRODUCTION

Geoinformation technologies are a new group of tools, methods, instruments and systems developed in recent decade to improve acquisition, processing, display and use of geoinformation technologies. Examples of such tools are GPS (Global Positioning System) receivers, GIS (Geographical Information System) tools, algorithms for spatial data modelling, remote sensing techniques, geostatistical tools etc. Geographical information system (GIS) technologies have been widely applied at all scientific fields and practical activities. These systems may be used as an aid to calculation of subsidies, serve as means of control and as support in decision making while following the latest technologies and standards.

GIS can be implemented as a comprehensive, multipurpose system (e.g. GRASS, ArcGIS), as a specialized, application oriented tool (e.g. GeoServer), or as a subsystem of a larger software package supporting handling of geospatial data needed in its applications (e.g. hydrologic modlelling system, geostatistical analysis software, or a real estate services Web site). The multipurpose systems are often built from smaller components or modules which can be used independently in application oriented systems. GIS represents a set of related objects and activities that serve with their mutual relations the general purpose which is decision making of spatial activities. This system based on computer technology that enables archiving and manipulation of spatial data, is designed to provide answers and establish relationships between different data and enables us to make the right decision faster and safer. Also, GIS is very useful in marketing research, in geology and construction, as well as in all other areas using maps-related data.

2. MAIN GIS COMPONENTS

GIS is established on the basis of certain principles, of which the most important principle is integration, and this is the most important ability of GIS. There are not other system that can integrate, ie unify, spatial and non-spatial information in this way. Then, there is the principle of availability. The principle of data editing is achieved by the perfect combination of hardware components, software, experts and excellent database. Then, the principle of terminology and language definitions, which means that the GIS language has a formalized character defined by ISO standards. The last, but not less important, is the principle of visualization, so that the data is clearly displayed and understood by their users.

A GIS can be divided into five components: people, data, hardware, software, and methods (procedures), as showed in Figure 1. All of these components need to be in balance for the system to be successful. No one part can run without the other.

Figure 1: GIS components

Human resources represent the core of GIS, and make it functional by correcting the disadvantages of this system. Spatial data is a set of attributes (qualitative, quantitative, descriptive ...) that explain or define an element of GIS (object, event, activity ...). Information systems transform data into information. Data in GIS are organized from a human-oriented to computer-oriented: real world → conceptual model → physical model → logical model, as shown in Figure 2:

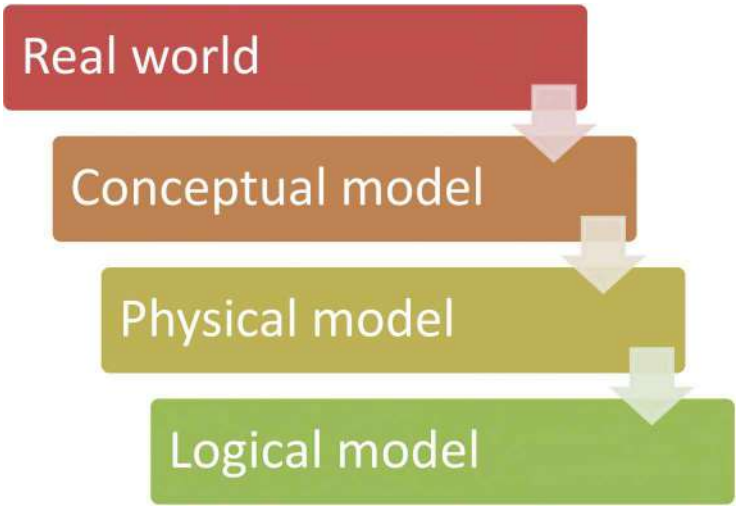

Figure 2: GIS data organization

Hardware affects the speed of the process, the way the system is formed, and the format of the output data. Software does not only include actual GIS software, but also various database software, drawing software, statistical software, software for analysis and photo processing, etc. Processes with different analyzes require well-coordinated methods to produce correct and required data.

3. VARIOUS APPLICATION OF GIS

3.1. GIS in forest inventory

GIS has shown as a good practice for forest management because it provides people with information that help better planning and making good development decisions. By creating maps in GIS tools it is possible to detect forest location, relations with the nearby places, and to find out what spatial patterns exist. Moreover, by surveying forest during longer period of time and creating maps, creation of overall difference map can be obtained. This map actually contains information about changes that happened during time of interest. The Forest Atlas is a dynamic tool that helps decision makers in the region to achieve sustainable management

of forest resources through strengthened land use planning and monitoring. Through a combination of interactive mapping applications, posters and analytical reports the Atlases provide users with timely, accurate, and synchronized information about land use allocation within national forest estates. With forest management becoming increasingly complex, due to greater environmental and social involvement and pressures, GIS is likely to play an increasingly central role. Application of GIS in forest inventory is shown in Figure 3.

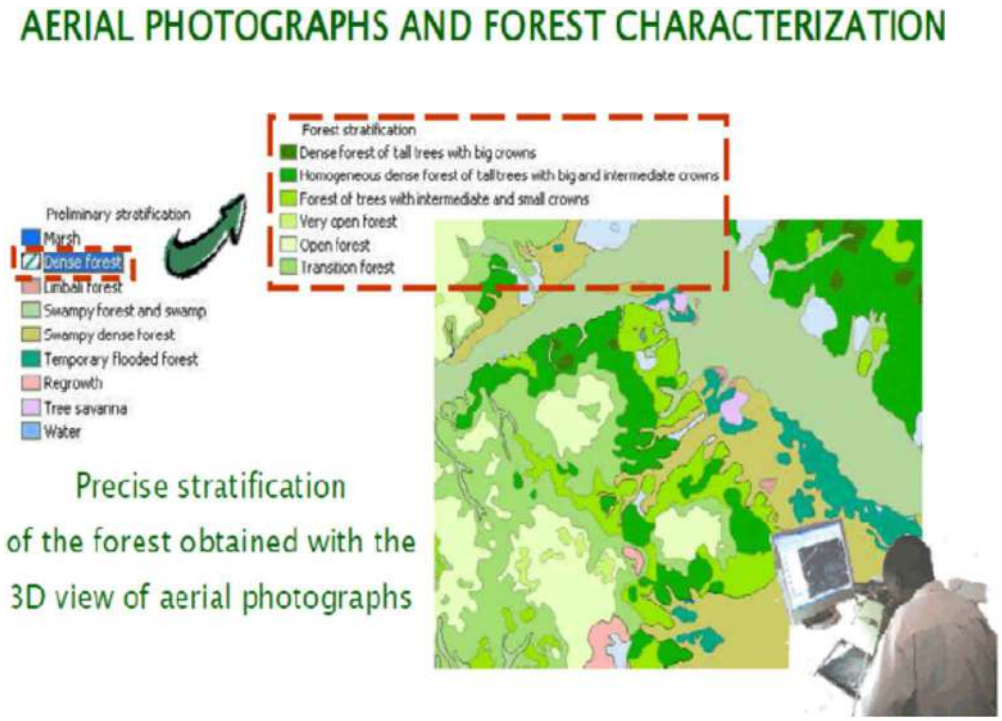

Figure 3: GIS in forest inventory

3.2. GIS in flood protection

Most of the human casualties in the last few decades have been caused by floods. In addition, material damages that result from this natural disaster reach great intensities. This is due to climate change, urbanization and other natural and anthropogenic factors. It is precisely here that GIS systems play an important role in the analysis and forecasting of potential risks from the occurrence of floods, as well as their mapping and analysis of vulnerable areas. It is important to create a system that will provide early warning and allow evacuation of the population before the flood waters reach the houses. Flood risk mapping involves hydrologic and hydraulic analysis, damage and risk calculations, and mapping of the floodplain. The predicted water levels and floods for the next 24 and 48 hours can be displayed via dynamic web pages, and overlaid with maps of the transportation network, property boundaries, municipal infrastructure and water depth contour lines. This combination of technology and software can provide good flood prediction precision and strong support to the public evacuation if flood events happen. The basic inputs for automated floodplain delineation are the DTM and the water levels at the cross sections obtained from the water gauges. The floodplain depth datasets are generated by computing the elevation difference between the water surface TIN and the ground surface DTM data. Based on flood depth data, the floodplain extent and flood depth contour maps can be generated. The Web-GIS interface is designed to calculate and display the spatial extent of predicted flood plain (see Figure 4), enabling the visualization of the transportation network, property boundaries, municipal infrastructure, flood polygons and water depth contour lines.

Figure 4: Flood risk map

3.3. GIS in tourism

Both tourism and IT increasingly provide strategic opportunities and powerful tools for economic growth, redistribution of wealth and development of equity around the globe. GIS technology offers great opportunities for the development of modern tourism applications using maps. This technology integrates common database operations such as query with the unique visualization and geographic analysis benefits offered by maps. GIS is used for bringing the georeferenced data (spatial and non-spatial) of geographic location Zlatibor and Zlatar into digital maps. Each object is assigned to a thematic layer. Each layer combines related objects like roads, building, protected areas or watercourses (Figure 5). GIS can be used in three types of applications such as inventory, analysis and evaluation of plan based on tourism development.

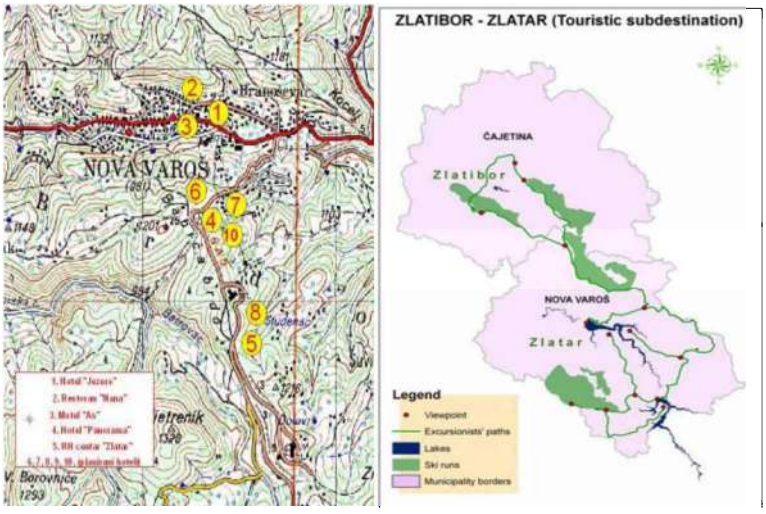

Figure 5: Maps with hotels at Zlatibor and Zlatar, tourist areas and main attractions

4. APPLICATION OF GIS IN URBAN PLANNING

Urban planning involves many functions, scales, sectors, and stages. In general, the functions of urban planning can be classified into general administration, development control, plan making, and strategic planning. Different functions, scales, sectors, and stages of urban planning make different uses of GIS. GIS tools are very important when considering making decision support systems for urban development, urban planning and usage ways of these areas, as well as making optimal solutions in terms of traffic regulation,

public transport and construction of various catering facilities. By using the GIS tool, you can create maps that graphically display current data of interest about an urban area. Based on the interpretation of these maps, planners and architects can make a decision where it would be the most rational to build facility, or how to regulate the green areas of the city or how to optimally manage traffic based on the analysis of the busiest parts of urban areas at different times of the day. GIS can also be used to model different development scenarios. It can show the modelling results in graphic form, making them easy to communicate with the decision-makers.

As an example of the application of data management for urban planning, one area of the city of Novi Sad- the Student campus, was chosen. In the case study, for representation of all above mentioned applications and for digital map creation, Google map is used. The aim of this paper is just to show various possibilities of GIS tools. In other circumstances, it should be used orthophoto or some other map with higher accuracy and better resolution. There are many programs that are used to create and visualize spatial data. Most professional programs are commercial, and they are free for some limited purposes. Commercial software usually comes in a combination of 3D display main elements, with additional features, such as GIS applications. They also allow working with geospatial data-on a large number of devices, as well as on the Internet search engine. The first step, using one of the programs, was digitization. Namely, the vectorization of scanned plans provides digital cadastral maps in vector form, which are presented in such a way and stored in digital form, represent a valuable database. Figure 6 shows the map of the Student campus in Novi Sad, and then the same digitized (on the left side the vectorization was done, all the streets, objects, parks were drawn, while on the left side are formed polygons- closed areas)

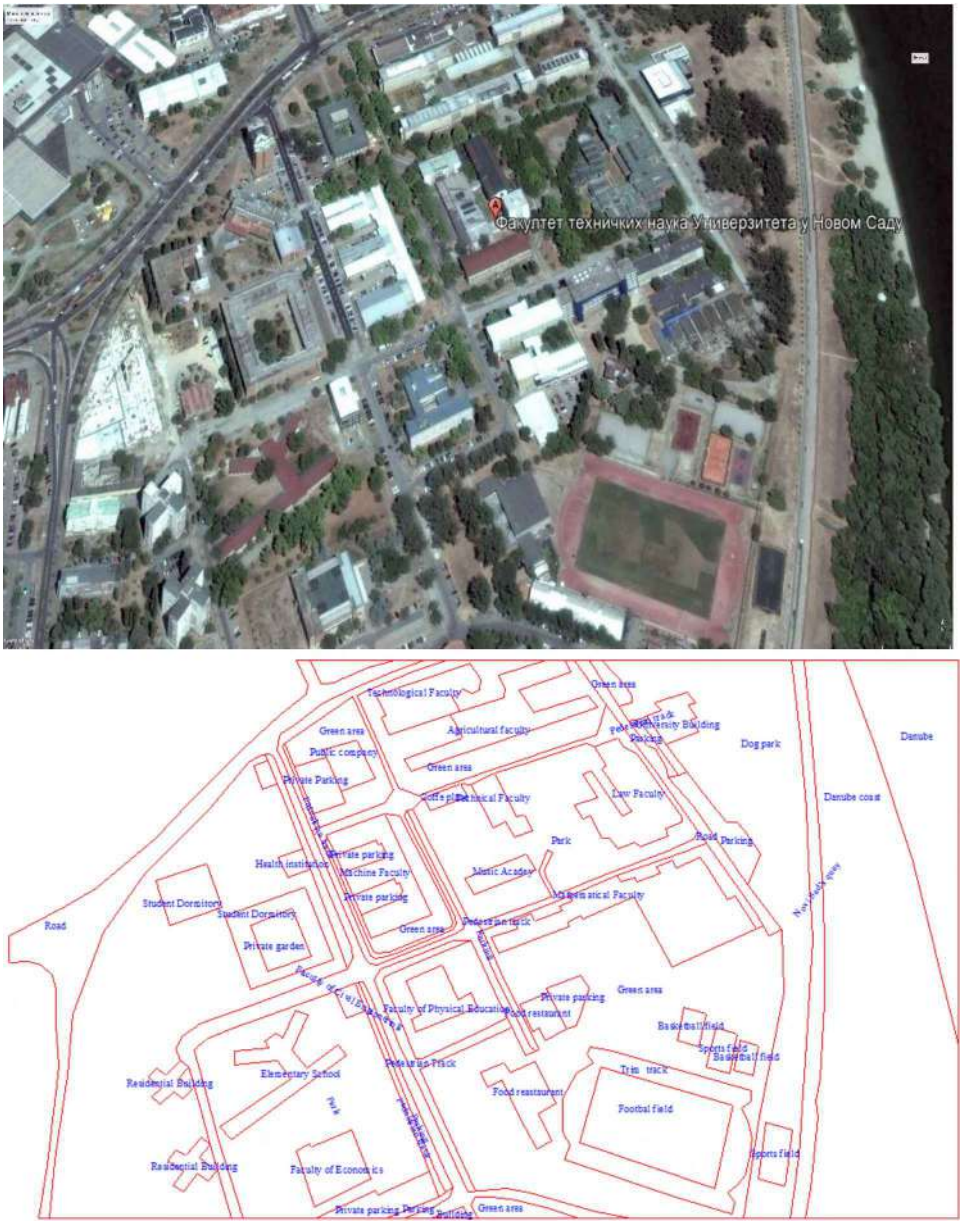

Figure 6: Map of case-study selected area and the same digitizied map

After forming data in the appropriate form for manipulation, it is possible to use various queries, that make selection based on the given criterion. Figure 7 shows a simple query that selects a particular object. Namely, this query has a wide use for quickly finding of a particular object, in terms of navigating throughout the city, for navigation and orientation etc. It can also serve when creating applications for tourists, where tourists can easily find all objects and areas of interest.

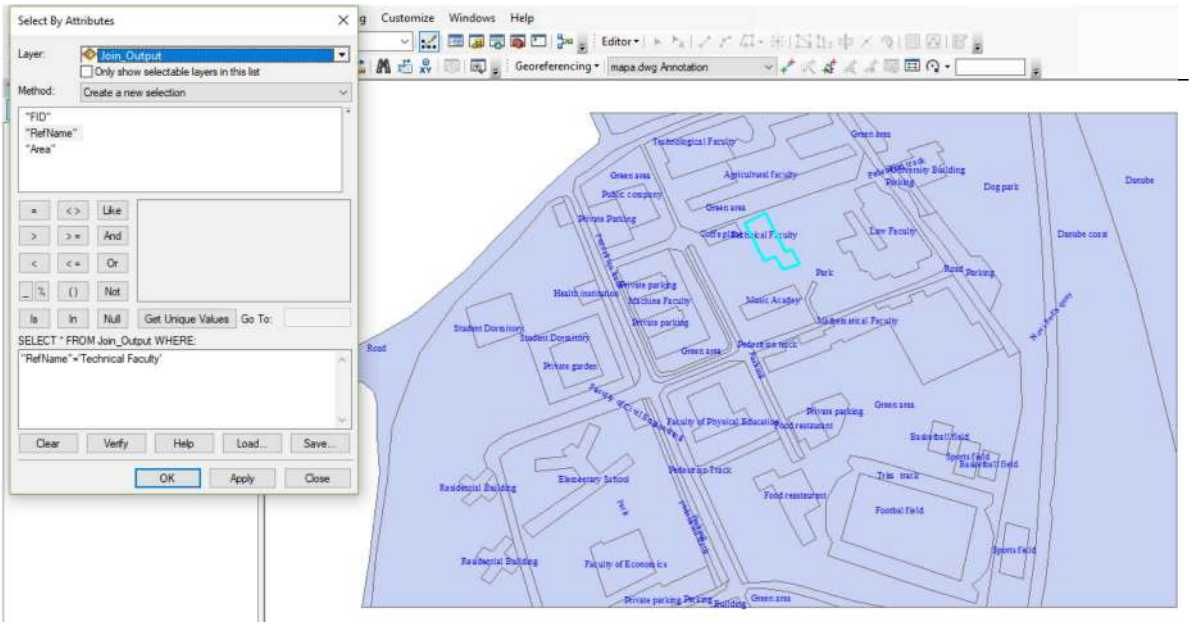

Figure 7: Selection of specified object

In addition, GIS allows an analysis of the distribution and representation of land types. It plays a great role in the expansion or regulation of parks and other green areas in accordance with urban plans. In the basis of selection, all parks with an area smaller than the given reference value (blue surfaces) are shown in Figure 8. This means that any polygons larger or smaller than some values can be selected, for updating or creation of maps, comparison with the situation in the Real Estate Cadastre or Land Cadastre and many other purposes.

Figure 8: Selection of all parks that have area smaller than predefined

Too high objects in some area can cause disturbances in terms of disrupting the harmony of the settlement. GIS technology is also used to check compatibility with the urban plan and to quickly find these facilities. Figure 9 shows the selected objects whose height is higher than the predefined value:

Figure 9: Selection of objects higher than predefined value

Figure 10 shows the application of geoinformation technologies for distance calculation, i.e. by marking the starting and ending points, and by defining a specific query, the shortest path is plotted, and its length is calculated:

Figure 10: Path from Health institution to Mathematical Faculty and Its distance

5. CONCLUSION

Most people think GIS is only about “making maps”. But governments, businesses and people harness the power of GIS because of the insights of spatial analysis. Before GIS, cartographers mapped out the land using paper maps. Over the years, people have witnessed a gradual shift away from paper maps. Instead, users build digital maps with computer-based spatial data.

Some of the largest problems of our planet are best understood spatially. For example, climate change, natural disasters and population dynamics are all geographic in nature. So, how to solve such problems in GIS? The answer is through spatial analysis which understand relationships between spatial and attribute data.

GIS is very important tool when it comes to natural hazards management and development planning. They can improve the quality and power of analysis and assist planners. This paper showed wide usage of GIS in data processing and management in the digital age, especially on example of urban management.

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DOING BUSINESS IN THE DIGITAL ECONOMY: SWOT MATRIX ENHANCEMENT FOR HIGHER ORGANIZATIONAL PERFORMANCE

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Abstract: *The article covers an analysis of possibilities for enhancing the well-known SWOT analysis for the digital age. SWOT analysis is one of the most frequently exploited strategic business and marketing planning methods, commonly used for the formulation of business, and/or marketing strategy. However, its implementation is predominantly based on occasional, not so formalized, and well defined procedures, making it in a significant sense a victim of subjectivity. The proposal is to overcome this lack of SWOT analysis by basing it on contemporary strategic planning approaches and tools for determining the real facts concerning its internal and external elements appraisal, such as, the resource-based view of the firm, the core competence of the firm, contingency planning, competitive intelligence and, social media listening. The accuracy with which the SWOT analysis is being performed determines significantly the quality of developed strategies and hence the expected organizational performance.*

Keywords*: SWOT, digital economy, the resource based view of the firm, the core competence of the firm, contingency planning, competitive intelligence, social media listening*

1. INTRODUCTION

The development and increased usage of digital computing technologies in business purposes has brought to the development of the digital economy. The term *digital economy* was coined and popularized by Don Tapscott in his 1996 book *The Digital Economy.* It appeared with the advent of the Internet and World Wide Web, which enabled a new economy based on the networking of human intelligence. In this digital economy, individuals and enterprises create wealth by applying knowledge, networked human intelligence, and effort to manufacturing, agriculture, and services. Kling and Lamb (2000) identify four subsectors of a digital economy: (1) Highly digital goods and services - these are goods that are delivered digitally and services of which substantial portions are delivered digitally; (2) Mixed digital goods and services - these include the retail sale of tangible goods such as music, books, and flowers via the Internet, as well as services such as travel reservations; (3) IT-intensive services or goods production - these are services that depend critically on IT for their provision; (4) The segments of the IT industry that support these three segments of the digital economy. Nowadays, digital economy intertwines with the traditional economy in larger scale, abounding in the total revenue share across organizations in every industry. It reshapes the way of doing business and competition by interconnecting and including every individual stakeholder in the life of organization from the very beginning. In digitally interconnected world, defined with the global competition, fast and significant changes, increased business complexity, faster information and communication flow, organizations have to apply an appropriate way of doing business and new concepts in the process of strategy development in order to achieve business success and leadership. The dynamic environment of the digital economy and the necessity of organizations to respond to the opportunities in the environment in the fastest, the broadest, and the most profitable manner, requires dynamic business planning model, that will enable organizations to respond to newly developed changes in the environment in every moment, to seize the newly developed opportunities, as well as to create the new ones, and to position themselves above competitors (Milić, 2008). In terms of discontinuity it is necessary to constantly monitor the environment and study the changes, with the aim to establish how they will affect the position of the organization in the market and the results of its operations, in order to consider possible ways to react by changing the objectives, structure and strategy of the organization, in order to preserve the organization's ability to achieve its business objectives. Management who behaves responsibly towards customers adjusts the activities of the organization to changed conditions in the market of products and services (Ilić, 2001).

SWOT matrix appears nowadays as the most widely used tool for analysis of the business environment. Traditionally related to the old economy, SWOT analysis can be very beneficial in a digital business world as well. It acts as a source of information for strategic planning, builds organization's strengths and reverses its weaknesses, maximizes its response to opportunities, overcomes organization's threats. SWOT analysis provides information that helps in synchronizing the firm's resources and capabilities with the competitive environment in which the firm operates. (https://www.managementstudyguide.com/swot-analysis.htm)

Whether operating in traditional or digital business environment, SWOT analysis appears as a vital tool for strategy development. However, the subjectivity, the lack of trust and the lack of willing for facing the reality can make it difficult for organization to obtain a realistic image of itself and its environment (Andrews, 1980, seen in Milićević, 2011). Hence, its strategies can be misleading and costly. The main reasons for this issue can be determined in two sources: aspects which are not in control of management, such as price increase, inputs/raw materials, government legislation, economic environment, etc. (https://www.managementstudyguide.com/swot-analysis.htm), and the other source lies in the techniques commonly used to identify the strengths and weaknesses of organization, as well as opportunities and threats arising in its external environment. The paper first introduces SWOT matrix with specific elements related to the digital economy. The enhanced SWOT matrix follows, with concluding notes in the end.

2. SWOT MATRIX IN THE DIGITAL ECONOMY

SWOT matrix came from the research conducted at Stanford Research Institute from 1960-1970. The research was funded by the Fortune 500 companies to find out what had gone wrong with corporate planning and to create a new system for managing change. The Research Team were Marion Dosher, Dr Otis Benepe, Albert Humphrey, Robert Stewart, Birger Lie (Humphrey, 2005). Since then, it has become the unchangeable tool for strategic business and/or marketing planning. It precedes any functioning of the company, which makes it suitable in the following situations: (1) exploring the possibilities of new initiatives; (2) making decisions on the implementation strategy of the new policy; (3) identifying possible areas that need to be adjusted; (4) processing and redirecting plans. This analysis is an excellent tool for organizing information, presenting solutions, identifying barriers and highlighting opportunities.

SWOT matrix is a tool for planning strategies that faces internal strengths and weaknesses of the organization with external opportunities and threats over which the organization has no control (Certo, 2003, seen in Milićević, 2011). In the essence of the tool, the organization should activate the strengths, overcome weaknesses, seize the opportunities, and defend itself against the threats. At the beginning of the eighties, H. Weihrich (1982) developed the TOWS matrix, which analyzes the same factors as SWOT, only based on the result of external factors, in reverse order in relation to the methodological approach of SWOT (Figure 1).

External factors / Internal factors	STRENGTHS (**S**)	WEAKNESSES (**W**)
OPPORTUNITIES (**O**)	SO: Maxi – maxi strategy	WO: Mini – maxi strategy
THREATS (**T**)	ST: Maxi – mini strategy	WT: Mini – mini strategy

Figure 1: The TOWS matrix

The basic strategies that came out from this TOWS initiative are: (1) SO: Maxi-maxi strategy - SO strategy uses internal strengths of the company to take advantage of external opportunities. This is the best strategy (maxi-maxi), but many companies are not able to apply it. Companies often must first apply some of the remaining of the three strategies in order to be able to apply the aforementioned strategy. (2) WO: Mini-maxi strategy - WO strategy is used when sometimes the key opportunities from environment are present, but the company has internal weaknesses that prevent it to seize the opportunity. WO strategy aims to correct the weaknesses to take advantage of chances (mini-maxi). (3) ST: Maxi-mini strategy - ST strategy uses company strenghts to avoid or minimize threats (maxi-mini). This does not mean that a strong organization should always avoid threats. It is essential that companies assess and measure the severity and immediacy of the threat before choosing this strategy. (4) WT: Mini-mini strategy - WT strategy is a strategy aimed to minimize weaknesses and avoid threats (mini-mini). The company faces a number of threats and its weaknesses can integrate, lead to bankruptcy or closing.

Since business and/or marketing strategy comes out as the result of this confrontation of internal and external factors, precise identification of internal and external variables is of the key importance for successful strategy development, and serves as the fundamental basis for successful strategic planning in

the case of SWOT analysis. Internal strengths and weaknesses of the organization operating in the digital economy cover three main components of the digital economy (Mesenbourg, 2001):

- E-business infrastructure, which relates to hardware, software, telecoms, networks, human capital, etc.
- E-business, which relates to how business is conducted, any process that an organization conducts over computer-mediated networks
- E-commerce, which relates to transfer of goods.

Identifying internal strengths and weaknesses in the digital economy is a demanding task that can be supported by the set of questions presented in Table 1. given in the Appendix of this paper.

The external appraisal of opportunities and threats includes the political, legal, economic, social, technological and competitive environment evaluation. The set of possible questions related to digital external opportunities and threats appraisal that can help in addressing this issue are presented in Table 2. given in the Appendix of this paper.

In its extension, SWOT analysis contains separated positive and negative factors which are related to a company and its competitors. In the process of strategy development, positive factors that include current strengths, future opportunities, and closely achieved success on the side of the organization, and weaknesses of its competitors are facing negative factors that contain current weaknesses, future threats, closely suffered failure on the side of the organization, and strengths of its competitors (Handscombe & Norman, 1989, seen in Milićević, 2011).

3. SWOT MATRIX ENHANCEMENT FOR HIGHER ORGANIZATIONAL PERFORMANCE

The above mentioned subjectivity issue of the SWOT matrix is largely driven by the process of SWOT analysis implementation.

The procedure usually begins with the discussion related to mission statement, objectives, and characteristics of the organization to set the stage for the SWOT analysis. In the following step, key factors related to internal strengths and weaknesses of organization, as well as external opportunities and threats are identified. In the next step, each key factor receives its score in determined range by each team member. Generation of potential strategies responding to each determined key factor follows, adopting strategies that are driven by the highest rated key factors (Dyson, 2004).

A common technique used to identify the strengths and weaknesses of organization is a brainstorming session with the group of 10-12 members (Young, 1989, seen in Milićević, 2011). The same technique is used for external appraisal as well. Preferably SWOT analysis should be carried out by company managers, but in cooperation with the external consultants having special analytical skills and independent view. This is significant because in organizations is often present either too optimistic or pessimistic view that is more pronounced, and this is reflected in the managerial perception. Definition of strengths and weaknesses in practice is partly a question of facts, and partly a matter of judgment. Subjectivity, lack of confidence and the desire for confrontation with reality may complicate the organization to know itself (Andrews, 1980).

This subjectivity issue can be controlled using modern approaches and concepts in strategic planning, such as the resource-based view of the firm, the core competency of the firm, contingency planning (Dyson, 2004).

In the case of extended SWOT analysis implementation, it can be further enhanced by applying the concept of competitive intelligence in the segment of competitor strengths and weaknesses identification, and social media listening in the digital business world also in the segment of external appraisal.

These contemporary strategic planning approaches and concepts provide objective foundation for gaining facts and arguments, while identifying key factors related to all the wings of the extended SWOT matrix.

The resource-based view of the firm focuses on the internal resources as key to the superior organizational performance. It was developed in 1980s and 1990s with the major works of Wenerfelt (1984), and others. The essence of this approach is that it takes into account only internal company resources to find sources of competitive advantage instead of searching at external environment for it. The resource-based view relies on tangible and intangible resources that are heterogeneous and immobile. Intangible resources possess higher competitive advantage potential relating to tangible resources, which can be shortly supplied by other competitors of the company, which makes them to be considered as the main source of sustainable competitive advantage. Barney (1991) further developed the resource-based view by selecting specific

criteria, that a resource is to meet in order to be classified as a strategic one. The criteria refer to valuability measured by the resource capacity to increase the organisation's effectiveness and efficiency, rarity which means that resources are rare and in high demand, inimitability which means that resources are difficult to imitate, and substitutability which means that resources are not readily substituted.

The core competence of the corporation was developed by Prahalad and Hamel (1990). It is also internally turned identifying organisation's competencies as the foundation for strategy development. A company's competitiveness derives from its core competencies and core products - the tangible results of core competencies. The core competence is the collective learning in the organization, especially the capacity to coordinate diverse production skills and integrate streams of technologies. It is also a commitment to working across organizational boundaries. Organizing around core competencies requires a radical change in corporate organization. The first step requires identifying core competencies, which meet these three requirements: they provide potential access to a wide variety of markets, make a contribution to the customer benefits of the product, and are difficult for competitors to imitate. The next step is to redesign the architecture of the company and provide an impetus for learning from alliances and a focus for internal development. Management should ask: How long could we preserve our competitiveness if we did not control this core competence? How central is this core competence to customer benefits? What opportunities would be foreclosed if we lost this competence? As one can see, the core competence of the firm also focuses on internal environment in its search for competitive advantage source.

Dyson (2004) observes these more contemporary approaches to strategy formulation as developments of the internal appraisal of SWOT analysis, which can enhance SWOT analysis by serving as objective measures of internal organizational environment. The advantage of SWOT analysis is its attempt to connect internal and external factors to stimulate new strategies. Hence resource and competency-based planning can enrich SWOT analysis by developing the internal perspective whilst keeping internal and external perspectives in play simultaneously. Therefore it is possible to see it as a firm foundation for resource and competency-based planning. Similarly, contingency planning is superficially a rather different technique that is completely focused on the external environment and identifies key external factors in a similar way to the external appraisal of SWOT analysis. The contingency planning evaluates "if-then" relationships (Milićević, 2011) resulting in the development of scenarios, and can thus also enhance SWOT analysis (Dyson, 2004).

Further, funding on the above described rationalization, one can conclude that the extended SWOT analysis can additionally be enriched and made more objective with the introduction of the competitive intelligence approach. Competitive intelligence is a concept that provides organizations to know their competitors, allowing them to predict the next moves of competitors, devise strategies that will allow them to exploit their weaknesses, block their strengths and achieve victory. Competitive intelligence is the activity of observing the external environment of the company in order to obtain information relevant to the decision-making process in the company (Gilad & Gilad, 1988). It is an analytical process that transforms disaggregated competitive knowledge in relevant, accurate and useful strategic knowledge about competitors, position, performance, capabilities and intentions. It has a wide range of information, which, when harvested and analyzed, offers a fuller understanding of the organizational structure, culture, behavior, capacity and weaknesses of the competitor (Sammon et al., 1985). Competitive intelligence refers to the selection, collection, interpretation and distribution of publicly divulged information about competitors, which have strategic importance. Competitive intelligence uses public sources to locate and develop information into knowledge of the competition and the competitors (Mcgonagle & Vella, 1990). This knowledge includes the following: competitors, technology, regulatory and legal changes, suppliers, material, trends in the industry and market, political and economic changes. Competitive intelligence allows organizations to understand: how competitor rationalizes, what is his power, what is his weakness, where organizations can attack him, where the risk of attack is too big, etc. Competitive intelligence is used to: detect competitive threats, eliminate or reduce surprises, strengthen competitive advantage by reducing the reaction time to react, find new opportunities. It allows organizations to, by knowing their competitors, be able to anticipate their next moves, exploit their weaknesses, and block their strengths.

In the digital economy, given the importance of social communication and listening to every organization's future, social media listening seems to possibly appear as an approach that can also enhance the SWOT matrix objectivity, in the domain of external appraisal as well. Even though, social media listening model is not yet fully developed, and companies are still trying to find what suits them the best, organizations will derive more enterprise value from figuring out how to include listening into the business and its operations instead of merely treating it as a basic requirement. Social media listening can be done by organizations of all sizes, from small businesses to global enterprises. In the process, there are several steps that organizations should follow: (1) Organize for listening. There are three concepts for listening organizations: centralized listener, a person responsible for overseeing listening and, possibly, an organizational social media strategy; listening team, a group of people dedicated to listening, made up of individuals in the

company from either a single department or cross-functional; listening organization, this model is meant for companies where listening data is a resource utilized by multiple departments and functions. (2) Set the objectives in relation to business goals. Listening research needs to be anticipatory, innovative, action-oriented, and focused on making real business impact in order to make a valued contribution. (3) Define key performance indicators. Organizations that listen to social media conversations can compute metrics such as relating to business process improvements, which include quickening resolution time, increasing customer satisfaction levels, cost-efficiency gains, or profitability enhancement. (4) Determine the research subjects: the voices and conversation sources best suited to the listening program. Accessing the right conversations requires a number of steps: (a) choosing where to listen - online sources can be placed into one of two groups: brand backyard – company blogs, customer and private communities, discussion forums, e-mail, customer service logs, corporate Twitter accounts, and official presences on social networking sites like Facebook, or consumer backyard – publicly available online blogs, forums, ratings and review sites, Twitter and status update features, social networks like Facebook, or media-sharing sites like YouTube and Flickr, and offline word of mouth; (b) determining the footprint of sources where the topic of interest is talked about, locating the specific blogs, forums, social networks and other sites where conversations of interest take place; (c) vetting the sources, investigating the sources and choosing the most important ones based on topicality, focus, currency, and authority; (d) selecting sources to use for listening, from the search engines, social media monitoring, text analytics, private communities, full-service listening platform vendors (Rappaport, 2011). It allows organizations to develop and implement customer-centric programs, to reinvent sales, to identify where to promote products, and, to find customers before they find them.

An enhanced extended SWOT matrix in the digital economy based on the analyzed strategic planning approaches and concepts is proposed in Figure 2.

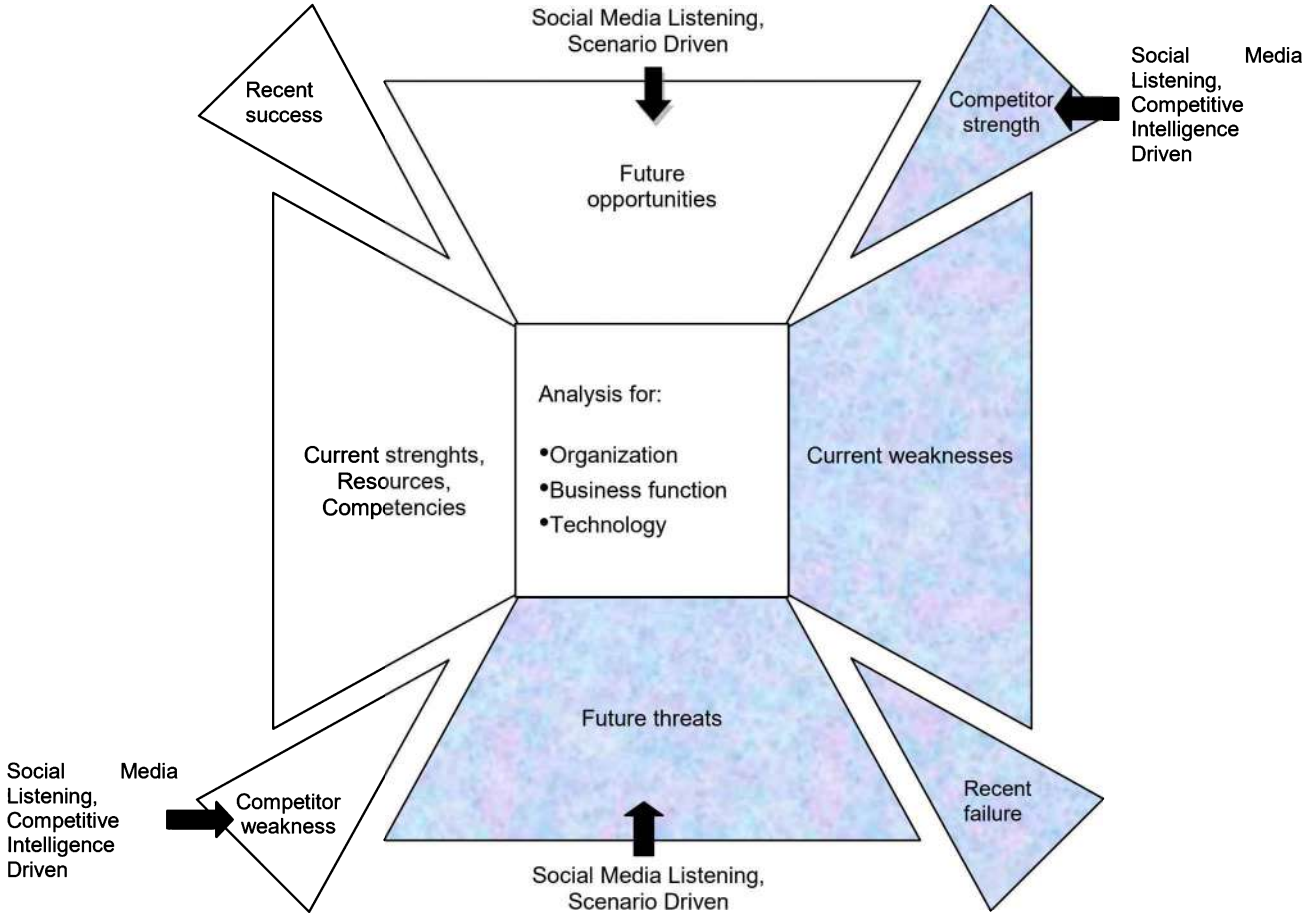

Figure 2: Enhanced extended SWOT matrix in the digital economy

4. CONCLUSION

SWOT matrix appears nowadays as the most widely used tool for analysis of the business environment. Traditionally related to the old economy, SWOT analysis can be very beneficial in a digital business world as well. However, the subjectivity, the lack of trust and the lack of willing for facing the reality can make it difficult for organization to obtain a realistic image of itself and its environment (Andrews, 1980, seen in Milićević, 2011). Hence, its strategies can be misleading and costly. In order to address this issue managers should turn to the contemporary strategic planning approaches and concepts, such as the resource-based view of the firm, the core competence of the firm, contingency planning, (and) competitive intelligence, and social media listening as tools, which have the potential to enhance the SWOT analysis objectivity, allowing it to play its role as a strategy development assistant securing higher organizational performance.

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APPENDIX

Table 1. Digital internal appraisal – strengths and weaknesses guiding questions (https://www.entrepreneurshipinabox.com/1484/social-media-swot-analysis/, adapted)
What is the experience of organization on digital computing technology?
What does organization do well, and what does wrong on them?
Does organization have enough staff for building a company presence on digital computing technology?
What is the motivation of company staff members for building the presence?
Does organization have an appropriate technology for building the presence?
How can organization use that technology?
What are the knowledge and capability of company employees to use that technology?
Do company employees use different digital computing technologies in their private life?
If they use something, can organization utilize that for its business purposes?
What is the level of cooperation between employees in organization?
Is management willing to use digital computing technologies?
Does management know how to train employees to use these digital computing technologies?
Does business allow entertainment?
Can company use that entertainment to build a presence?
What is the level of creativity in organization?
Does organization already have a website or blog that creates valuable content for its customers?
Are employees or company using these digital computing technologies for personal or business goals?
What are the types of digital computing technologies that organization uses, and how many technologies does it use?
What is company expertise in the industry?
What is the global expertise of company in the industry in which operates?

Table 2. Digital external appraisal – opportunities and threats guiding questions (https://www.entrepreneurshipinabox.com/1484/social-media-swot-analysis/, adapted)
Is the technological development in the field of digital computing technology an opportunity or threat for business?
What do customers value the most about business?
Are customers using technology to be present on digital computing technology?
What is the compatibility of company and company customers presence on these digital computing technologies?
What is compatibility of company employees and company customers presence on these digital computing technologies?
How does organization want its customers to communicate with its business?
How do company customers want to collaborate with company business?
Do company customers need training to use company products or services?
What strategies are using company competitors to build presence on these digital computing technologies?
How do company competitors communicate with their customers?
How do company competitors educate their customers?
Where are the customers of company competitors?
What is the expertise of company competitors?
What technologies are using company competitors?
Are company suppliers present on these digital computing technologies?
What impact can have company suppliers on company on these digital computing technologies?
Is there a threat that company supplier can enter company market?
Many illegal businesses are trying to sell through these digital computing technologies. What impact does this have on company?
Are in company community enough people trained to be a part of company business team?
Does educational system in company community include training about new technology?

STRATEGIC LEADERSHIP IMPACT ON NEW ORGANIZATIONAL CULTURE: EVIDENCE FROM A FAMILY-OWNED SME

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Abstract: *This paper analyses strategic leadership impact on the formation of a new organizational culture. It reviews different leadership strategies and styles used in the change management process while trying to identify those variables which influence its adaptation to exigences of the situation in the corporate environment. Through a case study, a reorganization project in a family owned small and medium enterprise (SME) existing for more than 60 years, will be explained how a corporate reorganization as a change process, could be accelerated and efficiently executed when the adequate leadership approach is applied. The research shows that leaders' styles and strategy, should be adapted to different phases of the change process, while continuously considering internal and external environments. In that way interdependence of strategic leadership and corporate culture, and their mutual influence brings positive effects on the reorganization.*

Keywords: *strategic leadership, corporate culture, change management, leadership strategies, situational variables*

1. INTRODUCTION

The past decade was marked by significant changes in the business environment, determined by few major shifts in the global economy. Globalization, as social, cultural, political, and economic phenomena, influenced and supported by innovation and advancement of the technology, have structured a new world setting. The decrease in costs and improvements in transportation and communication infrastructure, followed by trade liberalization have created a larger interconnection between the participants in the world economy. The Internet connectivity and the larger application of digital technologies, as well as rise in prosperity reflected in the raising number of consumers, are considered by McKinsey Global Institute research two crucial elements which have the major impact on evolution and growth of global economic flows (McKInsey Global Institute , 2014).

According to International Telecommunications Union (ITU) the internet usage grew by 170% in the period from 2010 to 2016 (ITU, 2018). The same source reports the overall ICT development in mobile-cellular telephone subscriptions by 135,2%, individuals using internet by 166,4%, fixed-telephone subscriptions by 73,1%, active mobile broadband subscriptions by 489,1%, and fixed-broadband subscriptions by 172% in this period (ITU, 2018). McKinsey Global Institute analysis suggested that 1,8 billion people, above all from the emerging markets, will become part of the consuming class (McKInsey Global Institute , 2014). Furthermore, the growth of the knowledge-intensive goods is reaching 1,3 times the rate of labor-intensive goods, which indicates the shifts and need in the education and forming systems. The contemporary business environment has created other unique business strategies which give the opportunities to local entrepreneurships to become important players in the global value chain from the very beginning of their existence. Even if there are concrete limitations to this, with an innovative, proactive and risk-seeking behavior, entrepreneurs are no longer confined to a local market when developing a new business (Girard, 2013). The earlier in its life cycle companies internationalize, the faster they will establish their position in the global markets. Continuously changing market conditions supported by globalization are identified as some of the main drivers for the internationalization of born global firms, as they facilitate and enable global operations (Doh & Luthans, 2009). In such an environment, creating and keeping a competitive advantage, as well as differentiation from the international competitors become more difficult. Small and Medium Enterprises (SMEs) are particularly affected by this situation. The limitations of the human and financial resources, technology, and infrastructure they face could be compensated by the agile organizational structure and motivated leadership, crucial advantages in the contemporary business circumstances. The recent years have shown the shift in the consumers' and costumers' report to the brands. They show more interest in the ethical policies, values, and practices companies communicate. Global competition together with higher importance and visibility of corporate culture to the external stakeholders, force companies to reassess and synchronize cultural, operational, and strategical aspects. Competitive advantage and successful operations are dependent on the ever-augmenting number of factors, the ability of leaders to

anticipate stakeholders' requirements, to adapt corporate strategy to the environmental conditions, and to support its implementation, receives the significant weight.

2. THEORETICAL BACKGROUND AND LITERATURE REVIEW

Hambrick and Pettigrew (2001) make the distinction between leadership and strategic leadership. Leadership can be referring to leaders of any level within the organization, whereas strategic leadership focuses on those at the highest levels within the organizational hierarchy. The authors point out that strategic leadership targets executive part, while not only considering the the relation between leaders and followers but focusing on both strategic and symbolic activities (Hambrick & Pettigrew, 2001).

The roles, functions, and behaviors of top managers differ from those of strategic leaders (Wideman, 2018). This will be described further in the case study, where we will point out the necessity of shfting the roles of managers and leaders during the reorganization, as well as adapting the leadership styles and strategies through different aproaches during stages of the change process. The simmilarities could be found in the works of Bass, who applied the research on leadership, through transactional and transformational leadership framework, to a top-level management (Bass & Avolio, 1990). According to author, a leader can have transactional, transformational, both, or none of those dimensions (Bass & Bass, 2008). Transactional leaders have a role to set goals, motivate, assess, and reward the team members while protecting and reinforcing corporate strategy, structure, and culture. At the other hand, transformational leaders focus on the creative, charismatic, and emotional aspect by intellectually stimulating and inspiring the group. Empirical research has shown that both characteristics are present in the same individual at the different intensities (Bass, 1998).

The tight coorelation between strategic leadership and organizational culture reviewed in the case study could be found in studies by Shein. Accoridng to him organizational culture evolves from its leadership at the same time it does impact the leadership's development (Schein, 1992). His further research shows how national, organizational, and occupational cultures impact performance of the organization (Schein, 2010). Aspects of culture and leadership were important in the following phase of this paper, where reorganization was analyzed through Kotter's Eight-step process for leading change (Kotter, 2018). The reorganization process was including transfer of knowledge, application of knowledge, and it identified also a characteristic of learning organization as described by Senge (2015) and Mikkelsen and Jarche (2015). During the reorganization process it was noticed that not all employees react in the same way. For this part of research, the theories of Maslow and McGregor were presented and used (Maslow, 1943; McGregor, 1957). The importance to adapt leadership styles in different situations were analyzed based on the Goleman's Six leadership styles (Goleman, 2000). Last sections of the case study are focused on review of leadership skills, through the model of Ancona (Ancona, 2018). As conclusion the interaction and interdependences between organizational culture, leadeship, and organizational effectivness are framed by the research of Parry and Proctor-Thomas (2002).

3. RESEARCH METHODOLOGY

The methodology used in this paper is theorethical and empirical research. In the Literature review section, thoeries relevant for the reorganization project described in the case study will be reviewed. The empirical part will be presented in the separate chapter, through a case study, where the change management process will be analized, described, and supported by the theoretical data.

4. CASE STUDY

4.1. Impact of organizational culture on strategic leadership

StSp's corporate culture differentiated it from its competitors because it was a reflection of the founder's charisma, innovative technology, product knowledge, his informal management style, personal values and practices which were highly adopted and promoted by the employees, both internally and externally. The informal communication, reflected in the operational procedures which were "customized" to almost every single business partner, was at the same time a source of both high operational inefficiency and competitive advantage. However, the patterns of the corporate culture which directed the way how the strategy was integrated into the daily operations were not tailored to motivate departments' managers to support the appearance of any new leader who will be capable to identify and capitalize on opportunities and hazards in both internal and external environments. For the successful implementation of the changes on the organization's both strategic and operational levels, it was necessary to evolve the general manager's

position – from being a CEO who inherited the company from her family to a leader who will conduct and adapt the company to the new micro and macro environmental circumstances. It was also important to understand and keep the positive aspects of the existing corporate culture and to give it a new direction and structure which will be more appropriate for the future strategy. Similar to other SME-s where changes are introduced and directed by a very small team, it was necessary to create such a mind-set where the same persons were able to combine strategic leadership and managerial skills, to be able to create a strategic vision which will be based on a unique business model, well managed resources, technology, innovation, recognizable culture, and to support it by operational excellence, efficiency, and quality.

By following the process comparable to the phases described by Kotter, such an environment was created where the structural changes could be set and the changes in corporate strategy were starting to be reflected in the corporate culture. The result was a higher flow of information and interaction between the functional areas, which made a stronger network within the team, and a better understanding of the need for changes. In the first phase of the process it was useful to have a newly employed member of the team to support the company's general manager in a transition period, and who could have an objective view on the situation and explain the sense of urgency for changes. It required the alternation of their management and leadership skills through the project life cycle. In this initial phase, it was quite difficult to get the support of the employees, who emphasized, even more, the existing culture and corporate practices. The General Manager started to realize that a lot of operational practices which reflected the corporate strategy and culture must be analyzed, reviewed, systematized and taken under control to be able to advance and fulfill the new strategy.

The reactions to the newly set practices among the different groups of employees were different. Members of the management were opposed to changes, as a consequence of the fear of losing control on the existing practices, processes, and procedures. They couldn't understand the need to change, and as they were opponent to it, it was necessary to invest more time to make it clear and to try to motivate them to transmit their knowledge, experience, and practices. As time passed, the other employees become curious to learn more about the corporate's new mind set, which caused a more direct and open communication in the team. After the initial phase when the initiative came from the top, employees gave their constructive opinion, suggest a solution or propose the best practice using the existing tools for the system improvement at their working place. Top management team could analyze afterwards the data and create a system of procedures and processes which was based on BRC (food safety system) and focus on the operational efficiency and cost cutting which will add the value to every activity trough the value chain. Both positive and negative results started to be communicated – so the employees became more involved. By understanding their work environment and having direct information from the top management instead of information based on rumors which they were used to, the team was well prepared for new business demands and targets. Structural changes could be set and the changes in corporate strategy were starting to be reflected in the corporate culture. The result was a higher flow of information and interaction between the functional areas, which made a stronger network within the team, and better understanding of the need for changes. The new strategic direction included the goal to become a company which continuously learns. That included the participation in various management education programs and networking system by the leading team.

4.2. Legal, current and emerging social concerns and expectations impacting on strategic leadership in the organization

Ethical, legal, and regulatory requirements, specific to the organization and the industry where it operated, were crucial to:

- back-up change process leaders;
- raise awareness of the need for changes in the team;
- make the members of the team participate actively.

The goal of the reorganization process which had an impact on corporate culture was to reposition the company and save it from the failure. One of the key elements used to back-up changes was the BRC food safety standard. All the employees were aware of the importance of this certificate and they treated it as a part of the company's competitive advantage. The procedures and processes described and regulated by this food safety controlling system were used as a strict pattern upon which the automatized control of all operations within the value chain was introduced. In a time of changes, when many new practices in the operational part of the business were introduced almost on the weekly base, the necessity for an interaction and feedback of all the employees was on the highest level. They were expected to "materialize" their knowledge, practices etc. and transform them in the manuals which described the way business was conducted. Those data were processed by a custom-made operations controlling system and daily analytics and followed up by the change-leaders team. BRC regulations were a strong support to facilitate the

acceptance of the new rules. The leaders' strategic direction was focused above all on making the connection between the company and its environment with the goal to make its resources and operations more responsive to the opportunities which appeared during the process of reorganization.

There were several legal and regulatory issues which were affecting the decision-making concerning the pace of the restructuring and the members of the team. More than 50% of the employees had aged over 50 and worked at least for 25 years for the company. The most of the employees have used the possibility from the employment and social legislation to work 4/5 or 2.5/5 which caused problems in information flow on the operational level, which was reflected on the service. Those were also the members of the team which delivered the highest resistance to changes. These limitations motivated leaders to use another legislation, so-called bridge-retirement, which allowed the employees to retire earlier on the cost of both government's social fund and the company. The space for new more motivated and ambitious employees was made. The replacements and systematization of the processes and procedures were operationally intensive and demanding. However, while bringing the risk of operational inefficiency which could be reflected on the quality of service, they were as well great opportunity to re-examine the existing practices.

Current and emerging social concerns which influenced the strategic leadership demands are correlated with the BRC quality system and the business ethics. According to BRC standards, only those suppliers, who respond to the high-quality control demands and who own an evenly weighted certificate could be considered. As most of the raw materials used by the company are coming from the least economically developed areas around the world, the ethical requirements concerning the employment conditions, sustainable business conduction, and impact on the environment in general varied among the members of the supply chain. This fact is confronted with the business ethics, generically described as a direction the business is conducted to gain the public acceptance. It influenced the strategic leaders' decision to introduce sustainability in both corporate culture and strategy and in that way, try to compensate and propose a kind of remedy for the "damage" which they couldn't control directly. Some of the measures were as follows: shift to more ecological packing, optimization of a transportation system which decreased CO2 footprint, control of the energy usage in the plant, support to sheltered work communities by using their services as outsourcing, etc. As mentioned in the previous section the new legislation was introduced concerning usage and declaration of some ingredients. These regulations followed social concerns targeting the effect of widely used taste enhancer, which could cause serious health disorders. The new trends in the food industry, promotion of the healthier lifestyle, declaration of ingredients used, such as salt content, allergens etc. The abovementioned problems were used to act proactively to the rising demands of the retail customers (biggest supermarket chains) in reporting about company's effects on the environment and community (e.g. carbon foot print, and social issues such as child labour).

Due to the newly formed circumstances in the internal and external environment, the company StSp needed a complete reorganization of its strategy and operations. As the leadership strategy had to support strategic direction, the company engaged people with a broader view on the micro and macro environment, leaders who avoid hazards, use opportunities, and transform them into a strategy. Company StSp which already acted in international environment, needed professionals capable to adapt their styles to the diversified teams. They had to understand people they are leading, synchronize them in teams, and coordinate their skills, knowledge, talents, and capabilities to create a synergetic environment so they could reach the strategic goal of repositioning on the existing market with:

- an enhanced competitive advantage;
- newly determined product range;
- operational efficiency;
- automatization of the procedures and processes.

In that way, the company was capable to react in a more flexible way and benefit the changes. The general manager's shift form manager to leader was an important milestone in the change process. It was necessary to create such an environment where she could enhance her leadership skills. In the first phase, the roles were clearly divided: general manager was focused on the operational segment, trying to maintain the organizational structure, directing existing procedures, and trying to avoid any unnecessary risk. Her focus was on day-to-day goals and objectives. At the other hand, change leader was focused on creating a long-time vision to enhance the competitive advantage by putting the focus on human resources, highly developed technology, and innovation. In the process of corporate restructuring management skills of the general manager were continuously interacting and alternating with leadership skills of the change leader. In that way characteristic of leaders to capture the opportunities from the environment through taking the risk in innovative ways, could be synchronized with the characteristic of managers to control of the organizational structure, procedures, quality etc. This interactivity had a positive impact on the decision making in general. By understanding well both positions, ideas, and possibilities, the leader with her long-term, strategic focus, and manager, with her focus on operational goals and objectives, made decision-making process shorter,

more concrete, with more efficient and effective results. Introducing the changes was a well-coordinated process between strategic vision and operational capabilities to react optimally in various situations. It required alternation of leadership behaviours in different phases, as described in situational leadership and consistent managerial capacities to make it operationally effective. Along with group's or individuals' performance readiness level, as well as the task or project which was supposed to be accomplished, time (or timing) had an important role as well in this process. The right capabilities were developed to be able to learn those new skills faster and to apply them optimally.

4.3. Leadership styles impact on strategic decisions

During the change process, leadership styles were adapted to situation. The interactive exchange of ideas was stimulated with a goal to form, keep and manage innovative culture, operational excellence, efficiency, and highest quality standards. The feeling that the ideas were accepted and that feedback mattered, motivated employees as well as business partners (both customers and suppliers) to participate in reaching company's goals. Every organization has leaders with various styles. In the SMEs, the structural setting and the business environment require from the owners to be leaders which are capable to combine at least two styles. The timing of the strategic changes, the readiness of the group, type of project to be accomplished and the leader's vision were playing an important role in applying the style which would bring the best results on strategic decisions for the future direction for the company concerning:

Table 1: Leadership styles and their impact on strategic decisions (adapted from Goleman)

Strategic decision subject	Goal	Leadership style used	Focus on
Competitive advantage	• Identify C A • How can we reinforce it, improve it and protect it?	Commanding in the 1st phase while the team was still not ready for the changes -> democratic later on when the team started to be responsive, creative, cooperative	Innovation, product range, operational efficiency, quality
Resources	• Define the most valuable resources	Visionary -> making clear to everyone that employees, network, knowledge and skills are the most valuable asset	Employees, technology, raw materials
Operations	• Form processes and procedures	Pacesetting by showing on own example the required standards in performing -> coaching later on as the employees were motivated and stimulated enough to perform highly	Systematization, control, best practices
Corporate culture	• HR • Public image	Commanding in the first phase -> affiliative later on	Introduction of the new company's culture internal and external
Hierarchy structure	• Decision making process • Functional areas network	Commanding -> visionary	Communication, information-flow optimisation, collaboration

The right balance between having a directing role which brings a structure in the execution of the tasks and supporting role which makes people feel positive about the role and relationship they are having within the team, gave extraordinary results.

Leadership style had to be adapted because of the different level and source of motivation. The fact that not all the employees were motivated at the same level, was one of the relenting factors in the time of changes, and difficult to accept above all from the point of view of the general manager. According to the Maslow's theory or hierarchy of needs, there are five levels of needs which each person strives to satisfy: basic needs, such as physiological and safety needs, psychological needs, such as love and belonging, and self-esteem needs, and the third group is self-actualization (Maslow, 1943). According to McGregor, there are two

different types of employees, the X, which should be strongly controlled and lead in all of their activities by the management, and the Y, which have satisfaction in doing their job (McGregor, 1957). We can compare these two theories and conclude that by the employees X, the source of motivation is based on the Maslow's lower levels of the hierarchy of needs, while for the employees Y the motivation results from the higher levels (need for self-esteem and self-actualization). By considering and understanding them, the leadership style can be adapted and successfully applied. However, in the time of radical changes within the company, certainly in the beginning phase, employees Y moved towards behaviour characteristic for employees X. This was caused by the lack of confidence in the new structure, uncertainty regarding the success of the reorganization and the fear of doing something wrong. By adapting leadership styles to the current demands of the environment, in accordance with the strategic decisions and vision set, the leader created such an environment where the other team-members could find the motivation on the other levels of their hierarchy of needs and found their purpose in achieving the strategic goals. Some of them showed the ambition and potential and become leaders themselves.

Leadership styles are reflected in the organization's culture and long-term strategy: a future vision created by following, understanding and reacting on the changes in external environment, its successful integration with the internal resources and operational capacities, and motivation of the employees and creation of the new leaders in order to reach the goals set. Different leadership styles have, accordingly, different effects on the organization. Leaders who continuously learn, as in the case of the company StSp, transfer the information and knowledge received to the company and apply them in the strategic management. They motivate other members based on their particular needs to follow the example and build up and share their knowledge, skills and practices in order to improve the overall organization structure in accordance with the strategy. We can resume different theories about leadership styles and synthetize them as follows through the process of changes in the company StSp. The strategic leaders were able to:

- Have a clear overview based on the multiple multi-level analyses of the company's internal and external environments. They were able to formulate the questions such as: Where are we now? Where we would like to be? Why do we have to change? What do we need to achieve it? What are our realistic capabilities? Do we have all the necessary resources to achieve our long-term vision? Why do we have to keep existing? What are the expectations of our stakeholders?
- Transmit the idea of need for changes to the employees; understand the group they will work with through this process; realize who will be the follower and who will be the opponent, and why; make an ever-spreading network across functional areas; motivate others to become leaders;
- Create a vision and strategy which will lead the company in a certain direction, but make it flexible enough to adapt to the opportunities, or avoid the hazards which they capture during the process;
- Create a structure to support the processes, finding the best practices, and synchronizing people you are leading: their capabilities, skills, knowledge, motivation, communication and interaction.

4.4. Shift of the leadership strategies during the change process

The autocratic leadership strategy was useful in the initial phase of the change process, because it gave a well determined frame and led the team with a system which provided them all basic resources and tools to optimally reach the strategic goals. This strategy took in consideration how could the employees participate in optimization of the overall business results, considering their full potential and readiness, an additional value and a source of the competitive advantage if they were systematized, managed and led in the right way. However, autocratic style was not optimal solution for the process: the lack of communication as well as the lack of the leaders across the functional areas which would look for the opportunities to improve the business, limited the implementation and the success of the new strategic goals set. Introducing the transformational leadership as a strategy was an optimal solution for the current situation. It was necessary to re-evaluate teams' structure, to focus on those team-members who had the willingness to participate, then to recruit new employees, who would support the changes. The individual assessment of the employees' capacities was useful, because they were more enthusiast to demonstrate them.

By communicating the ambitions and the reason why the changes were implemented, the leaders succeed to raise the level of motivation by inspiring the other members of the team. They committed in an easier way to the company's strategy and culture and appreciated that their presence matters. The innovation and creativity were stimulated by continuously cooperating on the optimization of the processes. The change leader and general manager were having a high impact on the group by doing many activities out of their own job description (Bass & Bass, 2008). The first purpose of that is to help the colleagues and create more tight bonds within the group. The second purpose was to get familiar with the procedures, processes and the team-members' comportment while doing their daily activities. The third purpose was to demonstrate that with well-structured manuals, directions, planning, and enthusiasm everyone could do the job in a satisfying way.

Situational variables played an important role in choosing a leadership strategy which would be optimal for the company. The questions to be answered were:

- Who are the leaders who will drive us through the process?
- How many of them we will need and in which functional areas?
- Are they capable to integrate their skills, behaviours, and ambitions in the organization's structure and long-term strategy?

The effects of the changes on the strategic level were visible through the correlation of organizational culture, leadership styles and organizational effectiveness. Organizational culture which changes according to the strategic goals, and influenced by strategic leader's and employees' behaviours, practices, values, as previously described, are reflected in the company's operations and image. Leader's style which is adapted to the circumstances: team's readiness, tasks' type, and structure, period of time, and the leader's source of authority and readiness to adapt to the new challenges, has an important role in shaping and promoting the culture. Along with the profit, sales volume, and production volume other indicators were added: production efficiency, number of employees and their contribution, number of customers, frequency of the orders of the purchasing department, quality standards as measured in number in customers' complaints. The follow-up of these factors has shown the real value and the influence of the employees on the results. Therefore, it was easier to make it clear why the effective leading of the team has to be one of the priorities for shaping a more successful future for the company.

5. RESEARCH RESULTS AND ANALYSIS OF FINDINGS

StSp is being successful in adapting to the environmental challenges for more than 60 years. Although both company's management and employees were aware that there was a high necessity for change, corporate culture wasn't adequate and ready for reorganization. The right and systematic approach of the general manager supported the change leader to restructure company in efficient way. The ability to adapt leadership strategy and to combine several styles according to the environmental variables provided long-term sustainable effects. Corporate capabilities (know-how, technology, operational and quality excellence) transformed in distinctive competences (innovation, operational flexibility, and quality) to provide optimal technological solutions in a much shorter period of time than the competitors, have built the competitive advantage.

The finding based on the case study is that the strategic leadership played a crucial role in corporate reorganization in a specific environment characteristic for family owned SME. Corporate strategy, vision, and objectives became clear to all the employees. Change leaders created corporate culture which enables agility by using communication and interaction to improve and support procedures and processes;

- automatizing follow-up of all the operations;
- further developing relations with stakeholders, in particularly with vertical and horizontal forces.

In this way the whole corporate structure could promptly react to changes in the environment. The low hierarchy and a short decision-making process, which helped people from the different functional areas to cooperate in a more fluid way and build up an efficient network, stimulated forming of leaders in all the departments. Those people, even if they had different motivations for the success of corporate strategy, influenced and supported the changes in the culture. They were reassured that their participation will bring the difference, as the effects of both short-term achievements as well as negative results were communicated and explained. Leaders helped and motivated other team-members to accept the changes, to participate in the creating of a new culture, and implementation of the strategy.

The leader's approach applied in family owned SME, could be used in the bigger systems and organizations. The insight in all the activities within the company, as well as the capability to lead and manage them, stimulate formation of such culture capable to react to the changes in the environment. The low hierarchy and a short decision-making process, which helped people from the different functional areas to cooperate in a more fluid way and build up an efficient network, stimulated forming of leaders in all the departments.

6. CONCLUSION

This paper has shown that strategic leadership, even if subjected to research for several decades, has become an important point of interest in organizational and management sciences. One of the reasons could be the fact that in the globalized market, where the flows of technology, resources, and information are more liberal than ever, creating low barriers to entry, human capabilities and skills are a driving force for differentiation and building of competitive advantage. The role of leaders is to create a flow of strategy, operations, and cultural aspect. That is: a clearly communicated strategy, based on the internal resources

and capabilities, forms operational excellence which enables companies to react to the environmental opportunities. This is feasible only if those concepts are incorporated in all the levels of the corporate culture. The interdependence of strategic, operational, and cultural aspects of the company and their effective synchronization have several advantages for building competitive advantage. The empirical research based on the case study has pointed out that the impact of strategic leadership, adapted to the situational variables, on organizational culture is significant during the change management process. Digitalization, customized ICT, and AI become essentials in helping companies to profile and preserve their competitive advantage. However, those new technologies should be seen as a tool which facilitates leaders and managers to better analyze the situation and to stimulate forming of cross-disciplinary teams capable of creating new approaches to change management. Education should play a crucial role in order to give a right direction to the processing of information, in overcoming the cultural differences and development and implementation of new technologies which should be focused on the problems of the present. Further research could be done on how neuroscience and artificial intelligence could be used to define and frame typical behaviors of the leaders and teams during change projects in order to shorten reorganization process.

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THE UNDERLYING THEORY OF PROJECT MANAGEMENT - A SYSTEMATIC REVIEW AND RESEARCH AGENDA

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Abstract: *Project management is developing field of academic study. Despite considerable diversity and richness, the current conceptual base continues to attract criticism on different accounts. The purpose of this paper is to review the conceptual base and current state of the project management research through two analytical frameworks: Nine schools of project management and Rethinking project management. Both analytical frameworks give valuable contributions to the development of project management knowledge and insights in current and future research. The paper concludes encouraging the development of the current body of knowledge and setting new research agenda. The paper could help both practitioners and academics to leverage their unique perspectives and have a holistic understanding of project management development.*

Keywords*: rethinking project management, project management schools, analytical frameworks, success, complexity, contextualization*

1. INTRODUCTION

Project management is one of the most important organizational developments in recent years (Winter, Smith, Morris, & Cicmil, 2006). In most organizations, management of projects has become an important way to structure work (Bakker, 2010) and implement strategy (Morris and Jamieson, 2004). A number of global trends influence the rise of importance of project management, such as the increased competitiveness of the global marketplace, emphasis on efficiency and growing customer expectations (Jugdev, Thomas, & Delisle, 2001). It is perceived that mobilization of projects, resources and competencies could bring strategic change, and thereby create competitive advantage and other sources of value for an organization (Turner, Anbari, & Bredillet, 2013).

The significant growth in project work across different sectors and industries resulted in the considerable economic importance of project management (Svejvig & Andersen, 2015). Over the past 50 years, project management grew exponentially to meet the demands of global competition (Jugdev et al., 2001). Turner et al. (2013) reported based on World Bank's report (2008) that more than 20 % of global economic activity takes place as projects, and in some emerging economies, it exceeds 30 %. With the exponential growth of project management and considerably poor performances of projects across different industrial sectors (Dalcher, 2014), management of projects become the important topic for both practitioners and academics.

Modern project management started as a sub-discipline of Operations Research. However, project management is now grown in the academic discipline in its own right. Despite this fact, the current conceptual base continues to attract criticism on different accounts. The purpose of this paper is to review the conceptual base and current state of the project management research through two analytical frameworks.

Paper is structured in four sections. In Section II nine schools of project management are discussed. In Section III concept of Rethinking project management is discussed. Finally, in Section IV some future directions for research and recommendations are presented.

2. NINE SCHOOLS OF PROJECT MANAGEMENT

Project management is a rather young academic discipline which dates back to early 1950's (Morris, 1997). As a research field project management has earned its place in the science of management as an organizational model and more generally as a system of anticipation and rationalization of temporary collective initiatives or even as a basis for a new theorization of the firm (Söderlund, 2004).

The categorisation of research traditions through the analytical framework based on "schools of thought" contributes to further development of existing theories and body of knowledge. First, it allows pluralism, which is important for scientific progress. Second, it avoids the traps of unification and fragmentation. And finally, it may contribute to the sophistication of existing body of knowledge and inspire new theories.

Building on previous work, there are several categorisations of project management schools. One of the first contributions in this field Anbari (1985) indicated that there are five schools of thought. Most recent, Turner et al. (2013) identified nine schools of project management. Also, important contributions in this field are those from Söderlund (2011), Bredillet (2004a) and Kwak and Anbari (2008). Despite the difference in the number, all nine schools were identified by the above-mentioned authors but differently grouped based on similarity in key concepts and issues, base discipline or research methodologies. Table 1 summarises origins research fields of project management and the key contributors.

Table 1: The Nine Schools of Project Management Research

School of Project Management	Field of study	Anbar (1985)	Bredillet (2004a)	Kwak and Anbari (2008)	Söderlund (2011)	Turner et al. (2013)
Optimization School	Operations Research	√	√	√	√	√
Modelling School	Management Science	√		√		√
Governance School	Functional School	√	√	√	√	√
Behaviour School	Organizational Behaviour and Human Resource Management	√	√	√	√	√
Success School	Strategy Management / Critical Success Factors		√	√	√	√
Decision School	Information Management	√	√	√	√	√
Process School	Operations Management	√		√		√
Contingency School	Contingency Theory	√	√		√	√
Marketing School	Marketing School		√		√	√

Main focus of optimization school is planning, scheduling, estimating, and efficiently carrying out the project task using optimization tools such as network scheduling techniques including the Critical Path Methods (CPM) and Program Evaluation and Review Technique (PERT), resource allocation and leveling heuristics, project crashing, resource-constrained scheduling, Graphical Evaluation and Review Technique (GERT), Critical Chain, Theory of Constraints, Monte Carlo Simulation of project networks and cost estimates, and variations of these methods (Turner et al., 2013). The future focus in this field is overcoming limitations of the tools and techniques to deal with growing complexity and speed of change (Söderlund, 2011).

The key idea of modelling school is to use system theory to model the project to deal with the increasing complexity of the projects. This school encompassed both hard and soft-systems methodology. The focus of hard system was modelling the project using techniques based on the System Dynamics approach. While “soft” system approach was based on dealing with inputs from organizational, behavioural, social and other effects from complex project environment (Williams, 2002). Research in this area will continue into modelling the total project management system, integrating hard systems and soft systems methodologies, including multiple constraints, and consideration of complex project environments.

The governance school is focused on the governance of relationship between project participants, investigating contractual aspects of the project. The majority of contributions include the application of agency theory, transaction cost theory and mechanisms of governance of the projects. Future research will include understanding the goal preferences among different actors and developing the governing mechanisms of projects with specific administrative problems and complex transaction.

The behavioural school originated from organization-theory. The research in this filed includes organizational behaviour (OB) and human resource management (HRM). Research within this school typically addresses team building, conflict management, leadership, communication, time pressure and learning dimensions to contribute to the knowledge of the nature and process of the behaviour of projects. The focus in this field continues into virtual project teams, HRM in project-oriented organizations, cross-cultural issues and knowledge management.

Success school represents significant research area and the considerable body of project management research. The research is focused on success criteria (measures that will determine the success or failure of the project), and critical success factors (the most important areas of the project that, if successfully managed, will lead to better performances). The importance of this filed is justified by the overwhelming

failure of the projects (Dalcher, 2014). Research can continue to further refine our understanding of the multidimensional construct of success, diversity of success factors and the relationship between project success factors and different dimensions of success.

Decision school research focuses primarily on the early stages of projects by investigating decisions made in this phase and the impact of those decisions on the project. Also, information management and information processing in projects constitute the second important field of research of this school. Studies within this tradition are built upon classic research within psychology and organization theory, in particular, decision-making theories (Söderlund, 2011). Future research agenda will address factors affecting initial estimates of cost and time, methods for handling deliberately optimistic estimates and improving such estimates, the relationship of the organization's portfolio to its strategy, as well as factors affecting the inclusion of projects and programs in the organization's portfolio (Turner et al., 2013).

In the process school, the main focus is to structure project as an algorithm that defines processes from the start to the end of the project to achieve the end objectives. “The project is like an algorithm that helps you solve the problem of how to get to that desired future state (Turner et al., 2013). One of the main contributions of this school is project life-cycle and project life-cycle management (Meredith and Mantel, 2006). The other focus of this school projects categorization (Crawford et al. 2005). Research may continue into the further investigation of categorization of projects, and alignment of project management process in different environments, as well as project audits and post-project reviews (Turner et al., 2013).

A considerable body of knowledge in project management reflects the contingency school of thought. The main premise is that there is a need to adopt a different approach to project management in consideration to different types of projects and project organizations, as well as different settings of the project environment. The school originates from organization theory, reflecting that there is a number of contingency elements affecting organizational design and processes. Research in this area could continue addressing uncertainty, complexity and deeper investigations into success factors and dimensions for different types of projects.

Marketing school or relationship school is a relatively young school of thought. The research within this school address project marketing (Cova and Hoskins, 1997) and stakeholder management (Welch, 2005). The main focus of the research in this field is investigating: 1) how companies sell and market their projects; 2) how clients buy projects; 3) how the early stages of a project can be seen as the management and organization of interactions between clients and the contractors; 4) how to overcome a lack of longterm relationships between stakeholders.

Despite distinction of different schools of project management, there is a certain level of overlapping, and further investigation of the interaction of different schools of thought should be one of the topics of the research agenda.

3. RETHINKING PROJECT MANAGEMENT

Rethinking project management (RPM) is a research field emerged in the 1980s to address the critic of technocratic and rationalistic viewpoint typical for classical project management. The purpose of RPM is to provide more holistic and pluralistic understanding of project management to enhance and expand the current knowledge and practice within the field (Svejvig & Andersen, 2015). Accordingly, several scholars have done a structured literature review to provide the new insights in contemporary trends in project management practice and compare it to the classical project management. Table 2 presents both classical project management and rethinking project management approaches.

Table 2: Classical project management vs Rethinking project management

Classical project management	**Rethinking project management**
Author: (Jugdev et al., 2001)	
Project management: a set of tool and techniques used to achieve project efficiency	Project management: a holistic discipline used to achieve project/program/ organizational efficiency, effectiveness and innovation.
Success: measured by efficiency performance measures	Success: a multidimensional construct measured by efficiency, effectiveness and innovation performance metrics
Practice project management: focus on the project details at an operational level and tactically	Sell practice project management: be an advocate and champion of project management by aligning its value to the firm’s strategic business priorities

Author: (Winter, Smith, Cooke-Davies, & Cicmil, 2006)	
The simple lifecycle-based model of a project, as the dominant model project and project management	Theories of the complexity of the projects and project management
Projects as Instrumental Processes	Project as a social processes
Concepts and methodologies which focus on product creation	Concepts and frameworks that focus on value creation as the prime focus of projects, programmes and portfolios
Narrow conceptualization of projects: projects in a single discipline with well-defined goals	The broader conceptualization of projects: multidisciplinary projects with multiple purposes
Practitioners as trained technicians	Practitioners as reflective practitioners
Author: (Andersen, 2008)	
Perspective: task perspective	Perspective: an organizational perspective
Project definition: a project is a temporary endeavour	Project definition: a project is a temporary organization
Main focus: execute the defined task	Main focus: value creation
Author: (Svejvig & Andersen, 2015)	
Executability, simplicity, temporality, linearity, controllability and instrumentality	Learnability, multiplicity, temporarily, complexity, uncertainty and sociability

Using inductive analysis (Svejvig & Andersen, 2015) categorized the rethinking project management body of knowledge in following six categories: contextualization, social and political aspects, rethinking practice, complexity and uncertainty, the actuality of projects and broader conceptualization. Table 3 presents categories identified through the inductive analysis, the description and main contributors.

Table 3: Categories of rethinking project management research (Svejvig & Andersen, 2015)

Categorization	Description	Contributors
Contextualization	Expanding thinking about projects in a broader context by focusing on the management of multiple projects, the organizational strategy and the project environment.	Dille and Söderlund (2011) Alderman and Ivory (2010) Maylor et al. (2006)
Social and political aspects	Focus on social and political processes rather than the traditional focus on specific tools and procedures.	Leybourne (2007) Sense (2009)
Rethinking practice	Alternative methods, perspectives and approaches to rethinking how practitioners work with projects.	Berggren and Söderlund (2008) Thomas and Mengel (2008) Louw and Rwelamila (2012)
Complexity and uncertainty	Literature is dealing with the increasing uncertainty and complexity in project and project environment.	Atkinson et al. (2006) Cooke-Davies et al. (2007)
The actuality of projects	Need for empirical studies of projects that show how projects are actually carried out.	Cicmil et al. (2006)
Broader conceptualization	Alternative perspectives on, projects, project management and project success, outline how the field is broadening beyond its current limits or describe the existing perspectives within the field.	Turner et al. (2010) Koppenjan et al. (2011)

The overall challenge for rethinking project management research is to provide significant new insights in practice of project management and inputs for future development. This is partially achieved through the development of a body of knowledge in this field, but certainly, it still lacks wide distribution in practice. The above mentioned six categories are at the same time items on research agenda. It is up to future research to explain how to expand thinking about projects in a broader context and what are important factors of broader contextualization, as well as increasing uncertainty and complexity in project and project environment. The future research in this field should also address the questions of social and political aspects, especially in the light of projects as a social process. There is a need to expand research on alternative methods, perspectives and approaches to rethink how practitioners work with projects, but also to show how projects are actually carried out. Finally, broader conceptualization is the field which aims to contribute with alternative perspectives on, projects, project management and project success, and outline how the field is broadening beyond its current limits or describe the existing perspectives within the field.

4. CONCLUSION

This paper demonstrates that project management is relatively young, but rapidly developing research field. In last 70 years, project management evolved from sub field to academic discipline in its own right. Despite this fact, the current conceptual base continues to attract criticism on different accounts. This paper provided the review of project management body of knowledge using two streams of the literature review. As a result, both approaches provided important insights in the current state of project management research and inputs for defining new research agenda.

There is a certain level of overlapping between contributions within different project management schools. Accordingly, there is a need to investigate the interaction between these schools and reconsider the categorization. Next, review of optimization school revealed that there is a need to improve tools and techniques to deal with growing complexity and speed of change. Review of modelling school suggested that research in this area should continue into modelling the total project management system, integrating hard systems and soft systems methodologies, including multiple constraints, and consideration of complex project environments. The governance school directed future research into better understanding of the goal preferences among different actors and developing the governing mechanisms of projects with specific administrative problems and complex transaction. The focus in behavioural school will continue into virtual project teams, HRM in project-oriented organizations, cross-cultural issues and knowledge management.

Review of success school revealed that there is interest in refining understanding of the multidimensional construct of success, diversity of success factors and the relationship between project success factors and different dimensions of success. The future research agenda within decision school should address factors affecting initial estimates of cost and time, methods for handling deliberately optimistic estimates and improving such estimates, the relationship of the organization's portfolio to its strategy, as well as factors affecting the inclusion of projects and programs in the organization's portfolio. Process school research may continue into the further investigation of categorization of projects, and alignment of project management process in different environments, as well as project audits and post-project reviews. Research in the contingency school research field should continue addressing uncertainty, complexity and deeper investigations into success factors and dimensions for different types of projects. Finally, marketing school is the most recent of schools of thought and the main focus of the research in this field could be investigating: 1) how companies sell and market their projects; 2) how clients buy projects; 3) how the early stages of a project can be seen as the management and organization of interactions between clients and the contractors; 4) how to overcome a lack of long-term relationships between stakeholders.

Categorization of project management literature as either classical project management or rethinking project management helps the development of new insights needed for a pluralistic understanding of project management. Using inductive analysis (Svejvig & Andersen, 2015) categorized the rethinking project management body of knowledge in following six categories: contextualization, social and political aspects, rethinking practice, complexity and uncertainty, the actuality of projects and broader conceptualization. This six categories actually represents the future research agenda from rethinking point of view.

Finally, the overall challenge for both analytical frameworks is to provide significant new insights from the current project management knowledge base. Both analytical frameworks are enriching the body of knowledge and providing different topics for future agenda, but both suggest that there is lack of relevance to practice. Accordingly, further development of a body of knowledge should reflect the practice in a wider sense to help both practitioners and academics to leverage their unique perspectives and have a holistic understanding of project management development.

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.

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KEY COMPETENCIES DETERMINING MANAGERIAL SUCCESS: PRIVATE AND PUBLIC SECTOR MANAGER'S PERSPECTIVE*

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Abstract: *Considering that one of the key priorities and needs of nowadays business organizations is to define knowledge, skills, abilities and personal characteristics that distinguish successful from less successful managers, the purpose of this paper is to explore and define list of key competences that enable them to achieve an exceptional level of performance in the workplace. The main goal of the research presented in the paper is the analysis of the specific attitudes of managers from both public and private sector in assessing the contribution of 49 individual competencies to their success. The research showed that opinion of both public and private sector managers is very balanced, given that the significant statistical differences exist in only five competencies, namely in dominance, helicopter approach, stress tolerance, flexibility and integrity and that the two sectors and managers working within them are equalizing, regardless of the particularities of public and private sector organization environment.*

Keywords: *competencies, public sector, private sector, competency management, research.*

1. INTRODUCTION

Today, every organization, either from public or private sector, having in mind the dynamics of the business environment in which it operates, has a strong need for successful managers. Thus, one of the key priorities and needs is defining knowledge, skills, abilities and personal characteristics that distinguish successful from less successful managers, allowing them to achieve exceptional performance level (Bhardwaj & Punia, 2013). Increasing competition, changing technologies and constant changes that characterize the external environment in which organizations operate, as well as the need to gain competitive advantage by increasing profitability and achieving a high level of performance, led to the creation of an approach based on competence management (Hondeghem et al., 2005). As many organizations have found that the key to their competitive advantage lies in human resources, more and more organizations are currently focusing on creating an adequate base of human resources and developing their capabilities, and the field of competencies and competency based management within organizations in expansion (Xuejun Qiao & Wang, 2009).

Although competency models have been used for more than 30 years for the purpose of selecting employees, a more recent trend is the definition of key competences as well as competency based approach integrated through other human resources processes, regarding evaluation and performance assessment, training of employees through various types of trainings and education based on competencies (Ennis, 2008). By defining the list of competences that contribute to the success of managers, the basis for defining the career path within the organization of each individual is created, then the development plan and the need for training of existing employees, as well as defining the profile of the newly employed, with the desired personal characteristics and competencies assessed based on an interview related to competencies and the entire selection and recruitment system that is in line with other human resource management processes. This connection and integration of the human resources management system within the organization allows for better results and achievement of competitive advantages on the market, since the organization in this case has the opportunity to shape its human resources and harmonize, develop and improve it in line with changing needs on the market (Donzelli et al., 2006). Also, such an integrated competencies based approach allows the organization to significantly reduce the costs of employee development (training realization according to specific needs of employees and effective training), easier organizational and individual analysis and assessment of each employee, adequate planning of workforce (according to the real organizational needs), faster adaptation to the external and internal changes that the organization faces,

* This paper is a result of the project no. 179081 funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia: Researching contemporary tendencies of strategic management using specialized management disciplines in function of competitiveness of Serbian economy.

achieving a higher level of performance (both at the individual and at the organizational level), adequate reward systems and basis for defining clear goals and career paths, higher levels of motivation and satisfaction as well as employee engagement, lower fluctuation costs, implementation of employee retention policy within an organization that represents one of the biggest challenges in today's business world, as well as a more adequate recruitment, selection and employment process (Gangani, et all., 2006).

Bearing in mind the above mentioned, the field selected for the purpose of this research presented in the paper is the field of competencies and competency based management approach, i.e. specificity of the contribution of individual competencies to the success of the managers according to the sector in which they are engaged –both in the private and public sector. The aim of this paper is to define and review the list of key competencies of successful managers in public and private sector organizations needed to achieve an outstanding performance in managerial positions. Certain similarities, differences, and specificities in terms of competencies that the managers consider to be key to success are determined through comparative analysis and analysis of public and private sector managers' attitudes. The theoretical review of literature, which is found in the first part of this paper, as well as the results of the research presented in the second part of the paper, provide the basis for understanding the factors that influence the success of managers and their performance in their workplace.

2. THEORETICAL BACKGROUND

The literature on competency management and its impact on different aspects and functions of the business provides a large number of definitions for competency. Some authors, such as Prahalad and Hamel, observe and define competencies from the perspective of the organization, while other authors, including Collin, Burgoyne and Boyatzis, define competencies as employee characteristics rather than characteristics of organizations in which employees work (Abraham, S.E. et al., 2001).

The concept of competence was first introduced by David McClelland, defining competences as characteristics and traits of excellent workers, and then popularized by Boyatzis, who defines competences as basic traits of persons that imply "motives, characteristics, skills, self-confidence and the social role that an individual occupies, as well as the body language that one uses, and whose application results in superior performance "(Alexander et al., 2013).

In 1973, David McClelland introduced the concept of competence, emphasizing the preference of testing competence, not intelligence, when selecting potential employees. In his opinion, this term can best be described as an iceberg, where the summit of the iceberg represents knowledge and skills (visible), while the basic characteristics of the personality, their characteristics, motives and traits, such as empathy, orientation to achievements, self-confidence, the larger, invisible part of the iceberg, hidden "below the surface of the water" (Neagu et al., 2014). In his research and published papers, Woodruffe (1993) emphasizes that the definition presented by Boyatzis in his research and works leaves space for different interpretation of the notion of competence, and he defines this term as "a set of behavior, knowledge, skills and understanding which are key factors for the efficient and effective execution of tasks "within the managers' workplace. For Nordhaug and Gronhaug (2004), the notion of competence includes "knowledge and skills needed for work" and for Cardona & Garcia (2005) perceive it as "visible characteristics and behavioral patterns that enable managers to perform effectively" and achieving exceptional performance levels (Bosch & Cardona, 2010).

Westera (2001) defines competencies from two perspectives, theoretical and operational, where the theoretical perspective implies competence as a "cognitive structure that allows the realization of certain behaviors", and the operational, "spectrum of skills, knowledge and abilities that enable conscious and deliberate decision-making" by the inclusion of one's own attitudes in day-to-day business challenges (Merikas et al., 2006). Dianati and Erfani (2009) define competencies as "a set of knowledge, attitudes, abilities and skills that enable individuals to work and perform activities to achieve a certain level of performance based on expected standards of competence." Mashhoodi (2010) defines a similar definition in his work, where he defines competences as "personal attributes that enable individuals to successfully achieve their goals and perform their tasks", while competencies, according to Sparrow (1995), are "behaviors, that is, a set of patterns of behavior that is related to work performance and which sets it apart from average employees." Draganidis and Mentzas (2006) defined competencies as "a combination of tacit and explicit knowledge, behavior and skills that provide individuals with the basis and potential for efficient performance of tasks", and de Beeck and Hondeghem (2010) under the competences imply "visible characteristics of employees, which are expressed in the form of applied knowledge or certain behavior within the workplace, i.e. work they perform, which contribute to the successful functioning of managers in different functional areas of the organization." Furthermore, according to Neagu and others (2014), competencies represent the components of a job, which are reflected in the behavior that is visible within the

workplace where an employee works. They are represented by common elements such as knowledge, skills, abilities, attitudes, personality traits, behavior and impact on performance at work, but, as Campion et al. (2011) emphasized, competencies represent and imply more than a simple list of these components.

Furthermore, it can be concluded and as Petersen (2006) points out in his paper, that most of the definitions in the existing literature in the area of competence define this term in the following two ways:
• describing the work tasks and the expected outputs - related to the ability of managers to perform work tasks, make decisions in accordance with standards set in the job description and the expected level of output to be achieved.
• through a description of certain behaviors - they relate to competence as a set of knowledge and skills that are expressed by behavior that results in effective and / or superior performance in the workplace.

Also, the conclusion and summary from most of the author's definitions and available definitions is the setting of a clear correlation between the competences and performances that an individual reaches (Anvari et al., 2016).

The use of the concept of competencies in organizations is the basis for the emergence and definition of the concept of competency based management, that is, a managerial approach based on competences. This approach involves the use of competencies and results of competency analysis and their level of development in order to perform adequate recruitment, selection, employment, evaluation, development and improvement of employees, as well as an adequate process and defining reward system in accordance with the above mentioned elements (Armstrong, 2006). Thus, a comprehensive definition of a managerial approach based on competencies, that is competency management, implies the identification of competencies and those employees having and achieving incredible performance compared to those with average results in all areas of management, as well as the use and application of this system for all processes of human resources (workforce planning, job evaluation, recruitment, selection, employment, performance appraisal and evaluation, training and education, i.e. the development and improvement of employees, defining the reward system, career path and employee improvement) (de Beeck, & Hondeghem, 2010) .

Therefore, in the scientific-research and practical sense, three eras of competence can be recognized. The first era, characterized by the work of scientists such as White, Boyatzis, McClelland, Schroder, Spencer-Spencer and Woodruffe, is the era of observing individual competences, while the other is focused on defining the competence model, as clearly shown in works by Mansfield, McLagan, RothwellLindholm and Lucia-Lepsinger (Skorková, 2016). The third, and also the last phase, is the era of defining key competences that are the basis of the competitive advantage of organizations and the success of managers, introduced in scientific and professional literature by Prahalad and Hamel, and which is the basis of the research that will be presented further in the paper.

3. RESEARCH METHODOLOGY

The data collection method involved the use of a questionnaire, prepared according to the questionnaire that was previously validated and presented in the scientific work of Bakanauskiena and Martinkiena (2015). The questionnaire sent to professionals engaged in managerial positions consists of 13 questions, divided into 3 categories. The first group of questions is focused on the demographic data of respondents, such as gender, age structure, level of previous education, past professional experience, the sector of an organization where managers are employed, as well as the level of management. The second group of questions relates to assessing the contribution of individual types of competencies to the performance of managers and their success. Competencies are grouped into five categories: competencies in the area of information management, competence in communication, managerial competencies, interpersonal and personal competencies. Questions are fixed with the ability to select only one response or evaluate the contribution of each individual competency to the success of the manager using the Likert scale, with scales of grades from 1 to 5, where grade 1 implies that competencies do not contribute to the overall success of managers, and grade 5 meaning that they greatly contribute to their performance. The third group of questions relates to the type tasks and job that managers perform in their positions at different managerial levels. The results were analyzed using the SPSS statistical data processing package. For the purposes of the research, non-parametric tests is applied since the main objective of the research is the data analysis from the aspect of belonging to the public and private sector, and that there is a significantly higher number of surveyed managers working on one of the positions in the private sector, as well as that these two groups are unequal in the sample.. For this purpose, the difference between these two groups of managers was used by the non-parametric Mann-Whitney test to determine whether there are differences between groups in terms of assessing individual competencies.

4. RESEARCH SAMPLE

For the research purposes, managers from the territory of the Republic of Serbia and Montenegro were examined. The total sample consists of 302 employees working on managerial positions within public and private sector organizations. Out of a total of 302 respondents, 60% are men, or 180 them, while a slightly lower percentage (122 (40%) out of 302) are women. The average years of age of the examined managers is 37.7. Most of the managers who participated in the research work on managerial positions within organizations belonging to the private sector (255 out of 302), i.e. 84% of them. On the other hand, 16% of the surveyed managers work within the organizations belonging to the public sector, or 47 of them. The average years of work experience of the respondents is 12.75, while the average years of work experience at managerial positions is 7.65. When it comes to managerial levels and positions on which surveyed managers are involved, even 38.1% of the respondents work within the positions belonging to the highest level of management, i.e. 115 of them work at top management level. The highest percentage of the sample consists of the middle-level management employees (148 (49%) of 302), while a smaller percentage of them are engaged in positions within the lower level of management (39 (12.9%) of 302). Analyzing the educational structure of the surveyed managers, it can be concluded that the highest percentage of them have completed master (154 (51%) of 302) and undergraduate (102 (34%) of 302) studies, while a slightly lower percentage of managers have completed MBA (25 (8%) of 302) and PhD (21 (7%) of 302) studies.

5. RESULTS

The study analyzed 11 competencies in the field of information management, such as: decisiveness, information collection, problem solving skills and analysis, numerical interpretation of information, decision-making based on information (judgement), creativity, risk taking, business sense, helicopter approach, organizational awareness and sensitivity, as well as awareness of organization and external changes. By analyzing the group of competencies in the field of information management, it is concluded that, according to managers from the overall sample, the most important competence is " decisiveness ". "Problem solving and problem analysis" holds the second place, according to the level of significance of the contribution of managers' success. "Numerical interpretation of information" is regraded as competence with the least significant contribution to the success of managers, according to managers who participated in the survey. By comparing the views of managers from the public and private sector, or using the non-parametric Mann-Whitney test, it was found that there is a difference between the responses of these two groups of managers in terms of competency assessment entitled "Helicopter approach". Bearing in mind that the statistical significance for the "helicopter approach" is $p = 0.002 \leq 0.05$, it is concluded that there is a statistically significant difference in the sample, between the answers of managers from the public and the private sector. By comparing the average ranking of the "helicopter approach" for the managers from the public (184.88) and private (145.35) sectors, it can be concluded that employees working within public sector organizations consider that the "helicopter approach" is more important and has a greater impact to the success of managers, compared to the opinion of private sector managers.

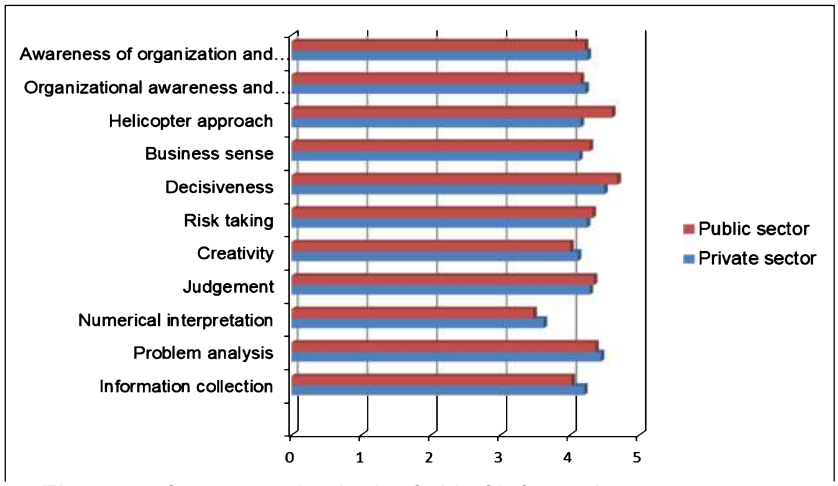

Figure 1: Competencies in the field of information management

Another group of competencies whose contribution to success is analyzed in the research are competences in the field of communication such as presentational skills, oral expression, perceptive listening, written communication and reading. By analyzing the opinions of 302 managers from the overall sample, it is concluded that the most important competence in the field of communication is "oral expression". The second one, according to the level of significance of the contribution of managers' success, is "perceptive

listening". Reading has the least significant contribution to the success of managers, according to the interviewed managers. By analyzing the individual attitudes of the managers from the public and private sector, it can be concluded that there is no statistically significant difference between the answers of these two groups regarding the competences in the field of communication, bearing in mind that the statistical significance for all competences is greater than p≤0.05.

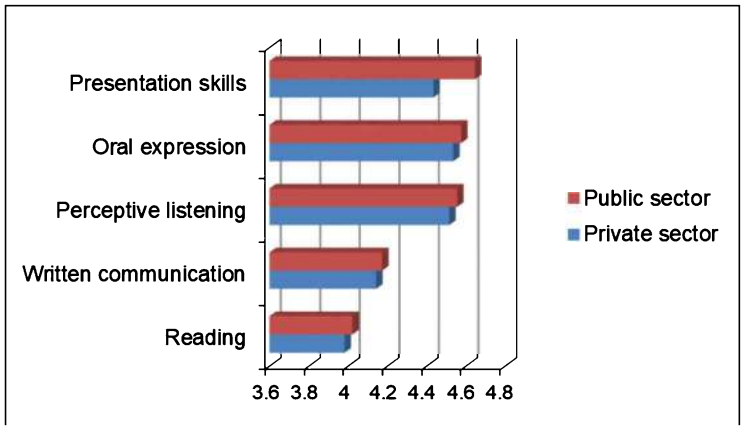

Figure 2: Competencies in the field of communication

The third group of competencies analyzed within the research is a group of managerial competencies such as planning, organizing, delegating, appraisal, development of subordinates and self-management. By analyzing the assessment of the contribution of a group of managerial competencies to the success, it can be concluded that "organizing" is the most important managerial competence, according to the managers who participated in the research, . The second one, according to the level of significance to the contribution of managers' success, is "development of other employees, i.e. subordinates", followed by "planning" and "appraisal" and providing feedback. The competence of "self-management" has the least significant impact to the success of managers, according to managers who are interviewed.. Using Mann-Whitney non-parametric test for testing the difference between the assessment of individual managerial competencies contribution to the success according to the opinion of public and private sector managers, it was found that there is no difference between the responses of these two groups of managers, bearing in mind that the statistical significance for all competences is greater from the limit p≤0.05.

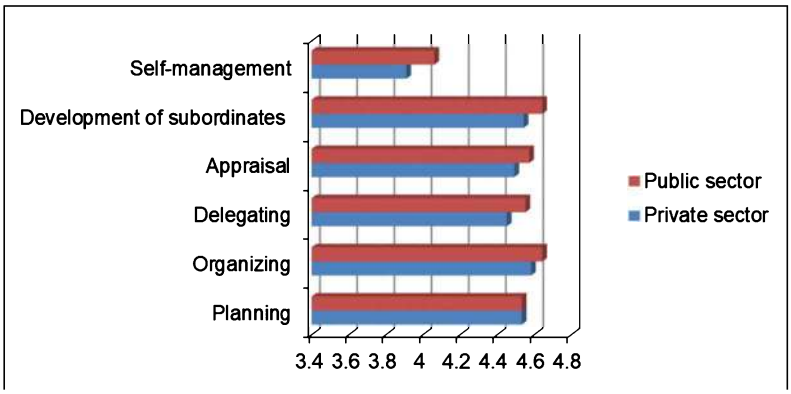

Figure 3: Managerial competencies

When it comes to interpersonal competencies, 8 interpersonal competencies have been analyzed in the research, such as: leadership, negotiating, motivating others, ascendancy, flexibility, sensitivity, persuasiveness and impact. By analyzing the fourth group of competences, i.e. interpersonal competences, it can be concluded that "leadership" is considered the most important interpersonal competence according to managers.. Also, according to managers who participated in the research, "motivating others" significantly contributes to their success. On the other hand, in this group of competences, the surveyed managers rated "ascendancy" with the lowest average grade. Applying the Mann-Whitney test, it was found that there is a statistically significant difference between the responses of these two groups of managers in terms of an assessment of interpersonal competence called "ascendancy", since the statistical significance for "ascendancy" is p = 0.003≤0.05. Comparing the middle ranking of interpersonal commerce, "dominance" for managers from the public (184.47) and private (145.42) sectors, it can be concluded that managers working within public sector organizations consider that "ascendancy" is more important competence and that it has greater impact on managerial success, compared to the opinion of private sector managers.

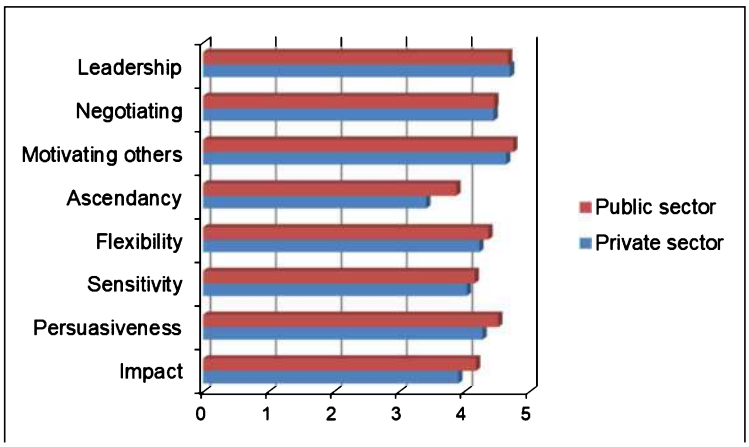

Figure 4: Interpersonal competencies

When it comes to the last group of competencies, managers evaluated the contribution of personal competencies such as: detail consciousness, tenacity, resilience, integrity, independence, adaptability, tolerance for stress, initiative, achievement orientation and energy. According to them, "initiative" and "tenacity" are the most significant personal competences, while "detail consciousness" contributes to their success to the least extent. Analyzing the impact of the individual personal competencies to the success according to the surveyed public and private sector managers, it can be concluded that there is a difference between the answers of these two groups of managers in terms of assessing personal competencies such as "tolerance for stress", "adaptability" and "integrity". By comparing the average ranking of the personal competence "tolerance for stress" for managers of public (176.80) and private (146.84) sectors, it can be concluded that the employees working within public sector organizations consider that "tolerance for stress" is more important competence and has a significant contribution to the managers success, compared to the opinion of their colleagues from private sector. Also, public sector managers (174.43) consider that personal competence "adaptability" significantly contributes to the performance of managers, compared to their private sector colleagues (147.27). On the other hand, private sector managers (156.46) consider that "integrity", as a personal competence, has a greater impact on the managerial success, than public sector managers (124.60).

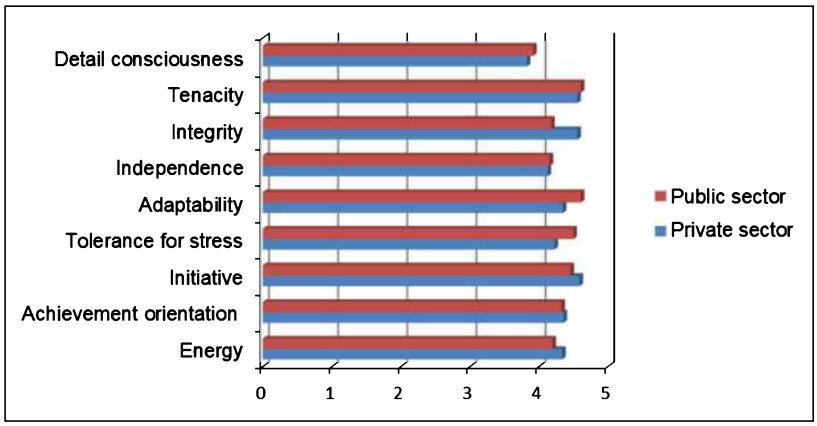

Figure 5: Personal competencies

Therefore, for a manager who works in private sector organizations, today, it is important to be a leader, to motivate other employees and encourage them to give their best in the organization they work in, to have good organizational skills, business initiative and integrity, and to be persistent in the tasks and projects. Also, it is important to work on the development of other employees. They need to have strong communication skills, such as oral expression and perceptive listening, and, in addition to these, they plan tasks and their way of reaching in an adequate way. On the other hand, key competences that define the performance of managers working within public sector organizations include competences such as the ability to motivate other employees within the organization, as well as decision-making and leadership skills. They also consider important having good presentation and organizational skills, the ability to perceive the wider context of the situation, i.e. having a "helicopter approach" and working on the continued development of other employees. In the opinion of this group of managers, in addition to the above competences, adaptability, resilience, oral expression and continuous assessment of employees and providing feedback on the work of the employees they manage are also important. Furthermore, perceptive listening, the ability to

effectively delegate tasks, planning and persuasiveness, in their opinion, also represent competencies that determine the success of a manager working within public sector organizations.

6. CONCLUSION

Having in mind that human capital today represents the basis for creating and maintaining competitive advantage in the changing and dynamic environment in which organizations operate and that one of the key priorities is the need to define knowledge, skills, abilities and personal characteristics that distinguish successful from less successful managers, which enable them to achieve an exceptional level of performance within the work environment, this scientific paper presents the results of the research on the attitudes of public and private sector managers regarding the assessment of the contribution of individual competences to their success. Based on the research conducted among 302 managers of various managerial levels from public and private sector organizations, the list of competences that represents key competencies for the success of managers in today's public and private sector organizations has been defined.

In the opinion of managers who work in organizations belonging to the private sector, competences such as leadership, motivating others, organizational competencies, initiative, integrity, tenacity, development of other employees, oral expression, planning and perceptive listening are key competences that are a precondition and basis for success of a 21st century manager. On the other hand, when it comes to managers working in organizations within the public sector, the most important competencies that define successful managers of today are competencies such as motivating others, deciveness, leadership, presentation skills, organizational skills, development of other employees, helicopter approach, flexibility, tenacity, oral expression, employee evaluation and feedback-appraisal, perceptive listening, delegating skills, planning and persuasiveness. As shown by the results of this research,the attitudes of managers of the public and private sector are very uniform, given that there are statistically significant differences in their attitudes for only five competencies - ascendancy, helicopter approach, tolerance for stress, adaptability and integrity. Public sector managers believe that competencies such as ascendancy, helicopter approach, stress tolerance and adaptability contribute to their performance at managerial positions, while private sector managers, in contrast to their public sector colleagues, have assessed the contribution of integrity as significant. Thus, as there are almost no key differences between public and private sector attitudes regarding competencies that define successful manager today, it can be concluded that there has been unification of these two sectors and employees working within them, despite the specific specifics that determine them.
The aforementioned specificities of public and private sector managers' attitudes regarding the assessment of the contribution of individual competences to them today are of strategic importance, especially from the aspect of human resources management, since human capital is the basis for creating and maintaining competitive advantage and high level of performance, and that the policies and practices that are defined for the purpose of retention of employees represent the biggest challenge of today's organizations. A set of key competencies defining a successful manager in today's business environment sets the basis for all human resource management processes and the development of employees within organizations in the public and private sectors.

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THE IMPORTANCE OF DIGITAL TRANSFORMATION FOR A SUCCESSFUL BUSINESS OPERATIONS

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Abstract: *At the time when Industrial revolution 4.0 is fundamentally changing the business environment, creating strategic capacities for a successful market positioning does not only presume a choice of relevant business strategies, but also a digital transformation of how companies do business. Unlike the traditional approach to doing business, which was based on an optimal combination of resources and a strategy of cost advantage or differentiation, open innovation has become the main driver of company growth and productivity in a digital environment, and innovativeness is one of the strategic factors that can help companies change the existing market limitations. This paper will focus, in particular, on an analysis of the impact information and communication technologies have on businesses today, and on the key challenges arising from the process of digitalisation.*

Key words*: Digital transformation, Industrial revolution 4.0, Innovation, Competitiveness*

1. INTRODUCTION

Ever since the industrial era and all the way through to the beginning of the digital period, the way companies did business was changing gradually, following the trends of the industrial revolutions. Natural resources and physical capital used to play the key role in company development, whereas in the modern environment, information and knowledge are the basis on which the competitive advantage is built. A company's added value is no longer generated from the company's physical assets, such as factories, equipment and machinery. Its value is now based on knowledge and intellectual property, which relies on the company's employees and their innovative ideas, technology, industrial and intellectual property rights, information systems, corporate and consumer brands, goodwill and other types of intangible assets, while intellectual capital is recognised as a company's key resource, Rakita (2013). Under these circumstances, innovation is recognised as the key driver of growth and productivity, while cooperation between companies becomes an imperative in order to maintain the competitive advantage in a global market, Onetti (2012).

Information and communication technology (ICT) is the basis of digital industrial revolution that today defines how modern companies operate and the global market functions. These technologies have essentially changed the way companies operate and create a competitive position for themselves in the market and have brought numerous advantages in terms of saving energy, space, money and time. ICTs have also facilitated management and improved flexibility of business systems, and provided for more reliable and secure operations. What will the fourth industrial revolution change in the way companies do business? The main effect of the Industrial revolution 4.0 is a creation of digital economy that combines the use of Internet with other advanced technologies that support companies' businesses and cause significant disruption in the business environment.

2. THE IMPACT OF INDUSTRIAL REVOLUTION 4.0 ON BUSINESS ENVIRONMENT

Many technical innovations are effectively changing the business environment today. The focus is on transition from industrial and traditional to a digital approach to business, and on creation of a digital economy based on knowledge. According to Schwab (2016), global businesses in Industrial revolution 4.0 will change not only the way companies operate, but also the way people live and communicate. Industrial revolution 4.0 according to Smokvina (2016), brings advanced industrial production, which relies partly on modern technologies for production automation, data processing and data exchange (p.30). This new industrial production framework merges two areas that used to be separate – robotics and e-business. In the core of the fourth industrial revolution lies the power of three technological innovations: automatisation, Internet of Things and artificial intelligence, Berger (2016). Industrial, economic and business models are changing fundamentally and humans are being removed from immediate production and monitoring of

manufacturing processes. In this way production can be accelerated and the number of halts and problems minimised.

According to Smokvina (2016), the fourth industrial revolution is based on six principles, which define the characteristics of the modern business environment (p.30-31):

- Interoperability – the ability of companies and people to connect and communicate in a cyber-physical system;
- Virtualisation – entails creation of a virtual copy of the physical world within a cyber-physical system in order to monitor and connect the system;
- Decentralisation – moving decision-making away from a few core people in a company. Product-related decisions have been transferred to consumers, who increasingly demand individualised products;
- Capacity to operate in real time – the data are collected and processed immediately. Production and conditions in manufacturing facilities are monitored constantly, and production is automatically shifted elsewhere in case of a disruption;
- Service-orientation – service architecture of companies is comprehensive and takes place via interconnected web services and Internet of Things;
- Modularity – thanks to standardised hardware and software systems, production can be flexibly adjusted to meet the manufacturer's requirements.

The second wave of disruptive technological advances includes inter-dependence of mobility, cloud-based ICT services, penetration of social networks and rise of big data applications. Thanks to these technologies the use of ICT services grew significantly across all areas of business. In the near future we can expect to see a sudden expansion of connected devices (internet of things) and machine to machine communication. The latest research show that in 2017, the digital transformation in the Industry 4.0 concept focused on specific segments, such as a new geography of innovation, and moving the focus from the West to the East. The main emphasis is placed on the importance of an ethical approach in the use of technologies and on use of ICT platforms to improve the business models, as well as, on cyber security and crypto currencies, Davis, Engtoft-Larsen (2018).

Table 1: Five digital technologies

Mobility and mobile applications: Technologies that enable voice and data connections between people, and increasingly between objects, while on the move.
Social media: This primarily refers to the use of these media for business purposes. These tools include: social networks (e.g. Facebook, LinkedIn, etc), microblogging (e.g. Twitter), blogs, internal wikis and/or other enterprise collaborative software.
Cloud: Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of computing resources (e.g. networks, servers, storage, software, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.
Big data analytics: Refers to the process of collecting, organising and analysing large sets of data ("big data") from a variety of different sources to discover patterns and other useful information and use them as a basis for right business decisions.
The Internet of Things (IoT): Describes the network of physical objects that feature an IP address for internet connectivity, and the communication that occurs between these objects and other Internet-enabled devices and systems.

Source: EC, (2014). *Digital Transformation of European Industry and Enterprises*, Brussels.

Many authors believe that the industrial revolution 4.0 needs a group of industry leaders to spearhead the coming changes and create the conditions for a faster digital transformation of traditional business models into a new digital era, Mithas (2013). Transformation of the existing business concept may be expensive and take time, because some countries believe robotisation is reducing the number of jobs their citizens can have, and modifying the existing business programmes may also require additional investments. According to Berger (2014), to develop companies that will take the leadership position in the area of digitalisation, three key factors are required:

- Accelerated innovation, which necessitates continued investment in research and development;
- Cooperation with other companies (including cooperation with companies in different industries from one's own);
- Creating a dynamic environment where key roles are given to cyber security, ecosystem and ICT, such as cloud computing.

Due to its complexity, it is still uncertain which direction the fourth industrial revolution will take. What is certain is the need for interconnection of all industrial sectors to work together in order to better understands the new trends. Governments, companies, academic communities and civil society have the responsibility

and the obligation to analyse changes brought about by the fourth industrial revolution, which has reshaped the functioning of economy and society, Schwab (2016). What must be considered is the social aspect of these changes and one cannot speak only about a new business environment, but about an entirely new social environment in which people live and work.

3. KEY CHALLENGES FOR BUSINESSES OPERATING IN THE INDUSTRY 4.0

Under the influence of fourth industrial revolution companies are facing with many challenges. In order to reach the successful market position in Industry 4.0 business environment they need to create strategic capabilities for the realisation of digital transformation. This transformation includes all the key segments of the business processes, and in particular, Schwab (2016):

- *Consumers* – consumer expectations are changing. Consumers are more demanding and more informed, because they have access to data;
- *Products and services* – quality of products and services is improving due to quick access to different data;
- *Partnerships* – new partnerships between companies are created, because mutual cooperation has become the key to maintaining a competitive advantage in the market;
- *Business models* – operational business models are transformed into new digital models.

Unlike the traditional business approach, the digitalisation process brings numerous challenges in managing demand. Companies must recognise what is important for their consumers and react timely to market changes and new market opportunities. By having easy and quick access to information, consumers can easily use different social networks to compare product prices and quality. Similarly, manufacturers can learn more efficiently what products and services their competitors offer or their potentials buyers want. All this information can be obtained in real time. Companies must join forces and change the way they operate in order to meet customer demands (become *customer-centric*) and must forecast which direction the market demands will take. With a careful analysis and observation of consumer portfolio, a relevant network between employees, suppliers, partners and investors can be created, who will develop the right proposal and idea for the new innovative enterprise. Furthermore, we must not forget that developing ideas requires leadership, an appropriate company culture and supporting human resources as the key means to realise the company goals.

The benefit brought about by digital technologies is greater interaction with the buyers and higher chances of meeting their expectations. This will definitely become a key element of competitiveness and maintaining the quality of products and services in the future. Unlike mass production and economies of scale, digital transformation shifts the focus to personalised and locally manufactured products, adjusted to the needs of individual users. Furthermore, the distribution of spare parts and simpler types of consumer goods is facilitated if only data is transferred remotely, while the production takes place locally. This is especially supported by application of 3D printing in factories which become less sensitive to labour costs, and are close enough to achieve product personalisation, Berger (2014).

The role of manufacturers, suppliers and consumers will change in the complex and intertwined network production by digital companies. In the new structure of the value chain industry leaders will have to face many new companies and have to support the concept of network manufacturing and the dynamics of manufacturing clusters, Popovčić-Avrić et al. (2017). The jobs are performed at dispersed locations, depending on the available workforce. One of the key opportunities is the phenomenon of “industrial democracy”, which means that the boundaries between physical and IT world are wiped out, and barriers to entry for small and specialised companies (SMEs) are lowered. The distribution of power is thus shifted between multinational companies, SMEs, or niche market players. In these conditions, the complexity of production and supply networks increases. This also leads to the concept of “mobile manufacturing units” – small autonomous productions cells that may be positioned to produce for the local market, without the need to build a complete and complex factory system. This may change the flow of direct foreign investment by giving more importance to rapidly growing markets and local needs, Berger (2014).

One of the main characteristics of digital economy is the creation of virtual or digital companies (*dot.com*), who transfer a large part of their operations to virtual platforms and communicate with their suppliers and consumer electronically. Electronic transactions made via Internet or other electronic channels allow for a flexible and quick cooperation between entities, Sofronijević et al. (2015). This is how the digital economy leads to faster reorganisation of company resources, creation of new values and generation of business models that are relevant for consumers.

The company needs an educated workforce to achieve digital transformation of its business processes. In a digital company propelled by technological changes, training and education of the workforce are fundamentally important, as they enable the employees to use the modern techniques and tools in their day-to-day work. The dominant technologies in the Industrial revolution 4.0 will be information technologies, electronics and robotics, but other knowledge sectors, such as bio and nano technologies, will also be represented. It will be taken for granted that employees have both social and technical skills. Companies will remain competitive only if they introduce the necessary training and life-long learning for their employees into the corporate culture.

The experiences of companies that operate successfully in the new digital environment point to the importance of ICT education. ICT education for all citizens determine the success of ICT investments, more than technologies themselves. That is why the states must support training of all citizens to use IT tools and technologies. Training and education are necessary so that consumer and companies gain the knowledge and skills they need to use the new technology efficiently, Radenković et al. (2014). In these circumstances, improving and adjusting the ICT education and training system and creating opportunities for lifelong learning (LLL) become a priority. National innovation capacities supported by ICT define to a great extent a company's ability to cooperate and join global value networks and e-business networks.

In a changing digital environment, successfully managing of the growing global business risks gets in importance. These risks are related to the need to: move the traditional borders between industrial and other sectors, change the business models and favour cooperation between companies in order to create high-quality digital products and services. The focus is shifting to continuous innovation as the companies have the imperative to shorten product life cycle and to face with the informed demand and increasingly stronger competition. The challenges the modern companies are facing also include: fostering innovation, readiness to take risks to bring those innovative ideas to fruition and adapting to new technologies brought about by the fourth industrial revolution. Due to complexities of the innovation process, companies are unable to maximise the benefits from innovation if they innovate in isolation. There are very few companies that have all the necessary information and resources to put a profitable innovation on the market. According to Mocker et al. (2015), due to lack of internal resources, companies are increasingly turning to cooperation with external partners.

Combining different synergic advantages has seemed like a good way to create value for all parties involved and prompted creation of many strategic business alliances. According to Rakita (2013), strategic alliances include all forms of international partnership arrangements that are more than classical market transactions and long-distance transfers, but less than mergers and acquisitions of companies from different countries (p. 271-272). The flexibility of these interest-based alliances leaves enough opportunities, without changing ownership, to draw on new sources of innovation-based competitive advantage, to manage the global business risk more effectively and to reinforsed a company's position in the market.

The fact that a company has started using digital technologies in its business, that does not necessarily mean the company has become a successful digital company. It will become so, when its repositioned organisational structure, strategies and the way the company operates, become the most important aspect of its agile operation. It is obvious that companies must incessantly adjust their business processes to increase productivity, flexibility and adaptability. According to Lovrić (2016), the key areas for digital transformation are digital business models (what the company should do), digital operational models (the way the company will do it) and digital talents and skills (who will do it).

A successful digital transformation of companies in Industry 4.0 assumes taking into consideration the following parameters, Marković (2016):

- *Creating value beyond the existing boundaries* and continuous redefining of the business to meet the consumer needs and the latest market trends. Digital companies must be ready to redefine completely the way they operate in search of new value sources for their buyers.
- *Creating value in the core business* – with new digital technologies (mostly ICT), companies can more easily connect their organisational parts and communication channels into an overarching value chain.
- *Raising the company's fundamental capacities* – with the help of modern technologies, companies can operate more quickly and be more agile, and with the help of open-source innovation, innovative products that have higher value can be created. Information technologies are expected to provide stable and reliable support for standard business processes, as well as for new products and services, or completely new business models (p.23-24).

4. DIGITAL ENTREPRENEURSHIP AS THE BASIS FOR DIGITAL TRANSFORMATION OF BUSINESS – EU EXPERIENCE

European Commission has been placing special emphasis on promoting smart use of digital technologies in European companies, with the aim to create new business opportunities and accelerate the transformation of the European business environment. The European Commission believes that the speed of adoption of digital technologies in the European economy will determine its future economic growth. Europe 2020 Strategy for growth and jobs is for that reason based on 4 key action areas, EC (2016): a) Digital Agenda for Europe, b) Digital Single Market Act, c) Industrial Policy for the Globalisation Era and d) The Entrepreneurship 2020 Action Plan.

The Entrepreneurship 2020 Action Plan stresses the potential of ICT to foster entrepreneurship, growth and job creation. The Commission puts the spotlight on digital entrepreneurship in particular, which encompasses all new jobs and transformation of the existing business enterprises through the use of digital technologies. Beside digital companies, the EU pays special attention to application of digital technologies in small and medium-sized enterprises, which are abundant in the European economy and are a significant factor in the growth dynamic of the entire European economy, EC (2016). To support the process of digitalisation of European companies, the European Fund for Strategic Investments has mobilised 315 billion EUR, EC (2015).

Digital Entrepreneurship Scoreboard 2015 indicates that many European countries are lagging behind in the creation of favourable conditions and environment for digital entrepreneurship. The countries that succeeded in creating a good enabling environment (UK, France and Germany) outperform the countries with weak enabling environments (Spain and Italy) in the process of digital transformation of their enterprises. There is still a large number of companies in Europe (around 40%) that do not use new technologies (cloud, mobile, social media and big data). These firms are typically SMEs operating in sectors such as mining, construction, manufacturing, transport and storage and utilities, EC (2015). On the other end of the spectrum are a group of companies whose operation is fully digital, by adopting all four technologies (cloud, mobile, social media and big data), but they account for less than 2% of the total number of companies. These are typically large companies operating in the sector of finance, IT and telecommunication, EC (2015).

The Commission confirmed that the transition into digital economy is the key precondition for improving competitiveness of the European economy by adopting the latest Declaration on the digital transformation in February 2016, which included seven recommendations for European companies to perform the transformation as quickly and as successfully as possible. The recommendations include accelerating the digital transformation process in order to create new business opportunities in the EU, mobilising investments and reskilling the workforce, who must also possess digital skills for a transformed European industry and economy, EC (2016). The entire process of digital transformation can only be performed by an educated workforce and companies whose corporate strategies place special focus on the issues of continued training and learning and make major investments in research and development, Vidas-Bubanja et al. (2017).

5. CONCLUSION

Intensive changes in the business environment brought by the fourth industrial revolution present numerous challenges for companies. Creating strategic capabilities for successful market positioning assumes digital transformation of the business and information and knowledge are recognised as key requirements for bolstering competitiveness. Digital transformation is a comprehensive change of the way modern companies do business, which is based on development and adoption of information and communication technologies and open innovation, which arise due to the interconnectedness of the global economy. Open innovation allows for better connectivity between all participants in the value chain in order to detect early the new technical possibilities and improve the business processes. Digital transformation of business processes can be observed in all the key areas of economy: industry and manufacturing, trade, banking, energy, transport, education, healthcare, as well as the media and publishing industry. Digital transformation leaders are companies that harmonise the social, financial and political framework to accelerate their innovation and improve their business.

Shifting the focus from a traditional to a digital approach to business means taking into consideration the changes in all the key segments of the business processes: from managing demand, through adopting digital business models and creating business alliances that will foster the innovation process and result in products and services of better quality. In the process of digital transformation, companies must start from raising awareness about changes in the overall business environment and the disruptive technologies brought by

the second digital wave. The basic motives that should move companies to adopt digital technologies include: the possibility to establish direct communication with consumers-users, global availability and expansion of the profit margins. Raising awareness about the need for digital transformation of businesses must take place at all levels, from the level of decision makers (who will initiate the reform process), to the level of local communities and enterprises (to help them recognise the new opportunities) Levi-Jakšić et al. (2014). Experiences in the EU show that activities that may especially contribute to digital transformation of businesses include: expanding the digital knowledge base, supporting a digital business environment, simplifying access to capital and finance, boosting digital abilities and talents, supporting a culture of digital entrepreneurship, EC (2016).

Companies can remain competitive only if they have a flexible and agile hierarchy, good strategies to attract and retain talent, real partners, and if they can combine different dimensions of their business (digital, physical and biological), Schwab (2016). Redefining completely the way companies operate in search of new value sources for their buyers is recognised as one of the key challenges of a successful digital transformation of companies. Digital transformation shifts the focus from mass production to personalised and locally manufactured products, adapted to the needs of individual users. Simultaneously, with the help of modern technologies, companies can operate more quickly and be more agile, and with the help of open innovation, higher-value innovative products can be created.

In the complex network production by digital companies, the role of manufacturers, suppliers and consumers will change, because the structure of the value chain will change. The business models of the modern digital companies are typically based on fragmentation of the value chain. Thanks to new digital technologies (mostly ICT), companies can more easily connect their organisational parts and communication channels into an overarching value chain, and thanks to lower barriers to entry, small players find it easier to enter markets and are in a position to offer products and services if increasingly higher quality.

ACKNOWLEDGMENT

This Research Paper was a part of the Project "Advancing Serbia's Competitiveness in the Process of EU Accession", no. 47028, and of the Project "Modelling of Serbia's Development and Integration into Global Trends, in the Light of Economic, Social and Political Fluctuations", no.179038, financed by the Serbian Ministry of Education, Science and Technological Development.

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THE MANAGEMENT OF DISASTERS IN FUNCTION OF THE ECONOMY COMPETITIVENESS

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Abstract: *This paper outlines and discusses a strategic and holistic approach to disaster management for nations worldwide. It notes the growing importance of investing funds in prevention but also rises awareness of consequences and causes of disasters. The paper then proposes a strategic approach to management from proactive pre-crisis planning through strategic implementation and finally evaluation and feedback. A discussion of crisis and disaster management literature and studies are also introduced. It notes that although crises and disasters cannot be stopped their impacts can be limited by both public and private sector managers. The paper concludes that the understanding and subsequent management of such incidents can be vastly improved through the extension and application of crisis and disaster management theory and concepts from other disciplines, coupled with the education of all the nations about behavior during and after the catastrophe. The paper offers five disaster trends, with brief overview in a view of planning the future actions based on analyses of stored data.*

Keywords*: disaster management, strategy, disaster trends, prevention*

1. INTRODUCTION

Certain infrastructures play a vital role in supporting our economy, safety and lifestyle. These complex and often interconnected systems have become essential for everyday life, but are frequently taken for granted. The moment when this attitude changes is when important services provided by such infrastructure are interrupted - when we lose easy access to electricity, healthcare, telecommunications, transportation or water supply, etc. It is at that moment that we become aware of our great dependence on these networks and the vulnerabilities that result from such dependence. In order to assess the vulnerability of those critical infrastructures (CIs), it is important to understand and define them, through the benefits they bring.

Projects for the construction of infrastructure facilities are characterized by initially high investments, non-commercial construction motives, hardly measurable benefits and abundant social direct and indirect benefits. It is precisely because of the high investment and the mentioned nature that these projects are estimated to be unjustified. Mechler (2005) points out that “Viability of such a project is tied very closely to the occurrence probability of disasters. For disasters happening relatively rarely (eg. earthquakes) it may be more difficult to secure investment funds than for more frequent events such as flooding. Furthermore, the problem of proper maintenance of installed infrastructure, a general problem with public investment projects, is an additional issue if there is little awareness that a severe disaster is a real possibility” (p. 12).

In the end, as a rule the investment motive is not profit but a positive impact on the quality of life of the wider community. If we look at these projects from another angle, the one that is provided by cost-benefit analysis, we will get a wider picture of the effects. During the application of this analysis, the problem that can be encountered is certainly the correct quantification of qualitative indicators as well as the capture of relevant data. Most often there are a lot of indirect effects on the community. It is important to pay attention to missed chances but also the savings. Only the achieved savings justify the investment of funds in the construction of infrastructure facilities. The relationship that needs to be reached concerns the amount of investment in remedying the consequences of catastrophic events as opposed to preventive investment at the moment when danger is just a prediction.

2. DISASTER MANAGEMENT

Disasters have negatively affected people since the very beginning of our existence. In response, individuals and societies have made many efforts to reduce their exposure to the consequences of these disasters by developing measures to address the initial impact, as well as the need for response and recovery after disasters. Regardless of the adopted approach, all these efforts have the same goal: disaster management.

Motivating concepts that lead to disaster management - reducing the risk to life, property and the environment - are mostly the same around the world.

However, Coppola (2015) points that the capacity to carry out this mission is not at all the same. Whether it's political, cultural, economic or other reasons, the unfortunate reality is that some countries and some regions are more capable than others to solve the problem. But no nation, irrespective of its wealth or influence, has made enough progress to be completely immune to the negative effects of disasters. Moreover, the existence of a global economy makes it difficult to keep the consequences of any disaster within the boundaries of a country (p.1).

2.1. Modern disaster management: A four-phase approach

When we talk about comprehensive disaster management, we have in mind four components also known as Coppola's (2015) four-phase approach - mitigation, preparedness, response and recovery, in the following way (p. 12):

- **Mitigation**. Also known as Disaster Risk Reduction (DRR), mitigation involves reducing or eliminating the probability or effect of the hazard, or both. Mitigation attempts to "treat" the danger so that it affects society to a lesser extent.
- **Preparedness**. This involves equipping people who may be affected by a disaster or who are able to help people with the tools to increase their chances of survival and to reduce their financial and other losses.
- **Response**. This involves undertaking actions to reduce or eliminate the impact of disasters that have occurred or are currently taking place in order to prevent further suffering, financial loss or a combination of both. Relief, a term commonly used in international disaster management, is one of the components.
- **Recovery**. This involves restoring the lives of victims to normal state after the impact of disasters. The recovery phase generally starts after the current response is completed and can last for months or years after that.

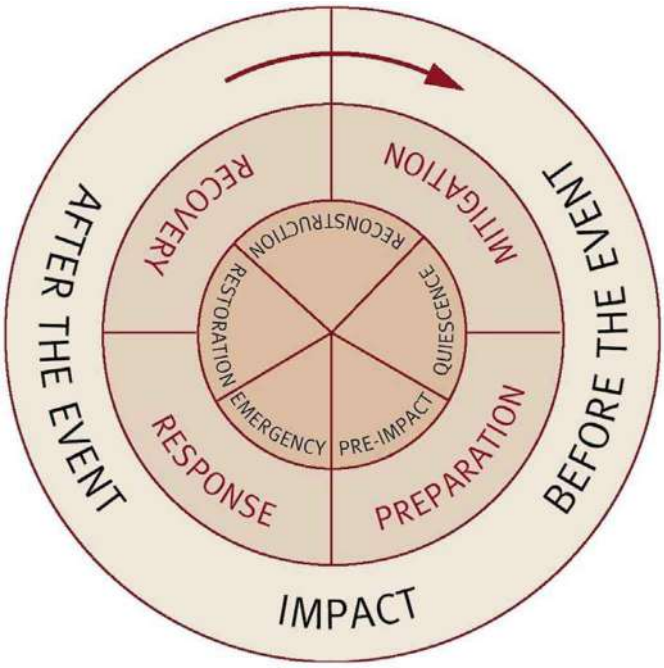

Figure 1: The disaster management cycle (Coppola, 2015)

We can notice the impact of strategic management on this approach. Strategic management creates a common vision that focuses on decisions, actions and people involved. The stages of the strategic management process form the core of the process itself and its main components. Thinking strategically, experts have a wider and longer-term view of the future, because without good-quality-plans management of a particular organization makes no sense (Obradović et al., 2012). This approach is exactly what is required in modern disaster management.

In the Table 1 Coppola (2015) gave us a parallel overview of two opposing approaches - on the one hand, a reactive response to the risks of catastrophic events, and on the other, investment in prevention and proactive regimes. (p. 17)

Table 1: Response and Recovery-Based Management versus Prevention and Risk Reduction-Based Management (Coppola, 2015)

Response and Recovery-Based Efforts	Prevention and Risk Reduction-Based Efforts
Primary focus on disaster events	Focus on vulnerability and risk issues
Single, event-based scenarios	Dynamic, multiple-risk issues and development scenarios
Basic responsibility to respond to an event	Fundamental need to assess, monitor, and update exposure to changing conditions
Often fixed, location-specific conditions	Extended, changing, shared or regional, local variations
Responsibility in single authority or agency	Involves multiple authorities, interests, actors
Command and control, directed operations	Situation-specific functions, free and open association and participation
Established hierarchical relationships	Shifting, fluid, and tangential relationships
Often focused on hardware and equipment	Dependent on related practices, abilities, and knowledge base
Dependent on specialized expertise	Focused on aligning specialized expertise with public views and priorities
Urgent, immediate, and short timeframes in outlook, planning, attention, and returns	Moderate and long timeframes in outlook, planning, values, and returns
Rapidly changing, dynamic information usage, which is often conflicting or sensitive in nature	Accumulated, historical, layered, updated, or comparative use of information
Primary, authorized, or singular information sources; need for definitive facts	Open or public in multiple, diverse, or changing sources; differing perspectives and points of view
In-out or vertical flows of information	Dispersed, lateral flows of information
Relates to matters of public security, safety	Matters of public interest, investment, and safety

3. DISASTERS CAUSED BY CLIMATE IN NUMBERS

According to data, the losses of global disasters have risen to the highest levels in the last four years.

Global natural disasters in 2016 caused economic losses of $ 210 billion, a 21% rise over the 16-year average of $ 174 billion. Losses were even more robust compared to the median ($ 132 billion) - an increase of 59% was recorded. Economic losses were attributed to 315 events, compared to the average of 271. The disaster caused insured losses of $ 54 billion, or 7% above the 16-year average of $ 50 billion and 37% more than the median ($ 39 billion). This is the largest amount of total insured losses since 2012, which ended the four-year downward trend. Significant events during the year were major earthquakes in Japan; hurricane Matthew in the United States and the Caribbean; catastrophic summer floods in China, Europe and the United States; several extreme weather outbreaks in the United States; wildfires in Canada and the United States; and drought in parts of Southeast Asia and Africa. The greatest three hazards - floods, earthquakes and severe weather - were accounted for 70% of all economic losses in 2016. While 72% of disaster losses occurred outside the United States, they still account for 56% of the global insured losses. This points to the gap in continuous protection in many areas around the world.

The deadliest event in 2016 was the April earthquake in Ecuador that killed at least 673 people. It is worth noting that the victims of the hurricane Metz were more than 600, and unofficial estimates of the number of casualties in Haiti were as high as 1,600. A total of 16 tropical cyclones (category 1+) were recorded in 2016; number equal to the average of 1980-2015. Fourteen cyclones occurred in the northern hemisphere, including two in the United States. Also, the year 2016 ended as the hottest year ever recorded since the global temperature of land and ocean (beginning of 1880). This is the third consecutive year of record making. April earthquakes in Japan were the most expensive single economic loss of the year. The Japanese government estimated that damage to the Prefecture of Kumamoto and neighboring prefectures

had an economic cost of more than $ 38 billion. This was also the most expensive event for the insurance industry with $ 5.5 billion.

The most expensive disaster in China occurred after annual floods along the Yangtze River Basin, causing a loss of $ 28 billion. For insurance companies, Hurricane Matthew was the most expensive catastrophe caused by weather conditions, with an estimated loss of nearly $ 5 billion.

The global economic losses in 2016 were ranked as the seventh recorded, and for the eighth time a record amount of $ 200 billion was achieved. The secured losses are the sixth place in the industry and for the ninth time the annual value exceeded $ 50 billion. (Aon Benifield, 2017)

4. DISASTERS, POVERTY AND DEVELOPMENT

Research and practice support the theory that there is a strong correlation between disasters and poverty. It is well documented that developing countries, which are more prone to disasters, experience stagnant or even negative development rates over time.

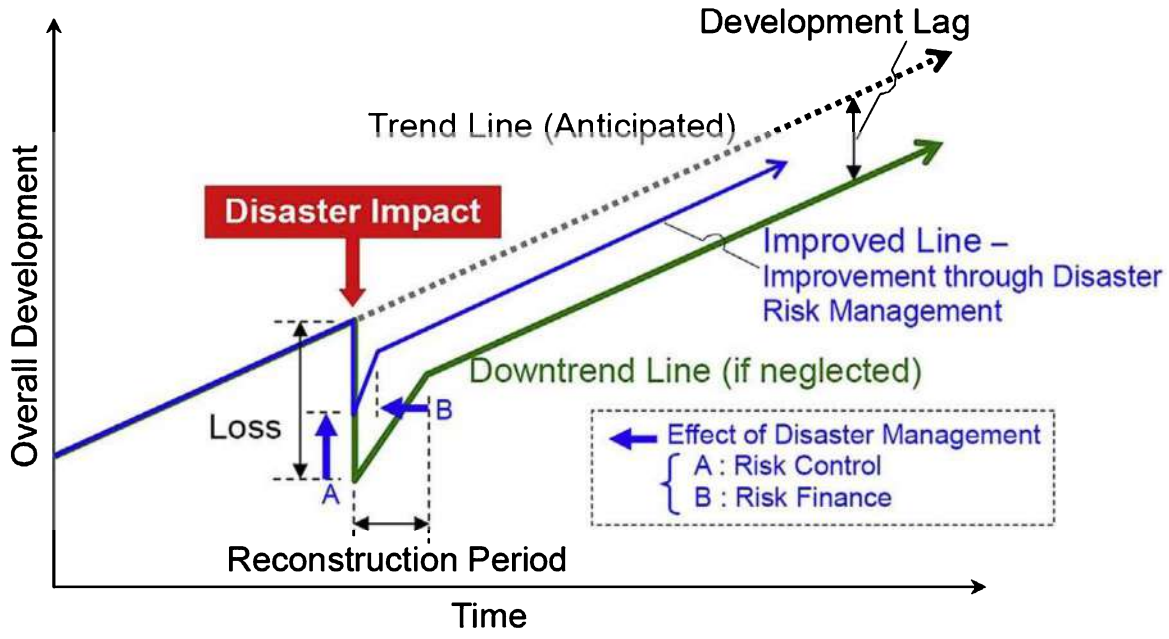

Figure 2: Impact of disasters on development (Coppola, 2015)

Throughout history, a natural disaster has led to significant changes in the functioning of the country. One of the spheres of influence could be the rate of development. For developing economies, the financial negative effect of these events can be devastating, in contrast to industrialized countries, where robust economies absorb such consequences. In 2001, for example, earthquakes occurred in both El Salvador and the United States (Seattle), each causing approximately $2 billion in damages. While this amount had little or no noticeable impact on the US economy, the financial consequences in El Salvador amounted to 15 percent of that country's GDP. Developing countries have significant consequences and impact on disasters caused by disasters. Each disaster is unique in its consequences, so there is no unique formula that can be used to accurately predict how these problems will be played. (UNDP, 2004)

If we talk about ways in which disasters damage poor countries beyond obvious consequences such as death, injury, and destruction of property, Coppola (2015) have mentioned following (p. 18):

- National and international development efforts are stunted, erased, or even reversed.
- Sizable portions of GDP often must be diverted from development projects, social programs, or debt repayment to manage the disaster consequences and begin recovery efforts.
- Vital infrastructure is damaged or destroyed—including roads, bridges, airports, seaports, communications systems, power generation and distribution facilities, and water and sewage plants—requiring years to rebuild.
- Schools are damaged or destroyed, leaving students without an adequate source of education for months or even years.

- Hospitals and clinics are damaged or destroyed, resulting in an increase in vulnerability to disease of the affected population.
- Formal and informal businesses are destroyed, resulting in surges in unemployment and decreased economic stability and strength.
- Reconstruction efforts result in shortages of materials and labor, which in turn drive up construction costs, inflate salaries, and draw workers away from other sectors where they are needed.
- Residents are forced or impelled to leave the affected zone, often never to return, extracting institutional knowledge, cultural and social identity, and economic viability from areas that cannot afford to spare such resources.
- Desperation and poverty lead to a rapid upsurge in crime and insecurity.
- A general feeling of hopelessness afflicts the affected population, leading to increased rates of depression and a lack of motivation to regain independence from outside assistance.

Based on facts mentioned above, it can be concluded that it is extremely important that disaster management is incorporated into national strategic documents such as strategies and action plans.

4.1. Example - Tsunami sets back development 20 years in Maldives

Within minutes of the December 2004 tsunami in the Indian Ocean, much of the economic and social progress in the Maldives was washed away.

According to government officials, the tsunami caused a 20-year setback in the development of this small country, an island nation off the coast of India, which only six days before the disaster had been removed from the UN's list of least developed countries. In particular, the tsunami and its resulting floodwaters dealt a serious blow to the tourism sector, the country's main source of income. Nearly one-fourth of the 87 resorts in the Maldives were severely damaged and declared unable to operate. Tourism directly accounts for one-third of the country's economy, with the resorts alone providing between 25,000 and 30,000 jobs. When tourism-related tax and customs revenues are included, tourism contributes up to 70 percent of the economy, with the sector expanding each year. These earnings had helped to improve living standards in the Maldives, including increased school enrollment, lower unemployment, and more students seeking higher education abroad (UNDP, 2005).

5. DISASTER TRENDS

In contemporary times, experts have become aware of the importance of accurate records and analysis of stored data in order to predict the future. As disaster data is becoming more and more accurate, scientists and managers have confirmed what has just been anticipated: the nature of the disaster is changing. The causative of these changes is mostly a human factor, and what is worrying is that disasters become more numerous year after year, affecting a larger number of people, either directly or indirectly. As disasters become deadlier and more influential, they also have impact on the finances of not only affected countries. This is exactly one of the negative sides of the global economy. Coppola (2015) points to the 5 latest trends (p. 20):

- The number of people affected by disasters is rising.
- In general, disasters become less deadly.
- All in all, disasters are becoming more expensive.
- Poor countries are disproportionately affected by the consequences of a disaster.
- The number of accidents is increasing every year.

People have always settled areas in order to meet needs such as the need for food, water, trade or even defense. In keeping with these needs, the risks of natural hazards are often neglected and understood as an "integral part of life" to be accepted. This has resulted in all risky settlements such as settlements along the river banks, seaside resorts, agricultural households on fertile slopes of active volcanoes, etc. As the number of settlers increases, the concentration of risk is also increased proportionally. Since 2000, it has been estimated that around 75% of the population is settled in disaster-prone areas. For this reason, it is logical that a large number of people per year are affected by disasters. (UNDP, 2005).

It is known that natural forces result in natural disasters from the emergence of the world - rivers have always swam, and earthquakes have occurred in every era of history. People only become victims of nature when they find themselves in it's path. Hence, as a species, we adjusted to the conditions of the location we inhabited and very often were successful in doing so. These results unfortunately failed to reach people when it comes to rare occurrences such as earthquakes or hurricanes. Modern science has made significant progress when it comes to protecting people from disasters developing new methods and technologies.

Globalization and increased international cooperation have helped the global community to effectively reduce risk and limit human-induced accidents. Although the number of accidents has tripled since the 1970s, the number of people around the world who have died has dropped by 50 percent.(UNISDR,2014) Experts have developed early warning systems, special protective structures for disasters, such as tornado security rooms, more effective management of the secondary consequences of catastrophes, such as hunger and disease, etc. which had an affected the fall of catastrophe fatalities.

If we talk about the costs of disasters, the situation is critical. At the end of the last century, the amount of economic cost of single event did not exceed 1 billion dollars, but after 2000 there are several cases where this amount is overcome. The new record was recorded in 2013 when 41 disasters surpassed $ 1 billion and totaled $ 125 billion. A year earlier there was a small number of catastrophes, but the cost was huge, 175 billion dollars. There are numerous reasons why disasters are more expensive - the number of people who inhabit sites at risk increases, there is a greater number of disasters, economies are much more dependent on technologies that can be canceled during disasters, secondary economic consequences are transmitted, etc. (World Post, 2014).

Natural disasters do not distinguish the poor from the rich countries, and affect all countries of the world. The difference arises when we talk about the consequences on the economy, and the speed of recovery after the disaster. The World Meteorological Organization of the United Nations (WMO) reported in 2011 that 95% of deaths from disasters occur in poor countries - a number that has been steadily growing for decades. About these statistics is worrying that UNDP has estimated only 11 percent of the world's "risky population" can be classified in the group of poor countries. In fact, on average, 90 percent of disaster-related deaths and deaths occur in countries with income levels below $ 760 a year per capita. These facts stem from the fact that the poorer nations predominantly settle in disaster-prone and high-risk areas due to their affordable accessibility, in facilities which are below any standard, but also are less educated about actions when a disaster occurs. The budget for protection is low on the list of priorities in view of other social and economic problems that require expenditure (Coppola, 2015).

Furthermore, all the evidence suggests that despite the recent decline in the number of annual events in the past decade, the rising trend will only continue without significant changes in development patterns. We can find two main reasons for an increase in the number of catastrophes. The first is based on climate change (and subject to great debate) and the other is human impact on nature.

6. CONCLUSION

Disaster management is a complex discipline. It involves actions that try to mitigate the effects of hazards, ensure that the population is prepared for catastrophes if they arrive, facilitate the response to disasters that occur, and help the recovery of society in months and years after the catastrophic events.

As it is presented through numerous papers, the consequences of disasters are becoming more expensive, reflecting not only the number of people affected, but the State as a whole; not only to the country in which they happened, but to the other countries connected through the global economy.

We also learned that the number of accidents has an upward trend, which should be our sign for change. Developing countries do not have the luxury of reactive strategies. As a rule, they are several times more expensive than prevention. In addition, long-term solutions are often not implemented in reactive strategies. The reason for this are most often limited resources.

Mobilizing resources for preventive strategies is a necessity. Not a single country is rich enough to ignore the savings achieved by the proper preparation for a catastrophic event. The hypothesis "Prevention requires high initial costs which has a negative impact on financial results in the short term, but the in the long-term period prevention results in multiple benefits that makes the investment of funds justified" is corroborated by many researches.

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.

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DATA PROCESSING AND ANALYTICS IN THE DIGITAL AGE 196

Tijana Dragojević, Jovana Svičević, Sandro Radovanović

CLASSIFICATION OF LIFE INSURANCE USERS USING DATA MINING 197

Marija Kuzmanović, Dragana Makajić-Nikolić

PREFERENCES OF WINE CONSUMERS TOWARDS LOCAL WINE BRANDS: CASE OF SERBIA 204

Milica Maričić, Milica Bulajić, Marina Dobrota

EASE OF DOING BUSINESS AND GROSS DOMESTIC PRODUCT: IS THERE A RELATIONSHIP? 213

Ivana Ivković, Vesna Rajić

CONFIDENCE INTERVALS FOR THE POPULATION STANDARD DEVIATION: SIMPLE RANDOM SAMPLING VS. RANKED SET SAMPLING 221

Nikola Cvetković, Nebojša Dragović, Aleksandar Đoković

FIELD STRESS DETECTION ALGORITHM USING REMOTE SENSING 229

Nikola Zornić, Aleksandar Marković

CRYPTOCURRENCY PRICE FORECASTING USING TIME SERIES AND MONTE CARLO MODELINGAND SIMULATION 236

Nikola Vojtek, Ana Poledica, Bratislav Petrović

STATISTICAL AND SOFT COMPUTING TECHNIQUES IN AIRLINE INDUSTRY – A LITERATURE REVIEW 244

Jovana Kuljanin, Milica Kalić, Manuel Renold

THE IMPACT OF LOW COST CARRIER ON COMPETITION IN LONG HAUL MARKET: LONDON - NEW YORK ROUTE 252

Strahinja Radaković, Milan Radojičić, Milica Maričić

MULTIVARIATE APPROACH TO MAKING SPONSORSHIP DECISIONS: THE CASE OF EUROPEAN FOOTBALL LEAGUES 260

Marko Prodanović, Damjan Rovinac, Stefan Radibratović

MEASURES OF DIGITALIZATION IN EUROPEAN ENTERPRISES: LINEAR REGRESSION MODEL 268

Višnja Istrat, Dajana Matović, Milko Palibrk

RESEARCH OF ASSOCIATION RULES AS DECISION MAKING TOOL FOR MANAGERS 274

Boris Delibašić, Sandro Radovanović, Miloš Jovanović

SKI LIFT TRANSPORTATIONS AS PREDICTORS FOR INJURY OCCURRENCE 279

Anja Bjelotomić, Aleksandar Rakićević, Ivana Dragović

DECISION TREE-BASED ALGORITHM FOR THE CLASSIFICATION OF MUSICAL INSTRUMENTS 284

Slaviša Arsić, Dragan Pamučar, Milija Suknović

DETERMINING THE WEIGHTS OF CRITERIAIN MENU EVALUATION USING BEST-WORST METHOD 292

Stefan Vujović, Danijel Mišulić, Sofija Krneta

ANALYSIS AND PREDICTIONOF VIEWSIN YOUTUBE INTERVIEWS 298

Matija Milekić, Aleksandar Rakićević, Pavle Milošević

NEURAL NETWORKS IN MARKET SENTIMENT ANALYSIS FOR AUTOMATED TRADING: THE CASE OF BITCOIN 305

Dušica Stepić

EXPERIMENTALCOMPARISON OF MULTI-LABEL LEARNING METHODS 313

Ivan Rakić, Željana Milošević, Slađan Babarogić

DATA MINING USING ORACLE DATA MINER AND ANALYTIC FUNCTIONS WITH HADOOP 320

Jelena Ljubenović, Ognjen Pantelić, Ana Pajić Simović

BIG DATA ANALYSIS IN SOCIAL MEDIA 329

Sofija Prokić, Jelena Ljubenović

QUERY PROCESSING ASPECT IN HETEROGENEOUS DBMS 336

CLASSIFICATION OF LIFE INSURANCE USERS USING DATA MINING

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Abstract: *The significance of life insurance as the safest form of investment is reflected in the benefits to both the individual and society. The topic of this research includes creation and evaluation of a few different models for classification of potential and existing life insurance users into one of 8 possible risk categories. The dataset which was used to carry out the research has been downloaded from Kaggle.com competition, Prudential Life Insurance. The construction and evaluation of the aforementioned models have been conducted using CRISP-DM methodology. Due to the characteristics of the dataset, which included 128 attributes, and specific application area, attributes section will be applied, as well as algorithm parameters optimization. The whole research has been conducted using open source web application Jupyter Notebook, which uses Python code language. It comes to the conclusion that XGBoost algorithm outperforms other algorithms used in this paper.*

Keywords: *Life insurance, multiclass classification, attribute selection, parameter optimization, principal component analysis*

1. INTRODUCTION

The problem of predictions in the field of life insurance lies in the fact that life insurance is a type of insurance that must be maximally adjusted to each user. This requires detailed analysis of all aspects of human life. In addition, it must be taken into account that the prediction is carried out for a very long period of time, which is an additional aggravating circumstance.

The dataset which will be analyzed is Prudential Life Insurance Assessment, one of the most famous life insurance companies. In America, only 40% of the households own a life insurance, and since life insurance payouts are quite big, and the repayment period long, it is clear why the insurance companies give great importance to previously conducted detailed research which also includes medical examinations. People refuse to take the medical exam which takes 30 days on average, while the classical insuring of life insurance is considered outdated.

Therefore, as a principal business problem, in the specific case of the Prudential Life Insurance Company, the selection of corresponding indicators so that the classification of potential users would be carried out significantly quicker while respecting user's privacy and personal data, is pointed out. The goal is to predict the value of the Response variable for each user Id that is to assign one of 8 values of the nominal Response variable to each Id value.

The complexity of this problem lies in the fact that it is a large dataset, and what is specific is that most of the data contain medical and financial information which represents a sensitive area of human life. Therefore, the selection of attributes as one of the approaches can contribute to a great saving of time and money.

In the following chapters, more will be said about the preparation and analysis of data as well as the modeling of the solution using a variety of different algorithms

2. LITERATURE REVIEW

According to the literature on this topic, we have come to the conclusion that data mining in the field of life insurance is used in four situations:

- Acquiring new customers.
- Retaining existing customers.
- Performing sophisticated classification
- Correlation between Policy designing and policy selection

Significant conclusions were made in Devale and Kulkarni article Applications of data mining techniques in life insurance (Devale,A.B, Kulkarni, Dr.R.V., 2012). They recommend KNN algorithm for performing

sophisticated classification. Also they emphasize advantages of linear regression, which may be used to solve a problem because insurance industry regulators require easily interpretable models and model parameters.

Since the set of data contains a large number of attributes, the speed of execution of the algorithm is a very important component. Within his article on the potential for machine learning in the prediction of insurance policy sales, Adrian B.F. Ampt notes that the statistical analysis has two problems (Ampt, 2017). It is too slow and the analysis is prone to mistakes. Ultimately the Decision Tree algorithm and Logistic regression could generate model quickly enough and make accurate predictions. The results are not as accurate as statistical analysis in some cases, but the results were competitive and consistent. The models could also be generated much faster than the statistical analysis which takes weeks to set up for a new dataset, whereas machine learning could make predictions within the eight-hour window, although often within a minute and even seconds. Finally, machine learning was able to handle irrelevant features very well, which means that the data scientist does not necessarily have to comb through the data to pick relevant features.

2. METHODOLOGY

3.1. Data understanding and data preparation

The dataset was first imported into a Jupyter notebook (Kluyver, et al., 2016) and all the libraries which will be used in the project work were also imported.

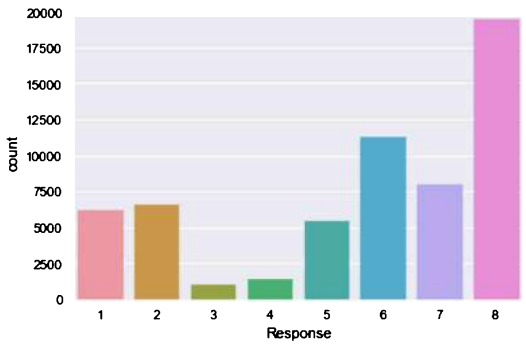

Figure 1: Distribution of classes of the output variable

It can be deducted from the image that there is an imbalance of classes (Satyasree, K.P.N.V., Murtthy J.V.R., 2013) and that classes 3 and 4 are significantly less represented than others, while class 8 counts the most.
A great number of missing values has been noted, which happens very often in real data sets and this presents a problem for algorithm application. In a Jupyter notebook, the presence of missing values can be checked by using the function *isnull()*.

The dataset contains following types of data:

- Categorical(nominal),
- Discrete and
- Continuous variables.

The variable which is predicted has an ordinal measure scale. This means that it is of a categorical type, with defined hierarchical relationship (ranked categories). Intervals between consecutive values are not necessarily the same.
So as to better understand the dataset, some of the variables will be presented and described:

- ID: key which uniquely identifies each line
- Product_Info_1-7: Normalized values pertaining to the type of product, that is, to the type of insurance
- Ins_Age: Normalized values of the age of potential clients
- Ht: Normalized height
- Wt: Normalized weight

- BMI: Normalized body mass index
- Employment_Info_1-6: A set of normalized values which refer to the employment history of the logged client
- Insured_Info_1-6
- Insurance_History_1-9
- Family_History_1-5
- Medical_History_1-41
- Medical_Keyword_1-48
- Response

Using the heat map graph, the correlation between all of the attributes is shown, so as to note which pairs of attributes are more correlated. It strives towards the elimination of highly related attributes since they can provide an unrealistic image about the efficiency of the applied algorithm.

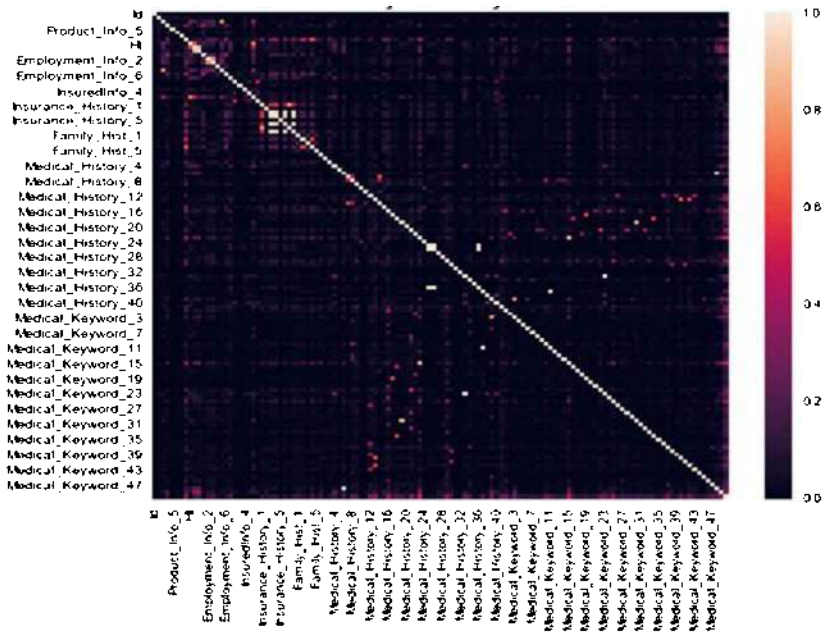

Figure 2: Display of the correlation between attributes

As expected, it is noted that there is a strong correlation between the pair of attributes Wt (weight) and BMI. Using analysis it has been determined that the three greatest correlations between pairs of attributes are:

- Medical_History_6, Medical_Keyword_48
- Medical_History_25, Medical_History_26
- Medical_History_33, Medical_Keyword_23

It can be concluded that the case of high correlation between attributes Medical History and Medical Keyword is probably about the medicinal state which is described using a specific term (Medical Keyword), therefore, about a kind of derived attributes. So as to better understand the above-mentioned correlation coefficients, it has been decided that the link between these attributes be shown in cross tables as well, which are shown in the images below.

Medical_Keyword_48	0	1
Medical_History_6		
1	37	3231
2	2	0
3	56106	5

Medical_Keyword_23	0	1
Medical_History_33		
1	34	5767
3	53541	39

Medical_History_26	1	2	3
Medical_History_25			
1	0	0	48040
2	3	11101	1
3	0	236	0

Figure 3: Crosstables

Taking into consideration that the size of the dataset is 59,381, it is very significant that in most cases, as much as 56,106, the attribute Medical_History_6 assumes value 3 when Medical_Keyword_48 assumes value 0. The situation is similar to the rest of the attributes which have high correlation coefficients.

Mutual information was calculated. That is a measure which measures in what degree one attribute determines another attribute, specifically in this case, in what degree do the input variables determine the output variable (Witten, I. H., Frank, E., Hall, M. A., Pal, C. J., 2016). The mutual information concept is connected with the entropy of an accidental variable, a basic term in the information theory, which determines the quantity of information that is kept in an attribute. The attribute which carries the most information, of all the output attributes, is BMI. It is interesting that the next ranking is Weight, which is, according to a previously calculated coefficient, highly correlated with the attribute BMI. Next, to these two attributes, three more are shown:

	0	1
0	BMI	0.222455
0	Wt	0.151538
0	Medical_History_15	0.149882
0	Product_Info_4	0.081243
0	Medical_History_23	0.079088

Figure 4: Mutual information

As part of the data preparation phase, the following steps were implemented:

1. Replacement of missing values

Since missing values (Kang, 2013) have been noticed inside of the dataset, the first step in the transformation phase is replacing missing values with some other values, other words, filling the lines. Since the occurrence of missing values can be a significant indicator too, here follow the attributes for which there is no data for all of the instances:

- Medical_History_10 99.061990
- Medical_History_32 98.135767
- Medical_History_24 93.598963
- Medical_History_15 75.101463
- Family_Hist_5 70.411411
- Family_Hist_3 57.663226
- Family_Hist_2 48.257860
- Insurance_History_5 42.767889
- Family_Hist_4 32.306630
- Employment_Info_6 18.278574
- Medical_History_1 14.969435
- Employment_Info_4 11.416110
- Employment_Info_1 0.031997

It is noticed that the missing values in a large number of cases occur with attributes which refer to data about the financial status of the subject, which could indicate wrong data collection methods or the sensitiveness of the subjects concerning this question group. Even though there are multiple methods to conduct the mentioned procedure, in this work, the method of filling the missing values with average values from the column in question was used. To that purpose, the *fillna()* method is used.

2. Defining the input and output variable

Set of the variable will be divided between a rising variable X(all variables, except the variable we are predicting and Id which does not carry information which helps predict the output variable) and Y(variable for which the predicting is done).

3. Adding new, derived variables

Also, it has been noticed that the attribute Product_Info_2 consists of a character part and a numerical part, therefore, two new columns will be created Product_Info_2_number and Product_Info_2_char, where categorical values will be placed in one column, and numerical in the other one, while the so-called dummy variables Medical_Keyword_1 –48 will be placed in a new variable Medical_keywords_sum. Besides that, for each of the attribute categories, new dummy variables have been derived, which expands the data set to a total of 942 attributes.

4. Principal component analysis

After that, for each of the attribute categories, principal component analysis has been conducted. For the attribute group InsuredInfo, 7 principal components define more than 90% variance in data, for MedicalKeyword 34, for MedicalHistory 2, for FamilyHistory 1, for EmploymentInfo 5, for InsuranceHistory 2 and for ProductInfo 3. All the principal components are then merged into a new dataset which will be the subject of algorithms.

3.2. Experimental Setup

When the data preparation phase is over, we move over to the next phase – modeling the solution and cross-validation. Since the output variable was categorical, the classification problem is to be solved. For that reasons, algorithms which are used to solve classification problems will be used. Since the Response variable has 8 values, that are 8 classes to which the corresponding instances need to be sorted, we are dealing with multiclass classification. Based on the dataset, its characteristics and the characteristics of the mentioned algorithms for multiclass classification, seven algorithms which will be used and which are expected to provide relatively good results have been selected, whether in the case of performance, execution speed that is or in the case of successfulness of the classification. The mentioned algorithms are: Random Forest (Ho, 1995), Gradient Boosted Trees (Friedman, 2002), Extra Trees, Extreme Gradient Boosted Trees (Chen, T., He, T., Benesty, M., 2015), Logistic Regression, Ridge Logistic Regression and Lasso Logistic Regression (Tibshirani, 1996).

For the classification problem, the most commonly used measures of the classification of successfulness are:

- Confusion Matrix
- Accuracy
- Precision and Recall
- F measure

Since it has been determined that there is an imbalance between the classes, there measure F1 is selected (Powers, 2011), which combines precision and recall, with the same priority, is assigned to both. The usage of the accuracy measure is avoided since it can create a false image of the efficacy of the model and present it as better than it really is. The F1 score also enables for a simpler comparison of two or more algorithms.

$$F1 = 2\frac{precision*recall}{precision+recall} \quad (1)$$

Since we are dealing with multiclass classification, so we could use the F1 score, it is needed to add the parameter average and calibrate it. Possible values of this parameter are:

- micro (calculates metrics on the global scale, counting the total number of TP, FN, FP)
- macro (calculates metrics for each output attribute while ignoring their imbalance)
- weighted (calculates metrics for each label and restores their average)

Of the above mentioned, a parameter has been applied with all three possible values, but only for Random Forest, while, for measuring successfulness of classification for other algorithms, the focus is on the F1 score with a micro parameter.

4. RESULTS

In the first phase, the mentioned algorithms have been applied on a new dataset which comprises of principal components of all groups of attributes, while the parameter default values have been left as they are. In the table below, shown are the resulting values of the F1 score for all seven algorithms with default parameters, as well as values of the F1 score derived from applying cross-validation. It can be seen that the Gradient Boosted Trees algorithm proved best, thus, in the next phase which includes parameter optimization, the most attention has been dedicated to this algorithm.

Table 1: Algorithms before optimization

Algorithms:	F1 score(micro)	F1 score(macro)	F1 score(weighted)	Cross validation(F1 micro, cv =5)
Random Forest	0.4526	0.3401	0.3830	0.4312
Gradient Boosted Trees	0.4777	0.3970	0.4258	0.4611
Logistic Regression	0.4314	0.3041	0.3614	0.4282
Ridge Logistic Regression	0.4042	0.1847	0.3157	0.4030
Extra Trees	0.4767	0.3323	0.4145	0.4107
Extreme Gradient Boosted Trees	0.4605	0.3613	0.3965	0.4535
Lasso Logistic Regression	0.4315	0.3041	0.3614	0.4285

Parameter optimization and attribute selection have been carried out only on the few selected algorithms, above all, so as to improve algorithm performance and reduce the overfitting problem of the training set. Specifically, with algorithms such as Random Forest, Extra Trees, Extreme Gradient Boosted Trees, calibration of the number of trees for the algorithms has been carried out. As for the attribute selection, it has been carried out for Ridge Logistic Regression (mainly for practical reasons, since this algorithm proved as the quickest one). Also, the selection of attributes on the basis of the mutual information measure has been tried out, where only those attributes which carry the most information have been selected.

Parameter optimization implied setting the number of estimators and the maximum depth of the tree. In addition, there is a grid search (Bergstra, J., Bengio, Y., 2012) for algorithms with internal cross-validation. It is significant that the algorithm as the optimum value for the parameter number of trees has taken the highest value from the offered, 140 while the optimal depth of the tree is 6.

Results after optimization:

Table 2: Algorithms after optimization

Score for fold	1.RandomForest	3. Logistic Regression	4.Ridge Logistic Regression	5.ExtraTrees	6.Extreme Gradient Boosted Trees	7.Lasso Logistic Regression
1	0.454	0.430	0.405	0.439	0.473	0.427
2	0.457	0.434	0.409	0.442	0.476	0.435
3	0.451	0.427	0.401	0.432	0.464	0.426
4	0.445	0.427	0.398	0.429	0.463	0.424
5	0.445	0.425	0.402	0.430	0.463	0.425
average	0.450	0.429	0.403	0.434	0.468	0.427

5. CONCLUSION

The main problem when working on a dataset was a large number of attributes that significantly slowed down the execution of most algorithms. That's why the focus was on attribute selection. In addition, an important role in improving performance is taken in the detailed preparation of data. An analysis of the principal components was performed, but it is important to emphasize that this analysis was performed on a group of attributes that related to the same aspect of the life of the respondents. The resulting main components for each of the 7 groups are then merged into a new set of data. This step has significantly contributed to improving the results, reducing the problem of overfitting and execution time.

As previously mentioned, in the scope of this research different algorithms have been applied, including ensemble algorithm, and it proved that they, in fact, gave the best results. Based on the results, it was concluded that the selection of attributes has a very large impact on the efficacy of applied algorithms;

therefore, further workings should pay more attention precisely to this phase of research. Besides principal component analysis, which has proved as a very good solution for reducing the number of attributes to which the algorithm is applied, it would be interesting to explore the possibilities of attribute selection based on mutual information indicators as well. Additionally, even though, due to technical reasons, it was not possible to conduct a more detailed optimization of parameters and define more values, significant improvements is possible concerning this aspect.

Although performance metrics, namely F1, seems very low with values less than 0.5 it is worth to notice that there were 8 different classes. Having this in mind, a naïve approach to solving would yield approximately 0.125 values. Therefore, obtained performances are indeed good. Additionally, it is worth to notice that best-performing algorithms were state-of-the-art ensemble algorithms such as Gradient Boosted Trees, Extreme Gradient Boosted Trees and Random Forest which is an indicator that problem we tried to solve is highly challenging and non-linear since the F1 score was lower for optimized Lasso Logistic Regression and Ridge Logistic Regression.

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PREFERENCES OF WINE CONSUMERS TOWARDS LOCAL WINE BRANDS: CASE OF SERBIA

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Abstract: *The wine market presents the consumer with a range of products and product attributes to consider when making a purchase decision. The study presented in this paper surveys the importance consumers in Serbia attach to both extrinsic and intrinsic attributes of the local wine brands. Five wine attributes were examined and tested through a discrete choice experiment. Two hundred forty wine consumers were asked to choose a wine they were most likely to purchase to have with friends and family. The results at the aggregate level indicate a high importance of the attributes brand and type of wine. Furthermore, preference-based segmentation based on individual respondents' utilities identified three distinct segments emerged from the overall sample.*

Keywords*: Wine, preferences, attributes, conjoint analysis, discrete choice experiment, segmentation.*

1. INTRODUCTION

In recent years, there is a growing interest in wine consumer behaviour. The dynamic nature of the wine sector increasingly attracts both practitioners and academics to undertake analysis of the different phases of the wine consumption process. This dynamics is reflected primarily in the growth and diversification of the offer, reduction of consumption in traditional countries, and emergence of new producer and consumer countries (Martínez, Mollá-Bauzá, Gomis, & Poveda, 2006). Moreover, in developed societies, consumer behaviour becomes diverse and creates continuous changes, both socio-economics and changes in modern lifestyles. These processes have led to a different patterns in the consumption of alcoholic beverages, especially wine (Caniglia, D'Amico, & Peri, 2006). Namely, while there has been a reduction in consumption of table wine, on the other hand there has been greater demand for quality wines and wines with regional specificity.

The consumer choice for wine is more complex than the choice for many other products, due to the large amount of different cues that may influence the purchase decision (Lockshin & Hall, 2003). The literature focusing on wine choice differentiates between two categories of choice attributes: extrinsic and intrinsic attributes (MacDonald, Saliba, & Bruwer, 2013). Intrinsic attributes are those associated with the vintage, type of grape, year and sensory characteristics of a wine (e.g. taste, flavour, sugar contentand colour), and extrinsic cues refer to non-sensory characteristics such as price, region of origin, brand and packaging (Lu, Rahman, & Chi, 2017).

Previous studies have identified numerous factors that have been found to have an impact on the wine selection process (Gustafson, Lybbert, & Sumner, 2016). Moreover, the specificity of wine as a product affects the willingness of consumers to even try out a particular type of wine (Everett, Jensen, Boyer, & Hughes, 2018). Most of the researches have focused on the importance different product attributes have on consumers when purchasing wine in the retail stores (Goodman, 2009), although there are also studies researching factors that influence the wine choice in the on-premise purchasing (restaurants, bar, café), depending on the price or information provided on the menu (Corsi, Mueller, & Lockshin, 2012). Surveys have suggested that price and grape variety are often the most influential variables when choosing a wine in retail stores, whereas, packaging and label design have been reported to be of lesser importance (Thomas & Pickering, 2003). The region of origin was found to be the most important driver for an on-premises wine choice by Australian, French and Italian consumers (Corsi, Mueller, & Lockshin, 2012). However, Lockshin and Corsi (2012) argued that consumers seem to be less confident when purchasing wine in a restaurant than in a store.

The vast majority of studies on wine consumer behaviour are focused on red (Mehta & Bhanja, 2018) or white (Saliba, Wragg, & Richardson, 2009) wine. However, recent market and industry trends show a growing popularity of rosé wine among consumers around the world, and thus, an increase in its production, but also researches (Kolyesnikova, Dodd, & Duhan, 2008).Price has always been considered one of the most important drivers of consumer choice, and wine is no exception. In particular, price allows customers to

make inferences about the quality and value of a product (Gustafson, Lybbert, & Sumner, 2016; Chrea, et al., 2011). Lockshin, Rasmussen, and Cleary (Lockshin, Rasmussen, & Cleary, 2000) highlight the fact that the brand name acts a surrogate for a number of attributes including quality and acts as a short cut in dealing with risk and providing product cues. Bruwer, Li, and Reid(Bruwer, Li, & Reid, 2002) concluded that wine markets have been segmented based on nine major segmentation variables: quality, consumption, risk reduction, occasion based, cross-cultural, behavioural, involvement, geographic, wine-related lifestyles. Using Conjoint analysis, Mehta and Bhanja (2018) identified five factors (price, brand, taste, origin and type of the wine) as important in the choice of wine. Moreover, authors identify price as the most important factor, followed by the type of the wine whereby red was the most preferred type. Escobar, Kallas, and Gil(2018)used Generalised Multinomial Logit Model (GMNL)to determine the impact of the 2008 economic crisis on preferences of the citizens of Catalonia towards four wine attributes: wine origin, wine references, grape variety, and price. The research showed that the wine origin was the most important attribute before the crisis, while the price became the most important attribute during the crisis.

The purpose of this paper is to empirically determine the consumers' preferences towards both extrinsic and intrinsic attributes of local wines in Serbia, as well as to determine whether those preferences are heterogeneous. To our knowledge, several research related to wine consumers' preferences were conducted in Serbia. Different methods have been used to investigate the relative importance of cues on consumer wine choice and purchase behaviour. Vlahović, Potrebić, and Jeločnik(2012) implemented poll research survey on a sample of 150 respondents in Belgrade in 2011 with goal to perceive factors that influence on demand of wine; Radovanović, Đorđević, and Petrović(2017) used Descriptive statistics and Chi-test to analyse the data collected in 2015. In this paper, Conjoint analysis, the techniques commonly used to analyse consumer preferences will be used. Conjoint analysis implies that consumers have to show their preferences to a set of products or profiles created through a combination of product attributes and attribute levels. The growing wine market in Serbia presents a remarkable opportunity for marketers to formulate a strategy targeted at the Serbian consumers.

2. METHODOLOGY

This study focuses on Serbian wine consumers' habits and preferences. An online discrete choice experiment was conducted on individuals who consumed wine at least once in the past 12 months.

2.1. Conceptual framework

Conjoint analysis is one of the most widely used research techniques which helps uncover how people make choices and what they really value in products and services. It originated in mathematical psychology, and was first introduced in marketing research in the early 1970s to evaluate consumer preferences for hypothetical products and services. Nowadays, it is widely used to understand customers' preferences in various markets both service and manufactures (Kuzmanovic, Radosavljevic, & Vujoševic, 2013; Vukic, Kuzmanovic, & Kostic-Stankovic, 2015).The foundation of conjoint analysis is breaking a product or service down into its components (attributes) and then testing combinations of these components in order to find out what customers prefer. It is then possible to estimate the value of each component in terms of its effect on customer decisions.

The most common type of conjoint analysis is Discrete Choice Analysis (often called choice modelling or choice-based conjoint analysis). Rather than merely asking respondents what they like in a product, or what features they find most important, discrete choice experiment employs the more realistic task of asking respondents to choose between potential product concepts (i.e. combinations of attributes and levels) carefully assembled into choice sets. Each respondent is typically presented with 8 to 12 choice sets (Samoylov, 2017).

The output from discrete choice analysis is measurement of utility or value. The utility scores are numerical values that measure how much each attribute and level influenced the customer's decision to make that choice.

2.2. Attributes used in the experiment

The first step in Discrete Choice Analysis is identifying key product attributes and corresponding levels. As noted above, trying to model all the influences on wine purchase behaviour is complex and the total number of attributes could make the design of such an experiment much too large to be practical. The literature review highlighted that the most important wine attributes are price, region of origin, and brand name. In this paper, in accordance with the aim of the research, the following attributes were taken into account: Winery, Price, Type, Sweetness and Sparkling (see Table 1).

We developed the levels of the attribute Winery from available data on the market share of brands in the Serbian wine market. Namely, there is a considerable number of small family winery in Serbia, whose wine is considered to be of high quality and popular among the consumers. Therefore, in addition to an industrial winery with a tradition (Rubin), five more wineries has been taken into account. Prices on the Serbian wine market for these producers range from 400 RSD to 1600 RSD, thus the four price points were selected for the attribute Price. Depending on grape variety, three types of wine are distinguished. Thus, for an attribute Type we choose three levels: Red, White and Rosé. Wines can be made with a wide range of sweetness levels, from dry to sweet one. The subjective sweetness of a wine is determined by the interaction of several factors, including the amount of sugar in the wine, but also the relative levels of alcohol, acids, and tannins. According to EU regulation 753/2002 (eur-lex.europa, 2002), the following terms may be used on the labels both table and quality wines (depending of the sugar content): Dry, Medium dry, Medium and Sweet. Based on the amount of carbon dioxide in the wine, it can be sparkling or non-sparkling. Sparkling wine is a wine with significant levels of carbon dioxide in it, making it fizzy.

Table 1: Key attributes and corresponding levels

Attribute	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**	**Level 6**
Winery	Rubin	Kovačević	Radovanović	Aleksandrović	Zvonko Bogdan	Matelj
Type	Red	Rose	White			
Sweetness of wine	Dry	Medium dry	Medium	Sweet		
Sparkling	Sparkling	Non-sparkling				
Price	400 RSD	800 RSD	1200 RSD	1600 RSD		

2.3. The choice experiment design and survey technique

Based on the attribute and their levels, total of 576 (=6x3x4x2x4) virtual wine concepts could be constructed. However, it is unrealistic for respondents to compare and select from such a great number of tasks. In general, respondents will fatigue after comparing more than 15 concepts. Experimental design methods and conjoint.ly platform (Samoylov, 2017) were used to structure the presentation of the levels of the five attributes in the choice sets. An implemented algorithm is used to insure each level of each attribute appears nearly an equal number of times across all surveys, but does not repeat in the other product concepts in each choice task. Because the number of choice sets is excessive for one respondent, the experiment is split into seven blocks, each consisted of 10 different choice tasks, i.e. 10 different purchase decisions.

The participants were provided with three product concepts plus the “None of the above” in each choice task and were asked to select the bottle of wine they would choose to buy to have with friends and family. Each product concept had one level of each of the five attributes. Respondents were given a short survey along with the choice tasks. Socio-demographic data (age, gender, household income, level of education) and wine consumption habits (frequency of drinking, place, quantity, wine type) were also collected.

2.4. Analytical and segmentation method

Discrete choice models (DCM) can be derived from utility theory. A DCM specifies the probability that an individual chooses a particular (wine) concept, with the probability expressed as a function of observed variables that relate to the concepts and the individual. The assumption is that the behaviour of the individual is utility-maximizing: individual *i* chooses the concept that provides the highest utility. The choice of the person is designated by variables y_{ij} for each alternative:

$$y_{ij} = \begin{cases} 1, & U_{ij} > U_{ik}, \ \forall j \neq k \\ 0, & \text{otherwise} \end{cases} \tag{1}$$

U_{ij} is the utility that person *i* obtains from choosing concept *j*.:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{2}$$

$V_{ij}$is the part of utility associated with the observed factors influencing it, whereas ε_{ij}represents the unobserved sources of utility. These unobservables can be characteristics of the individuals and/or attributes of the item, and they can stand for both variation in preferences among members of a population and measurement error (Hanemann & Kanninen, 2001). Then the probability of individual *i* choosing alternative *j* from a set of *J* mutually exclusive alternatives choice is given by:

$$P_{ij} = P(U_{ij} \geq U_{ik} \mid k \in J) \ \ \forall k \neq j \tag{3}$$

To estimate the model parameters (part-worths), multinomial logit model or Hierarchical Bayes (HB) estimation can be used. Amongst other benefits of HB, this approach allows more parameters (attributes and levels) to be estimated with smaller amounts of data collected from each respondent (Samoylov, 2017).Estimated part-worths can be further used to assess the relative importance of each attribute for each respondent or group of respondents. These values are calculated by taking the utility range for each attribute separately, and then dividing it by the sum of the utility ranges for all of the attributes (Kuzmanovic, Savic, Popovic, & Martic, 2013).

Rather than use socio-demographic variables to define segments a priori and to test whether these groups differ in their preferences and behaviour, we thought the opposite approach, post hoc segmentation, would be more effective, because it derives segments from differences in their preferences. Segmenting on behavioural differences has been found to be more robust and stable over time. For choice experiments, segments that differ in their choice drivers can be found with K-means cluster analysis, which will be applied in this paper here to find consumer clusters that differ in their preferences.

3. RESULTS

3.1. Sample characteristics

Data were collected online using Conjoint.ly platform in June 2017. In total, 256 individuals answered the survey. After the elimination of incomplete surveys and ineligible participants, 240 eligible surveys were collected. The sample characteristics as well as respondents' habits concerning wine consumption are presented in Table 2.

Table 2: Socio-demographics data and respondents' habits

Demographic	Category	Number of respondents	Percent
Gender	Male	123	51.25%
	Female	117	48.75%
Age	18-20	17	7.08%
	21-40	194	80.83%
	41-60	21	8.75%
	>61	8	3.33%
Level of education	Primary school	9	3.75%
	High school	43	17.92%
	Undergraduate	140	58.33%
	Master degree	45	18.75%
	PhD degree	3	1.25%
Employment status	Student	103	42.92%
	Unemployed	16	6.67%
	Employed	116	48.34%
	Retired	5	2.09%
Averaged monthly income	do 25000	34	14.17%
	25000-50000	80	33.33%
	50000-75000	58	24.17%
	>75000	68	28.33%
Frequency of wine consumption	Every day	5	2.08%
	Several times a week	30	12.50%
	Once a week	62	25.83%
	Once a month	82	34.17%
	Rarel g	61	25.42%
Quantity	1 glass	45	18.75%
	2 glasses	90	37.50%
	3 glasses	42	17.50%
	at least 4 lasses	63	26.25%
Place of consumption	At home	56	23.33%
	At friends'/family place	55	22.92%
	In clubs/pubs	47	19.58%
	In restaurant	82	34.17%
Type of wine	White	109	45.42%
	Red	66	27.50%
	Rose	65	27.08%

With regard to the frequency of wine consumption, ithas emerged that 34.17% respondents declared they drinkwine "once a month" and 25.83% of them declared they drink wine "once a week" (25.83%), while only 12.5% % of consumers declared that they drink wine "several times a week" or even every day (2.08%).Respondents declare that most often consume wine in restaurants (34.17%), and most of them drink

white wine (45.42%). As much as 81.67% of respondents are willing to experiment with new brands and types of wine. Only one third of the respondents (32.5%) do not take into account the choice of the type of wine depending on the food they consume, while 31.65% of the respondents declare that the choice of the wine type affects the season. More than half of the respondents (60%) mostly buy domestic (Serbian) wine brands.

3.2. Aggregated preferences

Results from the analysis are shown in Figure 1 and Figure 2. Figure 1 is the graph description of the attributes importance. It can be seen that most important attribute to Serbian consumers is the Winery, and its average importance value at the aggregate level is even 59.43%. The attribute Type has shown to be second by importance (24.69%). The third ranked attribute is Sweetness, with a relative importance of 8.8%. The least important attributes are Sparkling and Price with importance values of just 4.92% and 2.16% respectively.

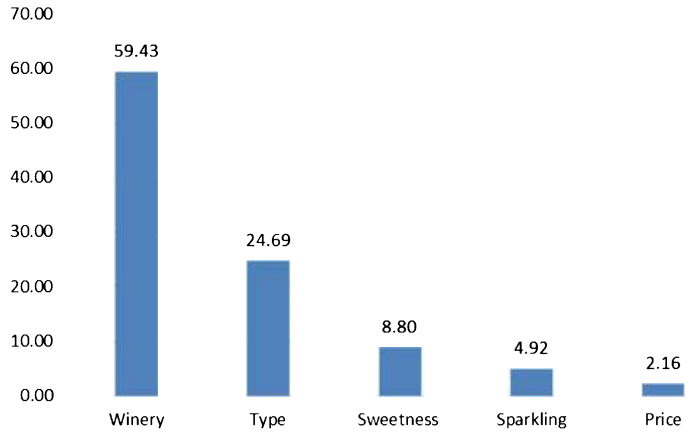

Figure 1: Relative importance of attributes (in %)

A more detailed insight into averaged preferences toward attribute levels (part-worths) is given in Figure 2.When it comes to the most significant attribute, Winery, respondents most prefer Kovačević, followed by Radovanović. The least desirable are Matalj and Rubin. On average, respondents almost equally prefer white and rose, and at least red wine, tilting with sweet wines, and most like medium and sparkling. When it comes to the attribute Price, at the aggregate level, there is no significant difference between the levels (price points), and at first glance the respondents are not price sensitive.

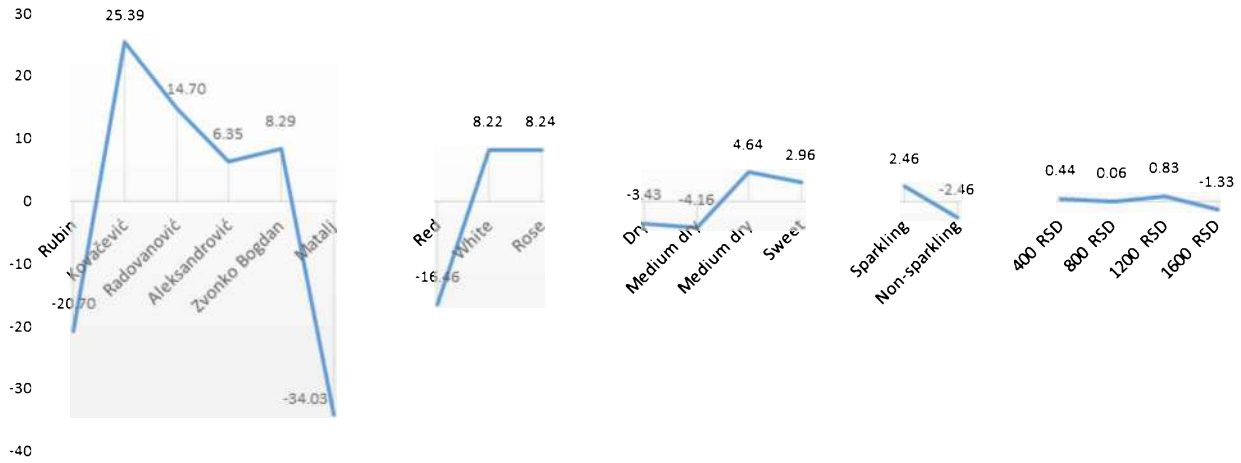

Figure 2: Averaged part-worth utilities

3.3. Post-hoc segmentation

A more detailed analysis of individual utilities revealed heterogeneity in consumer preferences, so three groups of consumers were isolated using *post hoc* segmentation (segmentation based on preferences). K-

means cluster analysis was used for that purpose. Table 3 shows the importance of attributes for each of the isolated cluster.

Table 3: Relative importance of attributes (in %)

	Winery	Type	Sweetness	Sparkling	Price
Cluster 1	33.10	**35.16**	10.99	8.61	12.14
Cluster 2	22.17	**38.22**	17.78	4.40	17.43
Cluster 3	**39.57**	31.91	2.80	7.27	18.44

Although the price proved to be the least (negligible) important attribute on the whole sample, it can be noted that it is significantly more important at the segment level. This result indicates that averaging can cause loss of important information related to the actual preferences of the respondents, which may be reflected in the wrongly defined market strategy. Similar observations are made for other attributes as well. After the clusters were developed, socio-demographic data were used to further profile consumers.

The Cluster 1 covers 26.25% of the respondents and consists mostly of employed male respondents, who regularly drink wine, most often at home. This cluster includes respondents who especially prefer the red wine (which is in sharp contrast with the sample as a whole) and usually consume it (54%), so it is not surprising that they find the Type to be the most important attribute (35.16%). Somewhat less important is the attributes of Winery (33.10%), where respondentsprefer Kovačević, Radovanović and Aleksandrović wine brands. The other three attributes are significantly lessimportant to this cluster. However, they prefer non-sparkling dry wines, with the price of up to 800rsd (see Figure 3)

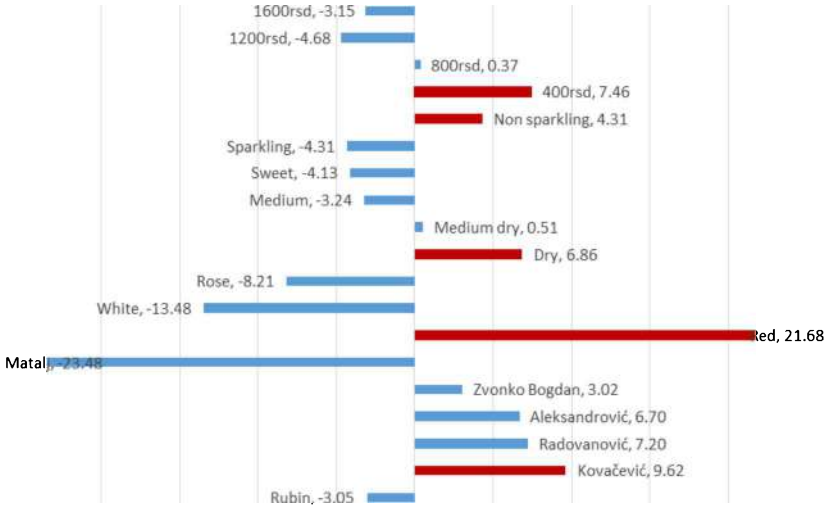

Figure 3: Preferences of Cluster 1

The second, somewhat larger cluster consists of 73 respondents (30.42%). The most important attribute for this segment is also Type (importance value = 38.22%), but respondents belonging to this cluster prefer rose wine, and to some extent white, while red wine is not preferred to them (see Figure 4). The Winery attribute is considerable less important for this cluster than for Cluster 1. In the same time, members of the Cluster 2 prefer the Kovačević brand wine by far more than the brands of other wineries. Sweetness and price are approximately equally important attributes (about 17%), whereby respondents prefer sweeter wines at a price of 400rsd. They are very price-sensitive, and expensive wines (from 800rsd) are negatively preferred. If they chose, they would rather choose sparkling wines.

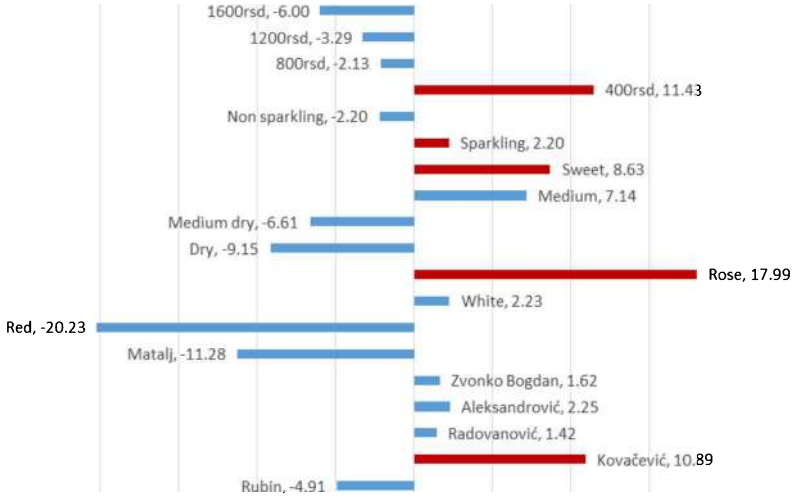

Figure 4: Preferences of Cluster 2

The demographic data shows that the majority of the respondents in this segment are younger women, with lower earnings and education than the remaining two segments. Members of this segment are less likely to drink wine than members of the Cluster 1, and when they drink it, they do it in a restaurant or in friends' home, and rarely at their own place. They usually drink rose or white wine, while only 15% drink red.

Cluster 3 is the largest one (43.33% of total sample) with Winery as the most important attribute (39.57%). Members of this cluster prefer Kovačević and Radovanović brands, followed by Zvonko Bogdan. Again, Matalj and Rubin are the least popular wine brands (see Figure 4). Type of wine is the second by importance attribute, where the respondents prefer white wine, but do not like red. This cluster is price-sensitive, but the respondents' preferences to price levels are unexpected. Namely, respondents prefer more expensive wines, which can be due to the fact that they use price to make inferences about the quality and value of a wine. Moreover, the quality wines of the favourite Serbian producers are exactly in the price range that the respondents prefer. Although sweetness is negligible important attribute for this cluster (only 2.8%), respondents prefer semi-sweet sparkling wines.

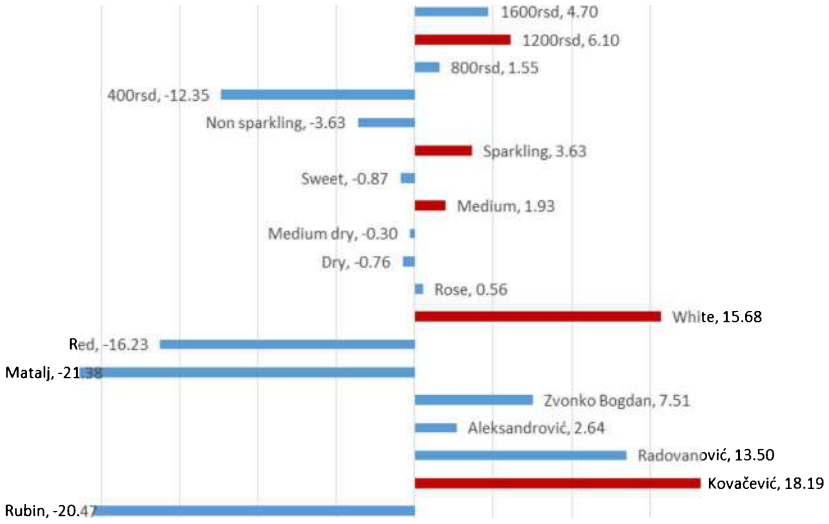

Figure 5: Preferences of Cluster 3

4. CONCLUSION

Wine is a difficult and confusing product for consumers to choose because of a large number of different cues that can influence purchasing decision. These cues are typically related to physical characteristics of wine as well as extrinsic attributes such as price and brand, labels and the like. Accordingly, understanding how consumers choose wine is a complex problem both for researchers and practitioners.

In this paper we have examined the importance consumers in Serbia attach to the key attributes of local wine brands. In addition to the brand, four attributes were also observed: price, type of wine, sweetness and whether it is sparking or not. To elicit consumer preferences, we used conjoint analyses, i.e. one of its forms known as discrete choice experiment.The average results on the whole sample indicated the high importance of the attributes brand and type of wine. However, heterogeneity in preferences were noticed and three unique segments were identified. These segments differ primarily in the type of wine their favour, but also whether they like sweet and sparkling wine or not. It turned out that the price is a moderately significant attribute in all three clusters, while Kovačević is the most preferred brand.

The findings in this study represent first empirical insights that examine the preferences of consumers towards wine characteristics using discrete choice analysis in Serbia.However, since 40% of the sample drinks wine at most once a week, the question arises as to whether the preferences of the true wine connoisseurs are the same. The future directions of the research should be towards eliciting the preferences of the connoisseurs of fine wines.

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EASE OF DOING BUSINESS AND GROSS DOMESTIC PRODUCT: IS THERE A RELATIONSHIP?

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Abstract: *Well-functioning legal and regulatory system is a prerequisite for creating an effective market economy. Therefore, it is in the interest of nations to improve their business regulation and stimulate business activity and growth. One of the means for measuring the ease of doing business is using the Doing Business Index (DBI) devised by the World Bank. In this paper, we examine the relationship amonggross domestic product (GDP) per capita and DBI topics which measure the ease of conducting business processes. Our approach is two-fold. First, we apply a machine learning algorithm, a clustering approach to cluster the countries ranked by the DBI, and second, we employ the Potthoff analysis to compare the regression models of GDP per capita made on retained clusters. The results of the conducted analyses indicate there are differences in the effects of factors of doing business on GDP per capita between clusters. We believe our research could provide additional insights on the topic of factors which influence GDP, application of composite indicator data, and comparison of regression models between groups.*

Keywords*: Doing Business Index, Gross domestic product, Potthoff analysis, Machine learning*

1. INTRODUCTION

Legal and regulatory system is a prerequisite for creating an effective market (Corcoran & Gillanders, 2015). Research has shown that more complicated and more costly procedures have a negative effect on the business environment and on the number of new companies. Namely, Klapper, Laeven, and Rajan (2006) showed that higher entry regulations decrease the number of new companies created. Next, Djankov et al. (2002) found that economies with higher entry costs have more corruption and larger percentage of unofficial economy. Ciccone and Papaioannou (2007) showed that more complex procedures reduce job creation. The same authors draw the conclusion that therefore the simplification of time-consuming government procedures related to doing and starting new businesses should be high on policy agendas.

In the last few decades, additional efforts have been placed to provide a ranking of countries, regions, or even cities based on their openness to business (Brunetti, Kisunko, & Weder, 1997; Davis, Kingsbury, & Merry, 2012). Besides simple performance indicators which are commonly used for ranking, recently composite indicators stood out as a reliable source of information and ranking, especially in the public sector (Jacobs & Goddard, 2007). One of the earliest such ranking of countries based on doing business and economy dates from 1990's. Namely, Cavusgil (1997) proposed a ranking of emerging markets using seven dimensions: Market size, Market intensity–economic intensity, Market growth–future market potential, Commercial infrastructure, Freedom (economic and political) and risk, Market receptivity –market accessibility, Market construction capacity. Mullen and Sheng(2006) aimed to extend and modernise the original study conducted by Cavusgil (1997) by employing novel and more specific indicators in their framework. Besides academics, the internationalorganisations also devise and publish composite indicators on the subject of ease of doing business. For this research, the most important one is the World Bank's Doing Business Index (DBI) published since 2003 (World Bank, 2017).

Gross domestic product (GDP) measures the monetary value of market production, of final goods and services produced for sale in a particular market and of nonmarket production, such as defence or education services provided by the government (International Monetary Fund, 2017). As such a metric, it provides information on the size of the economy and its performance. Therefore, it is used as an indicator of health of the economy whereas growth of the GDP implies the economy is doing good (International Monetary Fund, 2017). As the forecasting of future economic outcomes is a vital for decision-makers (Dritsaki, 2015), the question which arises is what influences the GDP and the growth of GDP. Different approaches have been taken to provide an answer. For example, time series analysis was used (Dritsaki, 2015). Schumacher & Breitung(2008) used expectation–maximization (EM) algorithm and principal component analysis (PCA) to forecast German GDP. Linear regression has also been used with success to model GDP. For example, Anghelache and coauthors(2015) aimed to regress final consumption and gross investment on GDP. Lakštutienė and Aušrinė(2015) modelled the GDP per capita using indicators of the capital market.

The academic community placed attention on the relationship between the GDP and the reform of business regulation and ease doing business. Namely, it is believed that the ease of doing business attracts foreign direct investments (FDI) which eventually have an impact on the GDP (World Bank, 2016). Many studies have been conducted to examine the relationship between FDI and gross domestic product (GDP) and showed positive relationship (Basu, Chakraborty, & Reagle, 2003; Hsiao & Shen, 2003; Nair-Reichert & Weinhold, 2001). Also, it has been shown that the ease of doing business and business regulation have an impact on the GDP. Namely, Djankov, McLiesh, & Ramalho(2006) in their model used as dependent variable the average GDP growth and as independent the normalized components of the World Bank's DBI. Also, Busse & Groizard(2008) used linear regression to model the GDP using FDI and the selected components of the World Bank's DBI. Their results indicate that the countries with lower level of regulation can stimulate growth by reforming. The two presented studies are important for the herein conducted research for two reasons. First, they show that there is relationship between GDP and ease of doing business which can be explored in more detail and second, that the values of World Bank's DBI

Our goal was to attempt to model the GDP per capita using the values of the DBI topics. However, our analysis aims to go a step further. Namely, we first propose the application of machine learning algorithm to divide countries ranked by the DBI. We collected the data on 187 countries, so our aim was to first group these countries into clusters and to compare the regression models built on each of the retained clusters. The proposed clustering approach is the Partition around medoid (PAM) algorithm (Kaufman & Rousseeuw, 1990) while the statistical analysis used to compare regression models is the Potthoff analysis (Potthoff, 1966). We believe that the obtained results can indicate whether there are differences between the regression models and which topics should policy makers from different clusters place more attention so as to increase their GDP.

The structure of the paper is as follows. Section 2 sees the introduction and a brief review of the DBI. The main concepts of the PAM clustering algorithm and the Potthoff analysis used to compare regression models are given in Section 3. Next, the research results are elaborated, while the discussion and the concluding remarks are given in the final section.

2. DOING BUSINESS INDEX (DBI)

Doing Business Index (DBI) is a complex composite indicator consisted of 10 topics made of 41 indicators in total. In our research, we focused solely on topic data. Herein, we will present the basics of each topic.

The first topic, *Starting a business*, is intended to measure the number of procedures, time, cost, and paid-in minimum capital to start a limited liability company. Next topic, *Dealing with construction permits* measures the number of procedures, time, and cost to complete all formalities to build a warehouse and the quality control and safety mechanisms in the construction permitting system. *Gettingelectricity*, quantifies procedures, time, and cost to get connected to the electrical grid, the reliability of the electricity supply and the transparency of tariffs. *Registering property* is related to procedures, time, and cost to transfer a property and the quality of the land administration system. The following topic, *Getting credit* measures movable collateral laws and credit information systems. *Protecting minority investors* deals with minority shareholders' rights in related-party transactions and in corporate governance. Payments, time and total tax and contribution rate for a firm to comply with all tax regulations as well as post-filing processes are quantified by the topic *Payingtaxes*. Time and cost to export the product of comparative advantage and import auto partsare measured in the topic *Trading a cross borders*. Succeeding topic, *Enforcing contracts*, measures how commercial disputes are resolved and the quality of judicial processes. The final topic, *Resolving insolvency*, deals with time, cost, outcome and recovery rate for commercial insolvency and the strength of the legal framework for insolvency(World Bank, 2017).So, to make the presentation of the results more clear (see Section 4), the topics have been coded from T1 to T10, in the order in which they have been briefly explained here.

The data collection process is based on a detailed reading of domestic laws and regulations as well as administrative requirements. The process itself is guided and overlooked by the World Bank experts. A signal that the data collected for the DBI is precise and of interest is the fact that there are 17 different data projects or indexes that use Doing Business Index data as one of their data sources (World Bank, 2017). For example, in a similar study, Morris and Aziz (2011) aimed to measure the relationship between the DBI topics and the FDI using the Pearson's correlation coefficient based on the results of Sub-Saharan Africa. Nevertheless, Arruñada (2007) argues that the procedure of indicator and topic data collection could be lteredso as to better represent the actual policies.

3. METHODOLOGY

3.1 PAM algorithm

Partitioning Around Medoids (PAM) is an implementation of the K-medoids algorithm. The algorithm partitions the entities into clusters and aims to minimise the distance between the entities assigned to a cluster and its centre, in this case, an entity (Kaufman & Rousseeuw, 1990). PAM has several favourable properties as it performs clustering with respect to any specified distance metric and it identifies clusters by the medoids. Thus, each element is considered as a potential medoid, while the other K-1 medoids are fixed (Van der Laan, Pollard, & Bryan, 2003). Nevertheless, the PAM algorithm has a slight drawback: it works inefficiently with large data set due to time complexity (Han, Kamber, & Tung, 2001). Namely, one of the advantages of the PAM method is the silhouette plot that shows how well cluster members are positioned within their respective clusters. Besides the calculation of the predefined number of clusters, it is possible to use the silhouette average widths for assessing the best number of clusters.

The silhouette plot shows how well cluster members are positioned within their clusters, and average silhouette widths enable us to assess the quality of the cluster structures. The silhouette width has a range [-1,1]. Values near +1 indicate that the entity is far away from any neighbouring clusters. A value of 0 indicates that the entity could be in the current cluster or in the neighbouring clusters and negative values indicate that the entity might be assigned to the wrong cluster. On the other hand, a value of the average silhouette below 0.5 shows a rather weak clustering structure, between 0.5 and 0.7 shows a reasonable cluster structure, and above 0.7 shows a strong structure(Kaufman & Rousseeuw, 1990).

3.2 Potthoff analysis

Multiple books and research articles aimed at introducing methods and tests to compare coefficients from ordinary least squares regression models (Howell, 2013; Potthoff, 1966). The Potthoff analysis stands out as a simple way of comparing linear regression models. Namely, so far it has been used with success in the fields of social psychology (Lawson & Lips, 2014), medicine (Akolekar, Syngelaki, Gallo, Poon, & Nicolaides, 2015), innovation management (Truong, Klink, Fort-Rioche, & Athaide, 2014), and others. Another evidence that the idea of comparing linear regression models is still developing, especially the Potthoff analysis, is the recently published SAS and SPSS code for related tests (Weaver & Wuensch, 2013).

In the simplest case, a Potthoff analysis is multiple regression analysis of the following model CGI: $Y = a + b_1C + b_2G + b_3C*G$, where Y is the criterion variable, C is the continuously distributed predictor variable, G is the dichotomous grouping variable, and C*G is the interaction between C and G. Grouping variables are commonly "dummy-coded" with *l*-1 dichotomous variables, where *l* is the number of groups (Wuensch, 2016). The same form would be made if there were more continuously distributed predictor variables. Namely, then there would be added *j* interaction variables, where *j* is the number of continuously distributed predictor variables.

Essentially, the Potthoff analysis consists of three tests: test of coincidence, test of intercepts, and test of parallelism. To conduct all three tests, four regression models should be made. Namely, the analysis is done as a series of multiple regressions with comparisons among the various models (Wuensch, 2016). The first model, named CGI, consists of the dependent variable explained through the continuous variable, grouping variable, and the interaction variable. The second model, C, models the dependent variable using only the continuous variable. The next model, CG, is formed using the continuous and grouping variable to explain the dependent variable. Finally, the fourth model is CI, where the explanatory variables are the continuous variable and the interaction variable. The model CGI is then compared to each of the three remained models using the partial F-test:

$$F = \frac{SS_{full} - SS_{reduced}}{(f-r)MSE_{full}} : F(m, n-k-1) \quad (1)$$

Where SS_{full} is the sum of squares of the model CGI, $SS_{reduced}$ is the sum of squares of the reduced model, which is C, CI, or CG depending on the test, *f* is the number of degrees of freedom of the full model, *r* is the number of degrees of freedom of the reduced model, while the MSE_{full} is the mean square error of the CGI model. The test has Fisher's distribution with *m* and *n-k-1* degrees of freedom, where *m* is the difference in the number of variables between the full and the reduced model, *n* is the number of observations, and *k* is the number of variables in the full model.

Test of coincidence compares CGI with the C model as it aims to explore whether there is difference between the intercept, slope or both between the observed groups. Namely, the null hypothesis that the regression line for predicting Y from C is the same at all levels of some grouping variable (Wuensch, 2016).

Further, the test of intercepts compares CGI with the CI model to test whether the intercepts are identical across groups. Finally, the test of parallelism compares CGI with the CG model. The null hypothesis states that the slope for predicting Y from G is the same for all observed groups of G.

The three presented tests can provide a detailed comparison of the two or more regression models created using the same variables on different groups. If there is a significant F result in the test of coincidence slopes and intercepts may then be assessed separately to determine whether they differ (Reynolds & Gutkin, 1980). So, the first test when conducting the Potthoff analysis is the test of coincidence, followed by the test of intercepts and test of parallelism if needed. However, before the Potthoff analysis, the grouping variable must be recoded meaningfully (West, Aiken, & Krull, 1996). In the conducted case study the grouping variable is the cluster the country belongs to.

4. RESULTS AND FINDINGS

The dataset on which the analysis was performed contained all ten topic values for 187 countries which are ranked by the DBI for the year 2016.The World Bank defines GDP per capita as the gross domestic product divided by midyear population (World Bank, 2018). The values of the GDP per capita have been collected from the World Bank database (World Bank, 2018) and normalisedusing *Min-Max* normalization. Afterwards, the first step in our analysis was to apply the clustering method, the PAM algorithm.

For our case study (187 entities, PAM algorithm, Euclidean distance), the "NbClust" package was able to obtain the results of 24 indices out of 30. The number of clusters suggested by the highest number of indexes was retained. In our case, seven indices proposed to retain two clusters. The most commonly used metric to evaluate PAM, the average silhouette width for the two retained clusters is 0.279, whereas the average silhouette width of each cluster is 0.190 and 0.451, respectively. Although the average silhouette of the first cluster is low, it is still positive. Countries which represent the cluster centres are Lebanon and Latvia.

Next, the descriptive statistics of the two retained clusters is presented in Table 2. The first column indicates the size of the clusters. We can observe that the clusters are not of similar size, 123 and 64 countries. Some of the countries which make cluster 1 are: Argentina, Brazil, China, India, Malta, Saudi Arabia, and South Africa. On the other side, some of the countries which make cluster 2 are: Australia, Belgium, Germany, Norway, United Kingdom, and the USA. As the clusters are large, the list of countries which make each cluster will not be listed completely, but it is available on demand. The next column indicates the mean value of topics in the specific cluster. According to the mean values in the first cluster, it can be observed that these countries underperform when it comes to certain topics and could reform to attract more FDI and investors. The topic with the lowest mean value in this cluster is T10, *Resolving insolvency*. On the other hand, the second cluster can be identified as a cluster of countries which perform well according to the DBI topics and whose laws aim to facilitate and stimulate doing business. It is also interesting to observe the minimum and maximum values of topics per cluster. In the first cluster, the lowest values of all topics expect T1 *Starting a business* and T9 *Enforcing contracts,* is 0, while in cluster 2, the situation is completely different. Namely, there is only one topic with the minimum value of 0, T2*Dealing with construction permits*. What can also be observed from Table 2 is that the standard deviation (StD) of topics per cluster is high.This could lead to the conclusion that although the countries have been grouped in two clusters and that the majority of indices suggested such a structure, the obtained clustering structure might not be that coherent.

Table 2 Basic descriptive statistics of clusters created using the PAM clustering method

Cluster 1	Size	Mean	Min	Max	StD	Cluster 2	Size	Mean	Min	Max	StD
T1	123	76.27	33.53	94.51	13.25	T1	64	89.94	63.60	99.96	5.81
T2	123	59.77	0.00	83.79	16.13	T2	64	70.77	0.00	86.30	12.20
T3	123	56.68	0.00	90.63	19.63	T3	64	78.83	43.42	99.88	12.13
T4	123	52.86	0.00	90.59	15.96	T4	64	75.64	49.62	94.46	11.00
T5	123	36.50	0.00	85.00	19.78	T5	64	66.72	35.00	100.00	15.02
T6	123	44.68	0.00	76.67	11.97	T6	64	63.46	38.33	81.67	8.79
T7	123	64.37	0.00	99.44	18.38	T7	64	79.89	48.60	99.44	10.13
T8	123	58.44	0.00	100.00	20.56	T8	64	88.77	59.61	100.00	11.21
T9	123	49.89	6.13	78.23	11.76	T9	64	65.20	32.43	84.15	9.51
T10	123	30.67	0.00	69.59	17.36	T10	64	66.32	20.30	93.81	16.79

To additionally inspect the clustering structure cluster means were compared using t-test as used by Russell and coauthors(2017)to compare means of clusters of countries. The results are presented in Table 3. As it can be observed, there is statistically significant difference in group means for all ten topics. This could lead to the conclusion that the clusters differ and that they are well separated. The absolute mean difference

varies from 10.99 (T2) to 35.65 (T10). The high absolute mean difference can also be acknowledged for T5 (30.22) and T8 (30.33).

Table 3 Results of the cluster means comparison t-test

Topics	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
t[1]	-9.78**	-5.22**	-9.51**	-11.45**	-11.67**	-12.19**	-7.44**	-13.05**	-9.61**	-13.47**
Abs mean difference[2]	13.67	10.99	22.15	22.78	30.22	18.78	15.52	30.33	15.32	35.65

[1] t – value of t-statistics
[2]Abs mean difference – Absolute mean difference between cluster means
**p<0.01

Prior to conducting the Potthoff analysis we modelled the GDP per capita for all observed countries (Table 4). The obtained adjusted R^2 is 0.466and the model is statistically significant ($F(10,176)=17.255$, $p<0.01$).Taking a closer look on the values of the obtained coefficients and their significance, we conclude that the intercept, *Getting electricity, Getting credit, Paying taxes, Enforcing contracts,*and *Resolving insolvency*are statistically significant for modelling the GDP per capita. The model created on all of the observed countries is statistically significant and of a good quality, indicating that the GDP per capita could be modelled using 10 DBI topics.

Table 4 Regression model of GDP for all the observed countries

Topics	Intercept	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
$\hat{\beta}_i$	-33.022	-0.038	0.124	0.170	0.014	-0.151	-0.083	0.202	0.019	0.221	0.292
t	-5.053**	-0.398	1.65	2.479*	0.192	-2.894**	-0.861	2.888**	0.328	2.340*	5.166**

* p<0.05, ** p<0.01

The next step in the analysis was the application of the regression analysis on the retained clusters. The models for Cluster 1 and Cluster 2 are presented in Table 5. The obtained adjusted R^2 is 0.274 for Cluster 1 and 0.508 for Cluster 2.The model created for the Cluster 1 is of a bit lower quality as 27.4% variability of GDP *per* capita is explained, while the model created for Cluster 2 is of a better quality as it explains 50.8% variability of GDP per capita. Both models are statistically significant ($F_{cluster1}(10,112)=5.595$, $p<0.01$; $F_{cluster2}(10,53)=7.506$, $p<0.01$).

Table 5 Regression models of GDP for the two retained clusters

	Topics	Intercept	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
Cluster 1	$\hat{\beta}_i$	-21.583	-0.039	0.114	0.126	0.008	-0.145	-0.096	0.165	0.031	0.211	0.100
	t	-3.232**	-0.466	1.631	1.994*	0.109	-2.747**	-1.06	2.708**	0.558	2.284*	1.655
Cluster 2	$\hat{\beta}_i$	-131.39	0.430	-0.039	0.564	0.078	0.039	-0.199	0.423	0.17	-0.089	0.543
	t	-3.846**	1.196	-0.182	2.749**	0.397	0.301	-0.788	1.539*	0.914	-0.386	4.233**

* p<0.05, ** p<0.01

When it comes to the model made for the countries in the first cluster, the intercept, *Getting electricity, Getting credit,Paying taxes,* and *Enforcing contracts* are statistically significant (Table 5). For*Getting electricity, Paying taxes,* and *Enforcing contracts*there is a positive relationship with the values of GDP per capita, while the ease of *Getting credit* decreases the value of GDP per capita. Topics which proved to be significant in Cluster 1 which attract attention are *Getting credit* and *Enforcing contracts.* The negative coefficient for *Getting credit* can be explained as that the credits given by banks in these countries might not generate enough positive return on investment (ROI).The negative impact of some indices seems to be logical (Messaoud & Teheni, 2014). When it comes to *Enforcing contracts,* the obtained coefficient can be explained as the more the country is prepared to enforce contracts, the foreign and domestic investors are more secure to invest knowing their investment can be timely solved in a quality and unbiased judicial process.

In the created model for Cluster 2, there are differences. Namely, the intercept is statistically significant, alongside *Getting electricity*, *Paying taxes* and *Resolving insolvency* (Table 5). All three topics have a positive relationship with the values of GDP per capita. Topic which proved to be positive and significant in

Cluster 2 which attracts attention is *Resolving insolvency.* The importance of this topics can be explained that if the investors know there is a legal framework for insolvency and that the commercial insolvency can be dealt in time and with a high recovery rate, they will invest more, which will eventually have an impact on growth.

Finally, we conduct the Potthoff analysis to inspect is there statistically significant difference between the two models. The analysis can provide valuable insights as if there is a difference in the regression models, it means that there is a difference in the importance of topics of doing business for the growth of GDP and GDP per capita. Therefore, the decision makers could be informed to use different approaches to increase the GDP per capita depending on the cluster they belong to.

The Potthoff analysis showed significant difference between the two models, ($F(10,165)=4.000$, $p< 0.01$), whereas that difference is in the slopes ($F(10,165)=4.2264$, $p< 0.01$), and in the intercept ($F(1,377)=13.925$, $p< 0.01$). This result indicates that the models significantly differ, and that both intercept and coefficients differ. Topics which are statistically significant for both models are *Getting electricity* and *Paying taxes*. Nevertheless, in the model for Cluster 1, *Getting credit* and *Enforcing contracts* are statistically significant, while in model for Cluster 2 *Resolving insolvency* has statistically significant impact on the GDP per capita.

These results indicate that government representatives in all analysed countries should place more effort to ease the procedures and cost of getting electricity and to create a reasonable total tax and contribution rate. The representatives in developing countries which are mostly in Cluster 1 should be stricter regarding the ease of allowing credit, while they should improve their laws on enforcing contracts. On the other hand, the more developed country, mostly in Cluster 2, should think of improving their laws regarding insolvency.

5. CONCLUSION

Extensive research was done on the subject of the effects of nations' political, legal, economic and social reforms on wealth and long-term growth(for example Acemoglu, Johnson, & Robinson, 2001; Knack & Keefer, 1995). Messaoud and Teheni (2014) went a step further and tried to model the relationship between business regulations and growth. Their results are also coherent with the results of Djankov, McLiesh, and Ramalho (2006) who stated that "good" business regulations lead to higher economic growth. Our paper is an attempt to extend the current literature on the topic.

The taken research approach was two-fold. We first clustered the countries ranked by the DBI. We retained two clusters, which are well separated. The first cluster is made of countries in which underperform when it comes to certain topics and could reform so as to attract more FDI and investors. On the other hand, the second cluster can be identified as a cluster of countries which perform well according to the DBI. In the next step, we performed the regression analysis of the GDP per capita and the Potthoff analysis. The chosen analysis has been used previously to compare regression models between groups (Lawson & Lips, 2014). Therefore, its results could indicate whether there is a difference in the models and should the decision makers use different approaches to increase the GDP per capita. The obtained results showed that the GDP per capita can be modelled using the DBI topics, that there is statistically significant difference between the two models. The observed difference indicates that policy makers in countries form different cluster should undertake different reforms to increase the GDP.

During our research we could identify two possible future directions of the study. One would be towards reducing the number of observed topics which make the DBI. For example, post-hoc I-distance could be implemented(Savic, Jeremic, & Petrovic, 2016). The second direction would be towards implementing hierarchical clustering methods (Miyamoto, 2012) or more advanced clustering methods, such as biclustering (Busygin, Prokopyev, & Pardalos, 2008) as the clustering results indicate that the currently suggested clustering scheme could be modified.

We believe our research could provide additional insights on the topic of modelling GDP, application of composite indicator data, and comparison of regression models between groups.

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CONFIDENCE INTERVALS FOR THE POPULATION STANDARD DEVIATION: SIMPLE RANDOM SAMPLING VS. RANKED SET SAMPLING

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Abstract. *Ranked set sampling (RSS) is the cost-efficient sampling procedure. This procedure gives more efficient estimators of the population parameters than the procedure based on simple random sampling (SRS), with the same sample size. In this paper, we compare the coverage probabilities of confidence intervals for the population standard deviation using the simple random sampling and the ranked set sampling. The following confidence intervals are considered: the exact, the Bonett, the Steve large sample normal approximations, the log asymptotic approximation and the adjusted degrees of freedom. The results for the Gamma, Log-normal and Exponential distributions and for the real data set are presented. The simulation study shows that the results obtained using the ranked set sampling are better than those using the simple random sampling.*

Keywords: *population standard deviation; confidence interval; coverage accuracy; ranked set sampling; simple random sampling*

1. INTRODUCTION

In this paper, we construct the confidence intervals for the population standard deviation. The population standard deviation is the most common scale parameter. The existing confidence interval for the estimation of the population standard deviation is the exact confidence interval, based on the statistic which has χ^2 distribution. This interval is appropriate if the distribution of the data is normal with no outliers. We are interested in confidence intervals which are appropriate if the data are not from the normal distribution, but from skewed distribution or have heavy tails. There are some alternatives to the exact confidence interval which can be used in such situations. There are no many authors who dealt with the confidence intervals that were less sensitive to the departure from normality and/or presence of outliers. Bonett (2006) proposed an approximate confidence interval for the population standard deviation which results were close to the exact confidence interval under the normality and had very good small-sample properties under the moderate non-normality. Cojbasic and Loncar (2011) and Cojbasic and Tomovic (2007) used the resampling methods for construction of confidence intervals for the population variance (taking the square root of the endpoints of that intervals gave the confidence intervals for the population standard deviation). Abu-Shawiesh et al. (2011) and Banik et al. (2014) conducted the large simulation studies in which compared the performances of the different confidence intervals for the standard deviation under the symmetric and skewed conditions. Hummel et al. (2005) proposed two alternative methods for finding the confidence interval for the standard deviation.

Ranked set sampling (or shortly RSS) is an alternative method of data collection and presents the cost-effective sampling procedure. The RSS is used for improving the estimators in the situations where the ranking of the units can be done easily compared to the effort required for the actual measurement of the variable of interest. This method was first proposed by McIntyre (1952). He estimated the mean of the population using the RSS instead of simple random sampling (or shortly SRS). Dell and Clutter (1972) showed that the ranked set sampling provided more precise estimates of the mean when the ranking of the units in the sample was easy. Using the RSS, Stokes (1980) concluded that an estimator of variance was asymptotically unbiased regardless of the errors that could occur during the ranking and that asymptotic efficiency of that estimator was better relative to the estimator based on the same number of the measured units from the random sample. Chen (2007) gave the review of the several variants of the ranked set sampling and presented some recent applications of that method. Samawi (1999) showed that the performance of the Monte Carlo methods, such as an importance or control variate sampling, were improved a lot using the ranked set sampling. Wolfe (2012) wrote the review article about the impact of the ranked set sampling on the statistical inference. Ganeslingam and Ganesh (2006) applied the ranked set sampling procedure on the estimation of the population mean and ratio using the real data set on the body measurements. Husby et al. (2005) used the crop production dataset from the United States Department of Agriculture to show the advantages of the RSS relative to the frequently used simple random sampling in the estimation of the mean and median of the population. Terpstra and Wang (2008) examined the several

methods for construction of confidence intervals for the population proportion based on the RSS. Albatineh et al. (2014) performed the simulation study in which evaluated the performance of the several confidence intervals for the population coefficient of variation, using the coverage probabilities and the width of the intervals. Albatineh et al. (2017) constructed the confidence intervals for the Signal-to-Noise ratio using the RSS. More about the ranked set sampling methodology and its application can be found in Ozturk (2018), Zamanzade and Mahdizadeh (2017), Zamanzade and Vock (2015), Zhang et al. (2016), etc.

In this paper, we examine the confidence intervals for the population standard deviation which are more adequate to use when the data do not follow the normal distribution. We construct the confidence intervals using the simple random sampling and the ranked set sampling. The examined intervals are implemented using the R programming language. We generate random data from the Gamma, Log-normal and Exponential distributions, respectively and compare the coverage probabilities of the presented confidence intervals. Then, we apply the considered intervals to the measure of the systematic risk data.

The goal of this paper is to present the ranked set sampling procedure for construction of confidence intervals for the population standard deviation. The contribution of this paper is to emphasize the advantages of the ranked set sampling procedure over the simple random sampling procedure. The paper is organized as follows: in Section 2, we describe the ranked set sampling methodology; in Section 3, we present the confidence intervals for the population standard deviation; in Section 4, we conduct the simulation study for the data from the Gamma, Log-normal and Exponential distributions and for the real data set; in Section 5, we summarize results and draw the conclusions.

2. RANKED SET SAMPLING METHODOLOGY

The ranked set sampling procedures can be balanced or unbalanced. Each procedure can be with the perfect or imperfect ranking process. In this paper, we consider the balanced RSS with the perfect ranking process (see Ganeslingam and Ganesh (2006), Wolfe (2012), Albatineh et al. (2014)). The process of generating the balanced RSS involves drawing k^2 units at random from the population. After that, these units are randomly divided into *k* sets of *k* units each (we get *k* simple random samples of the size *k*). Within each set, the units are ranked according to the variable of interest. The perfect ranking process implies that actual measurements of the variable of interest on the selected units are done and that ranking is based on them. Opposite to the perfect ranking process, the imperfect ranking process includes visual comparisons of the units or the use of the auxiliary varables. After the ranking process, from the first set we select the unit with the smallest rank $X_{(1)}$ (if the ranking is perfect or $X_{[1]}$, if the ranking is imperfect). The remaining *k*-1 units are not considered further. Then, from the second set we select the unit with the second smallest rank $X_{(2)}$, and so on, until we select the unit with the largest rank from the *k*-th set, $X_{(k)}$. This procedure results in *k* observations $X_{(1)}, X_{(2)},\ldots, X_{(k)}$ and is called the cycle. The number of the units in each simple random sample, *k*, is called the set size. If we want to obtain the balanced ranked set sample of size $n = mk$, we repeat the cycle *m* times (see Table 1). The complete balanced RSS with set size *k* and *m* cycles is given by $\left\{X_{(j)i} : j = 1,2,...,k; i = 1,2,...,m\right\}$. The term $X_{(j)i}$ is called the *j*-th order statistic from the *i*-th cycle.

Table 1: The balanced RSS with *m* cycles and set size *k*

Cycle 1	$X_{(1)1}$	$X_{(2)1}$	…	$X_{(k)1}$
Cycle 2	$X_{(1)2}$	$X_{(2)2}$	…	$X_{(k)2}$
…	…	…	…	…
Cycle *m*	$X_{(1)m}$	$X_{(2)m}$	…	$X_{(k)m}$

Source: Wolfe (2012)

The estimators of the mean and the variance of the population, based on the RSS, are given with the following formulas (see Stokes, 1980):

$$\bar{X}_{RSS} = \frac{1}{km}\sum_{j=1}^{k}\sum_{i=1}^{m} X_{(j)i}, \tag{1}$$

$$S^2_{RSS} = \frac{1}{km-1}\sum_{j=1}^{k}\sum_{i=1}^{m}\left(X_{(j)i} - \bar{X}_{RSS}\right)^2. \quad (2)$$

3. CONFIDENCE INTERVALS FOR THE POPULATION STANDARD DEVIATION

In this section, we report five confidence intervals for the population standard deviation.

- The exact confidence interval

Let $X_1,...,X_n$ be independent and identically distributed random variables from the normal distribution, i.e. $X_i \sim N\left(\mu,\sigma^2\right)$. Let $S^2 = \left(1/\left(n-1\right)\right)\sum_{i=1}^{n}\left(X_i - \bar{X}\right)^2$ be a sample variance. The statistic $\left(n-1\right)S^2/\sigma^2$ has χ^2 distribution with $n-1$ degrees of freedom. The exact $\left(1-\alpha\right)\cdot 100\%$ confidence interval for the population standard deviation, based on the previous statistic, is of the form:

$$\sqrt{\frac{\left(n-1\right)S^2}{\chi^2_{\alpha/2,(n-1)}}} \le \sigma \le \sqrt{\frac{\left(n-1\right)S^2}{\chi^2_{1-\alpha/2,(n-1)}}}, \quad (3)$$

Where $\chi^2_{\alpha/2}$ and $\chi^2_{1-\alpha/2}$ are the $\alpha/2$ and $1-\alpha/2$ percentiles of the χ^2 distribution with $n-1$ degrees of freedom.

The exact confidence interval (3) is very sensitive to minor violations of the normality assumption. In the cases of violations of the normality assumption, there are the confidence intervals which present the alternatives to the exact confidence interval. In remain of the section, we consider that confidence intervals.

- The Bonett confidence interval

Let $X_1,...,X_n$ be continuous, independent and identically distributed random variables with $E\left(X_i\right) = \mu$, $\mathrm{var}\left(X_i\right) = \sigma^2$ and the finite fourth moment. Bonett (2006) proposed the following estimator of the kurtosis, γ_4, which is asymptotically eqvivalent to the Pearson's estimator:

$$\bar{\gamma}_4 = n\cdot\sum_{i=1}^{n}\left(X_i - m\right)^4 / \left(\sum_{i=1}^{n}\left(X_i - \bar{X}\right)^2\right)^2,$$

Where *m* is a trimmed mean with trim-proportion equal to $1/\left\{2\cdot\left(n-4\right)^{1/2}\right\}$. This estimator tends to have less negative bias and smaller coefficient of variability than Pearson's estimator in the symmetric and skewed leptokurtic distributions. The $\left(1-\alpha\right)\cdot 100\%$ confidence interval for the population standard deviation can be written in the following form (see Bonett, 2006):

$$\sqrt{\exp\left[\ln\left(cS^2\right) - Z_{1-\alpha/2}se\right]} \le \sigma \le \sqrt{\exp\left[\ln\left(cS^2\right) + Z_{1-\alpha/2}se\right]}, \quad (4)$$

Where $c = n/\left(n - Z_{1-\alpha/2}\right)$, S^2 is the sample variance, $Z_{1-\alpha/2}$ is the $1-\alpha/2$ percentile of the Z distribution and $se = c\cdot\left[\left\{\bar{\gamma}_4\cdot\left(n-3\right)/n\right\}/\left(n-1\right)\right]^{1/2}$.

- The Steve large sample normal approximations confidence interval

Steve proposed the following $\left(1-\alpha\right)\cdot 100\%$ confidence interval for the population standard deviation (see Banik et al., 2014):

$$\sqrt{\frac{S^2}{1-Z_{\alpha/2}\sqrt{\frac{\hat{\gamma}-1}{n}}}} \le \sigma \le \sqrt{\frac{S^2}{1+Z_{\alpha/2}\sqrt{\frac{\hat{\gamma}-1}{n}}}}, \tag{5}$$

where S^2 is the sample variance, $Z_{\alpha/2}$ is the $\alpha/2$ percentile of the standardized normal distribution and $\hat{\gamma} = n \cdot \sum_{i=1}^{n}\left(X_i - \bar{X}\right)^4 / \left(\sum_{i=1}^{n}\left(X_i - \bar{X}\right)^2\right)^2$ is the kurtosis estimator.

- The log asymptotic approximation confidence interval (LOG CI)

The distribution of the sample variance, S^2, has the high skewness for small *n*. In order to reduce the skewness, Hummel et al. (2005) applied natural log to the sample variance in (5) and proposed the $(1-\alpha)\cdot 100\%$ confidence interval for the population standard deviation:

$$\sqrt{\left[S^2 \exp\left(Z_{\alpha/2}\sqrt{\frac{\hat{\gamma}-1}{n}}\right)\right]} \le \sigma \le \sqrt{\left[S^2 \exp\left(-Z_{\alpha/2}\sqrt{\frac{\hat{\gamma}-1}{n}}\right)\right]}, \tag{6}$$

Where $Z_{\alpha/2}$ is the $\alpha/2$ percentile of the Z distribution and $\hat{\gamma}$ is the kurtosis estimator.

- The adjusted degrees of freedom confidence interval (ADF CI)

Hummel et al. (2005) adjusted the degrees of freedom of the exact confidence interval (3) and proposed the following $(1-\alpha)\cdot 100\%$ confidence interval for the population standard deviation:

$$\sqrt{\frac{\hat{r}S^2}{\chi^2_{\alpha/2,\hat{r}}}} \le \sigma \le \sqrt{\frac{\hat{r}S^2}{\chi^2_{1-\alpha/2,\hat{r}}}}, \tag{7}$$

Where $\hat{r} = \dfrac{2n}{\hat{\gamma}_e + \left(\dfrac{2n}{n-1}\right)}$ and $\hat{\gamma}_e$ is the estimate of the kurtosis excess, which is defined as $\hat{\gamma}_e = \dfrac{n(n+1)}{(n-1)(n-2)(n-3)}\sum_{i=1}^{n}\dfrac{\left(X_i-\bar{X}\right)^4}{S^4} - \dfrac{3(n-1)^2}{(n-2)(n-3)}$. If the random sample is generated from the normal distribution, then $r = n-1$ and (7) reduces to (3).

The performance of all presented intervals will be considered using the SRS and the RSS. In order to get the estimators of the mean and variance of the population we will use the regular formulas for the SRS and Equations (1) and (2) for the RSS.

4. CASE STUDY

In this part of the paper, we present the results of applying the proposed methods on the simulated data and real-economic data.

4.1 Simulation study

In this part of our work we examine the coverage accuracy of two-sided confidence intervals for the standard deviation introduced in the Section 3. Our objective is to compare the performance of the confidence intervals for estimating the standard deviation using the SRS and the RSS. The nominal confidence level is set to 95% and we want to determine which of the proposed intervals will give the coverage probability that is the closest to 95%. For that purpose, we consider three scenarios. In the first scenario we deal with the Gamma distribution, while in the second scenario the subject of the consideration is the Log-normal distribution. In the third scenario we investigate the Exponential distribution. It is important to emphasize that we can deal with any other scenario with the other skewed distribution.

In the first scenario, we consider the Gamma distribution with the shape parameter 2 and with the scaling parameters 0.5, 1.6 and 3.2. For each combination of the parameter setting and the sample size (15, 20, 50, 80), we performed 1000 simulations. All examined intervals are implemented using the *R* programming language. In Table 2 we present the results of the coverage accuracy of 95% confidence intervals for the standard deviation of the Gamma distribution. It can be seen that for the small samples (size 15), the RSS Bonett interval gives the best results, i.e. the coverage probabilities that are the closest to 0.95 (the coverage greater than 0.932). For the moderate samples (size 20), the RSS Bonett interval gives the best coverage (below 0.961). In the case of big samples (size 50), depending on the scaling parameter of the Gamma distribution, the best coverage probabilities are obtained using the Bonett and the RSS Log intervals (the coverage greater than 0.939). For the samples of size 80, the Bonett interval and the RSS ADF interval give the best coverage accuracy (above 0.943).

Table 2: The coverage of 95% two-sided confidence intervals for the standard deviation of the Gamma distribution

a	***s***	***n***	χ^2	**RSS** χ^2	**Bonett**	**RSS Bonett**	**Steve**	**RSS Steve**	**Log**	**RSS Log**	**ADF**	**RSS ADF**
2	0.5	15	0.831	0.865	0.937	0.939	0.714	0.748	0.797	0.821	0.841	0.895
		20	0.838	0.881	0.909	0.960	0.769	0.773	0.788	0.864	0.857	0.907
		50	0.784	0.818	0.957	0.966	0.902	0.932	0.903	0.923	0.907	0.935
		80	0.803	0.861	0.945	0.958	0.913	0.936	0.923	0.943	0.926	0.952
2	1.6	15	0.824	0.887	0.911	0.936	0.750	0.757	0.767	0.784	0.835	0.883
		20	0.854	0.875	0.924	0.961	0.726	0.747	0.795	0.830	0.829	0.911
		50	0.805	0.898	0.933	0.972	0.900	0.923	0.885	0.939	0.908	0.934
		80	0.847	0.852	0.958	0.976	0.918	0.939	0.915	0.932	0.921	0.943
2	3.2	15	0.829	0.871	0.910	0.932	0.723	0.737	0.797	0.809	0.883	0.893
		20	0.807	0.868	0.923	0.952	0.750	0.832	0.840	0.845	0.853	0.905
		50	0.765	0.856	0.936	0.982	0.901	0.923	0.885	0.939	0.919	0.932
		80	0.758	0.840	0.952	0.965	0.907	0.941	0.905	0.938	0.922	0.936

In the second scenario, we deal with the Log-normal distribution with the shape parameter 2 and with the scaling parameters 0.25, 0.5 and 0.6. For each combination of the parameter setting and the sample size (15, 20, 50, 80), we generated 1000 samples. All considered intervals are implemented using the *R* programming language. In Table 3 we present the results of the coverage accuracy of 95% intervals for the standard deviation of the Log-normal distribution. For the small samples, the RSS χ^2 and the RSS Bonett intervals give the coverage probabilities that are the closest to 0.95 (above 0.924). In the case of the moderate samples, depending on the scaling parameter of the Log-normal distribution, the RSS χ^2 interval and the RSS Bonett interval give the best results (the coverage greater than 0.933). For the big samples (size 50) the best results are obtained with the Steve interval and the RSS Bonett interval (above 0.940). For the samples of size 80, the Steve, the RSS ADF, the Bonett and the RSS Bonett intervals give the coverage probabilities that are the closest to 0.95.

In the third scenario, we investigate the Exponential distribution with the rate parameters 0.5, 1.5 and 2.2. For each parameter setting and each sample size (15, 20, 50, 80), we performed 1000 simulations. All considered intervals are implemented using the *R* programming language. In Table 4 we present the results of the coverage accuracy of 95% confidence intervals for the standard deviation of the Exponential distribution. It can be seen that for the small samples, the RSS Bonett interval gives the best results (above 0.923). For the moderate samples, the RSS Bonett interval gives the best coverage (greater than 0.938). In the case of big samples (size 50) the best coverage probabilities are obtained using the RSS Bonett interval (above 0.945). For the samples of size 80, depending on the rate parameter of the Exponential distribution, the Bonett and the RSS Bonett intervals give the best coverage accuracy (above 0.942).

Table 3: The coverage of 95% two-sided confidence intervals for the standard deviation of the Log-normal distribution

μ	σ	n	χ^2	RSS χ^2	Bonett	RSS Bonett	Steve	RSS Steve	Log	RSS Log	ADF	RSS ADF
2	0.25	15	0.911	0.946	0.965	0.977	0.788	0.839	0.807	0.852	0.904	0.924
		20	0.920	0.937	0.964	0.980	0.833	0.883	0.864	0.874	0.915	0.935
		50	0.909	0.918	0.972	0.974	0.947	0.954	0.923	0.936	0.927	0.963
		80	0.912	0.938	0.969	0.980	0.945	0.964	0.929	0.943	0.942	0.955
2	0.5	15	0.817	0.846	0.922	0.942	0.658	0.690	0.747	0.759	0.769	0.838
		20	0.758	0.850	0.930	0.949	0.679	0.729	0.768	0.818	0.800	0.850
		50	0.669	0.828	0.937	0.953	0.911	0.927	0.872	0.910	0.904	0.914
		80	0.762	0.766	0.949	0.961	0.920	0.936	0.905	0.932	0.920	0.925
2	0.6	15	0.734	0.753	0.915	0.924	0.610	0.636	0.676	0.753	0.777	0.802
		20	0.709	0.737	0.900	0.933	0.579	0.612	0.749	0.760	0.785	0.840
		50	0.655	0.671	0.919	0.940	0.842	0.884	0.791	0.884	0.867	0.875
		80	0.556	0.682	0.939	0.941	0.866	0.888	0.862	0.886	0.884	0.897

Table 4: The coverage of 95% two-sided confidence intervals for the standard deviation of the Exponential distribution

λ	n	χ^2	RSS χ^2	Bonett	RSS Bonett	Steve	RSS Steve	Log	RSS Log	ADF	RSS ADF
0.5	15	0.757	0.799	0.904	0.930	0.614	0.637	0.763	0.769	0.781	0.797
	20	0.753	0.843	0.911	0.943	0.586	0.722	0.753	0.832	0.844	0.858
	50	0.720	0.762	0.938	0.958	0.813	0.907	0.848	0.891	0.904	0.910
	80	0.722	0.751	0.943	0.960	0.908	0.930	0.903	0.917	0.907	0.925
1.5	15	0.753	0.763	0.905	0.935	0.510	0.654	0.746	0.795	0.764	0.807
	20	0.769	0.786	0.931	0.953	0.631	0.763	0.770	0.836	0.797	0.836
	50	0.683	0.751	0.918	0.960	0.822	0.901	0.888	0.902	0.900	0.925
	80	0.658	0.744	0.942	0.963	0.916	0.934	0.914	0.920	0.918	0.933
2.2	15	0.746	0.755	0.904	0.923	0.625	0.652	0.720	0.726	0.780	0.839
	20	0.694	0.785	0.914	0.938	0.647	0.721	0.704	0.808	0.778	0.840
	50	0.687	0.734	0.931	0.945	0.883	0.897	0.875	0.908	0.893	0.906
	80	0.653	0.739	0.933	0.966	0.908	0.922	0.894	0.917	0.906	0.922

4.2. Application to the real data

In this part of the paper, we analyze the measure of the systematic risk data in 490 companies (it is about S&P500, but there are no data for some companies) on the 5th July 2017. The data are from the website http://finance.yahoo.com/.

In analysis of securities, the measure of the systematic risk (beta) takes a central place. The measure of the systematic risk represents the measure of the sensitivity of the yield of the securities to the changes in the yield on the market. Beta shows that if the yield on the market changes by one percent, by how many percentage points the yield of the securities will change.

Descriptive statistics for the analyzed data are given in Table 5. Figures 1 represents the histogram of the analyzed variable. We can see that the measure of the systematic risk is not normally distributed. Also, we used the Shapiro-Wilk normality test to examine whether the beta was normally distributed. The test showed the same result as the histogram (p-value is approximately 0).

Table 5: Descriptive statistics for the data set

Variable	*N*	Mean	Std. deviation	Skewness coef.
The measure of the systematic risk	490	1.02	0.52	0.43

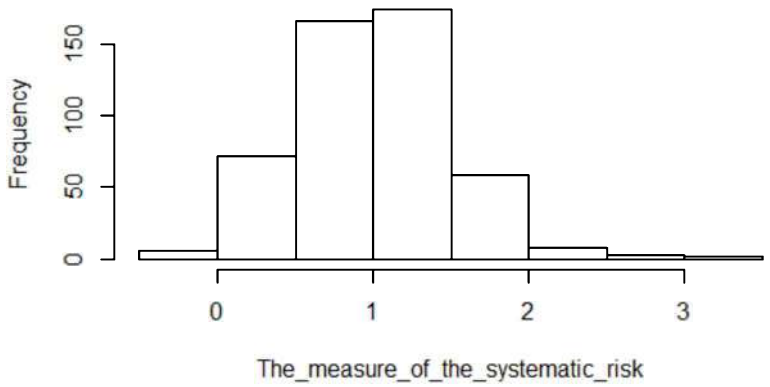

Figure 1: Histogram of the measure of the systematic risk

Results of the coverage accuracy of 95% confidence intervals for the standard deviation of the data set are given in Table 6. It can be seen that for the small samples, the RSS χ^2 interval gives the best coverage (0.945). For the moderate samples, the RSS ADF interval gives the coverage that is the closest to 0.95. For the samples of size 50, the RSS Steve interval is the best choice and in the case of the samples of size 80, the ADF interval gives the best coverage accuracy (0.946).

Table 6: The coverage of 95% two-sided confidence intervals for the standard deviation: the data set

n	χ^2	RSS χ^2	Bonett	RSS Bonett	Steve	RSS Steve	Log	RSS Log	ADF	RSS ADF
15	0.934	0.945	0.962	0.975	0.811	0.833	0.839	0.879	0.907	0.919
20	0.918	0.924	0.972	0.977	0.878	0.893	0.873	0.898	0.926	0.935
50	0.921	0.943	0.976	0.986	0.919	0.955	0.904	0.920	0.921	0.943
80	0.911	0.921	0.971	0.968	0.938	0.931	0.913	0.915	0.946	0.938

5. CONCLUSIONS

In this paper, we used the simple random sampling and the ranked set sampling to compare the coverage probabilities of confidence intervals for the population standard deviation. The exact confidence interval, the Bonett, the Steve large sample normal approximations, the log asymptotic approximation and the adjusted degrees of freedom confidence intervals were examined.

In the first scenario, we investigated the Gamma distribution. For the small and moderate samples, the RSS Bonett interval gave the coverage probabilities that were the closest to 0.95, whereas for the big samples the Bonett, the RSS Log and the RSS ADF intervals gave the best results. In the second scenario, we dealt with the Log-normal distribution. For the small and moderate samples, the best results were obtained using the RSS χ^2 and the RSS Bonett intervals. In most cases, for the big samples, the Steve interval and the RSS Bonett interval gave the best coverage. In the third scenario, we considered the Exponential distribution. For the small and moderate samples, the RSS Bonett interval was the best choice, whereas for the big samples, the Bonett and the RSS Bonett intervals gave the best results.

The analysis of the real data showed that for the small samples, the RSS χ^2 interval gave the best coverage accuracy, while for the moderate samples the best choice was the RSS ADF interval. For the big samples, the RSS Steve and the ADF interval gave the best results. We can see that using the RSS gives much better coverage probabilities, so we recommend using it when construct the confidence intervals for the population standard deviation.

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FIELD STRESS DETECTION ALGORITHM USING REMOTE SENSING

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Abstract: *As the human population is growing day by day, need for food is growing. However, possibilities for arable land are limited; it is necessary to improve the process of food production on the arable surfaces and use its full potential. With the development of remote sensing, it is possible to obtain information about agriculture surface without physical contact. Attention is devoted to monitoring the condition of crops and making different decisions based on the obtained data information in the electromagnetic spectrum. This paper presents an algorithm for detection of crop stress in the field using remote sensing. The algorithm is based on the extraction of vegetation indices from the image and comparing histogram of vegetation indices values of a healthy crop with all segments of the image. In this way, it is possible to notice the difference in vegetation indices between the healthy crop and stressed area.*

Keywords*: remote sensing, stress detection, agriculture, vegetation index, the algorithm*

1. INTRODUCTION

We live in the world where the current situation of global food security is one of the main issues. The balance between constantly growing food demand of the world population and global food production is alarming. From year to year, it is necessary to produce more food and raw materials which will be used in the further process of production, to feed growing population. As the climatic changes have a major impact on the production process, more efficient and acceptable production methods should be used. Given that the arable land has less, we must use their potential in the best possible way. Authors (Strange & Scott, 2005) explained that plant protection in general and the protection of crops against plant diseases in particular, have an obvious role to play in meeting the growing demand for food quality and quantity. Oerke, E.C., (2006) discovered that pathogens, animals and weeds, as direct yield losses are altogether responsible for losses between 20 and 40 % of global agricultural productivity. Zadoks, J. C., (1967) explained that crop losses due to pests and pathogens are direct, as well as indirect and they have some facets, some with short-term, and others with long-term consequences. Since the agricultural areas are very large, usually it is not possible to survey the whole field and detect all plant diseases. With the development and expansion of remote sensing in agriculture and using Unmanned Aerial Vehicles (UAVs) as part of it, this problem is overcome. Since every object on the earth, due to solar radiation, radiates the energy of a part of the electromagnetic spectrum, using remote sensing it is possible to obtain information of the observed part of the field that carries part of the electromagnetic spectrum. Analyzing changes in the spectrum are noticed. By measuring these changes and studying their relationships, information on plant health is obtained.

The literature about the use of remote sensing is extensive. It is used in various fields to obtain images without physical contact to object. Suresh, S. et al. (2018) explained how to improve remote sensing process by collecting better quality images from the satellite. Remote sensing found the application in different areas like geology, hazard assessment, oceanography, construction etc. In one paper, Rathje and Franke, (2016) found the use of remote sensing in geotechnical earthquake reconnaissance to document damage patterns and measure ground movements. Thus, the most important application was found in agriculture. The benefits of using remote sensing in agriculture over traditional were described on nitrogen stress detection in wheat by Wright Jr., D. L. et al. (2005). With the appearance of Unmanned Aerial Vehicles, use of remote sensing has experienced an expansion. Many authors (Konar & Iken, 2017; Omar et al., 2017; Xue et al., 2016) presented various possible areas of UAV's application and their benefits, such as intertidal monitoring, concrete bridge decks surveying and development of automatic aerial spraying systems. Remote sensing application in agriculture was found thanks to multispectral images used for extraction of vegetation indices. Berni, J. et al. (2009) explained how to extract information about vegetation and plant stress using multispectral images. McDonald, A. J. et al. (1998) evaluated different vegetation indices obtained with multispectral images on coniferous forests. Combination of the multispectral image and variable rate technology in remote sensing was used to detect tree health problems and application of a pesticide in the citrus production, as described by Du., Q. et al. (2008).

In agriculture, remote sensing is used for a variety of purposes. Ballesteros, R. et al. (2014) noticed that remote sensing high-resolution images with proper treatment might be considered as a useful tool for precision in monitoring crop growth and development, water requirements, yield production, weed and insect infestations, among others. Vegetation indices, there are a lot of possibilities for monitoring condition of the field. Gitelson and Merzlyak (1998) used vegetation indices to determine the concentration of chlorophyll in higher plant leaves. Zhuang, S. et al. (2017) also used them to determine water stress in early phases. For stress detection in the field, in many papers, k-means is used for classification. Badnakhe and Deshmukh (2011) applied k-means clustering with AI to detect crop diseases. Also, Cheng, H. et al. (2013) presented k-means for image segmentation in their paper. Further research has found that there are many algorithms for stress detection, usually specialised for a particular type of stress.

Paper is organised as follows. After the introduction, Section 2 is devoted to the methodology and algorithm used for stress detection. Section 3 refers to the application of the stress detection algorithm on a wheat field. In Section 4, there is a conclusion and directions for further research.

2. METHODOLOGY

Remote sensing is the process of collecting information about an object or phenomenon without making physical contact with the observed phenomenon or object. It is a phenomenon that has numerous applications including photography, surveying, geology, forestry and other. Also, because of its ability to collect information about the huge area for less time and without physical contact, the remote sensing has found significant use in agriculture. There are very many applications of remote sensing in a field of agriculture like crop production forecasting, crop detection, identification all types of stress. In the field of agriculture, using unmanned aircraft sensor, the object is recorded, which is, in this case, the earth's surface with the plant cultures. It is possible to determine plant stress using changes of the electromagnetic spectrum.

Plant stress is manifested as any state of the biological system that deviates from the optimum. Different intensity and length of negative effects affect the severity of stress, which always leads directly to a decrease in yield and quality of crops below the genetic potential. Stress causes a large number of natural and factors that are caused by man's actions. Some of the types of stress that are most commonly represented are stress from low temperature, stress from excess water, city and storms, stress from pesticides, whiskey mites, insects and plant diseases. It is thought that 90% of plant production worldwide is endangered by stress and that it has an increasing impact.

The algorithm for field stress detection using remote sensing shown in this paper consists of three main parts. First part includes the preparation of data, an image acquiring using unmanned aerial vehicles (UAV). The second part is pre-processing, which consists of selecting samples from the acquired image, selection of vegetation indices and extracting them, and input values for clusters. The last phase is processing of the image by comparing vegetation indices values of each image segment with the vegetation indices values obtained from samples and put it in the appropriate cluster defined in part two. Each part of the algorithm is explained below in more detail.

2.1. Preparation phase

The data preparation phase involves the process of collecting images from the air. One of the most advanced remote sensing technologies today is the use of UAVs equipped with a camera. This way, in a very quick and easy way, images of a certain surface are suitable for precision agriculture. Gathering images from the air is one of the essential steps of the entire image analysis process. When taking a certain surface, it is necessary to take care of more details to obtain a picture that is appropriate for the further analysis process. Image quality depends on several factors such as camera specifications, weather conditions and flying altitude.

In remote sensing in agriculture, several types of cameras are used to capture fields such as thermal camera, RGB and NIR cameras. Thermal technology is not so often used to getting images from the air because of low spatial and temporal resolution, low shooting and high price. Color RGB (Red, Green, Blue) present images that most closely represent how human eye would see a field from a plane. The advantage of this image type is that RGB is available from most aerial imaginary platforms. Thus, it has certain limitations. Generally, the crop needs to be significantly stressed to see a visual difference that can be identified in a colour image. Also, colour imaginary provides little opportunity to distinguish small differences in areas of high yield. RGB images are suitable for extraction of VARI and ExG vegetation indices. Near-infrared (NIR) imagery provides a greater assessment of plant health than traditional photos by visualising colour bands outside of what the human eye can see. It uses a false colour composite to display information that would normally be invisible to the human eye. The NIR map shows areas of highly vigorous crops in

bright red and weak crops or bare soil in grey. The most used image type in agriculture is Normalized Difference Vegetative Index (NDVI). This image type is often obtained using BNDVI filter, and the present calculated index used to monitor crop health and photosynthetic activity.

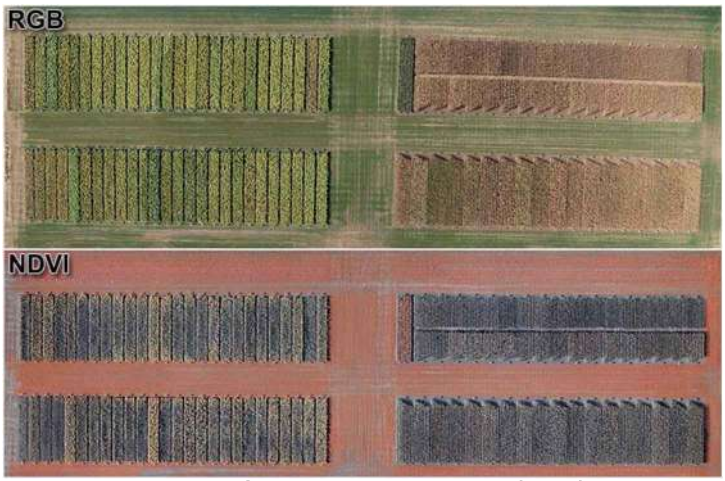

Figure 1: RGB and NDVI images of the field

2.2. Pre-processing phase

After image acquiring, it is necessary to select samples from the image of the field. The samples should be selected that represent a healthy plant crop. To achieve the efficiency of the algorithm, it needs to select at least ten samples.

Vegetation interacts with solar radiation in a different way than other natural materials. The vegetation spectrum typically absorbs in the red and blue wavelengths, reflects in the green wavelength, strongly reflects in the near-infrared (NIR) wavelength, and displays strong absorption features in wavelengths where atmospheric water is present. Different plant materials, water content, pigment, carbon content, nitrogen content, and other properties cause further variation across the spectrum. Measuring these variations and studying their relationship to one another can provide meaningful information about plant health, water content, environmental stress, and other important characteristics. These relationships are often described as vegetation indices.

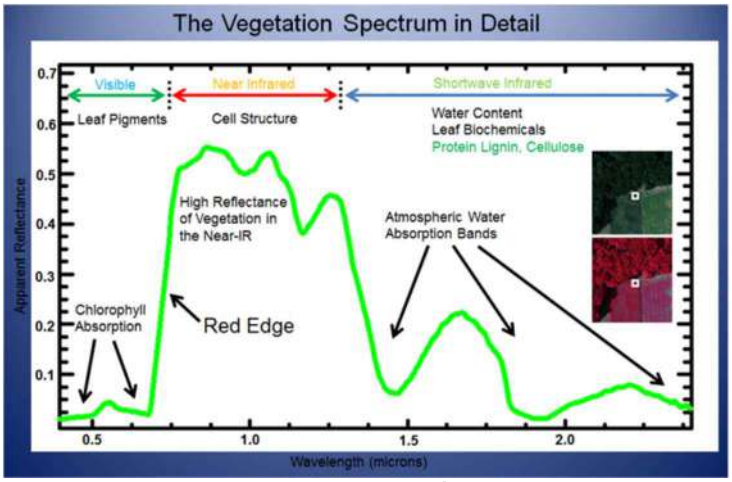

Figure 2: Vegetation Spectrum

The Normalized Difference Vegetation Index (NDVI) is perhaps the most well-known and often used vegetation index. It is a simple, but effective VI for quantifying green vegetation. The NDVI normalises green leaf scattering in the near-infrared wavelength and chlorophyll absorption in the red wavelength. The value range of an NDVI is -1 to 1 where healthy vegetation falls between values of 0.20 to 0.80.The vegetation atmospherically resistant index (VARIgreen) is based on the Atmospherically Resistant Vegetation Index (ARVI) and is used to estimate the fraction of vegetation in a scene with low sensitivity to atmospheric effects. The Excess Green Index (ExG) provides a near-binary intensity image outlying a plant region of interest, from which a segmentation can be accomplished with a suitable threshold.

Depending on the type of image (RGB or NDVI, plant species and type of possible stress, the appropriate vegetation index is selected to be extracted from each sample. The process of vegetation index extraction is following: every sample is divided into a certain number of segments (depending on the spatial resolution of the image), and vegetation index value is calculated. After that, for each sample, a histogram of segment vegetation indices is made. Passing through all the samples and calculating vegetation index histograms, one histogram which represents their average is calculated, and it will be used as a benchmark for the healthy plant for processing phase.

K-means is a widely used clustering algorithm in remote sensing for segmentation. The K-means clustering algorithm tries to classify objects based on a set of features into K number of classes. The classification is done by minimising the sum of squares of distances between the objects and the corresponding cluster or class centroid. Experimental results demonstrate that improved k-means clustering algorithm can reduce the computation amounts and enhance precision and accuracy of clustering (Ballesteros, R. et al., 2014). Thus, using k-means in many cases, it is not able to clearly distinguish a healthy plant from all types of stress in the field. The algorithm overcomes this problem explained in this paper. In the last step of pre-processing phase, the range of values of each cluster is entered. The algorithm is using three predefined clusters which represent: healthy plant, potential stress and stress in the field. Entered values should include a range of 0-100 which represents the percentage of overlapping histograms, so they do not match.

Example of cluster range:
- Healthy plant: 80-100% overlap
- Potential stress: 60-80% overlap
- Stress: 0-60% overlap

With vegetation index benchmark histogram calculated and entered cluster range values, the last phase of the algorithm is accessed.

2.3. Processing phase

Image processing phase is the finishing step of an algorithm for stress detection. Segments of the image are compared with it and depend on the percent of overlapping, clustered in one of the predefined clusters using benchmark vegetation index histogram.

In this phase, the whole image is divided into equal size segments (usually size $1m^2$). Then, passing through each image segment, the histogram value of extracted vegetation index is calculated. By comparing the resulting histogram with the benchmark histogram, the percentage of the overlap is determined. Depending on this percentage, the segment will be classified to a particular cluster which includes an overlapping percentage. After classification of all image segments process of stress, detection is finished, and every segment of the image contains information to which cluster belongs. In this way, stress detection has been determined, and the data is ready for further processing and decision making.

3. CASE STUDY

Wheat is one of the most important plants used in the everyday nutrition of people. As the world is harvesting more than 218 million hectares, it is very important that crops are healthy to meet the people needs. Since it is a highly sensitive plant, various insect species can very often harm her. Also, black rust and ash are some of the diseases that can affect the crop due to the action of various insects and microorganisms. All of this points to the importance of monitoring these changes that affect the plant itself. Stress detection algorithm described in the previous section will be applied to the wheat field.

Image acquiring process was carried out by passing and 8.9 ha field of wheat located in the Sutton Bridge, United Kingdom. Aerial images are collected flying 70m from the ground, using DJI's drone, Phantom 4 Advanced. It is equipped with integrated still visible-light camera (RGB) with 20 megapixels objective and 3-axis gimbal stabilisation. After collection of images, stitching software is used to format picture of the whole field.

Figure 3: Healthy wheat sample images

After image stitching, next step is a selection of samples which represent a healthy plant. Ten samples size of $1m^2$ is selected from the field image, and shown in Figure 3. For each sample, vegetation indices will be extracted. Since the image was collected using an RGB camera, the most appropriate vegetation index for stress detection of wheat is The Excess Green Index (ExG) which is calculated in the following manner:

$$ExG = 2g - r - b \tag{1}$$

$$r = \frac{R}{R+G+B} \qquad g = \frac{G}{R+G+B} \qquad b = \frac{B}{R+G+B} \tag{2}$$

Each sample is then split into 10x10 segments, and ExG vegetation index is calculated for all of them. After creating histograms of vegetation index values for all samples, an average histogram was obtained which will be used as a benchmark in the processing phase.

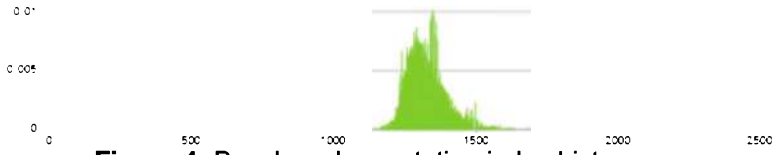

Figure 4: Benchmark vegetation index histogram

Before accessing image processing, cluster range values should be entered for percentages of overlapping. The empirical research found that the algorithm gives the best results for cluster values: Good (80-100% overlap of the histogram), Potential stress (50-80%) and Stress (0-50%).

When the cluster range values are defined, and benchmark histogram is calculated, the image processing step is accessed. Using software for image processing, by passing through each segment of the image, vegetation index histogram is calculated and then compared to benchmark histogram. Depend on the overlapping percent; the segment is classified to the appropriate cluster. In Figure 5, the original image, and image with classified segment are displayed by cluster colours. In the right picture, healthy plant is displayed with green colour, potential stress with a yellow and stressed area with red.

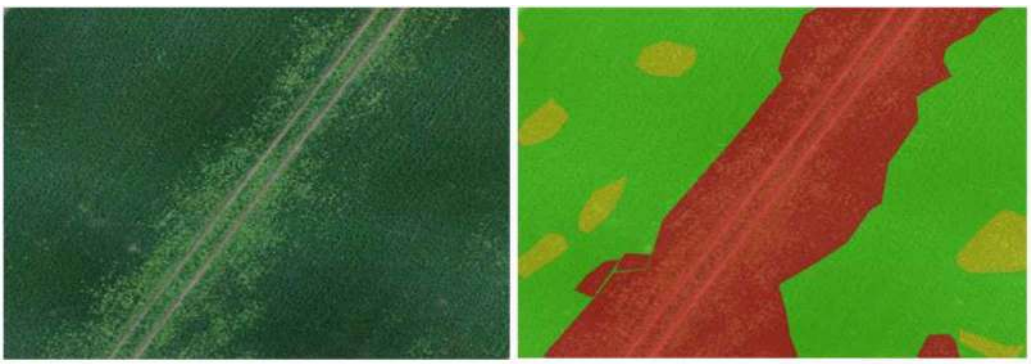

Figure 5: Original image and image with a clustered area

The stress detection algorithm has identified the areas that are affected by stress and need to be rehabilitated, as well as areas with potential stress to which attention should be paid.

4. CONCLUSION

It is possible to influence the health of the plants and yield significantly using and improving various algorithms for stress detection in the field with remote sensing. The algorithm shown in this paper is very convenient to display generalised stress in the field. With geographic information system (GIS), used to capture, store, manipulate, and present geographic data, it is possible to extract georeferenced data for each segment of the field. From these data, in a very easy way, exact coordinates of areas that are under stress should be extracted, and then healed appropriately. In the future, emphasis should be placed on comparing this algorithm with existing ones, with the aim of improving it. Also, the focus should be on possibilities of integration the data obtained with this algorithm with GPS based technologies.

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CRYPTOCURRENCY PRICE FORECASTING USING TIME SERIES AND MONTE CARLO MODELING AND SIMULATION

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Abstract: *Over the recent years cryptocurrencies have attracted a significant amount of attention. Everything started with Bitcoin and built up to the situation where we have over 1500 cryptocurrencies. Cryptocurrency market is the new stock market. Highly volatile, decentralised, open, widely accessible market. In this paper we will employ time series analyses together with Monte Carlo simulation to build financial simulation model for forecasting the price, analysing profitability and risk for some of the most popular cryptocurrencies. Although the cryptocurrency market has massive oscillations, any contribution to modeling its value increases the awareness of potential profits and losses.*

Keywords*: cryptocurrency, time series, simulation, model, Monte Carlo, profitability*

1. INTRODUCTION

Cryptocurrencies can be defined as digital, computer currencies whose implementation stands on the principles of cryptography, both to validate the realised transactions and to enlarge the currency in circulation (Cocco, Concas, & Marchesi, 2017).

The most well-known and widely used cryptocurrency is Bitcoin (BTC). At the same time, this cryptocurrency has the highest market valuation, usage, merchant acceptance and popularity (Hayes, 2015). Bitcoin was introduced in 2009, as the first decentralised digital currency platform, a currency which does not have a central authority to regulate it's usage, validate, and settle transactions (Gandal & Halaburda, 2016).

Following Bitcoin's footsteps, other cryptocurrencies were launched (Iwamura, Kitamura, & Matsumoto, 2014). Everyone can create its own cryptocurrency in minutes (Long, 2018). All cryptocurrencies formed after Bitcoin are called altcoins. Some of the most popular altcoins are Ethereum (ETH), Litecoin (LTC), Ripple (XRP), Zcash (ZEC), and Monero (XMR).

Bitcoin is one of the most studied cryptocurrencies, many authors analysed its pros and cons. Barber, Boyen, Shi, and Uzun (2012) pointed to several problems with Bitcoin, such as technical vulnerability, potential deflationary spiral, accidental loss of bitcoins, and malware attacks. Yermack (2013) analysed Bitcoin price against fiat currencies and showed that its volatility undermines its usefulness as a currency. Baek and Elbeck (2015) presented strong evidence to suggest that Bitcoin volatility is internally (buyer and seller) driven – leading to the conclusion that the Bitcoin market is highly speculative. Urquhart (2016) showed that Bitcoin market returns are significantly inefficient if observed at once, on the whole sample, but when sample is split into two subsample periods, test indicate that Bitcoin is efficient in the latter period. Bitcoin showed vast success and popularity since its creation (more in the recent years), thanks to its added value. Namely, some of the most important pros of Bitcoin are anonymity, decentralised nature, enhanced revenue, and use of proof-of-work mechanisms (Moore & Christin, 2013).

Cryptocurrencies have not been a topic of great interest for scientific papers until recently. Namely, only 193 articles have been published by the end of 2017 in journals indexed on Clarivate Analytics Web of Science Social Sciences Citation Index (SSCI) and Science Citation Index Expanded (SCIE) with the topic "cryptocurrency" OR "bitcoin" (Clarivate Analytics, 2018). Most of the authors tried to determine which factors influence the cryptocurrency price, trade volume, and volatility. Kristoufek (2013), for example, showed that there is a connection between the search queries and the Bitcoin price. Glaser, Zimmermann, Haferkorn, Weber, and Siering (2014) studied whether the reason for interest in cryptocurrencies on Wikipedia is looking for the new investment asset or the usage as currency itself. The result of the study showed that most of the interest is due to the asset aspect. It will be interesting to investigate their value if they ever become usable for their primary purpose – as medium of exchange for goods and services. Although concept of digital currency would highly increase efficiency of payments in digital world, it currently involves high risk for both consumers and businesses, due to its value instability.

This paper presents steps in modelling the cryptocurrency price and trying to forecast it. The first step was to apply time series analyses for fitting the cryptocurrency historical price data using specific time series model. Afterwards, the resulting function is used for forecasting the price with the help of Monte Carlo simulation.

After defining cryptocurrency and short literature review, in section two, the process of collecting data and building the model is presented. In the same section, the example of investment profitability analyses is demonstrated using the developed model as a framework and running simulation experiments. The results are analysed afterwards. Finally, in section three, conclusion and some future directions of the research are provided.

2. CRYPTOCURRENCY INVESTMENT SIMULATION MODEL

Three most popular cryptocurrencies have been chosen for building the model for forecasting cryptocurrency price: Bitcoin, Ethereum, and Litecoin. Data has been collected for the daily closing price in USD ($) for each of them. Bitcoin data covers the period from 17.07.2010 to 29.04.2018 (CryptoCompare, 2018a), Ethereum from 07.08.2015 to 29.04.2018 (CryptoCompare, 2018b) and Litecoin from 24.10.2013 to 29.04.2018 (CryptoCompare, 2018c). There are a lot of online cryptocurrency historical price databases, but CryptoCompare is selected as the one that has prices for all the mentioned cryptocurrencies. Simple descriptive overview of the data is presented in Table 1.

We can see that Bitcoin price has grown from an average of $0,14 in 2010 to $9.883,01 in 2018. The rate has been even higher for some periods of time, reaching the maximum value of $19.345,49 on 16.12.2017. Ethereum and Litecoin saw excessive growth in value, too.

Table 1: Cryptocurrency prices

Year		Bitcoin price [$]	Ethereum price [$]	Litecoin price [$]
2010	Days	168		
	Mean	**0,14**		
	Std. Dev.	0,09		
2011	Days	365		
	Mean	**5,64**		
	Std. Dev.	5,62		
2012	Days	366		
	Mean	**8,29**		
	Std. Dev.	3,21		
2013	Days	365		69
	Mean	**200,15**		**16,75**
	Std. Dev.	260,77		12,96
2014	Days	365		365
	Mean	**522,89**		**9,93**
	Std. Dev.	176,24		6,32
2015	Days	365	147	365
	Mean	**272,02**	**0,95**	**2,67**
	Std. Dev.	58,92	0,32	1,02
2016	Days	366	366	366
	Mean	**567,00**	**9,76**	**3,76**
	Std. Dev.	138,35	3,67	0,47
2017	Days	365	365	365
	Mean	**3981,07**	**221,68**	**49,85**
	Std. Dev.	3987,18	183,80	64,13
2018	Days	119	119	119
	Mean	**9883,01**	**776,79**	**175,53**
	Std. Dev.	2370,88	256,57	41,11

Table 2: Time series fit details

	Bitcoin price [$]			Ethereum price [$]			Litecoin price [$]		
Type	AR2	GARCH	ARMA	MA1	GARCH	MA2	GARCH	MA1	AR2
Function	Logarithmic	Logarithmic	Logarithmic	Logarithmic	Logarithmic	Logarithmic	Logarithmic	Logarithmic	Logarithmic
Detrend	First Order	First Order	First Order	First Order	First Order	First Order	First Order	First Order	First Order
Deseasonalize	None	None	None	None	None	None	None	None	None
Akaike (AIC) Rank	#1	#2	#3	#1	#2	#3	#1	#2	#3
Akaike (AIC) Fit	-7093.55	-7090.92	-7073.86	-2562.13	-2554.05	-2553.77	-3684.91	-3644.12	-3638.54
Bayesian (BIC) Rank	#2	#3	#4	#1	#3	#4	#1	#2	#4
Bayesian (BIC) Fit	-7069.75	-7067.12	-7050.06	-2562.13	-2534.47	-2534.20	-3663.30	-3644.12	-3616.94
Parameters	4	4	4	3	4	4	4	3	4
Parameter #1	Mu	Mu	Mu	Mu	Mu	Mu	Mu	Mu	Mu
Value	4.27E+11	4.27E+11	3.89E+11	5.27E+11	5.27E+11	5.27E+11	2.39E+11	2.39E+11	2.39E+11
Parameter #2	Sigma	Omega	Sigma	Sigma	Omega	Sigma	Omega	Sigma	Sigma
Value	6.94E-02	4.71E+11	6.90E+12	6.67E+12	4.39E+11	6.78E+12	6.18E+11	8.07E+12	8.01E+12
Parameter #3	A1	A	A1	B1	A	B1	A	B1	A1
Value	3.33E+12	2.78E+11	-1.90E-01	-7.34E+11	2.63E+11	-1.52E-02	3.78E+11	-1.07E-01	-1.15E-01
Parameter #4	A2	B	B1		B	B2	B		A2
Value	-1.77E-01	3.40E+11	2.74E-01		3.19E+10	1.23E+12	4.63E+10		-4.71E+12

Eleven time series algorithms have been employed on cryptocurrencies prices using Palisade @RISK 7.5.2 plug-in software for Microsoft Office Excel 2016. @RISK features automatic detection of required transformations to achieve stationarity. Each algorithm used logarithmic data transformation and first-order detrend. There have not been need to de-seasonalize the data. Akaike Fit (Akaike information criterion – AIC) and Bayesian Fit (Bayesian information criterion – BIC) are used as quality measures for time series fit. Results for the best ranked algorithms for each cryptocurrency are presented in **Error! Reference source not found.**.

AR2 – the autoregressive model showed the best result for representing Bitcoin price, and it will be used for creating the financial model for cryptocurrency profit analyses. This fit is presented in Figure 1, together with parameters for AR2 @RISK function.

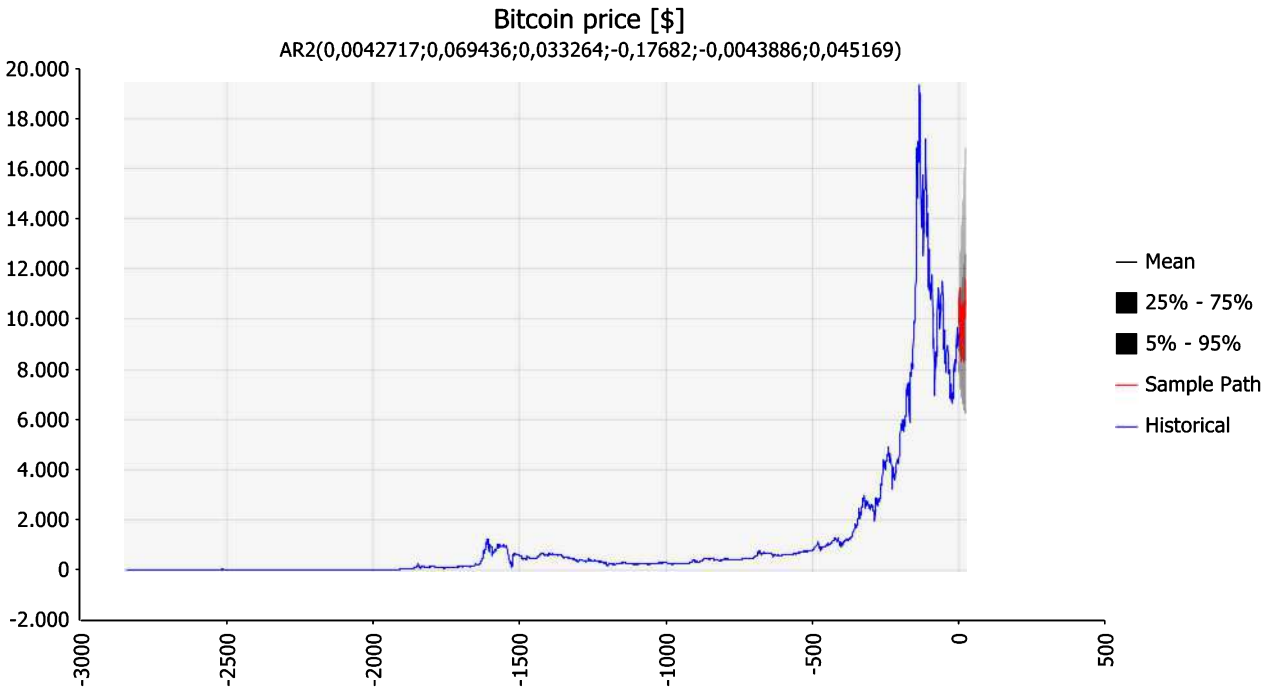

Figure 1: AR2 time series for Bitcoin price

Figure 2: MA1 time series for Ethereum price

MA1 – moving average model showed the best results for representing Ethereum price according to both quality measures, and it will be used for simulating price in the financial model. This fit is presented in Figure 2, including parameters for MA1 @RISK function.

GARCH – generalised autoregressive conditional heteroskedasticity model is selected for representing Litecoin price trend. It has been ranked as the best one according to both quality measures, and it will be used for simulating price in the financial model. This fit is presented in Figure 3, as well as parameters for GARCH @RISK function.

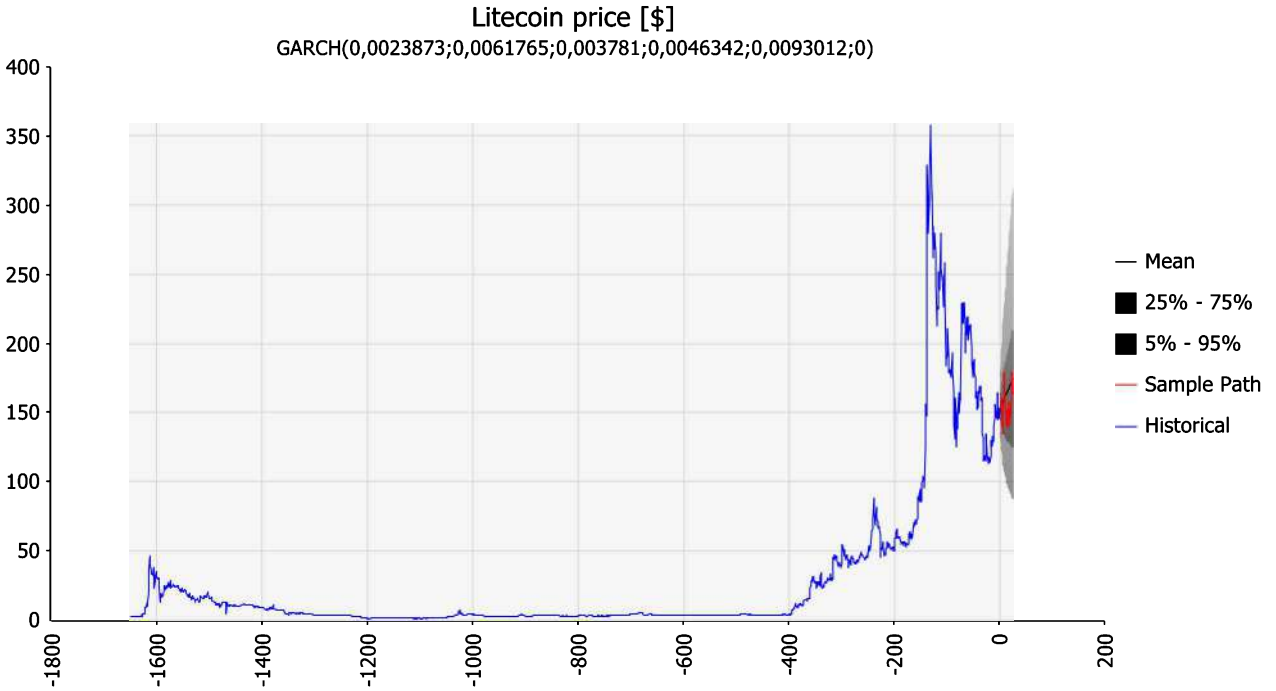

Figure 3: GARCH time series for Litecoin price

We will analyse a hypothetical situation where $10.000 is invested in each observed cryptocurrency on 29.04.2018 (Figure 4 – yellow fields are for input variables, blue for calculation steps, and green for output). Based on the investment, quantity of each cryptocurrency bought is calculated. In the next step, three time series fit functions are used for generating market price on 29.05.2018. Afterwards, the new cryptocurrency value and profit are calculated. Note that RiskOutput() is used for setting the profit as simulation output variable.

	A	B	C	D	E	F	G	H
1	Cryptocurrency	Price [29.04.2018]	Quantity	Investment [29.04.2018]	Price [29.05.2018]	Value [29.05.2018]	Profit	Profit [%]
2	Bitcoin	$ 9.310,52	1,07	$ 10.000,00	$11.139,58	$ 11.964,51	$ 1.964,51	19,65%
3	Ethereum	$ 683,51	14,63	$ 10.000,00	$ 856,09	$ 12.524,90	$ 2.524,90	25,25%
4	Litecoin	$ 153,38	65,20	$ 10.000,00	$ 181,03	$ 11.802,60	$ 1.802,60	18,03%
5								
6								
7								
8								
9								

=D4/B4
Time series functions
=C4*E4
=RiskOutput()+F4-D4
=G4/D4

Figure 4: Predicted cryptocurrency profit

After building the model, simulation is conducted using @RISK software with 100.000 iterations (Figure 5).

In each iteration, the cryptocurrency price on 29.05.2018 is generated using the selected time series model, other values are calculated and results are saved in database. When the simulation is finished, results are presented in form of probability distributions with extensive statistical indicators.

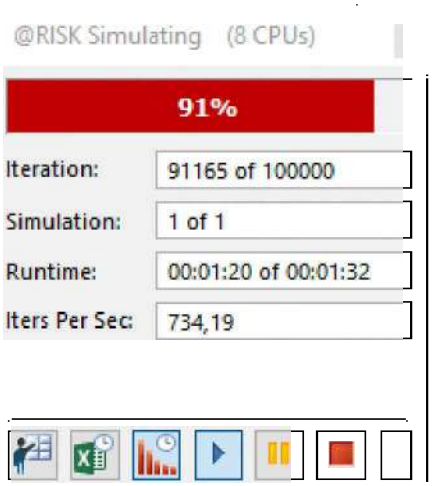

Figure 5: @RISK Monte Carlo simulation

We can say that investment into any cryptocurrency involves high risk, as the market is highly volatile (Yermack, 2013). Our results showed that the average profit on Bitcoin investment on 29.05.2018 should be $1.964,51, with a standard deviation of $4.135,37. Highest loses are set at $7.548,15 and the highest profit at $37.488,39. If we take a look at Figure 6, we can see that the profit will be between -$3.500 and $9.616 with 90% chance. Results for Ethereum and Litecoin are analysed in a similar manner.

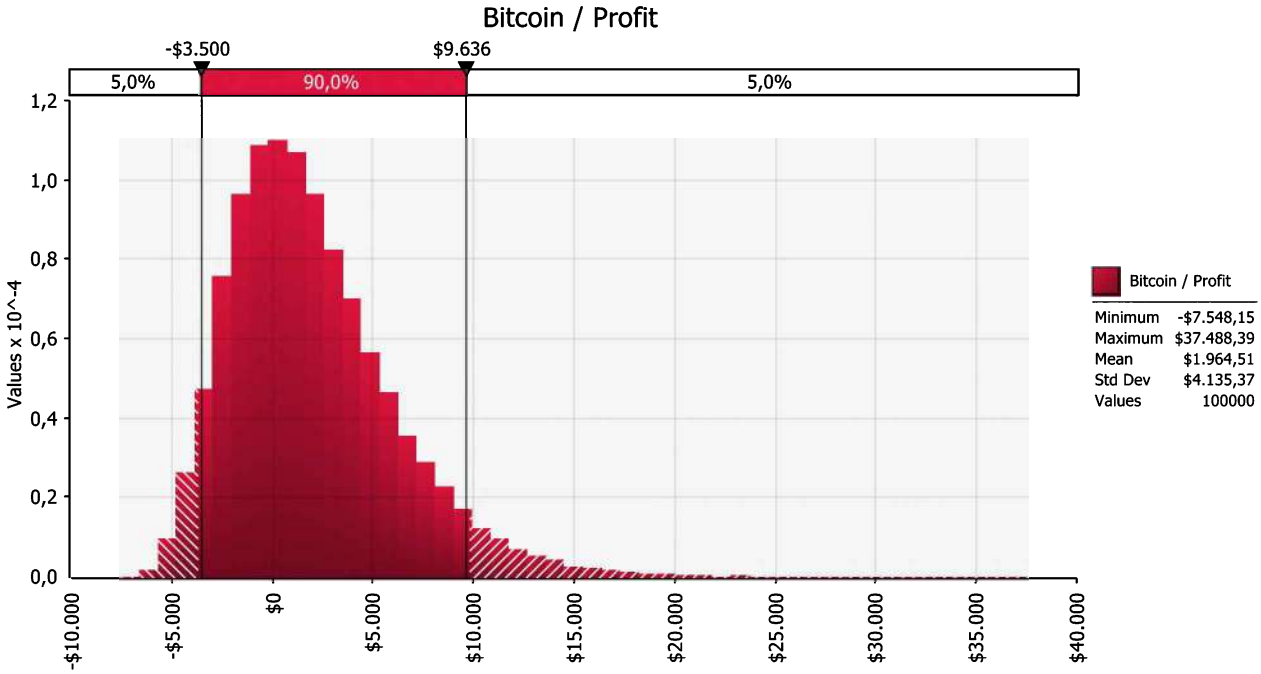

Figure 6: Bitcoin profit

Based on the current market situation and our predictions, Ethereum shows the highest potential for growth and profitability (Figure 7). Namely, mean profit on an investment of $10.000 into Ethereum is $2.524,90, and the maximum possible profit is $46.346,79.

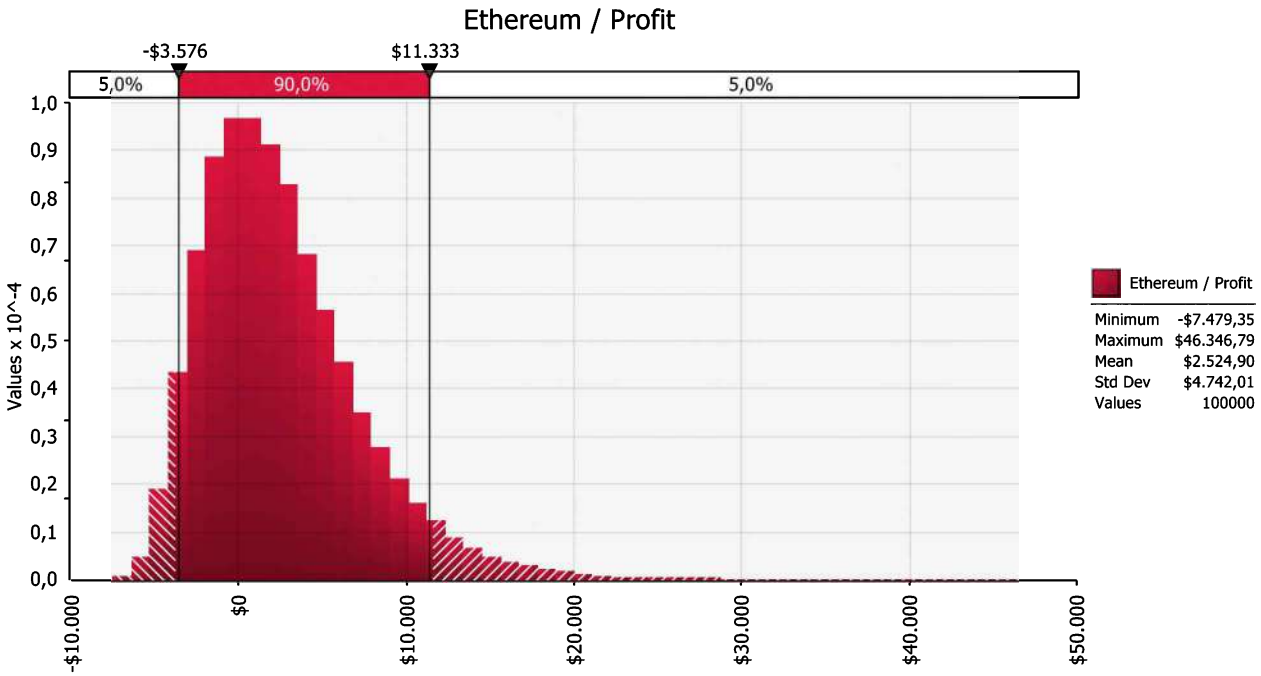

Figure 7: Ethereum profit

Litecoin carries the highest risk (Figure 8), with highest standard deviation and highest possible loses, but also it has the highest potential profit of $71.228,63.

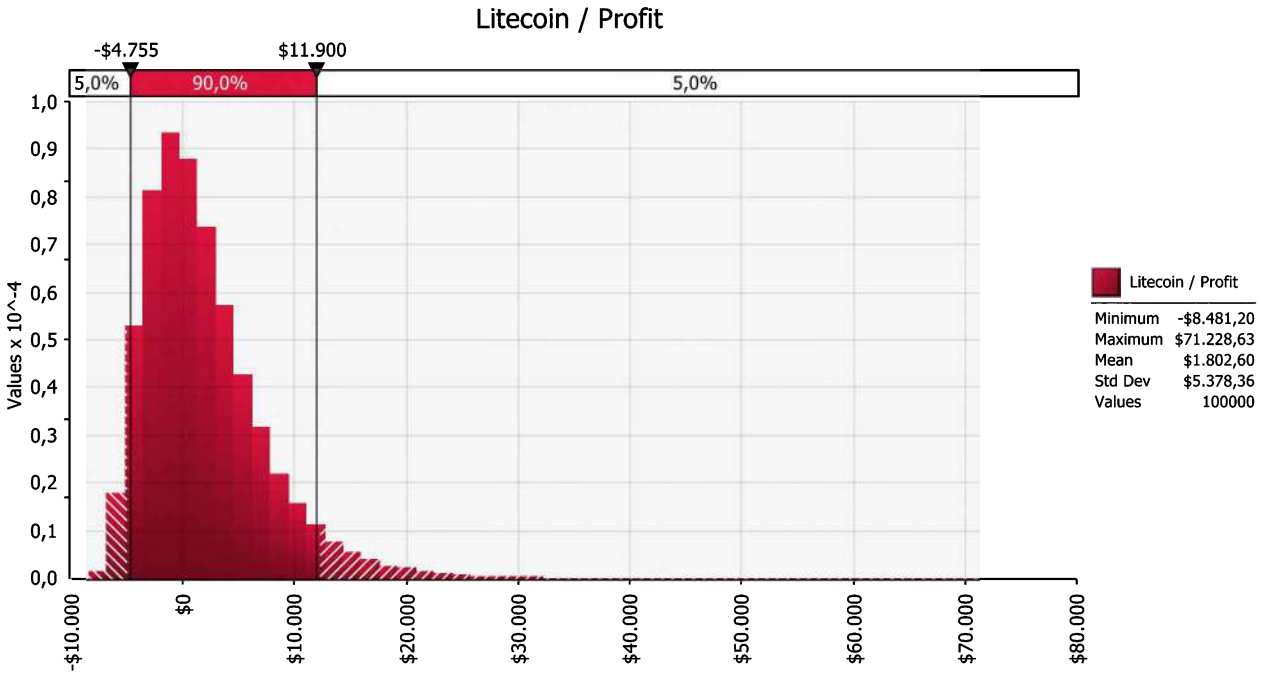

Figure 8: Litecoin profit

3. CONCLUSION

Cryptocurrency popularity is inevitably rising (Cheah & Fry, 2015). Our aim in this paper was to make a step towards equipping individual investors with a model for cryptocurrency price analyses using well-known time series analyses and Monte Carlo simulation.

To encourage other researchers on modelling and forecasting cryptocurrency price, the data sources and widely accessible tools for analyses are suggested. Afterwards, the model is created using the mentioned methodologies. Additionally, the model is employed on the example of investment and results are analysed.

Bitcoin price is prone to speculative bubbles and the bubble component contained within Bitcoin price is substantial (Cheah & Fry, 2015; Fry & Cheah, 2016). The market is highly volatile, but any kind of information gathering and analyses are giving higher insight into the possible price trends. Combination of time series with Monte Carlo simulation gives the investor possibility to analyse potential price in terms of probabilities and statistical indicators.

Monte Carlo simulation results for the three observed cryptocurrencies show high investment risks, but also high potential profits. Ethereum emerged as the cryptocurrency with highest mean and potential maximum profit, while Litecoin has the lowest mean profit and highest maximum losses. Bitcoin is in the middle, with lowest standard deviation, and solid mean profit.

During the research, we identified several future directions of the study. Firstly, the built model can be enabled with portfolio optimisation features. This would significantly reduce potential investors' risk and make investing more tempting. The other direction is regarding the number of cryptocurrencies analysed. The model can be simply expanded to involve a higher number of cryptocurrencies, especially the new and rising ones.

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STATISTICAL AND SOFT COMPUTING TECHNIQUES IN AIRLINE INDUSTRY – A LITERATURE REVIEW

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Abstract: *Statistical and soft computing techniques are widely used in airline industry for processing a large amount of data and assisting in the decision making process, since they are capable to capture both internal and external factors. Depending on the data, presence of vagueness, uncertainty and model existence, statistical and soft computing techniques could be applied in various processes. Aim of this paper is to provide the analysis of the literature covering the usage of these techniques in airline industry. We reflect on 44 papers published in a period 1961-2018. It consisted of 3 stages: initial analysis (publishing year), brief analysis of proposed methods and identification of operations/business processes. Results are indicating an extensive usage of statistical techniques. However, due to the ability to tolerate imprecision and uncertainty, there is a lot of opportunity for the application of soft computing techniques, especially for the passenger demand, overbooking and no-show forecasting.*

Keywords: *soft computing techniques, statistical techniques, airline, forecasting, no show*

1. INTRODUCTION

Nowadays, processing a large amount of data in airline industry is much easier than in previous few decades. Development of computational technologies allowed carriers to process data much faster and to make real time decision (Min & Joo, 2016; Pineda, Liou, Hsu & Chuang, 2018). Numerous techniques based on mathematics theory are applied in this complex process, and depending on the nature of the problem, there are - statistical or soft computing techniques. As pointed out by Lim and Balas (2013), the main difference is that statistical techniques (ST) are based on principles of precision and certainty, and soft computing techniques (SCT) tolerate imprecision and uncertainty. When it comes to the big data processing, ST need more time and a precisely formulated analytical model for computation. On the other hand, when observing vagueness and inconsistency in data, application of SCT could offer required and much needed solutions.

Two most commonly used SCT are fuzzy logic (FL) and neural networks (NN). As pointed out by Zadeh (1994), FL could be used to a highly extent in solving problems related to the vagueness and NN could be applied in situation in which uncertainty is highly present. When it comes to the ST, time series and statistical analyses are frequently used approaches. Both could be very efficient in capturing trends among data, seasonal components and could be a strong predictive tool with a precisely formulated analytical model. In airline industry, there are several fields in which both SCT and ST could be applied and contribute to the great extent. Fuzzy logic is mostly applied to measure quality of airline service (Li, Yu, Pei, Zhao & Tian, 2017) and neural networks are proposed for various predictions – aircraft maintenance operations (Luxhoj, Williams & Shyur, 1997), seat inventory management (Sun, Brauner & Hormby, 1998) and forecasting passenger demand (Chikr-El-Mezouar & Mohamed Hassan Gabr, 2011). Time Series analysis technique is used for building ARIMA models for forecasting passenger trends (Riddington, 1987) and statistical analysis is applied for building a model that is calculating the overbooking level (Amaruchkul & Sae-Lim, 2011). One of the overlapping area for both techniques is forecasting passenger demand. As highlighted by Cheng and Mengting (2018), various methods and their combinations could be found on this topic. Good example could be Faraway and Chatfield (1998) who combined neural networks and time series to create forecasting model. Aim of this paper is to provide the analysis of the literature covering the usage of both statistical and soft computing techniques for solving issues and challenges in airline industry. The analysis is covering 44 papers published in a 1961-2018 period. Next two sections contain the analysis of papers in which SCT and ST are used respectively. Focus of the analysis is to highlight proposed solutions and applied methods, and to link them to the carrier's business processes and operation areas in which they are used. Section four contains numerical analysis. Section five concludes the paper.

2. APPLICATION OF SOFT COMPUTING TECHNIQUES IN AIRLINE INDUSTRY

Due to the complexity and frequency of changes in the airline industry, carriers are often forced to take into account the uncertainty and ambiguity in the decision making process. Depending on the type and subject of

the decision, SCT could be used to embrace uncertainty and deal with the incomplete and inaccurate information. Fuzzy logic could be applied to measure airline service quality, in new routes selection and supplier evaluation. Neural networks are finding their application in forecasting passenger demand, as a standalone technique or with the combination of other SCT and ST. Beside the FL and NN, other SCT were also considered as a part of this research - genetic algorithms and case based reasoning approach. In the following subsections, 17 papers dealing with the application of SCT in airline industry were analyzed.

2.1. Fuzzy logic

One of the key contribution of the fuzzy logic could be seen through the treatment of linguistic variables (Sugeno & Tanaka, 1991) and by applying fuzzy rules and fuzzy graphs (Zhu & Xu, 2014). With respect to the airline industry, an extensive usage of FL is recorded in measuring carrier's service quality. Chou, Liu, Huang, Yih and Han (2011) proposed weighted SERVQUAL method. Since human judgments are often vague, they stated that it is more adequate to use linguistic approach for describing the expectation value, perception value and important weight of evaluation criteria. Proposed method was applied on the Taiwanese airline and in the conclusion, recommendations were made for the carrier to improve current service quality. Li, Yu, Pei, Zhao and Tian (2017) developed a hybrid approach based on fuzzy analytic hierarchy process (AHP) and 2-tuple fuzzy linguistic method. The performance of the proposed three-stage model was measured on a three airlines' in-flight service quality in China. As stated by Perçin (2017), evaluation of the service quality in airline industry has become one of the most challenging tasks that could influence carriers' success on a long term basis. Using the combined fuzzy decision-making approach, Perçin proposed a method for evaluation of the service quality performance of airlines in Turkey. Combined approach, included fuzzy DEMATEL for dealing with the interactions among the evaluation criteria, fuzzy analytic network process for considering the interdependence and calculate the relative importance of each criterion and fuzzy VIKOR for evaluation and ranking.

Similar to addressed carriers' service quality, methods for evaluating service quality of an airport towards carriers were proposed. Pabedinskaitė and Akstinaitė (2014) also used SERVQUAL method, to assess the quality of airport services that has been provided to the carriers. Their method resulted in a set of criteria that are taking into account the changes in consumer needs. Evaluation of the service quality provided by the airports was also a subject of a research conducted by Pandey (2016). Author conducted investigation of service quality using the fuzzy multi criteria decision making method in order to identify the scope of improvements. Two airports in Thailand were assessed, and results indicated that the service quality of both airports is satisfactory, and some areas are marked for improvement.

In addition to the service quality evaluations, FL were also applied in other areas. Atli and Kahraman (2012) developed an aircraft maintenance planning system, in which for minimizing aircraft maintenance planning time, they proposed fuzzy critical path algorithm. Schedule planning was covered by Deveci, Demirel and Ahmetoğlu (2017). They proposed the interval type-2 fuzzy TOPSIS multi-criteria decision-making method for identifying the aspects and selecting the new routes. Rezaei, Fahim and Tavasszy (2014) analyzed suppliers within airline retail industry and emphasized the importance of selecting the most suitable supplier(s) that will meet a carrier's specific needs. Since this is a complex process characterized with the involvement of many, sometimes conflicting, qualitative and quantitative criteria, authors proposed a fuzzy AHP.

2.2. Neural Networks

A significant organizational and technological advantages are offered by neural networks within the decision making process (Aiken & Bsat, 1999). NN could be very useful with the imprecise and data with nonlinear relationship, and when exact model don't exist or it is poorly defined. When it comes to the airline industry, an extensive usage of NN is present in forecasting passenger flight demand. One of the earliest application in this field is proposed by Nam and Schaefer (1995). They highlighted forecasting passenger demand as crucial and necessary for carrier when making decision regarding seats allocation, hiring additional staff during the summer months, or even when ordering materials that have long delivery lead times. Authors also expressed their suspicion that the appropriate statistical technique will provide the best results. Thus, they proposed NN to be applied and included in the forecasting process. Chikr-El-Mezouar and Mohamed Hassan Gabr (2011) proposed iterated neural network models for time series analysis and performed validation on the two time series datasets - airline data and sunspot data. Comparing with the Box-Jenkins ARIMA model, NN gave slightly better results. Similar, Weatherford, Gentry and Wilamowski (2003) proposed NN for forecasting passenger demand and compared results with the traditional forecasting techniques - moving averages, exponential smoothing and regression. Results indicated that even basic NN structures provided better forecasts results.

The application of NN in the forecasting passenger flight demand is evident, but it is not limited to only that field. Luxhoj, Williams and Shyur (1997) developed NN model for prediction of the inspection profiles for aging aircrafts issue. The aim of the NN was to provide the number of abnormal and potentially unsafe conditions in aircraft and/or aircraft components/equipment that carrier could expect. Performance of the proposed NN model was tested against the performance of regression based model, and both models provided good prediction results. A more complex neural network model was applied by Sun, Brauner and Hormby (1998) to help in the decision making process within the carrier's revenue management system. Their findings implied that a significant improvement in accuracy can be achieved by applying NN.

2.3. Genetic algorithms and case based reasoning

A recent research conducted by Demirel and Deveci (2017) is proposing the application of genetic algorithm (GA) variants in the crew pairing process. Main objective of the GA is to generate a combination of crew pairings that will have minimal cost, will cover all flight legs and meet legal criteria. Similar, Kotecha, Sanghani and Gambhava (2004) proposed GA for solving the carriers' crew pairing problem. They added new cost-based uniform crossover (CUC) to the GA in order to solve set partitioning problem efficiently. Combined GA and CUC model was tested using the 28 real-world airline crew scheduling problems and promising results were obtained. Chiu, Chiu and Hsu (2004) proposed the usage of GA in the combination of case based reasoning (CBR) in the aircraft maintenance process. Objective of the proposed machine learning method is to retrieve similar cases for Boeing 747-400, and GA was applied for determining the dynamic weights and to introduce much needed non-similarity functions. In order to enhance the performance of the seat inventory management system, Chang, Hsieh, Yeh and Liu (2006) proposed a CBR seat allocation system in the combination with the dynamic probability method. Using the large carrier data, new combined system provided better results from the first-come first-served method that was currently applied.

3. APPLICATION OF STATISTICAL TECHNIQUES IN AIRLINE INDUSTRY

Processing a large amounts of data, using one of the ST require a significant amount of time and a precisely formulated analytical model. Considering a problem in which these conditions are met, ST could provide excellent results in various decision making processes. Among many techniques that could be categorized here, it can be said that time series and statistical analyses are frequently used approaches within the airline industry. In addition, other ST were also considered - operational research, stochastic programming and others. In the following subsections, 25 papers dealing with the application of ST in airline industry were analyzed.

3.1. Time series analysis

Time series analysis is widely applied ST in airline industry for forecasting passenger flight demand. One of the earliest research was conducted by Riddington (1987), who emphasized the financial benefits that carrier will achieve if forecasting accuracy is increased. Riddington proposed ARIMA model with the combination of cash management process in order to increase accuracy in predicting passenger flight demand. Research examined the effect of forecasting accuracy using the 'safety stock' approach and cash-management policy. Based on the obtained results, Riddington concluded that "*far greater returns can be achieved by adopting, in financial areas, approaches common in planning physical inventories*".

Forecasting method that combines time series analysis with additional approach was proposed by Benitez, Paredes, Lodewijks and Nabais (2013). With the modified Grey model authors introduced new aspect of time-varying coefficients which enabled recent data within database to be more influential. Solution has been tested on approximately 18000 routes from airport origin to airport destination, which is equal to 5857 routes, operated by different airlines, from city origin to city destination. Results indicated that modified Grey model worked properly for all airports and connections. To identify passengers demand trend, Tsui, Balli, Gilbey and Gow (2014) proposed a combination of two ARIMA models - the Box-Jenkins seasonal ARIMA (SARIMA) and the ARIMAX. Proposed solution was tested using the data of the Hong Kong airport. Different monthly time series were used for testing. SARIMA models were tested using the monthly time series between January 1993 and November 2010 and ARIMAX models were applied on the periods of January 2001 to November 2010. As concluded, even for different forecasting periods, both models provided accurate forecasting results with low MAPE and RMSE values.

3.2. Statistical analysis

Statistical analysis found its place within the revenue management area in airline industry. Various methods and solutions were created with the aim to optimize inventory, minimize the worst case regret, and forecast number of seats that carrier should allow to be overbooked. As explained by Somboon and Amaruchkul

(2017), maximization of profit could be achieved by seat inventory control and overbooking (accept number of reservations greater than plain capacity to compensate late cancellations and no-shows). Authors developed two-class overbooking model using the show-up probability, and conduct testing on a real life data. Based on the findings, they concluded that the profit is higher if overbooking limits are included.

To optimize inventory capacity, Chen, Günther and Johnson (2003) proposed optimal yield management policies that are considering statistical learning approach. As emphasized, a good yield management policy could be crucial to the carrier, since it allocates airplane seat capacity to various fare classes and maximizes revenue. Another capacity optimization method was proposed by Amaruchkul and Sae-Lim (2011). Their overbooking models comprised of three show-up rate distributions - normal, beta and deterministic. For testing and comparison purposes, binomial model was used as a benchmark. Based on the obtained results, model with beta show-up rate performed best. Lan, Ball, Karaesmen, Zhang and Liu (2015) developed a simultaneous overbooking model that minimizes the worst case regret. As important factor in airline network management area, Grammig, Hujer and Scheidler (2005) highlighted forecasting passenger demand. Thus, they introduced a multinomial probit specification model for forecasting number of passengers and tested it on a real airline booking data.

3.3. Other statistical techniques

One of the earliest researches of the booking problem with multiple fare classes was conducted by Thompson (1961). Later, Rothstein (1984) analyzed the same problem in order to emphasize the operational research techniques that carriers applied. After 60's and early 80's, this field gets more "deserved" attention from a both researchers and practitioners. Belobaba (1989) proposed a probabilistic decision model to be implemented as a part of carrier's automated booking limit system. Smith, Leimkuhler and Darrow (1992) analyzed multiple models for revenue management in airline industry, and Robinson (1995) proposed probabilistic decision making model to set booking limits on future flights (seat inventory utilization). Van Ryzin and McGill (2000) recommended a simple approach based on adaptive algorithm and stochastic approximation theory to tackle the same problem - seat utilization. Similarly, other researchers proposed solutions with stochastic programming technique (Ahmed & Poojari, 2008; Gu & Zhu, 2016).All efforts towards the seat utilization should lead towards financial results. To measure airline financial performance, Weatherford and Belobaba (2002) proposed simulation analysis based on heuristic decision rule model. The same effort was made by Boyd and Bilegan (2003) who concluded that seat inventory utilization mechanisms are arguably the most important factors for carrier for achieving revenue. Fan and Wang (2013) even included risk and discount in the seat control model using the Markov decision process. To maximize revenue, another group of authors (Huang, Ge, Zhang & Xu, 2013) also used Markov decision process approach and applied on parallel flights with transference. As demand for flights increased progressively, focus slightly shifted from seat optimization to forecasting passenger flight demand. Under the limited demand information, Lan, Gao, Ball and Karaesmen (2008) proposed a new static and dynamic booking control policies. Filder, Wei and Ismail (2011) observed existing forecasting econometric models and evaluated their forecasting performance using multiple error measures. Zeng and Li (2015) analyzed passenger seat choice behavior and suggested overbooking policies to be applied. To determine the level of overbooking, the efficient way is to forecast no show, as suggested by several authors (Fildes, Nikolopoulos, Crone & Syntetos, 2008; Kunnumkal, Talluri & Topaloglu,2012).

4. NUMERICAL ANALYSIS

This section represents the numerical analysis of the literature review. Next figures represent analyzed papers by year and technique group.

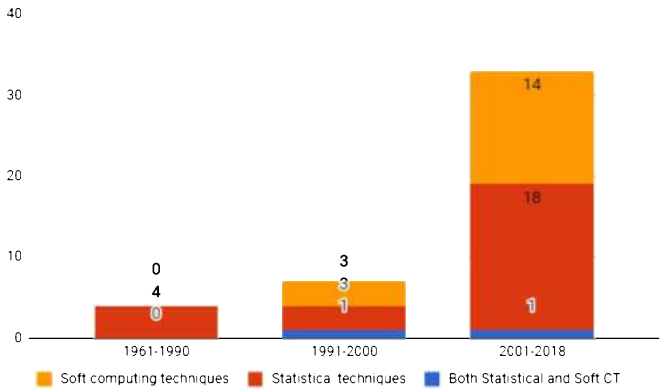

Figure 1: Analyzed papers by year and technique group

Among the total of 44 papers, 17 (38,6%) are covering SCT, 25 (56,8%) are covering ST and 2 (4,5%) are covering combination of both. Publishing years are grouped into three periods, based on the interests in the application of various techniques within the airline industry: (1) 1961-1990, early start; (2) 1991-2000, slow expansion; and (3) 2001-2018, progressive increase of interest. This can also be confirmed by observing the number of papers found and analyzed in those periods. This is not a finite number of papers, but it can definitely serve as a representative example how application of various techniques in solving airline industry issues moved through time. Next figure shows the methods proposed and analyzed in papers.

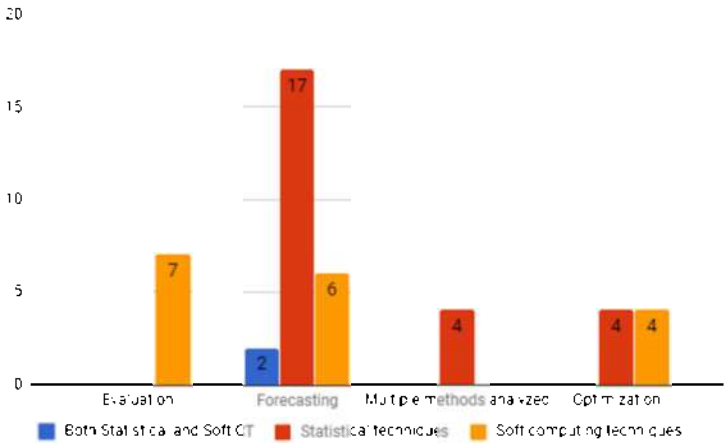

Figure 2: Analyzed papers by methods covered and technique group

Majority of papers are proposing a forecasting method (25) with an extensive usage of ST. In terms of the evaluation methods, a primary role of SCT is evident (7), which is opposite when it comes to papers that analysed multiple methods (4). For the optimization, equal number of statistical and soft computing techniques is captured. Next figure shows the business processes/operations within airline industry that are covered in papers.

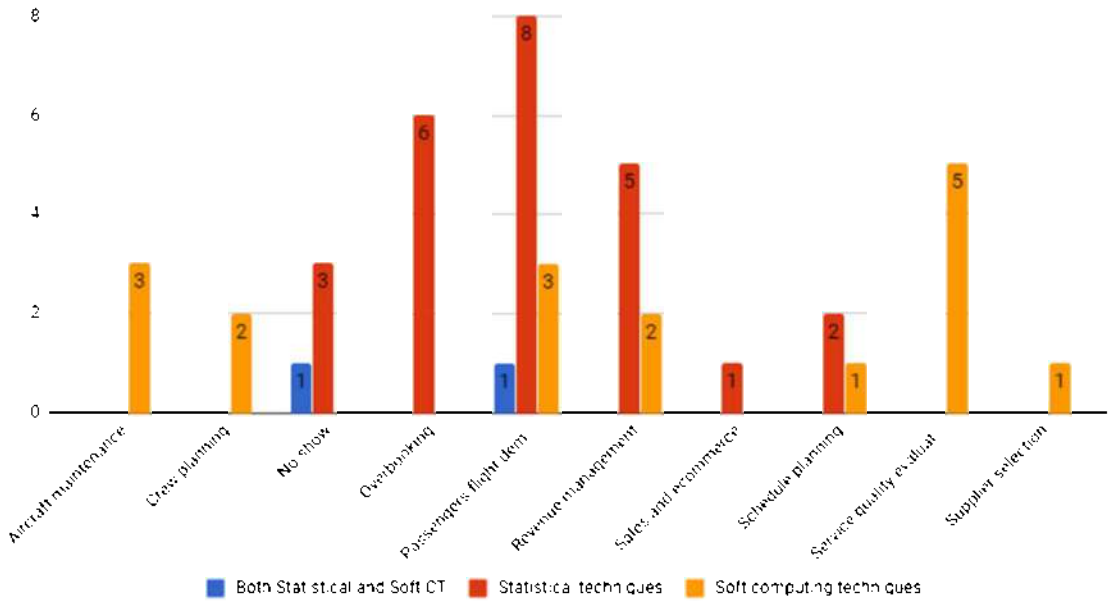

Figure 3: Analyzed papers by business processes/operations covered and technique group

The majority of analyzed papers are considering passenger flight demand forecasting (12), and among others, next business processes/operations are highlighted: seat utilization as a part of revenue management (7), overbooking (6), Service quality evaluation (5) and no show (4).

5. CONCLUSION

Complexity of business processes and operations, and the need for processing large amounts of data, made airline companies an interesting field for the application of computer techniques. Depending on the data, presence of vagueness, uncertainty and model existence, statistical and soft computing techniques could be applied in various decision making processes within airline industry.

Aim of this paper is to provide the analysis of the literature covering the usage of both statistical and soft computing techniques for solving issues and challenges in airline industry. For the purpose of this literature review, papers from various scientific journals were used. Analysis covered three stages: initial analysis (focus on publishing year and techniques), brief analysis of the proposed methods and identification of operations/business processes. Based on the initial analysis, it can be said that the airline industry is receiving a lot of attention nowadays when it comes to the application of SCT. A majority of founded and analyzed papers are covering a period of 2001-2018, and just few of them could be found in earlier periods. More than half of the papers are proposing a forecasting method (25) with an extensive usage of statistical techniques. Passenger flight demand forecasting is still one of the most interesting topics (12), as well as inventory seat utilization as a part of revenue management (7).

Based on the analysis, it can be concluded that there is still a lot of opportunity for the application of SCT, especially when it comes to the passenger demand, overbooking and no show forecasting. Although this research is not final and certainly not covering all papers that are dealing with the application of SCT and ST in airline industry, it could be used as a guide for additional researches and reviews.

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THE IMPACT OF LOW COST CARRIER ON COMPETITION IN LONG HAUL MARKET: LONDON - NEW YORK ROUTE

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Abstract: *The introduction of low cost model into long-haul service has been a challenging task which is proved to be successful for several carriers across the globe. Norwegian Air Shuttle has been the pioneering carrier in Europe that adopted the low-cost model in long-haul market mainly focusing its network on high density transatlantic routes from Scandinavian cities as well as from United Kingdom. This paper performs analysis on some aspects of competition in the route that connects two metropolitan cities London and New York. By employing descriptive statistics, the comprehensive analysis on certain competition indices such as market share, market concentration index (HHI) and price comparison of fares has been performed in this paper. The findings approve that Norwegian expansion at London Gatwick has became a serious threat to well established carrier on this route, particularly British Airways that put substantial effort to create counter strategy to efficiently combat the rival.*

Keywords*: Low cost long haul model, Norwegian Air Shuttle, transatlantic route, British Airways, secondary airport*

1. INTRODUCTION

The Deregulation Act stipulated in 1978 in United States has become a milestone for revolutionary changes bringing the number of innovations. The most important among them are regulatory changes that certainly shape the market structure allowing the entrance of new players on the market and providing the level playing field for all participants. The wave of changes was riding at phenomenal speed serving as an impetus to other regions, specifically Europe, to liberalize its market across national borders. The emergence of low-cost business model can be perceived as a “pure fruit” of market liberalization (Francis et al., 2006) in Europe that permanently alter the landscape of competition. In such new circumstances, the full-service network carriers (FSNCs) initially protected by the state, coped the severe competitive pressure induced by low-cost carriers (LCC) and their business model that aims at keeping the costs as lower as possible. Although the LCCs organize their network as point-to-point system opposed to FSNCs that highly rely on hub-and-spoke network concept, they still have a large portion of overlapping market in which a fierce battle is evident among them.

Thanked to its simple operating model with no-frill product (Cento, 2009) and their network focused on connecting intra-European destinations , the LCCs successfully survived the crisis occurred as an outcome of terrorist attack in 2001. Moreover, the emergence of LCCs with their flights operated from secondary, less congested airport (in the vicinity of primary airports) become a serious threat to FSNCs that operate their flights from primary (hub) airports. In that sense, the competition must be light at a broader context taking into account not only competition among competitors on specific airport pairs, but also between city pairs or even region levels.

According to Dobruszkes (2006) who used exhaustive data from 2004, the LCCs contained 18% of regular intra-European seats at the time, and that these seats were limited almost exclusively to Western Europe (98%). In the following years, the LCCs put substantial effort to diversify its networks towards markets of Central and Eastern Europe (Dobruszkes, 2009). Finally, in recent years some European carriers have attempted to incorporate the low-cost business concept into long-haul markets mainly by connecting large European cities with large metropolis in North America. The aim of this paper is to investigate some aspects of competition on long-haul route where low-cost carrier offer its service in addition to several full-service carriers that are traditionally dominant in these markets.

The paper is divided as follows. After a brief Introduction, the Section 2 provides literature review on long-haul low cost business model. Section 3 outlines some essential information on long-haul low cost model that emerge as a new business concept by exploring Norwegian Air Shuttle as a representative of the airline group that successfully applies this business model. The Section 4 highlights some aspects of competition between on the route between London and New York characterized by the presence of both LCC and FSNCs. In this section, several measures that represent some aspect of competition will be calculated such

as market share and HHI index. Additionally, the price competitiveness of airlines on this route will be given through comparison of air fares obtained by Internet search. Finally, Section 5 concludes the paper.

2. LITERATURE REVIEW

The long-haul low cost business model has been relatively novel in airline industry. In recent few years, abundant of literature investigate the viability of such concept that require the radical enhancement in order to be profitable. Bearing in mind that large number of airlines adhered to this model in recent past, the investigation of cost and revenue aspect of their business model become essential factor for their sustainability on the dynamic competitive market. Low cost business model has been reserved for short and medium-haul routes for years with 50-60% cost savings compared to FSNCs, the advantage that is impossible to achieve on long-haul routes.

The viability of low cost business concept into long-haul service has raised the fierce debate among scholars and airline experts who broadly investigated the financial aspects of such model. Morrell (2008) was among the first who examined the applicability of well-established LCC business model advantages into long-haul service. The author took a rather pessimistic approach and questioned the problem of generating demand (due to the lack of connecting passengers) to support the existence of hub by-pass service. The author also claimed that lowering long-haul fares significantly from current fares is not feasible for LCCs. On the other hand, Daft and Albers (2012) held optimistic side emphasizing the importance of revenue consideration as a key factor of feasible existence of LCC long-haul service. The authors found that ancillary revenues can significantly contribute to airline's profitability. The recent study conducted by De Poret et al. (2015) who performed a detailed financial assessment of low-cost operation on the transatlantic market leads to similar conclusions. Namely, the authors revealed that higher seating densities, higher cargo revenues and additional ancillary revenues can ensure the economic viability of long-haul LCC operation

Despite previous work that focused on revenue side of long-haul low cost model, Soyk et al. (2017) focused solely on evaluation of cost differences between 37 airlines that operates transatlantic routes, among which there are those who adopt low-cost business model. The authors found that emerging long-haul LCC carriers within derived cluster achieved 33% lower unit costs compared to legacy hub carriers, of which 24 percentage points were evaluated as sustainable. Finally, in the contrast to the previous researches, Soyk et al. (2018) found that the emerging North Atlantic long-haul LCCs do not have a revenue disadvantage compared to FSNCs particularly on dense routes approved by the application of new metric proposed.

In addition to already well-established European long-haul carriers, one can anticipate that prominent LCCs such as Ryanair could pave the way for successful acquiring of long-haul operation in the future, the idea which is thoroughly investigated in van den Hoek (2017). Having in mind that there is a potential of between 20 and 113 out of 442 routes of up to 12,000 km that do not have non-stop flight to and from Europe (Wilken et al., 2016) combined to the tendency of LCCs to enter the charter airline long-haul territory (Rodríguez and O'Connell, 2017), the development of future network of LCC long-haul carriers will be challenging task.

3. THE EVOLUTION OF NORWEGIAN LONG HAUL LOW COST BUSINESS MODEL

As stated in Wensveen and Leick (2009), the concept of low-cost long haul flying dated back to 1977 when Skytrain, the company founded by Freddie Laker, operated between New York and London offering airfares substantially lower than its legacy competitors. However, it took several decades that this concept becomes well established in airline industry. The current iteration of the long haul low cost model has been around for a decade, with Jetstar (2006) and AirAsia X (2007) the initial pioneers (CAPA, 2017). Concerning European floor, Norwegian Airlines was the pioneering company that launched its first long haul flight in 2013 between Oslo and New York and shortly after between Stockholm and New York. In addition to these transatlantic flights from Scandinavia (including Copenhagen), the carrier introduced long-haul links from three large European cities: London (2014), Paris (2016) and Barcelona (2017). By the end of October 2017, the airline long haul network encompassed 26 destinations and 28 routes that place it as a largest long haul low cost operator in terms of network size and in the second place in terms of weekly seats (Table 1).

However, this network expansion is supported by the strategy of exploit new Boeing 787-9 with 294 seats onboard. The long-haul strategy for the 787 fleet currently highly relies on dense routes into popular leisure markets that can easily be stimulated by low-fares. These routes include New York (via JFK and now Newark), Los Angeles, San Francisco (via Oakland) and Miami (via Fort Lauderdale).

As abovementioned, Norwegian put substantial effort to position itself on U.K. market since 2014 by operating its transatlantic flights from the less congested airport in London airports system, London Gatwick (LGW), which provides more flexibility in terms of airport charges as well as slots allocations. Table 2

outlines the characteristics of six competing routes between Norwegian and legacy carriers British Airways which traditionally been dominant in these markets. On the other hand, British Airways flights are mainly concentrated at London Heathrow (LHR), although it directly competes with Norwegian on San Francisco and Orlando routes from London Gatwick.

Table 1: Long haul low cost operations ranked by weekly seat capacity (2nd -8th October 2017)

Rank	Airline	Weekly seats	Number of routes
1.	AirAsiaX	133458	21
2.	Norwegian	87337	48
3.	Scoot	69144	18
4.	Jetstar Airways	46900	14
5.	Air Canada rouge	37923	20
6.	Thai AirAsia X	31668	4
7.	NekScoot	24070	6
8.	Cebu Pacific	13080	5
9.	Azul	12466	4
10.	Eurowings	11780	12

Source: CAPA (2017)

However, not all routes presented are characterized by the same level of competition between those two airlines. It is evident that competition will be intensified when there is overlapping characteristics of service offered. However, the market share on specific routes will be highly affected by passenger's personal preferential towards. The competition will be certainly intensified when both carriers offer their flights with similar schedule (the same day and approximately the similar departure times) such as the case with New York and Los Angeles routes. On the other hand, Norwegian operates Miami route only twice a week, while the same route with one stopover is served by British Airways in the code share with its partner American Airlines every day with high frequency accounting up to ten daily flights. Since direct flight is not offered by British Airways, it is reasonable to expect that certain amount of passengers will be attracted by Norwegian direct flight if the timetable fits specific passenger's requirement.

Table 2: The characteristics of the competing transatlantic routes between Norwegian Air Shuttle (DY) and British Airways (BA) in 2017/2018 winter timetable

Destination airport	Origin airport	Days of operation	Frequency	Schedule departure
New York (JFK Airport)				
DY	London Gatwick	1234567	2 daily flights	06:00; 17:10
BA	London Heathrow	1234567	13 daily flights	From 08:25 to 19:50
BA	London Gatwick	1234567	1 daily flight	16:45
Los Angeles (LAX Airport)				
DY	London Gatwick	1234567	1 daily flight	12:50
BA	London Heathrow	1234567	5 daily flights	From 10:35 to 15:30
Boston (BOS Airport)				
DY	London Gatwick	1234567	1 daily flight	16:00 (4, 7); 16:20 (1,3); 16:50 (5)
BA	London Heathrow	1234567	4 daily flights	From 11:15 to 19:10
Fort Lauderdale-Miami (FLL Airport)				
DY	London Gatwick	1234567	1 daily flight	16:20 (1); 14:55 (3,5); 14:50 (7)
BA	London Gatwick	1234567	1 daily flight	09:05 (1, 4); 09:10 (6)
Florida Orlando (MCO Airport)				
DY	London Gatwick	1234567	1 daily flight	14:05
BA	London Gatwick	1234567	1 daily flight	11:35 (1,2,3); 11:00 (7)
		1234567	2 daily flights	11:35; 13:20
San Francisco – Oakland (OAK Airport)				
DY	London Gatwick	1234567	1 daily flight	12:55 (2, 6); 12:45 (4); 14:20 (7)
BA	London Gatwick	1234567	1 daily flight	08:45 (1); 10:10 (3); 11:00 (6)

It is evident that Norwegian's less-price based strategy aims at diverting the portion of those price sensitive passengers away from legacy carriers, and to secure some portion of business traffic in order to increase its yield. For example, on New York routes, traditionally perceived as the most popular touristic market, the Norwegian's average fare is approximately 30% less than its rival British Airways price. However, British Airways offers fourteen daily flights spread across entire day at LHR compared to one daily flight offered by

Norwegian. With its well-established flights to New York, British Airways can capture the portion of passengers that highly regards early departure times. With its late afternoon flight, Norwegian could count on the price sensitive segment of passengers who are willing to arrive late afternoon in New York and it is likely that certain portion of these passengers previously used the legacy carrier's flight. Afternoon departure times are generally characteristics for all Norwegian transatlantic routes from London Gatwick, as it is probably seen as a good strategy that provides the balance between different passenger segments' requirements.

The next section provides the comprehensive assessment of different aspects of competition that exists or has existed in the high-density market such as those that connects two metropolitan cities London and New York. The influence of Norwegian on legacy carriers, specifically British Airways as a dominant player in London-New York market, will be thoroughly discussed through traffic and capacity statistics.

4. THE OUTLOOK OF LONDON – NEW YORK ROUTE

The London New York route has always been perceived as one of the high density route in the world. Two metropolises have historically had important links that catalyze the mobility of people, trade and service. Moreover, London stands out as an important gateway that consolidates a large portion of traffic from different part of Europe, Africa and Asia that terminate in New York area. Both London and New York are served by multiple airport system, which allow the large number of possible connections between two cities Table 3 provides the list of airports that serves these two metropolitan cities along with their respective number of passengers.

Table 3: Airports serving the metropolitan areas of London and New York (Port Authority, 2015)

City	Airports	IATA code	Number of passengers in 2015 (mil.)
London Airport System	London Heathrow	LHR	74.9
	London Gatwick	LGW	40.3
	London Stansted	STN	22.5
	London Luton	LTN	12.3
	London City	LCY	4.3
New York metropolitan area	John F. Kennedy International	JFK	56.8
	Newark Liberty International	EWR	37.5
	LaGuardia Airport	LGA	28.4

For example, London is served by five airports among which London Heathrow is the largest one and serves as a hub of full-service carrier British Airways. On the other hand, New York metropolitan area is served by three airports, among which JFK is the largest and most important one from which large number of intercontinental flights have been performed. In other words, the same city pair (i.e. London-New York) can be realized throughout different airport pairs offering the potential passengers possibility to make selection between different airports as well as between different airlines.

4.1. Number of passengers and airlines' market share

In order to have better insight into the different degree of competition, Table 4 outlines the characteristics of three routes (airport pairs) that serve these two metropolitan areas in 2016. The data on the number of passengers have been retrieved from U.S. DoT's T-100 database provided by Bureau of Transportation Statistics that allows the free access.

Table 4: Some characteristics of London –New York route in 2016

Airport pairs	Airlines operated	Number of passengers	Total number of passengers (% of all pax)	Market share per route per airline
LHR-JFK	British Airways (BA)	651 397	1 434 051 (69.9%)	45.4%
	Virgin Atlantic (VS)	406 229		28.3%
	American Airlines (AA)	238 756		16.6%
	Delta Air Lines (DL)	135 282		9.4%
	Kuwait Airways (KU)	2 387		0.2%
LGW-JFK	Norwegian Air Shuttle (DY)	112 469	168 480 (8.2%)	66.8%
	British Airways (BA)	56 011		33.2%
LHR-EWR	United Airlines (UA)	232 118	449 963 (21.9%)	51.6%
	British Airways (BA)	134 599		29.9%
	Virgin Atlantic (VS)	74 050		16.5%
	Air India (AI)	9 176		2.0%

Source: Bureau of Transportation Statistics (2018)

As seen from Table 4, London – New York route was operated by two European carriers (BA and DY), four American carriers (VS, AA, UA, DL), one Middle Eastern carrier (KU) and one Asian carrier (AI). The high density route among these three options is certainly one that connects two major airports (LHR and JFK) within the cities. This route encompassed the market share of 69.9% in terms of passengers that commenced their trip at London. BA is dominant carrier on this route accounting for 45.4% of all passengers transported and followed by three American carriers – VS, AA and DL which market share accounts for 28.3%, 16.6% and 9.4% respectively. The second dense route is one that connects LHR with EWR, the second largest airport in New York area, with market share of almost 22%. Similar to LHR-JFK route, this route is operated by BA as a dominant player (51.6%), two American carriers that combined have a market share of almost 50% and Air India with only 2% of share. Finally, the route that connects second largest airport (LGW) and major airport in New York (JFK) is characterized by the presence of low-cost carrier DY that started its operation in the third quarter of 2014. In order to reduce the competitive pressure induced by low fares offered by DY, BA has recently announced its flights to JFK from LGW. However, the market share of BA is significantly lower compared to DY that held almost 70% of share and transported more than hundred thousand passengers in 2016.

Fig. 1 depicts the historical trends in terms of number of passengers on the route London New York including the traffic on all three possible airport cities pairs. It was felt that 2010 was an appropriate start year because this period coincides with recovery of airline industry after the severe world economic crisis occurred in 2008.

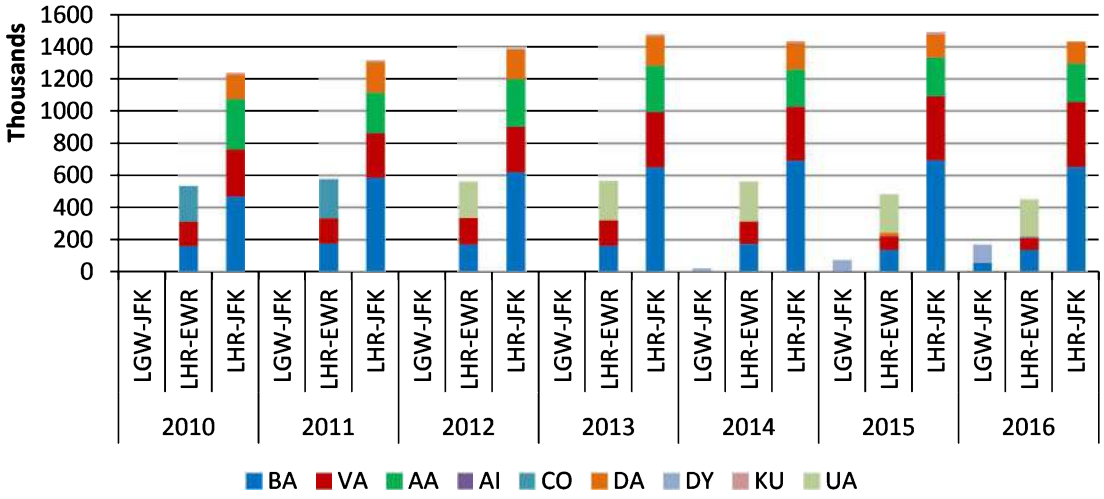

Figure 1: Number of passengers at three routes connecting London and New York

As observed from Fig. 1, the number of passengers from London Heathrow to New York JFK had seen the steady growth in the period from 2010 to 2013. Afterwards, the number of passengers fluctuated around 1.45 million reaching its peak in 2015 when almost 1.5 million people were transported between these two points. Among five airlines operated these routes, it is evident that BA has the highest market share. BA is currently the most dominant carrier on this route with market share encompassing approximately 45% of total passengers carried, followed by three American carriers: VA, AA and DA. However, not all of them have been the real competitors. For example, AA offers some portion of its flight in the cooperation with BA through code-share agreements, while other portion operates independently. Over the time horizon, VA has radically increased its market from 23.7% in 2010 to 28.3%, whereas AA reduced its share from 25.2% in 2010 to 16.6% in 2016. Finally, Kuwait Airways has been present on this route during the observed period, but its market share is not significant (less than 1%). On the other hand, the number of passengers at LHR-EWR was stable during the period from 2010 to 2014 accounting for around half million passengers with slight decrease in 2015 and 2016. Continental Airlines (CO) was present at this route with significant market share in the past, but it withdrew the market in 2012. Finally, the flights to New York have been introduced from LGW for the first time in 2014 when DY offered its service by affordable prices. Since then, this carrier records the rapid expansion with number of passengers exceeding one hundred thousand in 2016.

4.2. The market concentration of London – New York route

The Herfindahl–Hirschman index (HHI) is defined as the sum of squared market shares of airlines in a market and thereby provides an easily interpretable measure of concentration (Lijesen, 2004). The HHI for specific route can slightly vary depending on the measure used to express the market share and thus it can be calculated by either capacity offered or number of passengers transported. The HHI ranges from the value close to zero, indicating nearly perfect competition to ten thousand, indicating a monopoly. For the purpose of this paper we calculated the value of HHI based on market share expressed through number of

seats (i.e. capacity of aircraft) offered by specific airline. It is worth mentioning that depending on the configuration of the aircraft operated, the values of HHI can slightly differ. As a carrier with the most carried passengers, BA's configuration of two most dominant aircraft type B777 (two version – V1 and V2) and B747 (three versions – V1, V2 and V3) (Table 5) can have impact on the value of HHI. Fig. 2 shows the different value of HHI based on maximum, medium and minimum configuration of aircraft operated this route.

Table 5: British Airways B777 and B747 configuration

	B777			B747		
	B777-200 (V1)	**B777-200 (V2)**	**B777-300**	**B747-400 (V1)**	**B747-400 (V2)**	**B747-400 (V3)**
Standard seats	203	122	185	243	185	145
Recliner seats	24	40	44	36	30	30
Flat bed seats	48	48	56	52	70	86
Open suites	-	14	14	14	14	14
Total	**275**	**224**	**299**	**345**	**299**	**275**

The U.S. Department of Justice considers a market with an HHI of less than 1,500 to be a competitive marketplace, an HHI of 1,500 to 2,500 to be a moderately concentrated marketplace, and an HHI of 2,500 or greater to be a highly concentrated marketplace (Investopedia, 2018). As observed from Fig. 2 the market concentration index ranges from less than 1,600 in 2010 to more than 1,800 in the case of moderate capacity. Thus, the London New York route can be characterized as a route with medium level competition, which is certainly benefit for potential passengers perceived through lower fares and higher level of service.

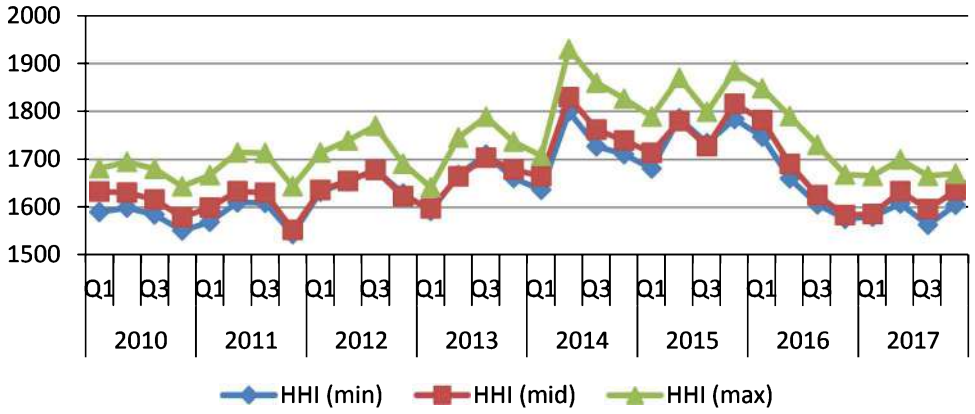

Figure 2: HHI index for different aircraft configuration for London New York route

4.3. Price competitiveness between BA and DY

In order to investigate the price competitiveness of two major rival BA and NY, the fares from both carriers are collected throughout time-horizon starting from fixed points in the time (2nd October) encompassing twelve points in time ranging from 7 days before departures to 6 months (7 observations in total). For each of time point, the average value in economy travel class (the lowest tariff) are calculated and presented in Fig 3.

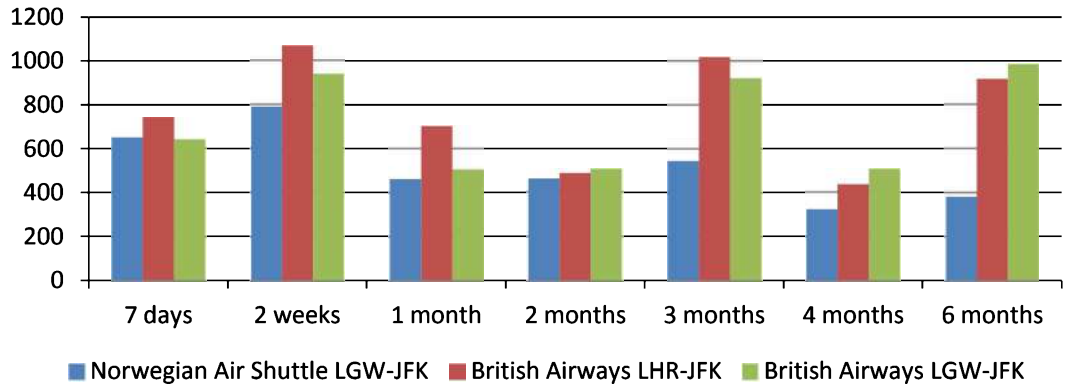

Figure 3: Average fares of BA and DY on routes connecting London and New York (in EUR)

DY average ticket price is even two times lower for this route than that offered by its major competitor BA. This makes the LGW-JFK route appealing to price sensitive passengers. Moreover, the differences in price is

significant enough to seriously harm BA market position, although it still can count on its well established hub-and-spoke network that serves as a "feeder" to these long-haul flights. The evidence of rising competition can be found in British Airways strategy that has been recently announced through "squeezing" 52 seats on its Boeing 777 flights from Gatwick by shrinking seating space (Telegraph, 2016). The configuration of British B777 counts 275 seats in 3 classes, and with additional seats BA services will be more in accordance with Norwegian's B787 with 294 seats onboard. In this way, the airline attempts to reduce its unit cost and to offer even more low fare in order to retain its market position on competitive routes. According to comparative analysis of fares provided by BA from LGW provided in Fig. 3, it seems that BA successfully applied the mentioned strategy.

5. CONLUSION

The long haul routes have been traditionally reserved for full-service carriers that successfully manage to collect a large number of passengers over their hub-and-spoke network system. However, in recent few years, the situation has been radically changed with several low-cost carriers that started to efficiently operate long-haul routes. One of the most successful one among them in Europe was certainly Scandinavian carrier, Norwegian Air Shuttle with its aggressive strategies that aims at diverting a large portion of passengers, particularly those price sensitive, from well-established airlines. The Norwegian routes are still focused on touristic destinations that characterized the high demand during the entire year.

The paper investigates some aspects of competition on London New York route as one of the highest density route in the world. Norwegian initially used the opportunity to solely operate from London Gatwick, less congested airport in London Airport System offering one daily flight and offering the fares which are almost double lower than its major competitor British Airways from London Heathrow. In order to efficiently combat the fierce competition imposed by low-cost rival, British Airways started to operate the flights from the London Gatwick implying the strategy of "squeezing extra seats". In such way, British Airway succeeded to offer lower fares which are highly in line with those offered by Norwegian. However, the introduction of low-cost service in this market stimulating the demand generating the new growth in market that is well matured.

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 (2011–2018).

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MULTIVARIATE APPROACH TO MAKING SPONSORSHIP DECISIONS: THE CASE OF EUROPEAN FOOTBALL LEAGUES

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Abstract: *Sponsorship, as a communication activity, has significantly developed in the last several decades. Although the budgets that the companies are willing to allocate for sponsorship are growing, the sponsor's attitude towards sponsorship and sponsoring events is changing. The decision on which athlete, sports club or competition to sponsor is nowadays a highly important decision which can have a significant impact on the brand image, brand awareness, brand preference, and attitude towards the brand. Therefore, analytical approach should be taken. Herein we suggest a multivariate approach to making sponsorship decisions. The proposed approach was employed on the case of European football leagues: Premier League (United Kingdom), La Liga (Spain), and Ligue 1 (France). We hope the presented research will provide additional insights on differences between the three European football leagues and on the application of multivariate analysis in decision making in sport sponsorship.*

Keywords*: Sport sponsorship, Football, Data analysis, Clustering, Decision making*

1. INTRODUCTION

Sponsorship can be defined as an investment, in cash or products or services, in return for exploitable commercial rights (Smith, Graetz, & Westerbeek, 2008). The possibility of displaying advertisement messages to wider public has attracted the attention of marketing managers to turn to sponsorship as the mean of marketing communication. Sponsorship of sport, arts, and entertainment-related events and competitions has slowly, but surely, become an important part of the marketing mix (Jensen & Cornwell, 2017). According to the International Events Group (2017), companies spent $60.1 billion on sponsorship in 2016, whereas the most common type of sponsorship is sport sponsorship.

With the development of information systems and technology it became possible to use distinct methods of tracking and collecting data from the sport matches. The collected data could later be used by various interest groups: team managers, journalists, data analysts, and of course, the fans (Radojičić, Djokovic, & Jeremić, 2016). The application of statistical and mathematical methods, data visualization, and data mining to the collected data from the pitch to gain information on previous play and predict future results is considered sports analytics (Alamar, 2013). Experts in sport marketing are taking the advantage of the acquired data and the results provided by sports analytics to assess their current marketing activities, but also to predict new ones (Fried & Mumcu, 2017). Namely, the obtained results can help the experts to make the decision which event or talented individual to sponsor.

The big five of the European football are the English Premier League, Spanish La Liga, German Bundesliga, Italian Serie A, and French Ligue 1. In the last several years the Serie A has witness a decline in both results and attendance (Kate Langshaw, 2017; UEFA, 2016), leaving Premier League and La Liga to dominate. In the last four years of the last 15 major European and International major club titles, Spanish clubs have won 14 and English clubs just one. In our analysis, we chose the Premier League, La Liga and Ligue 1. Bundesliga was listed out of the analysis as their league consists of 18 clubs compared to 20 in the chosen three and Serie A was ruled out due to the current decline of the League.

The aim of this paper is to try to assist marketing and brand managers in the process of deciding which football league and football club to sponsor. Namely, using statistical multivariate analysis, we strive to inspect the differences between three leading European football leagues based on seasonal post-match data. The research hypothesis is that there are differences in the football style that these clubs play within their leagues, and that the clubs although from three different leagues can be grouped. The analysis could assist the decision makers to choose the football clubs which play similar style when making their sponsorship mix of clubs and leagues in which they will be present.

The structure of the paper is as follows. Section 2 sees a brief literature review of sport sponsorship and decision making in sponsorship. The research results are elaborated in the next section while we finish the paper with the discussion and the concluding remarks.

2. LITERATURE REVIEW

In the following two subsections we will place our attention on the role of sport sponsorship in the integrated marketing communications of a company and the possible benefits the sponsoring company might gain from such activities. Accordingly, we give an overview of the process of decision making in sponsorship.

2.1. Sport sponsorship

Sport events attract the attention of a large number of spectators and thus are increasingly being broadcast worldwide. As a result of this high media coverage, sport sponsorship takes on an international character, and the budgets allocated for becoming an official sponsor of a global sports event are rising and have no tendency to decline (O'Reilly, Lyberger, McCarthy, Séguin, & Nadeau, 2008). For many world acknowledged brands, sponsorship of sports event plays a central role in their integrated marketing communication (Santomier, 2008).

Sport sponsorship has become the most common form of sponsorship (Quester, 1997). Sports events and sporting competitions have traditionally been given significant support by the sponsors (McCarville & Copeland, 1994). However, the popularity of sport sponsorship has grown significantly in the past century thanks to drastic social changes, i.e. the development of information technologies, the Internet, social media, media, and transport. Namely, the marketing experts saw the possibility to use the attention of spectators during sports events to show them their sponsorship messages. Therefore, sport sponsorship has become a long-term marketing strategy which is used to communicate with a large external and internal audience to gain competitive advantage (Papadimitriou & Apostolopoulou, 2009).

Another major benefit of sponsorship sport events is the presence of heightened emotions. Namely, visitors and viewers of sport competitions are emotionally involved with the game, their club, favourite athlete, or national team (Biscaia, Correia, Rosado, Ross, & Maroco, 2013). Global brands are aware of the emotional impact of sport and utilize it to connect with the consumers (Santomier, 2008). Namely, the best world-class athletes and teams are sponsored by the largest companies in the world under the motto "the best with the best" (Šurbatović, 2014). In this way, companies want their brand to be identified with athletes and teams and want to transfer the positive sports results to their products and services. Therefore, sport sponsorship has become an effective marketing strategy for companies, but at the same time it is an important source of revenue for sports organizations.

2.2. Decision making in sponsorship

Decision making is sponsorship is a topic which is slowly, but surely gaining importance. As the decision on sponsorship activities can impact the brand, the question "whom to sponsor" still remains a challenging practical and academic question (Lee & Ross, 2012).

There are several studies which have employed statistical, data mining, and decision-making techniques in the field of sponsorship. Lee & Ross (2012) employed Analytic Hierarchy Process (AHP) to identify the decision-making factors of sport sponsorship. Their analysis covers sponsors of clubs competing in different sports, therefore providing insights on the importance of factors from different perspectives. Research also shows that AHP could be easily combined with other multiple attribute decision making (MADM) methods such as TOPSIS (Isik, Ozaydin, Burnaz, & Topcu, 2016).

Another interesting approach, although not yet applied in the sphere of sponsorship, is the application of Data envelopment analysis (DEA) and efficiency analysis the efficiency of sports teams. According to the received results of efficiency analysis, managers can choose whether a player should be given more play time or not, the board can decide to decrease or increase player's salary, or sponsors can make a decision which player or team to sponsor. For example, an interesting distance-based approach to efficiency initially suggested by Jeremic et al. (2012) was applied to evaluating efficiency of basketball players (Radovanović, Radojičić, Jeremić, & Savić, 2013).

Multivariate statistical analyses were also employed to assess the effectiveness of sponsorship, which can be used in decision making in sponsorship. For example, linear regression was employed to model the accuracy and certainty of brand recognition (Olson & Mathias Thjømøe, 2009). On the other side, multivariate statistical analyses were used in sports analytics. Multiple linear regression was used to calculate the efficiency of football players in the UEFA Champions League (Radojičić, Djokovic & Jemremić,

2016), while cluster analysis and Principal component analysis (PCA) were used to assess players of Real Madrid and Barcelona (Radojičić, Milenković, Totić, Bijelić, Djoković, 2013).

The presented literature review shows that the field of application of statistical and mathematical methods on data related to sport is developing and that the obtained results can be of use for decision making in sponsorship.

3. RESEARCH RESULTS

In the proposed research we collected the data on the Premier League, La Liga, and Ligue 1 for the season 2016/17. The data was collected from the official web sites of the three leagues which provide aggregate statistics (Soccer Stats, 2018). The chosen indicators which we observed in the analysis can be grouped as follows:

- Attractiveness of the game – Measured through indicators *Goals for, Number of assists, Total shots, Shots on goal, Goals scored from direct play*
- Roughness of the game – Measured through indicators *Number of yellow cards, Number of Red cards, Number of fouls against.*

We chose the indicators of attractiveness and roughness of the game as we believe these features of the game can attract or turn away football fans and spectators. Accordingly, we consider that these features might be of interest for sponsors, so as they could choose the league and/or club which will attract the most viewers.

3.1. Comparison of the three football leagues

In this part of our analysis we aimed to inspect whether there is statistically significant difference between the values of the chosen eight indicators within the three leagues. The first step was to determine whether the observed indicators are normally distributed or not. The Kolmogorov-Smirnov test showed that none of the indicators is Normally distributed, therefore, in the next steps of the analysis we used nonparametric tests.

When it comes to the comparison of attractiveness indicators between the three leagues the Kruskal-Wallis test indicates that there is no statistically significant difference. This means that the spectator or viewer of the French League can expect to enjoy the same attractiveness of the game as the spectator or viewer of the Spanish or English league. There is no statistically significant difference between the total number of goals for ($KW=2.483$, $p>0.05$) and for the number of assists ($KW=0.346$, $p>0.05$). Also, goals are scored after a similar number of shots on goal ($KW=4.159$, $p>0.05$) and total shots ($KW=2.946$, $p>0.05$). In the three observed leagues, there is no difference in the number of goals scored from direct play ($KW=4.601$, $p>0.05$). All this could lead to an important conclusion that the French league, which might not be financially and marketing supported as English or the Spanish League, is not missing out on-field excitement. Namely, Premier League clubs' revenue in 2016 was €110m per club, compared to €44m in La Liga, and €21m in Ligue 1 (UEFA, 2016).

Analysis of the roughness indicators shows there is difference between the leagues. It has been established that there is statistically significant difference: *Number of yellow cards* ($KW=32.256$, $p<0.01$), *Number of Red cards* ($KW=16.559$, $p<0.01$), and *Number of fouls against* ($KW=26.051$, $p<0.01$). All indicators are related to the subjective factor reflected through referees, because they are the ones who assess whether a particular start or duel will be defined as a foul and whether it will be sanctioned by a card. As there has been noted that there is difference between the three leagues in terms of roughness, we examined more closely the Medians of the three indicators per league. The results are given in Table 1.

Table 1: Median of the chosen three indicators of roughness per three observed leagues

League	**Number of yellow cards**	**Number of red cards**	**Number of fouls**
Premier League	71.5	2.0	430.5
La Liga	97.5	4.0	537.5
Ligue 1	65.0	4.0	470.0

According to the median, the most yellow cards are awarded in the Spanish league. However, the situation is different when the number of red cards is observed. In La Liga the red cards are awarded more often, and the same accounts for France. The results of French League have the lowest median of *Number of yellow cards* and the highest median of *Number of red cards.* This could indicate that style of the League 1 is rougher with more tackles which are sanctioned. On the other hand, this could indicate that the referees in the league do not allow rough play. As far as the number of fouls is concerned, they are most often awarded in the Spanish league, which has the median of 537.5. This result could be interpreted as that the referee

organization in Spain suggests their referees to protect the players from possible injury and stop any signs of dangerous play. It is presumed, that such a decision has been made because La Liga, especially Real Madrid and Barcelona, has the best and the most expensive players of today's. Namely, their injury and absence from the field would mean a drawback for the team. On the other hand, it would also be a financial loss for the entire league reflected through marketing activities and sponsorship contracts, and primarily by selling broadcast rights. The least fouls are awarded in Premier League, which means that their referees allow a rougher game. It can also be concluded that the Premier League is therefore the most dynamic of the three leagues as it has the least stoppage time during matches.

To additionally inspect the relationship between the chosen three indicators, we conducted the correlation analysis per league (Table 2). It can be observed that there is high positive correlation between fouls and yellow cards over all leagues, which ranges from 0.702 (Premier League) to 0.619 (La Liga). Such a result indicates that a large number of fouls is accompanied by a larger number of yellow cards. Interestingly, the correlation between the number of yellow and red cards is only observed in the Spanish league. The relationship is such that a greater number of yellow cards leads to a greater possibility of obtaining red card. This indicates that in the French and the English league there is a greater possibility of getting a direct red card. The Pearson's correlation coefficients show that there is no statistically significant relationship between number of fouls and red cards, which may indicate that most red cards are not received after two fouls, whereas that players after the objection or inappropriate tackles often earn the most severe warning.

Table 2: Correlation analysis between the chosen three indicators of roughness per three leagues

League		**Number of yellow cards**	**Number of red cards**	**Number of fouls**
Premier League	**Number of yellow cards**	1	0.226	0.702**
	Number of red cards	0.226	1	-0.026
La Liga	**Number of yellow cards**	1	0.506*	0.619**
	Number of red cards	0.506*	1	0.168
Ligue 1	**Number of yellow cards**	1	0.382	0.646**
	Number of red cards	0.382	1	-0.045

Note: *p<0.05, **p<0.01

3.2. Clustering clubs from the three football leagues

The second direction of our research was to cluster clubs of the three observed leagues according to "roughness" and "attractiveness". To conduct the analysis, we performed the K-means clustering (Hartigan & Wong, 1979). K-means clustering algorithm partitions n observations into k predetermined number of clusters in which each observation belongs to the cluster with the nearest mean, serving as the centre of the cluster. Therefore, on our analysis, the cluster centre is a fictive club. To cluster clubs according to "roughness" we used *Number of yellow cards, Number of red cards,* and *Number of fouls.* We retained three clusters which we named Rough, Medium rough, and Soft clubs.

The distance between the cluster Rough clubs and Medium rough clubs is 74.682, between Rough clubs and Soft clubs 151.281, and between Medium rough and Soft clubs 77.336. The cluster centres are presented in Table 3. It can be observed that the clubs in the cluster Rough clubs tend to receive more yellow cards, red cards, and commit more fouls. Interestingly, the Medium rough clubs almost receive the same number of red cards as the Rough clubs. According to the cluster centre of the third cluster, the clubs in cluster tend to play "clean" and avoid making fouls.

Table 3: Cluster centres of the three retained clusters of clubs based on "roughness"

Cluster	**Number of yellow cards**	**Number of red cards**	**Number of fouls**
Rough clubs	102.3	4.4	564.7
Medium rough clubs	77.2	4.2	494.3
Soft clubs	66.0	3.2	417.8

The analysis which would be of interest for the decision-makers is to observe how many clubs from each league is in each of the retained clusters and to provide additional information on the retained clusters. Table

4 provides valuable insights. The cluster Rough clubs consists of 12 clubs of which 11 are from Spanish league, and only one from French league (Toulouse). Interestingly, there is no club which plays in the Premier league that is characterized as rough. For the European football it is a good result that this is the smallest cluster, meaning that the clubs from the first leagues of these three countries primarily practice "fair play". When it comes to the cluster Medium rough clubs, the clubs in this cluster have a similar average of red cards as Rough clubs, but they have considerably fewer fouls made and yellow cards obtained. This cluster is mostly made of French clubs (10), followed by Spanish (7) and English clubs (5). The last cluster includes 15 clubs from Premier League, nine from Ligue 1 and only two clubs from La Liga. Interestingly, the two clubs from La Liga are the two best Spanish clubs, Real Madrid and Barcelona. Therefore, according to the number of fouls that their players make, the number of red and yellow cards received, Real Madrid and Barcelona are more similar to English than Spanish clubs.

Table 4: Cluster centres of the three retained clusters of clubs based on "roughness"

Cluster	**League**			**Total**
	Premier League	La Liga	Ligue 1	
Rough clubs	0	11	1	**12**
Medium rough clubs	5	7	10	**22**
Soft clubs	15	2	9	**26**

However, since the previously conducted Kruskal-Wallis test indicated that there might be difference in the referees' criteria between the observed leagues, these assigned cluster names should be taken with caution. Namely, the "soft" clubs do not have to play without contact yet that referees hesitate to give their players red or yellow cards. One thing is certain, Real Madrid and Barcelona in the Spanish league have a similar treatment from the referees as clubs from the English League.

For potential further, in-depth analysis, we provide the list of clubs within each cluster (Table 5).

Table 5: Clubs which make each of the three retained clusters on based on roughness indicators

Rough teams	**Medium rough teams**		**Soft teams**	
Sevilla (ESP)	Middlesbrough (UK)	Watford (UK)	Chelsea (UK)	Hull City (UK)
Espanyol (ESP)	Everton (UK)	Monaco (FRA)	Tottenham (UK)	Sunderland (UK)
Alaves (ESP)	Real Sociedad (ESP)	Olympique Lyonnais (FRA)	Stade Malherbe Caen (FRA)	Montpellier (FRA)
Malaga (ESP)	Las Palmas (ESP)	Olympique de Marseille (FRA)	West Ham United (UK)	Barcelona (ESP)
Valencia (ESP)	Manchester United (UK)	Nantes (FRA)	Arsenal (UK)	Paris Saint Germain (FRA)
Real Betis (ESP)	Villarreal (ESP)	Saint-Etienne (FRA)	Southampton (UK)	Nice (FRA)
Deportivo La Coruna (ESP)	Atletico Madrid (ESP)	Avant de Guingamp (FRA)	West Bromwich Albion (UK)	Girondins Bordeaux (FRA)
Leganes (ESP)	Crystal Palace (UK)	Lille (FRA)	Bournemouth (UK)	Rennes (FRA)
Sporting Gijón (ESP)	Athletic Bilbao (ESP)	Metz (FRA)	Liverpool (UK)	Angers (FRA)
Osasuna (ESP)	Eibar (ESP)	Dijon (FRA)	Leicester City (UK)	Real Madrid (ESP)
Granada (ESP)	Celta Vigo (ESP)	Nancy (FRA)	Stoke City (UK)	Manchester City (UK)
Toulouse (FRA)			Swansea City (UK)	Lorient (FRA)
			Burnley (UK)	Bastia (FRA)

To cluster clubs according to "attractiveness" we used *Goals for, Number of assists, Total shots, Shots on goal,* and *Goals scored from direct play.* We again retained three clusters which we named Attractive, Watchable, and Boring clubs.

The distance between the clusters Attractive and Watchable clubs is 144.595, between Attractive and Boring clubs 237.800, and between Watchable and Boring clubs 93.869. Comparing the distances between clusters retained in case of "roughness" and "attractiveness", it can be observed that in the case of "attractiveness" the clusters are more separated. The cluster centres are presented in Table 6. According to the cluster centres it can easily be concluded that there is difference in the values of attractiveness indicators which achieve the clubs in the three clusters. Attractive clubs dominate within all five attractiveness indicators.

Table 6: Cluster centres of the three retained clusters of clubs based on "attractiveness"

Cluster	Goals for	Number of assists	Total shots	Shots on goal	Goals scored from direct play
Attractive clubs	86.3	57.1	601.3	238.4	67.2
Watchable clubs	53.9	37.1	479.3	176.9	38.8
Boring clubs	41.8	27.5	399.9	130.3	28.7

Additional analysis of the three retained clusters is presented in Table 7. Among the 60 observed football clubs, more than half of them can be classified as Boring clubs. Namely, the play of 34 clubs is mostly oriented to defence and actions to save their goal. The league with most Boring clubs is the French league, where 43.33% of them practices such tactic, followed by Spanish league (36.67%), and English league (33.33%). Interestingly, the least boring and the most attractive clubs come from the English league. The six attractive clubs from the Premier league are the clubs which finished the season 2016/17 on the top six places (Arsenal, Liverpool, Manchester United, Manchester City, Tottenham, Chelsea). Expectedly, the two attractive clubs from the Spanish league are Barcelona and Real Madrid. However, the analysis of the attractive clubs from the French league provides interesting insights. Olympique Lyonnais has been grouped as an attractive club, while Nice was not. However, Nice completed the championship as third, and Olympique Lyonnais as fourth. Therefore, although Olympique Lyonnais played more attractive football, Nice had better defence which eventually led to its better rank. The provided clustering structure indicates that the Premier League is the most attractive league, where the spectators could expect more goals and more shots on target.

Table 7: Cluster centres of the three retained clusters of clubs based on "attractiveness"

Cluster	League			Total
	Premier League	La Liga	Ligue 1	
Attractive clubs	6	2	3	**11**
Watchable clubs	4	7	4	**15**
Boring clubs	10	11	13	**34**

For potential further, in-depth analysis, we provide the list of clubs within each cluster (Table 8).

Table 8: Teams which make each of the three retained clusters based on attractiveness indicators

Attractive teams	Watchable teams	Boring teams		
Arsenal (UK)	Southampton (UK)	Leicester City (UK)	Stoke City (UK)	Hull City (UK)
Chelsea (UK)	Everton (UK)	Swansea City (UK)	Burnley (UK)	Sunderland (UK)
Tottenham (UK)	Bournemouth (UK)	Middlesbrough (UK)	Crystal Palace (UK)	Watford (UK)
Paris Saint Germain (FRA)	West Ham United (UK)	Las Palmas (ESP)	Deportivo La Coruna (ESP)	Leganes (ESP)
Real Madrid (ESP)	Sevilla (ESP)	Alaves (ESP)	Eibar (ESP)	Celta Vigo (ESP)
Manchester City (UK)	Villarreal (ESP)	Real Betis (ESP)	Sporting Gijón (ESP)	Nice (FRA)
Olympique Lyonnais (FRA)	Atletico Madrid (ESP)	Stade Malherbe Caen (FRA)	West Bromwich Albion (UK)	Girondins Bordeaux (FRA)
Manchester United (UK)	Real Sociedad (ESP)	Espanyol (ESP)	Saint-Etienne (FRA)	Rennes (FRA)
Monaco (FRA)	Athletic Bilbao (ESP)	Granada (ESP)	Metz (FRA)	Lorient (FRA)
Barcelona (ESP)	Malaga (ESP)	Bastia (FRA)	Toulouse (FRA)	Nancy (FRA)
Liverpool (UK)	Valencia (ESP)	Lille (FRA)	Osasuna (ESP)	Nantes (FRA)
	Olympique de Marseille (FRA)			Dijon (FRA)
	Angers (FRA)			
	Montpellier (FRA)			
	Avant de Guingamp (FRA)			

4. CONCLUSION

The field of study of application of statistical, mathematical, and data-mining techniques in sponsorship and in sports analytics is developing (Radojičić, Djoković & Jeremić, 2016). In this paper, we aimed to enlarge the current literature on the topic of decision making in marketing, particularly in sport sponsorship. Herein, we applied statistical multivariate analyses to ease the sponsors' decision making when choosing which league or club from the Premier League, La Liga or Ligue 1 to sponsor.

Our results show that there is no statistically significant difference between the three observed leagues when it comes to attractiveness, meaning the matches in all three leagues are of same quality. However, difference was spotted when it comes to roughness. Maybe there really is the difference in the style of play, but maybe there is difference in the referees' approach to what *a foul is* and what is not. This result might indicate that the game in La Liga might be a little bit slower and with more stoppage time due to referees' decisions. The results of clustering showed that Real Madrid and Barcelona are more similar to English than Spanish clubs and that most of the clubs from the three leagues are oriented to defence and actions to save their goal.

Several future directions of the study could be determined. One direction could be towards the introduction indicators of popularity of football clubs on social media. Namely, football clubs have large, committed communities of fans who can easily be communicated with via sponsorship. The second direction of the analysis could be the application of Structural Equation Measurement (SEM) analysis. Namely, SEM has been used with success in the analysis of data related to football. For example, it was used to examine the linkages between financial performance, sporting performance and stock market performance of English football clubs (Samagaio, Couto, & Caiado, 2009). Also, other statistical multivariate analysis such as Principal Component Analysis could be employed (Moura, Martins, & Cunha, 2014).

We hope the presented research will provide additional insights on differences between the three European football leagues and on application of multivariate analysis in decision making in sport sponsorship.

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MEASURES OF DIGITALIZATION IN EUROPEAN ENTERPRISES: LINEAR REGRESSION MODEL

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Abstract: *The main idea of this research is to show how digital world expansion that is ubiquitous nowadays affects the economies. We observed the financial measures of digitalization, as total turnover from e-commerce in enterprises, and nonfinancial indicators such as percentage of enterprises that are purchasing or selling online, that own a website and advertise through the internet, that employ ICT specialists, as well as the percentage of employees that use a computer or mobile internet connections. In this paper, we mainly focused on countries in EU. A backward linear regression model was employed in the analysis. Our findings show that the total turnover from e-commerce is mostly affected by Internet advertising, number of ICT specialists employed and the percentage of enterprises that are selling online. The obtained model accounts for 73% of the variability. The presented research might provide insights on the factors which influence digitalization of enterprises.*

Keywords*: European Union, digitalization, enterprises, e-commerce, the linear regression model*

1. INTRODUCTION

Economic growth, as a very important feature for every country, depends on many factors such as natural resources, implemented laws, available technology, human capital. The digitalization is one of them, especially important nowadays. Because of this, the whole world, including European Union (EU), started to measure digitalization and to collect data for analysis in order to increase its positive effects. The term digitalization could be defined as a process of creating new value through the aspects of digital technology (Schallmo & Williams, 2018a). It focuses on capabilities which support the whole business idea, and with the fast development in the field of ICT, countries, industries, and companies compete and create value in completely new ways (Schallmo & Williams, 2018b).

World institutions are continually reporting on how to stimulate the digital transformation of European economies and enterprises, and proposing short and long-term strategies on digital entrepreneurship to maximize its impact (Ardolino et al., 2017). Before any new processes implemented, it is important that we have a clear picture of how the new process affect other parts of the industry. More particularly, EU has noticed that digitalization can affect massively on traditional businesses and industries, by creating and destroying jobs (European Economic and Social Committee, 2017). Logically, by implementing new methods of work and new technologies, not all the people in the industry, especially older generations, can follow up new trends and be ready to change their work routine. Accordingly, it is clear that implementing digitalization can have a positive effect, but it is also really important to be aware of the downsides and to find a reasonable solution to minimize the possible negative effect.

It is also important to mention that not all EU countries are developed, and according to that, digitalization is not the main focus for all. Research showed that in developing countries population age and urban population are positively associated with the ICT adoption (Billon, Marco, & Lera-Lopez, 2009). Additional research showed that in developing countries Internet costs are negatively associated with ICT adoption (Chen, Jaw, & Wu, 2016). However, a number of researches argue that ICT and the Internet decrease production costs, enhance the creation and spread of new ideas, support knowledge, sharing, and improve R&D processes (Kamalipour & Friedrichsen, 2017; Matt, Hess, & Benlian, 2015; Meijers, 2014). The main belief of these authors is that ICT is tightly linked to higher economic growth (Czernich, Falck, Kretschmer, & Woessmann, 2011; Degryse, 2016; Heeks, 2010). Therefore, countries should create strategies in order to use the potential that the digitalization has (O'Donnell, 2016).

The Digital Economy is a global phenomenon, and in order to see the whole potential of the digital economy, it is important to review EU on a global level. In order to do that, European Commission has introduced Digital Economy and Society Index - DESI (European Commission, 2018), which evaluates the performance of both the individual EU countries and EU as a whole in comparison to 15 other countries: Australia, Brazil,

Canada, China, Iceland, Israel, Japan, Korea (Rep.), Mexico, New Zealand, Norway, Russia, Switzerland, Turkey, and the United States.
When we discuss about digitalization, NRI index is something worth to mention. NRI represents a key tool in assessing countries' preparedness to reap the benefits of emerging technologies and capitalize on the opportunities presented by the digital transformation and beyond. More particularly, the World Economic Forum experts assess the factors, policies, and institutions that enable a country to fully leverage information and communication technologies (ICTs) for increased prosperity and crystallizes them into a global ranking of networked readiness at the country level in the form of the NRI (The Global Information Technology Report , 2016).

The research conducted in this paper aims to find the connections between different digitalization indicators. Connection between indicators could be very useful for society in global, especially for companies and counties in developing stage. We observed the financial measures of digitalization, as total turnover from e-commerce in enterprises, and nonfinancial indicators such as percentage of enterprises that are purchasing or selling online, that own a website and advertise through the internet, that employ ICT specialists, as well as the percentage of employees that use a computer or mobile internet connections. In this paper, we mainly focused on countries in Europe, specifically the 28 countries that are the members of the EU, EU-28.

The paper is organized as follows. The next section gives the list of indicators that are used in this study, as well as the employed methodology. The third section presents the results and discusses the findings of the research. The final section gives some concluding remarks on the presented topic.

2. METHODOLOGY

This paper focuses on investigating and modelling the relationship among different measures of digitalization in the enterprises in Europe. The data for this analysis are collected from Eurostat and are publicly available (Eurostat, 2017). The data are collected for 28 European countries (EU-28). We observed a set of eight variables that measure the digitalization of the enterprises in the economies of European Union countries:

- *Value of E-Commerce Sales of Enterprises* – This indicator measures enterprises' total turnover from e-commerce. It is given as a percentage of total turnover and includes all the enterprises, without financial sector (ten persons employed or more).
- *E-commerce Purchases of Enterprises* – The percentage of enterprises that have ever made any purchase through computer-mediated networks.
- *E-commerce Sales of Enterprises* – The percentage of enterprises that are selling their products online (which covers at least 1% of their turnover).
- *Internet Advertising of Enterprises* – The percentage of enterprises that use any social media for advertising over the internet.
- *Computer Internet Connections used by the Employees in Enterprises* – Persons employed that are using computers with access to World Wide Web; a percentage of total employment.
- *Mobile Internet Connections used by the Employees in Enterprises* – This indicator counts persons employed in a company (a percentage of total employment), which were provided with a portable device that allows a mobile connection to the internet for business use.
- *Enterprises that have a Website* – Percentage of enterprises that own a website, enterprises without financial sector (ten persons employed or more).
- *Enterprises that Employ ICT Specialists* – A percentage of enterprises that employ ICT specialists, without financial sector.

In order to investigate and model the relationship among digitalization indicators in enterprises in EU, we observed the variable *Value of E-Commerce Sales of Enterprises* as a dependent variable. We have chosen this specific variable because it can be defined as a financial indicator that describes the current turnover from digital commercialization. We aimed to investigate whether the set of seven other variables, which could be defined as the explanatory variables, significantly influence the e-commerce sales in Europe.

We used backwards multiple least squares 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:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + ... + \beta_k X_{ki} + \varepsilon_i \quad (1)$$

where Y_i is an i-th observation of 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.

3. RESULTS AND DISCUSSION

Table 1 gives the descriptive statistic of the variables used in the research. As described in Section 2, variables are mainly given as the percentage of turnover/enterprises/employment/etc. Thus, all the variables are normalized. Among the observed variables, the variables *E-commerce Purchases of Enterprises* and *Enterprises that have a Website* have the widest range. The largest mean value is for the *Enterprises that have a Website*, 76.11%, which tells us that this is the mostly spread digitalization indicator in the countries of EU. Other two digitalization indicators that are spread across Europe are *Internet Advertising of Enterprises*, with the mean value 49.96%, and *Computer Internet Connections used by the Employees in Enterprises*, with the mean value 48.86%. The largest standard deviation is noticed with the variable E-*commerce Purchases of Enterprises*, SD=16.41%, followed by *Internet Advertising of Enterprises*, SD=13.13%.

Table 1: The descriptive properties of variables defined in Section 2

Employment rates of recent graduates	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Value of E-Commerce Sales of Enterprises	4	33	16.360	7.445
E-commerce Purchases of Enterprises	11	75	38.571	16.419
E-commerce Sales of Enterprises	7	30	17.250	6.598
Internet Advertising of Enterprises	27	74	49.960	13.128
Computer Internet Connections used by the Employees in Enterprises	27	75	48.860	11.891
Mobile Internet Connections used by the Employees in Enterprises	10	51	25.071	10.846
Enterprises that have a Website	45	96	76.110	11.955
Enterprises that Employ ICT Specialists	10	33	20.960	5.175

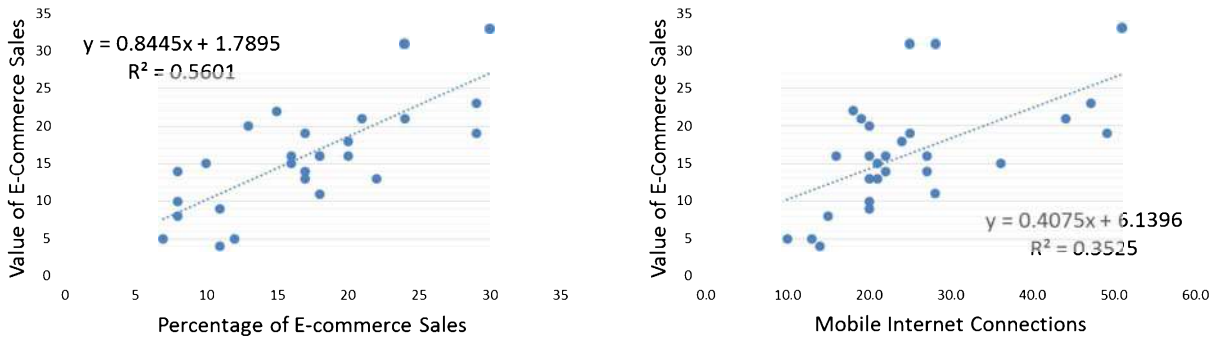
The basic objective of this study was to determine the relationships between *Value of E-Commerce Sales of Enterprises* and the overall digitalization performance. For this purpose, we calculated Pearson correlation coefficients that are given in Table 2.

Table 2: Pearson's correlation coefficients between variables

Employment rates of recent graduates	Value of E-Commerce Sales	E-commerce Purchases	E-commerce Sales	Internet Adv.	Computer Internet Conn.	Mobile Internet Conn.	Enterprises with a Website
E-commerce Purchases	0.556**						
E-commerce Sales	0.748**	0.603**					
Internet Advertising	0.205	0.454*	0.516**				
Computer Internet Connections by Employees	0.444*	0.785**	0.666**	0.648**			
Mobile Internet Connection by Employees	0.594**	0.669**	0.747**	0.575**	0.822**		
Enterprises that have a Website	0.525**	0.720**	0.661**	0.618**	0.821**	0.618**	
Enterprises that Employ ICT Specialists	0.495**	0.420*	0.469*	0.733**	0.401*	0.495**	0.503**

*p<0.05, **p<0.01

From Table 2, we can see that the variable *Value of E-Commerce Sales (percentage of turnover)* is strongly correlated with *E-commerce Sales (percentage of enterprises that are selling online)* and *Mobile Internet Connections used by the Employees in Enterprises*. These relationships are graphically presented in Figure 1, *a* and *b*. Pearson's correlation coefficient ranges from 0.205 to 0.822 and we have only one coefficient which is not statistically significant, the correlation coefficient between *Internet advertising* and *Value of E-Commerce sale* (r=0.205, p>0.05).



(a) *(b)*

Figure 1: Relationship between *Value of E-Commerce Sales* and (a) Percentage of E-commerce sales and (b) Mobile Internet Connection used by the Employees in Enterprises

From Figure 1*a* and Table 2, it can be seen that the Pearson's correlation coefficient between *Value of E-Commerce Sales (percentage of turnover)* and *E-commerce Sales (percentage of enterprises that are selling online)* is r=0.748 (p<0.001). The coefficient of determination is R^2=0.5601, indicating that the percentage of enterprises that are selling online alone explains 56.01% of the variability in the percentage of total turnover for e-commerce. In Figure 1*b* and Table 2, we see that the Pearson's correlation coefficient between *Value of E-Commerce Sales (percentage of turnover)* and *Mobile Internet Connections used by the Employees in Enterprises* is r=0.594 (p=0.001). The coefficient of determination R^2=0.3525, which means that 35.25% of total turnover for e-commerce is explained solely by mobile internet connections.

In order to model the presented relationships, we have built the linear regression model. As mentioned previously, we used backwards multiple least squares linear regression model. The original regression model is presented in Table 3.

Table 3: The original multiple linear regression model for the dependent variable *Value of E-Commerce Sales of Enterprises*

Explanatory variables	**B**	**SE**	**Beta**	**t**	**95%CI B**	
Intercept	-2.174	5.785		-0.376	-14.241	9.894
E-commerce Purchases of Enterprises	0.055	0.082	0.121	0.670	-0.116	0.225
E-commerce Sales of Enterprises	0.687	0.191	0.609	3.598**	0.289	1.086
Internet Advertising of Enterprises	-0.396	0.111	-0.698	-3.555**	-0.628	-0.164
Computer Internet Connections used by the Employees in Enterprises	-0.067	0.204	-0.107	-0.327	-0.493	0.359
Mobile Internet Connections used by the Employees in Enterprises	0.117	0.161	0.171	0.730	-0.218	0.452
Enterprises that have a Website	0.110	0.134	0.177	0.822	-0.170	0.391
Enterprises that Employ ICT Specialists	0.775	0.260	0.539	2.978**	0.232	1.318
F	10.974**					
R^2	0.793					
Adjusted R^2	0.721					

*p<0.05, **p<0.01

In the original linear regression model, all of the variables defined for this research were included in the analysis. From Table 3 it can be seen that, among all of the listed variables included in the model, only *E-commerce Sales of Enterprises, Internet Advertising of Enterprises,* and *Enterprises that Employ ICT Specialists* influence the dependent variable *Value of E-Commerce Sales of Enterprises.* All other variables' influences are not significant (p>0.05). With the adjusted coefficient of determination R^2=0.7210, the model reveals that 72.1% of the variability of total turnover for e-commerce is explained by the given combination of explanatory variables. The whole model is significant at 0.01 level of significance (F=10.974, p<0.001). The model also exhibits a large level of multicollinearity among explanatory variables.

Table 4 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 to create the model that would better fit the given data.

Table 4: The reduced multiple linear regression model for the dependent variable *Value of E-Commerce Sales of Enterprises*

Explanatory variables	B	SE	Beta	t	95%CI B	
Intercept	1.144	3.255		0.352	-5.573	7.862
E-commerce Sales of Enterprises	0.906	0.133	0.803	6.796**	0.631	1.181
Internet Advertising of Enterprises	-0.363	0.087	-0.639	-4.165**	-0.542	-0.183
Enterprises that Employ ICT Specialists	0.844	0.214	0.587	3.941**	0.402	1.286
F	25.335**					
R^2	0.760					
Adjusted R^2	0.730					

*p<0.05, **p<0.01

From Table 4, it can be seen that the reduced model includes only three, of initially seven explanatory variables. As indicated by the original model, only E-c*ommerce Sales of Enterprises, Internet Advertising of Enterprises,* and *Enterprises that Employ ICT Specialists* significantly influence *Value of E-Commerce Sales of Enterprises*. The most influential indicator is *E-commerce Sales of Enterprises* (percentage of enterprises that are selling online). What is interesting to see from result is that the values of *Internet Advertising of Enterprises* have a negative impact on the dependent variable. This result could be interpreted as that the use social networks for advertising does not automatically mean the sales are going to rise.

The estimated model is presented as follows in the given formula:

$$\hat{Y} = 1.144 + 0.906X_1 - 0.363X_2 + 0.844X_3 \quad (2)$$

where Y is the dependent variable *Value of E-Commerce Sales of Enterprises*, X_1 is *E-commerce Sales of Enterprises*, X_2 is *Internet Advertising of Enterprises*, and X_3 is *Enterprises that Employ ICT Specialists*. With the adjusted coefficient of determination R^2=0.730, the model reveals that 73% of the variability of the total turnover of e-commerce in European enterprises is explained by the given combination of explanatory variables. The whole model is significant at 0.01 level of significance (F=25.335).

4. CONCLUSION

This research focused on creating a model that would analyze the dependence of a total turnover of e-commerce in European enterprises, as a financial indicator, from a set of indicators that measure the state of digitalization transformation.

After four iterations in a backwards linear regression model analysis, the final model shows that the dependent variable *Value of E-Commerce Sales of Enterprises* depends on *E-commerce Sales of Enterprises, Internet Advertising of Enterprises,* and *Enterprises that Employ ICT Specialists.* Other four variables (*E-commerce Purchases of Enterprises, Computer Internet Connections used by the Employees in Enterprises, Mobile Internet Connections used by the Employees in Enterprises,* and *Enterprises that have a Website*) are not statistically significant in creating the model. The final model, presented in table 4, has the coefficient of determination R^2=0.73, which means that 73% of the variability of total turnover for e-commerce is explained by the given combination of explanatory variables.

This analysis could be useful for researchers and companies which have implemented digitalization or have a plan to do so in a future. According to this data, all the enterprises can focus only on three variables and consequently, reduce costs in the process of digital transformation. Besides companies, research can be helpful for policy makers and governments as it provides insights that ICT specialists are needed in companies so as to increase the value of e-commerce sale and thus increase the level of economic activity. For example, policy makers could promote higher education in the ICT field.

As a direction of future research, it would be interesting to analyze the same regression model, using the same variables, but on different groups of countries (divided for example according to different life standards). It is possible to get certain changes in scores because of the market diversity and different people priorities according to their living standards (developed countries, developing countries, or undeveloped countries).

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RESEARCH OF ASSOCIATION RULES AS DECISION MAKING TOOL FOR MANAGERS

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Abstract: *In modern business it is a challenge to find possibilities to improve business decision-making of managers. Managers' decisions directly affect the profit and success of companies at the market. As very complex process that should result with right managers' decisions, there is need to improve methods and techniques of modern decision-making. In the paper the significance and application of association rules will be analysed on the example of car sales. Research will be dealing with data in large databases of car sales by use of data mining software Orange. Main results provide recommendation to create suitable promotional activities according to existing and potential buyers, with car offers and additional equipment that are bought together. One of advantages of this model, when compared to others, is that it could also be applied in other industries. Associations have been used in order to make convenient and interesting product offer for* the market.

Key words: *decision-making, data mining, association rules.*

1. INTRODUCTION

Business decision-making is choosing the best solution of all available alternatives, according to (Suknović and Delibašić 2010). According to (Agrawal et al, 1993), Agrawal first established the association rules with the purpose of analysis the market basket.

Although the market basket is mostly being used in sales, it is important to highlight that there are also other segments where its application is significant: analysis of finances, medical analysis, then analysis of insurance companies or telecommunications services.

The example of company Catalogue sales is one of the examples of successful application of method of association rules in marketing, especially on improvement of sales (Verhoef et al, 2010). The most important result of the application of association rules is oriented towards the need to create thematic catalogues that will contain certain items of products that will adapt to market segments.

In order to solve the problem of company Colorful world of colors the method of association rules had been used (Verhoef et al, 2010). Company recognized the fall of sales of certain products. The goal was to find out if these are products that are sold together with some other products or on their own. Analysis was designed so that it was analysed the preferences of buying non-popular set of products in combination with the main set of products. In main set of products are the ones that bring the biggest sales profit. Research showed that the buyers continued to buy products from the main set, and the sales of non-popular products stayed at the same level.

Another example of application of method of association rules has been described in the frame of searching the web (Verhoef et al, 2007). Searching the association rules were used to reveale the web pages that are jointly used. For instance, information that users who approach to pages A and B also do it for page C, can be used to create certain links (i.e. from A to C), which would result for further analysis of e-business.

Extensive research on association rules mining has been conducted in (Martin et al, 2014). This research extends evolutionary algorithm based on decomposition to perform learning of the intervals of the attributes and a condition selection for each rule. Application of association rules on market basket analysis had been described in (Omondi, A. O., and Mbugua, A. W., 2017). The methodology used contain minimum spanning trees. According to (Jain, S. et al, 2018), the importance of data mining and business strategy have been described with patterns that emerged as results. In (Griva, A. et al, 2018) there is business analytics approach that describes customer visit segments from basket sales data.

Researchers were dealing with the extensive application of method of association rules in business decision-making. This method has been proved to be the most successful in the field of market basket. This paper presents the application of association rules with the purpose of discovering patterns of the customers' buying habits in the car industry.

2. RESEARCH

Data mining is mostly oriented towards the model creation. Under right circumstances, model can provide the explanations how output elements of certain interest, such as precise order or unsuccessful payment of bills, are connected and can be predicted by available facts.

Association rules determine the items that are bought together. According to (Grabmeier, J., and Lambe, L., 2007), the term of association rules was firstly used by Agrawal. The task of association is to find out rules that exist between the cases in the dataset. According to (Grabich, M., 1997), knowledge is accumulation of the facts and information, whilst wisdom is the synthesis of knowledge and experience that deepen our understanding of the connections between different entities and eventual some hidden message in their existing. We can say that knowlege is tool, while wisdom is set of skills where we use knowledge as the tool. Cases for association rules are grouping the items that are bought together in shopping in supermarket – the field of market basket is dedicated to this issue (Fernando, B., and Susanto, B., 2011).

The importance of rules, that is the quality of rules discovered by the association, is determined based on the markers of support and confidence. Support is the procentual part from the sample that applies to certain rule, that is the number of instances that satisfy a rule. Confidence tells what percentage of cases posess attribute A, also posess attribute B. The biggest fault of the association rules is that in most cases of analysis on large databases many rules are not interlinked, so their simplicity can go to unconsistency (Doko A., 2010). There are numerous approaches that can be used for revealing certain rules, and the most basic one is the Apriori algorhitm. This algorhitm works on the preassumption that if certain number of items is present in the dataset, than each item is also present (Grabmeier, J., and Lambe, L., 2007).

This paper shows the structure of data, the evaluation process and the application of association rules. Based on the structure of research data, as well as the use of tools of business intelligence, the end-result will be the model of business decision-making and knowledge discovery.

According to (AL-Zawaidah and 2011), there are three dimensions that determine the complete development of modern decision-making. Those are: qualitative aspect, quantitative aspect and information-communication aspect. In this paper the multidisciplinary approach will be described. Data will be shown in quantitative way and will be processed by numerical values. Methods and techniques of business intelligence will be applied. Attributes will be described in order to ensure the qualitative aspect of modern decision-making.

Description of the result will ensure qualitative aspect. Use of software architecture and visual overview of data will ensure information-communication aspect of modern decision-making. Data that was used in research is connected to car sales. Total of 1728 transactions are being processed. Attributes are connected to buying (very high rate of transactions, high, medium and low), maintenance of cars (very high rate, high, medium, low), number of car doors (two, three, four, five), number of persons (two, three, four), seating space (small, medium, large) and safety (low, medium, high).

All data are divided into four classes: accurate, unaccurate, good and very good. Orange has options for each phase of CRISP-DM methodology. From large database of car sales transactions, data will be processed in software Orange Canvas (Figure 1), in order to find the association rules. Associations could help buyers with provided knowledge about the best car offer. Buyers help the process of association rules in the selection of cars, based on relavant sales data.

This paper describes the model of application of business intelligence on business problem, with the use of modern software architecture. Orange, as very suitable and user-friendly software, contains numerous options for data mining, such as model creation, testing, data vizuelization, application of model, etc. One of the popular technologies for data mining is CRISP-DM methodology.

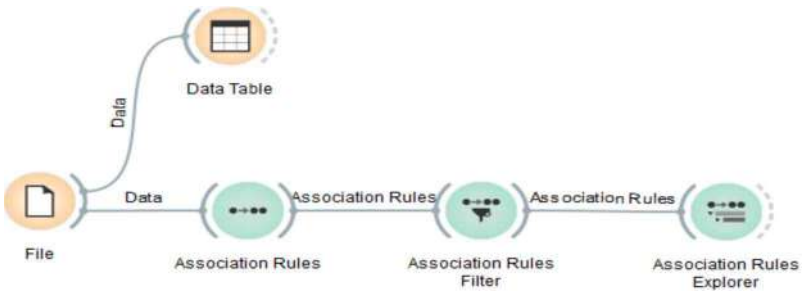

Figure 1: Model of association rules created in software Orange Canvas

3. DISCUSSION

The parametars for support and confidence are being defined. In this case minimal support is defined at 30%, and minimal confidence is 50%. In further research this parametars were changed in order to show how their change affect the end-result of finding the association rules.

Considering that the minimal support is set at 30%, there are only two association rules derived. First association with provided parametars is that car for two persons belongs to class that is called unaccurate. Moreover, 30% of all car sale transactions for two persons were from the class unaccurate. Support of 50% means that when customers buy from the class unaccurate, there is 50% probability that they will buy cars for two persons. It is predicted that in all future transactions, cars from this class would be offered to customers. Second association rule is that when safety is defined as low, then it follows that the most often car is from class unaccurate. These changes of parametars show the strength of created association rules. The higher the parametars are, the stronger association rules are (with highest probability to show).

Orange is convenient for goods visual overview of gained results. Report shows the number of gained association rules, as well as their description (Figure 2).

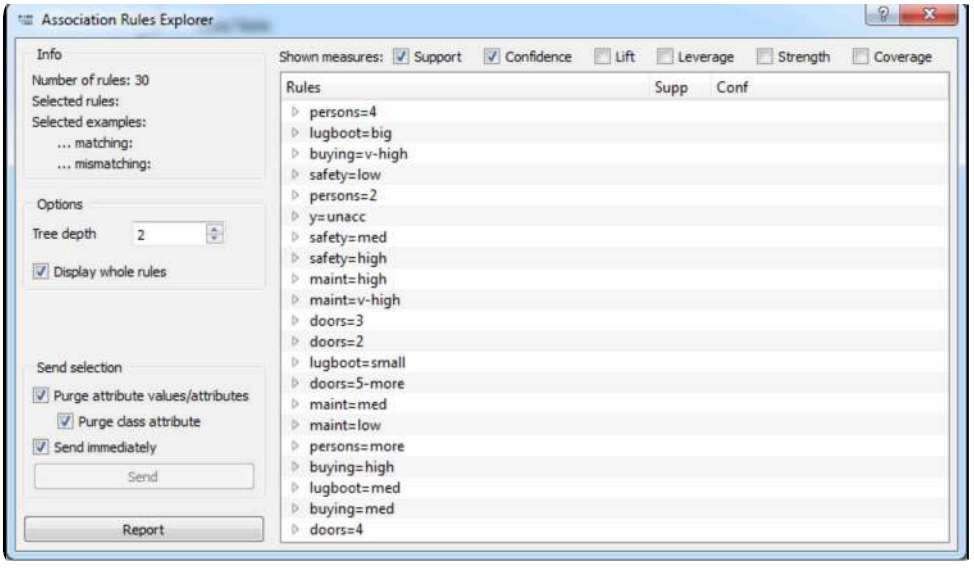

Figure 2: Association rules

By reducing minimal support from 30% to 10 %, and increasing minumal confidence from 50% to 60% different results are achieved. The number of revealed association rules has increased. There are thirty new association rules with support rate from 11% until 33% and confidence rate from 62% until 100%. Further explanations show patterns that are used to create best set of products for sales which results with highest degree of sales and customer satisfaction. On the left-hand side of the graphicon (Figure 3) there is overview of gained association rules. More details in (Istrat, 2017).

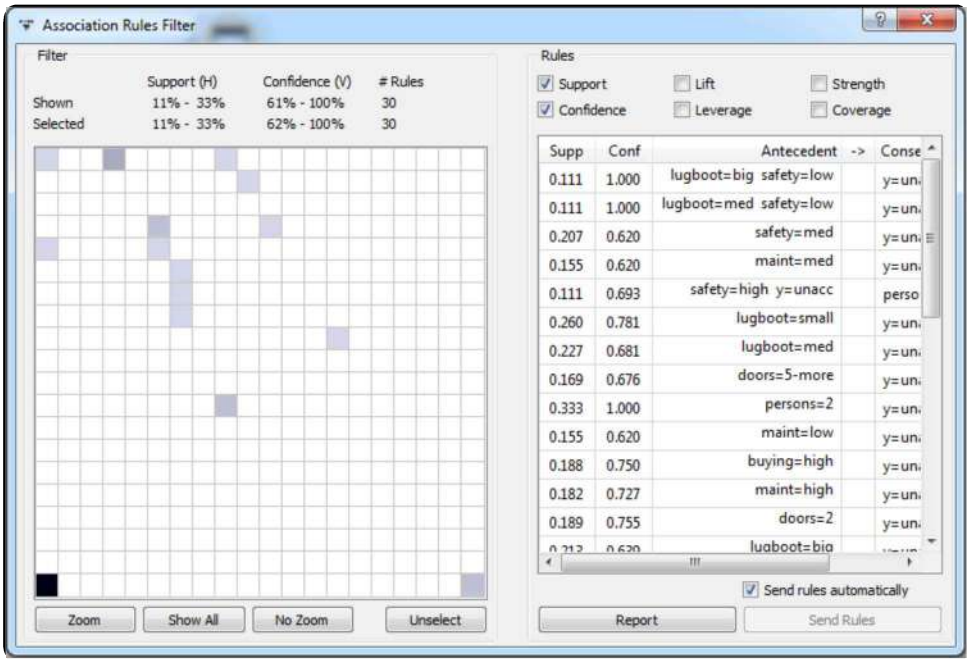

Figure 3: Overview of obtained association rules

From the obtained association rules one was highlighted with biggest support of 0.333 and biggest confidence of 1. It is the rule when customers buy car for two persons they most often decide to buy from the class that is defined as unaccurate. Analysis of each association rule show precise patterns of buyers' behaviour. Another association rule that is distinguished by importance is the one with support of 0.260 and confidence of 0.781 which shows that when smaller space inside the car is needed, then buyers most often buy from class unaccurate. Nonstandard data (outliers) can cause problems in creating the model. Outliers represent rare events that are extemptions from the ruled in data. They can affect that the model applied on all data won't be with high quality, because it is difficult for algorhitms to find the regularities in the presence of extemption. There are no outliers in this research. More details in (Istrat and Lalić, 2017).

Putting data through Apriori algorhitm provided association rules that are then checked and only the most important are chosen to show and create meta rules, in order to get the most acceptable solution. This solution is applicable not only in finding the original universal rule for improvement of car sales, but for other items as well. Recommendation is creating the marketing campaigns based on knowledge that was revealed by use of tools of business intelligence. It is recommended that customers are provided by questionnaire that would search for what car characteristics are the most important.

In the case there are car characteristics (attributes): price, maintanance costs, number of doors, number of seats, size of the truck and safety. Gained association rule showed that buyers that buy car for two persons and which find safety at low level, they most often do it from the class unaccurate.. It is recommended to create promotional activities according to existing and potential buyers, with car offers and additional equipment that are bought together. Advantage of application of this model when comparing to others is that it could be applied also in other different sectors (banking sector, education, etc.). The topic of research is very interesting and provides extensive space for further elaboration of association rules application. Real-term settings and practical implication of research provide advantage when compared to other similar research. Experienced business intelligence analytics were used to define the results of the research.

4. CONCLUSION

It is challenge for researchers to provide sigificant scientific and expert contribution. Innovation of research of application of business intelligence is shaped with knowledge and creativity, as well as the use of modern software architectures from the field of data mining. Gained associations were used with purpose to make the best products' offer at the market. The process of improvement of model was shown with the help of knowledge that managers get through association rules about habits and buyers' behaviour in shopping. Better choice of the product offer for launching at the market was improved by efficiency of management of sales with the help of business intelligence. Developed model points out at the significance of methods and techniques of business intelligence for support of management of business systems in creating maximization

of profit. The goal of further research would be creating the model of business decision making that is applicable to market in business systems of different areas and with commercial purpose.

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SKI LIFT TRANSPORTATIONS AS PREDICTORS FOR INJURY OCCURRENCE

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Abstract: *Ski lift transportation data is readily available in ski resorts, still heavily underused. There are many ways this data can be used, but in this paper, we study the applicability of this data for injury occurrence prediction on the data from ski resort Kopaonik. We propose a decision tree model for studying injury occurrence. We find that the most relevant predictor for injury occurrence is the number of ski lift transportations. While the number of ski lift transportations is below a certain threshold we can predict the number of injuries on a day almost linearly with the number of ski lift transportations. When the number of ski lift transportation increases, i.e. when the ski resort gets congested, the occurrence of injuries depends on the level of satisfaction skiers achieve. If skiers have an above average or even a below average level of satisfaction, the injury occurrence risk is high. If skiers experience average level of experience then the risk of injury is average or low.*

Keywords*: Ski injury occurrence, data mining, ski lift transportation data, Ski resort Kopaonik*

1. INTRODUCTION

The problem studied in this paper is the daily occurrence of ski injuries based on ski lift transportation data, a readily available resource in ski resorts. Studying this problem is important as ski injuries pose a major public healthcare problem with significant medical costs worldwide. Ski resorts are interested to accurately predict the daily level of injury occurrence. This is important for allocation of medical resources in ski resorts. Insurance companies are also interested to know more accurate statistics for ski injury occurrence for defining ski insurance prices. The problem of predicting injuries has usually been assessed by assessing the number of skiers in the resort and knowing the injury rate of ski injury occurrence which is usually 0.2% (Ruedl et al. 2013). Bohanec and Delibašić (2015) have proposed several models for daily ski injury occurrencebased on ski lift transportation data. Their models were concerned whether injuries will occur on a certain day or not, and whether an above average number of injuries will occur. This paper extends the problem defined in the paper from Bohanec and Delibašić (2015) by predicting whether injuries will occur at an expected level (within one standard deviation of the normalized residual between expected injury occurrence and real injury occurrence) or injuries will occur at a higher or lower level. Our results suggest that the number of ski lift transportations is a great predictor for situations when there is a specific amount of skiers in the ski resort. Above this amount of skiers, i.e. when assumably congestion in ski resort occurs, ski lift transportation number are not a reliable predictor of ski injury occurrence. To understand the behaviour of skiers better we introduce a skiers satisfaction measure which gives better insight whether injuries will occur at lower, higher, or expected values.

The remainder of the paper is structured as follows. In Section 2 we provide background on ski injury research based on ski lift transportation data. In Section 3 we explain the data and the methods used in this research. In Section 4 we present the obtained results. We make the conclusion in Section 5.

2. BACKGROUND

The study of ski injury based on ski lift transportation data is recently getting more attention (e.g. Dallagiacoma, M. 2017). Ski lift transportation data is a resource kept within ski resorts and usually only used for simple reporting for ski resort management. Delibašić, et al. (2017a) have proposed spatial and temporal clustering models based on ski lift transportation data. The identified clusters provide motivation for the marketing team of ski resorts to enable more intelligent ski ticket formats to their users. Delibašić et al. (2017c) have extended the previous work of skiing clusters by investigating hidden factors that motivate skiers to choose a specific path.

Ski injury is a well-studied area (e.g. Dalipi, F., & Yayilgan, S. Y. 2015), however, the data from ski lift transportation has only been recently started to be used for studying ski injury.

Delibasic, B., & Obradovic, (2012) proposed a decision support system prototype for early warning for ski injuries. The same authors also suggested (Delibašić, B., & Obradović, Z. 2015) that skiing in groups has a significant influence on ski injury occurrence. Bohanec, M., & Delibašić, B. (2015) proposed severaldata-mining and expert models for predicting daily injury risk for a ski resort. Dobrota, et al. (2016) clustered skiing trajectories and found clusters with varying levels of injury risk. Delibašić, et al. (2017b) have proposed a ski injury assessment model for individual skiers. This study suggested ski injuries to be early failure events, i.e. it was shown that the first couple of hours of skiing are more critical to get injured than the later hours.

3. DATA AND METHODS

The data for this research stems from the ski resort Kopaonik, Serbia, which is Serbia's largest and most significant ski resort bordering its southern province Kosovo & Metohija. The data is from the period 2006 to 2011 and belongs to the company Ski resorts of Serbia. The injury data is provided with courtesy of the Mountaineer rescue service of Serbia which covers the ski resort of Kopaonik with its ski patrol. In this research also data from the Serbian hydrometeorological service was used.

The basic format of the ski lift transportation data is:
- Date and time of ski lift gate entrance
- Location of ski lift gate
- Skier ID

The complete dataset for this research had the following attributes:
- Average daily temperature
- Average wind speed
- Average cloudiness
- Daily number of ski lift transportations in the ski resort
- The total daily sum of vertical meters of all skiers in the ski resort
- Total number of skiers

The output attribute was the risk level which could have been:
- Low injury occurrence
- Expected injury occurrence
- High injury occurrence

The output attribute was calculated as a normalized residual. For each skier day, the expected level of injury was calculated based on the number of ski lift transportations, as ski lift transportations showed a better correlation to the number of injuries than the vastly used measure which is the number of skiers.

Then the residual was calculated as the difference between the expected injury occurrence and the observed injury occurrence. As it was not the same if there was a difference when there is a small number of ski lift transportations in the ski resort or a huge number of ski lift transportations, the residual was normalized taking into account the largest number of ski lift transportations.

For the analysis in this paper, we used the data mining software Orange from the University of Ljubljana (Demšar et al 2013). We used Sieve diagrams which find a correlation between attributes based on the strength of the chi-square statistics. We also applied decision trees and other popular data mining algorithms to test the strength of our results.

4. RESULTS

We found a strong correlation between the number of ski lift transportations and the risk level. In Figure 1 this relationship can be seen. This relationship indicates that while the number of ski lift transportations is below 38,193 then mostly the expected level of injury risk can be noticed, i.e. we can safely use the number of ski lift transportations to predict ski injury. However, if the number of ski lift transportation is higher than this number then either a low or above average number of injuries can be expected.

On the decision tree on Figure 2, this point is made clearer. The most important indicator of risk injury prediction is the number of ski lift transportations (the rootof the tree). If the number of ski lift transportations is 36,523 or below than an expected level of injuries will occur. We are confident of this finding with 97.9% percent at the training set. However, when there is a larger number of ski lift transportations it is much more difficult to get an overall good prediction. The decision tree on Figure 2 has an overall classification accuracy at the test set 88.9% while the majority class prediction (which is the expected value) has an occurrence of 89.6% which means that the decision tree makes a worse prediction than if using only the expected value as the forecast. Although accuracy is low, it is more important to identify injury behavior. In other words, false

positive (predicting injury that did not occurred) prediction is of less cost compared to false negative predictions (predicting that injury will not occur, but it occurred). Therefore, recall of prediction model is more important.

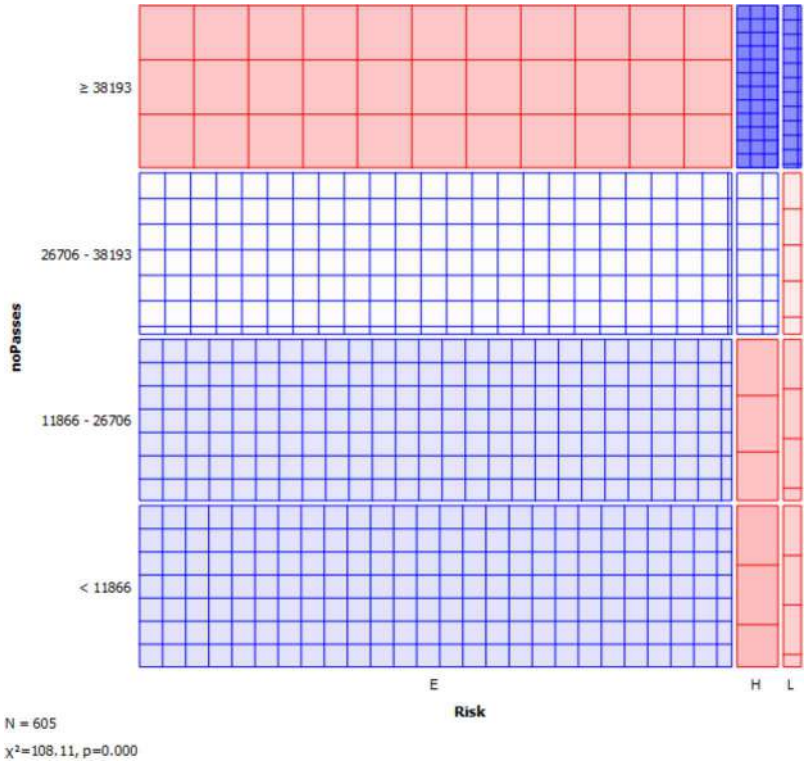

Figure 1: Sieve diagram showing a correlation between the number of ski lift transportations (noPasses) and the risk level (E-expected, H-high, L-low)

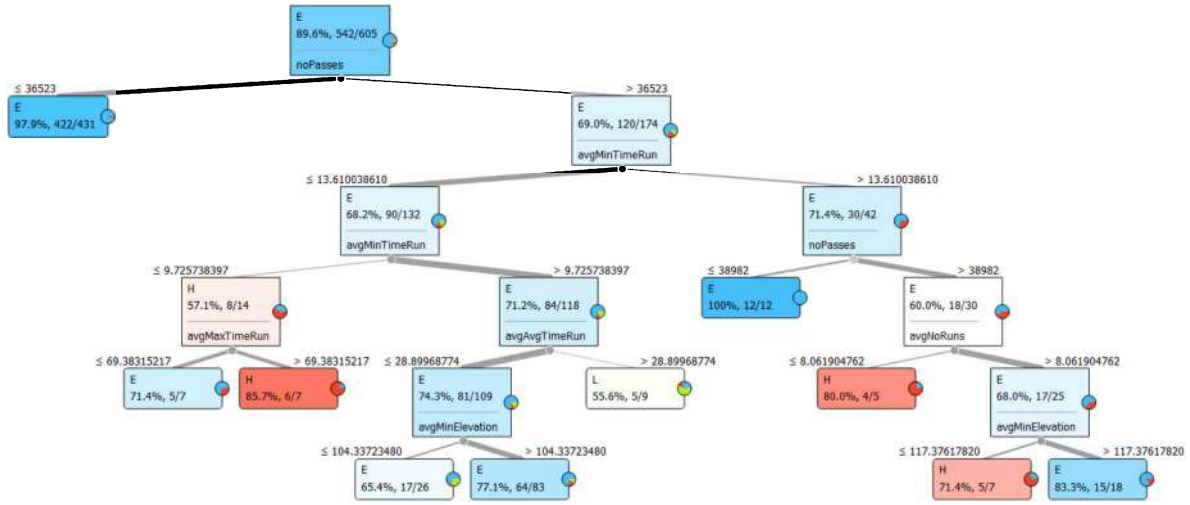

Figure 2: Basic decision tree model

In order to understand what is happening when there are a lot of transportations in the ski resort (the ski resort has a lot of skiers in the system) we propose a measure for quantifying success in the ski resort. We assume that each skier's goal is to achieve as much skiing in the resort as possible. We measured this success with achieved vertical meters (the sum of height above sea level between ski lift exit points and ski lift entrances) within a certain time period.

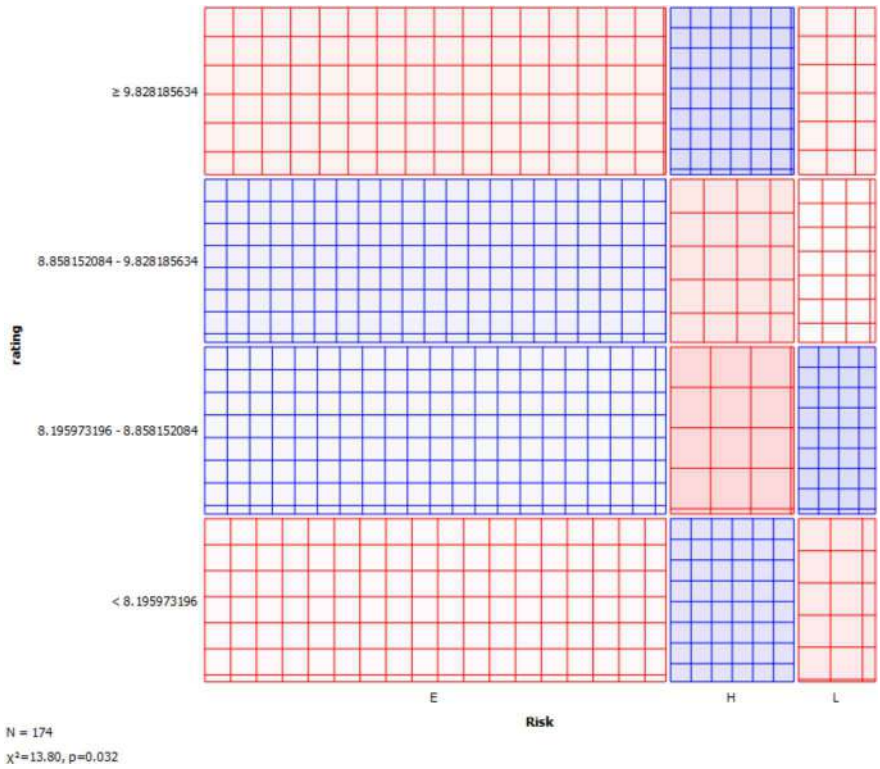

Figure 3: The relationship between the rating of the success of skiers and the risk level

The rate of success is shown in (1). It is calculated for each day, and is the ratio of the total amount of vertical meters (vm) skiers have achieved and the total time (t) skiers have spent in the ski resort:

$$SR(d) = \frac{\sum vm}{\sum t} \tag{1}$$

From Figure 3 it can be noticed that if the rating of success is below 8.19 or above 9.83 (vertical meters per minute) an above average level of risk can be expected. If this level is between 8.86 and 9.83 an average level of injury can be expected. If this level is between 8.19 and 8.86 either an average or low level of ski injuries can be expected.

This finding is interesting as it suggests that a smaller, but also greater, a rating of success influences high risk of injury. This can be explained as follows. If skiers' population have a high rate of success, they ski at faster speeds. Faster speeds induce greater levels of risk, which is a well-known result known from road traffic injuries. On the other hand, if the rate of success is below a certain threshold either the conditions of skiing are not optimal (low visibility, bad conditions of slopes) or the ski resort is overcrowded. This way injury due to collisions is more likely to occur. In any case, it worth noticing that safer skiing can be expected when this ratio is between 8.2 and 9.8 vertical meters per minutes.

We have also analyzed the performance of several data mining algorithms on the dataset that only included days with ski lift transportations above 36,523. The results are shown in Table 1.

Table 1: Data mining algorithm performance is shown in percentages

Algorithms	Accuracy	Recall (Expected Risk)	Recall (High Risk)	Recall (Low Risk)
AdaBoost	56.9	70.8	30.3	4.8
Logistic Regression	69.5	100	3	0
Naïve Bayes	54	71.7	15.2	1.43
Random Forest	59.8	85.8	3	0
Tree	61.5	79.2	33.3	1.43

It can be noticed that algorithms have it overall difficult to predict the occurrence of the low-risk level. On the other hand, algorithms don't achieve a better accuracy of prediction over 69.5% which is the majority class

predictor (Logistic regression models uses this method for prediction). However, if we inspect recall of the models we can observe that lower accuracy models had better recall for high risk of injury. For predicting high-risk occurrence two algorithms showed to be the best, AdaBoost and the Decision tree where the decision tree had a slight advantage of 3%.

5. CONCLUSION

This paper has studied the occurrence of ski injury based on ski lift transportation data. It was shown that this data can only be used a good predictor until a certain amount of ski lift transportation happens in the ski resort. After this level, the injury risk can vary significantly. We, therefore, introduced a success measure of skiers which showed to be significantly correlated ($p=0.032$ from Figure 3) to the risk level occurrence. From data, it can be noticed that the safest skiing occurs when skiers have a balanced success score. If this score is above or below the average values high risk of injuries could occur. Ski resorts could influence the safety of the ski resorts by controlling that skiers achieve the optimal success scores. This could be either done by intelligently slowing down the ski lifts if skiers speed too much. Ski lift speeds could be also better adjusted to achieve faster transportations when there is congestion in the ski resorts. Of course, better warnings of skiers to ski safely could also be of great help.

This paper suggested some first insights into studying the daily level of injury occurrence in ski resorts. Further efforts should be made in understanding what is happening in ski resorts which are congested and how this influences the level of injury. We propose to introduce new features which could probably be better predictors, such as quality of snow or other quality of success measures, for data mining models, but also to test these findings on other ski resorts to prove the validity of these findings.

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DECISION TREE-BASED ALGORITHM FOR THE CLASSIFICATION OF MUSICAL INSTRUMENTS

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Abstract:*This paper examines the use of binary decision tree for classification of musical instruments, using mel-frequency cepstral coefficients as timbre features. We analyze 4094 samples of bass clarinet, contrabassoon, flute, oboe, trumpet and violin to get their timbre coefficients. The dimensions of these coefficients are reduced using principal component analysis. A binary tree is created and optimized to predict the instrument classes based on these timbre coefficients.*

Keywords*:Binary decision trees, musical instrument classification, mel-frequency cepstral coefficients*

1. INTRODUCTION

The human capability to perceive differences between musical instruments is a subject of research for a number of years. Even with minimal musical knowledge, most people can easily make distinction between familiar musical instruments, even played at the same loudness and pitch. By definition of American National Standards Institute (1951) the quality of auditory sensation by which a listener can distinguish between two sounds of equal loudness, duration and pitch are known as timbre. Hence it could be said that musical instrument recognition is strongly dependent on timbre. Unfortunately, unlike pitch and loudness, timbre has proven to be somewhat difficult to measure or quantify (Loughran, Walker, O'Neil & O' Farrell, 2000).

Over the last decade, numerous studies have been investigating the nature of speech and speaker recognition research. Progress has been made on the analysis of speech waveforms, in its perception by humans, and in the use of different statistical methods for classification. On the other hand, the topic of instrument classification and recognition has been studied less. In this paper, we will be relying on knowledge gained in speech research, such as the *mel-frequency cepstral coefficients.*

This paper focuses on the automatic recognition of musical instruments, where the idea is to build a binary decision tree that can "listen" to the musical sounds and recognize which instrument is playing. The experimental material consists of 4094 single notes, the timbre of which has been studied comprehensively. Combined with the state-of-the-art automatic sound source recognition systems, these form the foundation for the most important part of this work: the extraction of perceptually relevant features of acoustic musical signals and their classification into instrument groups.

Binary trees are one of most common and powerful data structures in the computer science The computational cost of making a tree is fairly low, but the cost of using it is even lower - $O(\log N)$ (Castan, Ortega & Lleida, 2010). Binary trees are used as a cornerstone of classification analysis, which is the main reason it is discussed in this work.

The literature review and motivation part of this paper introduces the studies of the sound timbre and classification methods used for their recognition. Following, Section 3 reflects the method used in the experiment and explains the core idea of the work, while details on implementation of binary tree are given in Section 4. Finally, results are concluded in Section 5.

2. LITERATURE REVIEW

As mentioned, the field of speech/music classification was studied by many researchers. Firstly, there are numerous studies that analyze the behavior of different classification algorithms used for music and speech other than binary trees. In the Tables 1 and 2, a brief overview is given on general studies already done in the field of music recognition.

Large amount of data is in the audio format, from several resources such as broadcasting channels, databases, Internet streams and commercial CDs. This has made space for a new field of research, audio content analysis (ACA), or machine listening, whose purpose is to analyze the audio data and extract the

content information directly from the acoustic signal (Burred & Lerch, 2004). Speech and music classification is also useful in other forms of applications, for example, content-based audio coding or indexing other data, such as classification of video content through the accompanying audio. Spurred by the growth of annotated datasets and the democratization of high-performance computing, feature learning has enjoyed a renewed interest in recent years within the MIR community, both in supervised and unsupervised settings (MATLAB, 2015).

Table 1: Summary of studies in the field of audio classification

Authors	Classification method	Main application	Audio materials	Results
Saunders (1996)	Multivariate Gaussian classifier	Automatic real-time FM radio monitoring	Different types of music, commercials, talk	95-96% of accuracy
Footer (1997)	MFCCs, short-time energy	Using acoustic similarity to retrieve audio documents.	409 sounds and 255 (7sec long) clips of music	High rate of success, although no specific accuracy rate provided
Burred and Leech (2004)	KNN classifier, 3 component GMM classifier, MFCC	Classification of music into genres and audio classification	Speech, 13 genres of music, background noise	94,6% hierarchical approach and 96,3% direct approach
Marques and Moreno (1999)	Gaussian mixture model, Support Vector Machines, mel-frequency feature set	Automatic annotation system	Bagpipes, clarinet, flute, harpsichord, organ, piano, trombone and violin	GMM had an 75% accuracy rate, SVM 70% accuracy
Eronen (2001)	Distance-based algorithms, probabilistic classifiers	Listen and recognize the instrument playing	29 instruments	35% accuracy between 29 instruments, 77% accuracy between six instrument families
Toghiani-Rizi and Windmark (2017)	Multilayer perceptron	Musical instrument recognition	Feature vector of length 50, containing a normalized frequency spectrum of the audio signal	Average accuracy of 93,5%

Numerous studies have been done in the field using binary decision trees (Table 2).

Table 2: Summary of studies in the field of audio classification using binary decision trees

Authors	Main application	Audio materials	Results
Wold, Blum and Wheaton (1996)	Building a system to distinguish between sound classes	laughter, bells, synthesizer, different instruments	98,6% accuracy
Han, Pen, Jeon, Lee and Ha (1998)	Genre classification	Songs from three genres: jazz, classical and popular music.	55% accuracy
Lavner and Ruinsky (2009)	Segmentation of audio signals into speech and music	12 hours of speech, 22 hours of music	99,4% accuracy for speech, 97,8% for music, quick adjustment to altering speech/music sections
Castan, Ortega and Lleda (2010)	Classification of audio frames into speech or music	20 tracks, that alternate segments of music, speech or both	99,56-99,94% accuracy

Nowadays, many Internet search sites, such as AltaVista and Lycos, evolved from purely textual indexing to multimedia indexing. It is estimated that there are approximately thirty million multimedia files on the Internet with no effective method available for searching their audio content (Swain, 1998). If every sound file had a corresponding text file that accurately described human perceptions of the given audio content, audio files

could be easily searched. For example, in an audio file containing only speech, the text file could include spoken text, names, most frequent words etc. In a music file, the annotations could include instruments recognized in the file or parts of the songs used. There is an uncountable amount of audio data stored off and online with no adequate classification technique based on its content, so the interest of creating computer systems and algorithms to classify instruments is evident. In that manner, automatic methods able to effectively index multimedia files are key.

With a goal of gaining broader knowledge about audio information retrieval, we chose binary decision trees as the cornerstone of our analysis, as it is easy to use, but also provides a lot of useful information. Binary trees are closely related to information theory. The idea behind trees is to choose the most informative feature at each step. The principle is to quantify how much information is provided by knowing certain facts. Additionally, binary trees usually give highly accurate classification rates, which is the reason they will be used in this work. The goal is to provide basic classification insight in order to carry out our analysis further.

3. THE PROPOSED MODEL

In this study, we investigate a problem of classifying samples of six instruments: bass clarinet, contrabassoon, flute, oboe, trumpet and violin. The first part of the experiment is focused on extraction of relevant timbre features from original input dataset. The second one regards the construction of a binary decision tree, which will be used to classify input data into instrument groups.

3.1. Feature extraction

The original data is represented as a set of tones played on different instruments. Instruments used in the experiment are bass clarinet, contrabassoon, flute, oboe, trumpet and violin. Each instrument covers a range of different dynamics and scales, ranging from pianissimo to fortissimo, from second to eighth octave, respectively.

Since the goal of this paper is to determine the timbre similarity between tones of the same instruments, first we must extract and explicitly represent timber features of the sound. This is done using **Mel-Frequency Cepstral Coefficients (MFCCs)**. It is well known that the MFCCs are a compact and efficient representation of speech (Castan *et al.*, 2010).Each coefficient has a value for each frame of the sound. We examine the changes of these coefficients across the range of the sound. In order to obtain MFCCs we must:

1. Divide signals into frames,
2. Get the amplitude spectrum of each frame,
3. Take the log of these spectrums,
4. Convert to mel-scale,
5. Apply the discrete cosine transform (DCT).

First, we divide signals into frames. This is done using a windowing technique. In most applications, the audio signal is analyzed by means of *short term* or *short-time* processing technique, according to which the signal is broken into, in our case, overlapping windows (frames) and the analysis is carried out on a frame bases (Giannakopoulos & Pikrakis, 2014). The reason we use windowing is because sound signals aren't stationary and their properties vary usually very dynamically over time. So in order to catch the switch in time between the frames, we use overlapping by some percent (25%, 50%, 75% etc.). In this experiment, the overlapping step is set to 50%.

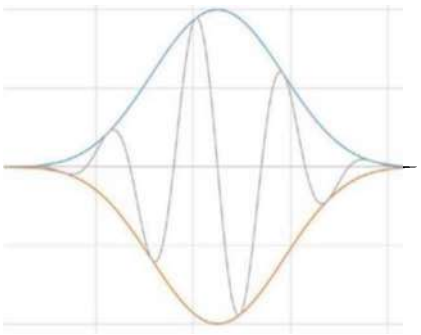

Figure 1. Windowed sample (Marsland, 2009)

Mel-scale is a perceptual scale of pitches judged by listeners to be equal in distance from one another (Stevens, Volkmann, & Newman, 1937). We project our signals onto mel-scale in order to represent the computed sounds in a way that's similar to human perception of the tones.

Sampled, these tones were split into windows, or frames. Windowing reduces the amplitude of the discontinuities at the boundaries of each point of the sampled signal. This makes the endpoints of the waveform meet and, therefore, results in a continuous waveform without sharp transitions. Applying a window minimizes the effect of spectral leakage (National Instruments, 2015).

This way, we are able to catch changes between the signal frames and apply the discrete Fourier transform (DFT), which is kind of a cornerstone of digital signal processing. Discrete Fourier transform gives us a frequency-domain (spectral) representation of the signal:

$$X[k] = \sum_{n=0}^{N} x[n] e^{\frac{-2j\pi kn}{N}}. \quad (1)$$

Or, if we rewrite it:

$$x(n) = \frac{1}{N} \sum_{n=0}^{N-1} X(k) y_k(n), \quad (2)$$

where $y_k(n) = \frac{-2j\pi kn}{N}, \quad n = 0,...,N-1.$

It can be seen that the original signal can be represented as a weighted average of a family of fundamental signals (basis functions), where each signal, $y_k(n)$ is a complex exponential and its weight is equal to the *k*th DFT coefficient (Giannakopoulos & Pikrakis, 2014).

After these transformations our data is represented in frequency or spectral domain, where we get the most of our timbre information from. Most commonly used and very efficient algorithm for the computation of DFT coefficients is fast Fourier transform. We are particularly interested in the magnitude of the *k*th DFT coefficient, since it represents a measure of intensity with which the respective frequency participates in the signal $x(n)$ (Giannakopoulos & Pikrakis, 2014).

Discrete Cosine Transform is used to reduce the data. DCT represents our input as a sum of cosine waves oscillating at each frequency of the signal. Discrete Cosine Transform can be expressed as:

$$y(k) = a(k) \sum_{n=0}^{N-1} x(n) \cos\left(\frac{\pi(2n+1)k}{2n}\right), \quad k = 0,1,...,N-1. \quad (3)$$

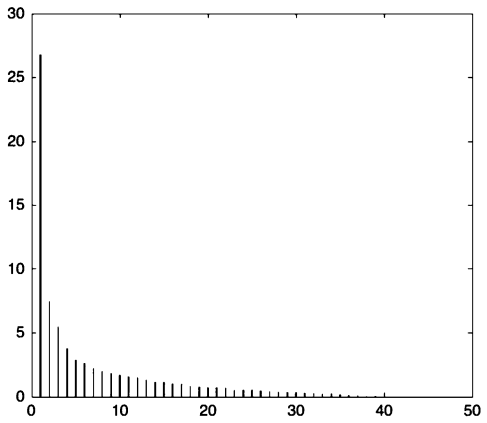

Figure 2. Eigen spectrum of the violin tone A3 *(forte)*

Afterthisalgorithmhas been applied, we have got a matrix of values for each sample sound. That is, every sound is represented with the *number of coefficients observed*, in this case **40**, by the *number of frames* in size. Since we must represent our data it in a more compact way, we are using **Principal Component**

Analysis (PCA). We apply PCA to the calculated coefficient data. PCA provides a roadmap for how to reduce a complex data set to a lower dimension to reveal the sometimes hidden, simplified dynamics that often underlie it (Wold, Blum, Keislar & Wheaton, 1996). This way, we get our final matrix of input data. It shows that one principal component is enough to describe the data needed for this model.

In Figure 2 werepresenttheeigenspectrumof a tone A from thethirdoctave, playedwith forte dynamics on the violin. Wecansee, thatthefirst principal componentoutof 40 describesthe most ofthe signal. Three, orfour at most, principal components are enough to describethe data in most efficientway. In thisexperiment, we are using one principal component. Finally, weapplybinarydecisiontreeontoour set ofsignals.

3.2. Decision tree

Tree-based algorithm used in this study is **Classification and Regression Trees (CART)** algorithm. As the name indicates, it can be used both for classification and regression (Saunders, 1996). CART uses **Gini impurity** as information measure. The 'impurity' in the name suggests that the aim of the decision tree is to have each leaf node represent a set of data points that are in the same class, so that there are no mismatches. This is known as purity (Marsland, 2009).

The CART classification method is implemented using MATLAB *fitctree* function. Once fitctree function returned classified tree, there are a number of parameters which can be used in order to optimize the tree in the best manner. In this experiment, we focused on getting the best values for name-value arguments *Maximum number of categories (MaxNumCategories)* and *Minimum Leaf Size (MinLeafSize)*. After setting up these arguments, another method for optimizing the decision tree is used, called pruning. Pruning optimizes tree depth (leafiness) is by merging leaves on the same tree branch (Marsland, 2009). Now that the tree is improved it can be used to classify and predict outputs of our test dataset.

3.3. Classification details

Since the feature extraction is a big and complex process and isn't quite the focus of the work, we are not going to overview that part of the experiment. We are using the output matrix of the feature extraction process as our input matrix. It is represented as a set of 4094 sound signals and 40 cepstral coefficients describing the timbre for each of them.

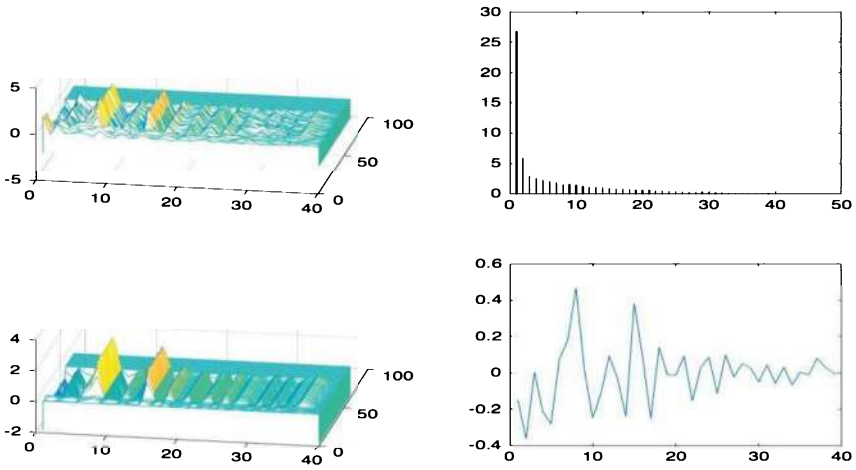

Figure 3: Representation of tone A4, *mezzo forte,* played on the oboe

Figure 3 is a representation of the oboe tone A, from the fourth octave, played in mezzo forte dynamics. In the upper left corner, we can see the spectral envelope of the sound, in its original form. Figure from the lower left corner shows the same tone, but with dimensions reduced using Singular Value Decomposition. We can see from the similarity of two left figures, that even with reduced dimensionality we still get a good approximation of the analog music signal. On the right part of the picture, in the upper corner is eigen spectrum of the tone. It allows us to see that two or three principal components are enough to describe the whole signal, while even with one we get all the information needed. Lower left graph is a 2-D representation of the signal with reduced dimensions.

In order to construct the tree, we first separated the data into training and testing sets. We are going to optimize our binary tree to fit our problem adjusting parameters *minimum leaf size* and *maximum number of*

categories. In order to grow an efficient tree, we must consider its simplicity and predictive power. Usually, a deep tree with many leaves is highly accurate on the training data. On the other hand, the tree is not guaranteed to show a comparable accuracy on an independent test set. This leafy tree tends to overfit, or overtrain, and test accuracy is often far less than its training (resubstitution) accuracy. A shallow tree does not attain high training accuracy. But it can turn out more robust – meaning, its training accuracy could be close to that of a representative test set and shallow tree is easy to interpret.

The argument that we used to control the depth of decision trees in MATLAB is *MinLeafSize*. Function *fitctree* splits a categorical predictor using the exact search algorithm, if the predictor has at most *MaxNumCategories* levels in the split node. Passing a small value can lead to loss of accuracy and passing a large value can increase computation time and memory overload (Marsland, 2009). Commonly used method for optimization is called pruning which is commonly used in construction of binary decision trees. Pruning optimizes tree depth or leafiness by merging leaves on the same tree branch. Pruning is implemented with MATLAB function *prune*. Now our tree is final, optimized, depth-adjusted binary decision tree that we can now use to classify our test, using MATLAB function *predict*.

4. RESULT ANALYSIS

There are several possible uses of a learning tree. Creating tree to classify unknown sounds is the first one. Others include the analysis of the tree: which questions, or we could say attribute, splits the data? In our case: which coefficient has the biggest informative value? Furthermore, the tree can be used to improve the analysis, by finding out what's wrong with the misplaced data (Marques & Moreno, 1999).The main focus of this paper is to classify the sounds using binary decision tree. In addition, we will analyze which timbre attribute split the data into instrument classes.

The argument that we used to control the depth of decision trees in MATLAB is *MinLeafSize*. Function *fitctree* splits a categorical predictor using the exact search algorithm in case the predictor has at most *MaxNumCategories* levels in the split node. Otherwise, *fitctree* finds the best categorical split using one of the inexact algorithms. Passing a small value can lead to loss of accuracy and passing a large value can increase computation.

In order to test our tree, we will feed it with test data. As we mentioned, this is done using predict function in MATLAB. Function returns predicted class labels for our classification tree and predictor, in our case testing dataset. This vector is crucial in understanding how well our tree classified data. Output argument LABEL is a vector of the same type as the response data used in training tree, ctree. Each entry of LABEL corresponds to the class with minimal expected cost for the corresponding row of testing input features. We used two measures to calculate the error rate of the tree: resubstitution loss and cross-validation error. Both values are fairly low, where resubstitution loss is 0,065% and cross-validation error 0,13%.

Table 3: Confusion matrix for binary tree classifier

	Bass clarinet	**Contra-bassoon**	**Flute**	**Oboe**	**Trumpet**	**Mandolin**
Bass clarinet	163	0	0	0	0	0
Contra-bassoon	0	166	0	0	0	0
Flute	0	0	147	0	0	0
Oboe	0	0	0	130	0	0
Trumpet	0	0	0	0	99	0
Mandolin	0	0	0	0	0	316

With respect to our low classification error, we can see that tree predicted only 2 samples out of class. As confusion matrix shows us, tree misclassified two flute samples as the violin tones. This makes sense, because the flute and violin are two instruments that can reach to the highest tones. Also, this confirms the rules our binary tree defined for this problem. As we can see in the figure 4 below, the first question our tree asks is: Does our input signal's 40th cepstral coefficient hold a value that's larger than -0,0344922? If it does have a value larger than -0,0344922 it is directed to the class six, which is enumeration for the violin, and further classified. On the other hand, if it doesn't, then it is classified as class three, in our case the flute.

This is also an example of another use of binary trees – analyzingthe factors influencing classification. Unlike neural networks, binary trees offer the possibility of insight in our system, which can give us a lot of useful information for method improvement.

Spectral component is any of the waves that range outside the interval of frequencies assigned to a signal. By extracting these spectral features, meaning each spectral component of the tone, and calculating their

amplitude, we are presented with the occurring frequency of each spectral component in a single tone. In other words, we are able to see how much of each non-fundamental frequencies of the tone are represented in the signal. Differences in these frequencies define what we call timbre of a tone.

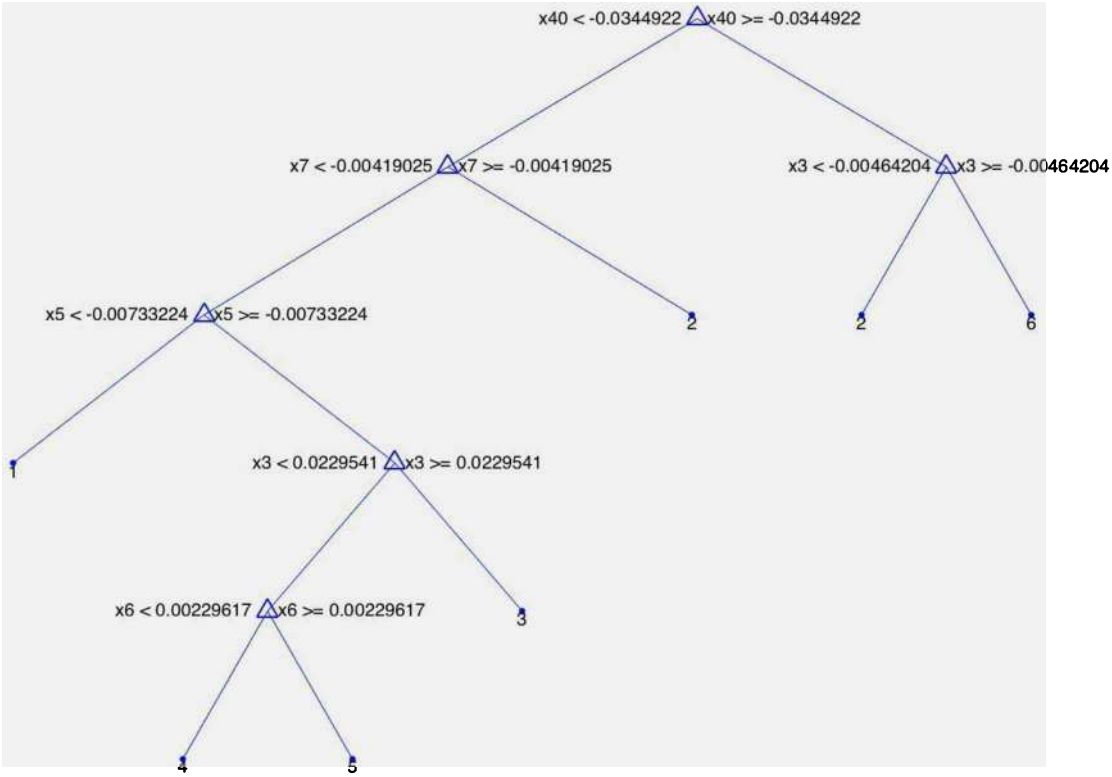

Figure 4: Representation of classification binary decision tree for our problem

We log these frequencies, actually mel-scale it, and by doing it we adjust it to human perception of the sound, since we perceive it logarithmically. Human ear perceives frequencies lower than 1 kHz on a linear scale, after which it switches to log scale. Meaning, we perceive less the difference between higher tones, ones over 1 kHz, then we do with the lower ones.

Analyzing the tree to see which attributes it used to split the data, we can see in which range of the frequencies bears the most information. We can see that the lower indexed filters are more present than the higher ones, but the *highest indexed* one is the most informative one. This makes sense, since the lower filters present lower non-fundamental frequencies, and together they represent a lot of spectral information, but the amount of highest frequencies is what makes the big difference. The bass clarinet could never get the high notes of the violin. It is important to notice, that the first 13 filters stand for lower frequencies, while the rest 27 stand for higher frequencies, in log space.

5. CONCLUSION

This paper has presented the classification of musical sounds in instrument families using binary decision trees with the accuracy of 99,87%. The automatic tree construction, using *fitctree* function, has created well-balanced, efficient trees. Binary decision trees are easy to use and usually give accurate results for classification and regression, so we often use them as a cornerstone of classification analysis.

As we can see, binary decision trees give a high accuracy in musical signal classification, not just for our problem type. We notice that in all of the mentioned studies in the field accuracy is rarely lower than 90%. Since the data is represented in a compact manner, with most important features represented directly and our data vectors are decorrelated, it makes it much easier for our tree classifier to segment the data. This is a good sign for our information retrieval method. In addition, optimization of the tree parameters benefits the high accuracy. Optimal parameters have been set for this specific problem.

We used cross-validation error and resubstitution error to measure the accuracy of classification tree. These measures were also used for evaluating the efficiency of the tree supplied with different-valued parameters

MinLeafSize and MaxNumCategories. We have created a high accuracy tree, with our features extracted from unified audio data, with dimensions reduced. Analyzing the tree, we can see that a major part of timbral information lies in the lower frequency range, but the filter bearing most valuable information is the highest indexed one, meaning the first question and the crucial information is the amount of the highest frequencies presented in a single tone.

There are a lot of questions and space for future work. Analyses should be done on how cepstral coefficients behave in the same instrument family, as well as changes in cepstrals just for one instrument. The effect of playing techniques could also be taken into account. These analyses would bring us closer to understanding and using timbre of a sound with more clarity.

Further work should also check accuracy of binary tree with different parameterization, more instrument families, and different sound representation and see the effect on the result and accuracy. Using different filter shapes within the first layer seems crucial for an efficient learning with spectrogram-based CNNs (Shlens, 2003), which is another direction for research.

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DETERMINING THE WEIGHTS OF CRITERIA IN MENU EVALUATION USING BEST-WORST METHOD

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Abstract: *The evaluation of dishes represents basic activity in the structuring of the menu, which allows the optimal use of resources in order to fully satisfy the expectations of users and restaurant management. Models for menu analysis allow systematic evaluation, by comparing individual dishes according to previously selected criteria. This paper presents a new approach for determining the weights of criteria in menu evaluation using Best-Worst Method (BWM) which objectivize the inconsistencies in expert judgment. The model was successfully tested on the menu of a collective nutrition restaurant, where nine relevant experts have influenced on forming the weight coefficients of three groups of criteria.*

Keywords*: menu evaluation, collective nutrition, restaurant management, BWM, MCDM, expert judgment*

1. INTRODUCTION

A high-quality menu allows optimal utilization of capacity and resources of a restaurant in order to fully satisfy the expectations of users and restaurant management. The menu represents a worthwhile synthesis of needs of the target group of users, on one hand, and the ability of a restaurant to prepare a dish in a cost-effective way according to the defined standards, on the other. The menu is structured based on the production capacities of a restaurant (technical, technological and organizational), available resources and preferences of restaurant service users.

In the process of menu optimization, the evaluation of dishes constitutes a basic activity by which the dishes with lesser performance and a smaller contribution to the set goals, are innovated or substituted with better ones. All business decisions of restaurants related to production and placement are derived from the menu. (Taylor, J., Brown, D., 2007). The menu interprets to the guest restaurant's offer, kindness, and a type of service and influences the creation of a unique experience in dining (McCall, M., Lyn., A., 2008). For this reason, researchers in many studies are working to create a model for optimizing menus to increase efficiency, customer satisfaction and profit (Taylor, J., Reynolds, D., Brown, D., 2009).

An early attempt to menu analysis, as first introduced by Miller (1980), employed a four quadrant matrix with vectors associated with sales and popularity, measured as sales velocities. Kasawana and Smith (1982), later, using the Boston Consulting Group Portfolio Analysis as the basis for the Menu Engineering Matrix approach, incorporated contribution margin defined as the difference between the sales price of an item and the cost of food product to produce that item. They considered high gross profit and low food cost as mutually exclusive. Pavesic (1983), used wighted gross profit/contribution margin to replace the individual menu item gross profit and included “popularity” as an indirect third variable. Hayes and Huffman (1985) developed an individual profit and loss statement for all menu components in an attempt to alloacate all costs including labor and fixed costs to individualy menu items. Bayou and Bennet (1992) developed a profitability analysis model to evaluate the financial strength of menu items in an attempt to allocate variable costs such as labor. Horton (2001) proposed different approach and modified Kasawana and Smith’s Menu Engineering Model by including estimated labor into the contribution margin (gross profit).
Tom and Annaraud (2017) applied fuzzy multi-criteria decision making techniques to Kasavana and Smith model in order to reduce inaccuracies in the evaluation of alternatives presented by linguistic expressions and providing more relevant information to the decision makers.
Previous researchs did not advantage multi criteria decision making methods based on non-matrix access, wich disable aggregation of wide range relevant criteria for evaluation menu items, both quantitative and qualitative, in a peculiar comparable figure. A new approach, presented in this paper exceeds specified limits and allows for more accurate menu evaluation and an optimization of menu assortment by elimination or substitution of weak ranked menu items with a new better ones.

In this study, the authors have chosen to apply BWM for determining the weight coefficients of criteria due to following advantages (Rezaei, 2015): (1) A smaller number of comparisons in pairs, e.g. The Analytical Hierarchy Process (AHP) method (Satty, 1980) requires n (n-1) / 2 comparisons, while BWM requires 2n-3 comparisons; (2) The weight coefficients obtained by using BWM are more reliable - comparisons are made

with a higher degree of consistency; (3) In most models for multi-criteria decision-making (MCDM), e.g. AHP method, the degree of consistency represents a check whether the comparison of criteria is consistent or not; in BWM degree of consistency is used to determine the level of reliability since BWM outputs are always consistent; (4) When comparing in criterion pairs BWM uses only integer values, unlike AHP which also requires the use of fractional values.

2. BEST-WORST METHOD

This section shows BWM algorithm that includes the following steps:

Step 1. Identification of the evaluation criteria set $C=\{c_1,c_2,...c_n\}$, where n represents the total number of criteria.

Step 2. Identification of a single criterion with the most dominant and most inferior impact provided that if there are two or more criteria of the same importance only one is arbitrarily chosen.

Step 3. Determining the dominance of the most important criteria from the set C in relation to other criteria of the same set, this is measured on the scale of numbers 1-9. The measurement result is represented by vector "best in relation to others" (BO):

$$A_B=(a_{B1},a_{B2},...,a_{Bn}) \tag{1}$$

where a_{Bj} represents the advantage of the most dominant criterion B in relation to criterion j, where $a_{BB}=1$.

Step 4. Determining the dominance of all the criteria from the set C in relation to the most inferior criterion of the set, expressed by a number on scale 1-9. The result of measurement is represented by vector "others compared to the worst" (OW):

$$A_W=(a_{1W},a_{2W},...,a_{nW}) \tag{2}$$

where a_{jW} represents the dominance of criterion j in relation to the worst criterion W, where $a_{WW}=1$.

Step 5. Calculation of optimal values of weight coefficients of the criteria from set C, $(w_1^*,w_2^*,...,w_n^*)$, whereby the condition should be satisfied that maximum absolute values of differences (3)

$$\left|\frac{w_B}{w_j}-a_{Bj}\right| and \left|\frac{w_j}{w_w}-a_{jW}\right| \tag{3}$$

for all values of j be minimized. This condition can be represented by the following minimax model:

$$\begin{aligned}&\min\max_j\left\{\left|\frac{w_B}{w_j}-a_{Bj}\right|,\left|\frac{w_j}{w_w}-a_{jW}\right|\right\}\\&s.t.\\&\sum_{j=1}^{n}w_j=1\\&w_j\geq 0\ \ \forall j\end{aligned} \tag{4}$$

The previous model (4) can be represented by an equivalent model in the following way:

$$\begin{aligned}&\min\xi\\&s.t.\\&\left|\frac{w_B}{w_j}-a_{Bj}\right|\leq\xi,\forall j\\&\left|\frac{w_j}{w_w}-a_{jW}\right|\leq\xi,\forall j\\&\sum_{j=1}^{n}w_j=1\\&w_j\geq 0\ \ \forall j\end{aligned} \tag{5}$$

By solving the system of equations and inequations of the model (5), optimal values of the evaluation weight coefficients $(w_1^*,w_2^*,...,w_n^*)$ and ξ^* are obtained.

For each value $a_{BW}\in\{1,2,...,9\}$ the values of consistency index are calculated $CI(\max\xi)$, (Rezaei, 2015), Table 1

Table 1: Consistency index values

a_{BW}	1	2	3	4	5	6	7	8	9
$CI(\max \xi)$	0.00	0.44	1.00	1.63	2.30	3.00	3.73	4.47	5.23

By solving the system of equations and inequations of the model (13), we get the optimal values of evaluation weight coefficients $(w_1^*, w_2^*, ..., w_n^*)$ and ξ^*.

It is considered that the values of evaluation weight coefficients are reliable if the condition represented by the expression (6), (Rezaei, 2015) is satisfied,

$$CR = \frac{\xi^*}{CI} \leq 0,25 \tag{6}$$

$$CR \in [0,1]$$

where CR is the degree of consistency. From the expression (6) it can be noticed that as the value ξ^* increases, the value of CR increases, that is, the reliability of comparison results of the defined criteria by experts is decreased. If the condition represented by expression (6) is not satisfied, the optimal weight coefficients of criteria are calculated in the form of interval numbers by solving the model (7)

$$\begin{array}{ll} \min w_j & \max w_j \\ s.t. & s.t. \\ \left|\frac{w_B}{w_j} - a_{Bj}\right| \leq \xi^*, \forall j & \left|\frac{w_B}{w_j} - a_{Bj}\right| \leq \xi^*, \forall j \\ \left|\frac{w_j}{w_w} - a_{jW}\right| \leq \xi^*, \forall j & \left|\frac{w_j}{w_w} - a_{jW}\right| \leq \xi^*, \forall j \\ \sum_{j=1}^{n} w_j = 1 & \sum_{j=1}^{n} w_j = 1 \\ w_j \geq 0 \ \ \forall j & w_j \geq 0 \ \ \forall j \end{array} \tag{7}$$

For each interval value, the center of the interval is determined, which is used to rank the criteria of alternatives (Reazei, 2016).

3. DETERMINING THE WEIGHTS OF CRITERIA USING BWM

In the first step, based on the expert experience, nine relevant criteria for menu evaluation have been identified: Time required for preparation, Technical-technological and organizational requirements (TTOR) for storage of meal components, TTOR for meal preparation, Price, Energy value, Digestibility, Sensory properties, Elan for work and Possibility of preparation in unforeseen circumstances, for which the labels and explanations are given in Table 2

Table 2: Evaluation Criteria

Criterion label	Criterion name	Explanation
C1	Time needed for preparation	The duration of technological process
C2	TTOR storage of meal components	Space, appliances and storage facilities
C3	TTOR for meal preparation	Space, machines, appliances, accessories, recipes, qualifications of people
C4	Price	Cost of fresh foods
C5	Energy value	Caloric value of a meal
C6	Digestibility	A subjective feeling in the body after consuming a meal
C7	Sensory properties	Appearance, smell, taste, texture
C8	Elan for work	Mental and physical work after the meal
C9	The possibility of preparation in unforeseen circumstances	In case of TTOR dysfunctionality

In the second step, BWM (Rezaei, 2015) was applied and a comparison of the best criterion with the others was made using the nine-degree scale [1.9], where 1 is the same significance, and 9 is a distinct dominance. The survey included nine reference experts with a minimum of ten years experience who carried out a comparison and the obtained results were presented with nine BO vectors, (Table 3)

Table 3: BO vector of compared criteria

	Criterion	E1	E2	E3	E4	E5	E6	E7	E8	E9	GM	Rank
BO	C1	4	6	7	4	8	9	4	5	5	5,53	8
	C2	2	2	8	8	7	8	1	9	9	4,72	6
	C3	1	1	5	7	2	2	2	6	8	2,88	2
	C4	3	7	3	9	3	6	3	8	7	4,93	7
	C5	7	3	1	2	1	5	7	1	1	2,25	1 (B)
	C6	8	4	4	6	4	3	9	2	3	4,30	4
	C7	5	5	2	3	9	7	6	3	6	4,65	5
	C8	9	8	9	1	5	1	8	4	2	3,90	3
	C9	6	9	6	5	6	4	5	7	4	5,60	9 (W)

In the next step, the experts compared the worst criteria with the others and the results were presented with nine OW vectors, (Table 4)

Table 4: OW vector of compared criteria

	Criterion	E1	E2	E3	E4	E5	E6	E7	E8	E9	GM	Rank
OW	C1	6	4	3	6	2	1	6	5	5	3,70	2
	C2	8	8	2	2	3	2	9	1	1	2,88	4
	C3	9	9	5	3	8	8	8	4	2	5,55	8
	C4	7	3	7	1	7	4	7	2	3	3,82	3
	C5	3	7	9	8	9	5	3	9	9	6,34	9 (B)
	C6	2	6	6	4	6	7	1	8	7	4,44	6
	C7	5	5	8	7	1	3	4	7	4	4,27	5
	C8	1	2	1	9	5	9	2	6	8	3,49	7
	C9	4	1	4	5	4	6	5	3	6	3,82	1 (W)

The values of BO and OW vectors were aggregated using the expression for geometric mean (GM) calculation, and then they were assigned the ranks which were used to form the model (5). Thus, for BO vector in table 3 for criterion C1, averaging was carried out as follows

$$GM_1 = \sqrt[9]{E_1 \cdot E_2 \cdot ,...,\cdot E_9} = \sqrt[9]{6 \cdot 4 \cdot 3 \cdot 6 \cdot 2 \cdot 1 \cdot 6 \cdot 5 \cdot 5} = 3.70$$

In the same way, the ranks of remaining criteria in Tables 3 and 4 were obtained. Based on the acquired values of criteria ranks, the model was set (5)

$$\min w_j$$

$$s.t.$$

$$\begin{cases} \left|\frac{w_5}{w_1} - 8\right| \le \xi \ ; \\ \left|\frac{w_5}{w_2} - 6\right| \le \xi \ ; \\ \left|\frac{w_5}{w_3} - 2\right| \le \xi \ ; \ \left|\frac{w_5}{w_4} - 7\right| \le \xi \ ; \\ \left|\frac{w_5}{w_6} - 4\right| \le \xi \ ; \\ \left|\frac{w_5}{w_7} - 5\right| \le \xi \ ; \ \left|\frac{w_5}{w_8} - 3\right| \le \xi \ ; \\ \left|\frac{w_5}{w_9} - 9\right| \le \xi \ ; \\ \sum_{j=1}^{9} w_j = 1 \\ w_j \ge 0, \ \ \forall j = 1,2,...,9 \end{cases} \quad \begin{cases} \left|\frac{w_1}{w_9} - 2\right| \le \xi \ ; \\ \left|\frac{w_2}{w_9} - 4\right| \le \xi \ ; \\ \left|\frac{w_3}{w_9} - 8\right| \le \xi \ ; \ \left|\frac{w_4}{w_9} - 3\right| \le \xi \ ; \\ \left|\frac{w_6}{w_9} - 6\right| \le \xi \ ; \ \left|\frac{w_7}{w_9} - 5\right| \le \xi \ ; \\ \left|\frac{w_8}{w_9} - 7\right| \le \xi \ ; \\ \sum_{j=1}^{9} w_j = 1 \\ w_j \ge 0, \ \ \forall j = 1,2,...,9 \end{cases}$$

The model shown is solved using the Lingo 17.0 software. By solving this model, the final values of weight coefficients were acquired

$$
\begin{aligned}
w_1 &= 0.03687;\\
w_2 &= 0.06155;\\
w_3 &= 0.19627;\\
w_4 &= 0.04988;\\
w_5 &= 0.26313;\\
w_6 &= 0.11567;\\
w_7 &= 0.08035;\\
w_8 &= 0.17174;\\
w_9 &= 0.02453.
\end{aligned}
$$

Using the expression (6), the value of consistency degree (CR) is calculated,

$$CR = \frac{\xi^*}{CI} = \frac{1,725083}{5,23} = 0.3298$$

Since the minimum consistency condition is not satisfied ($CR > 0.25$), the optimal weight coefficients of criteria are calculated in the form of interval values by solving the model (7). In the following section a model for obtaining the interval values of weight coefficient of the first criterion is shown.

$$
\min w_1 \qquad \max w_1
$$

$$
s.t. \qquad s.t.
$$

$$
\begin{cases}
\left|\frac{w_5}{w_1} - 8\right| \le \xi^*;\\
\left|\frac{w_5}{w_2} - 6\right| \le \xi^*;\\
\left|\frac{w_5}{w_3} - 2\right| \le \xi^*;\ \left|\frac{w_5}{w_4} - 7\right| \le \xi^*;\\
\left|\frac{w_5}{w_6} - 4\right| \le \xi^*;\\
\left|\frac{w_5}{w_7} - 5\right| \le \xi^*;\ \left|\frac{w_5}{w_8} - 3\right| \le \xi^*;\\
\left|\frac{w_5}{w_9} - 9\right| \le \xi^*;\\
\sum_{j=1}^{9} w_j = 1\\
w_j \ge 0,\ \ \forall j = 1,2,...,9
\end{cases}
\qquad
\begin{cases}
\left|\frac{w_1}{w_9} - 2\right| \le \xi^*;\\
\left|\frac{w_2}{w_9} - 4\right| \le \xi^*;\\
\left|\frac{w_3}{w_9} - 8\right| \le \xi^*;\ \left|\frac{w_4}{w_9} - 3\right| \le \xi^*;\\
\left|\frac{w_6}{w_9} - 6\right| \le \xi^*;\ \left|\frac{w_7}{w_9} - 5\right| \le \xi^*;\\
\left|\frac{w_8}{w_9} - 7\right| \le \xi^*;\\
\sum_{j=1}^{9} w_j = 1\\
w_j \ge 0,\ \ \forall j = 1,2,...,9
\end{cases}
$$

$$
\begin{cases}
\left|\frac{w_5}{w_1} - 8\right| \le \xi^*;\\
\left|\frac{w_5}{w_2} - 6\right| \le \xi^*;\\
\left|\frac{w_5}{w_3} - 2\right| \le \xi^*;\ \left|\frac{w_5}{w_4} - 7\right| \le \xi^*;\\
\left|\frac{w_5}{w_6} - 4\right| \le \xi^*;\\
\left|\frac{w_5}{w_7} - 5\right| \le \xi^*;\ \left|\frac{w_5}{w_8} - 3\right| \le \xi^*;\\
\left|\frac{w_5}{w_9} - 9\right| \le \xi^*;\\
\sum_{j=1}^{9} w_j = 1\\
w_j \ge 0,\ \ \forall j = 1,2,...,9
\end{cases}
\qquad
\begin{cases}
\left|\frac{w_1}{w_9} - 2\right| \le \xi^*;\\
\left|\frac{w_2}{w_9} - 4\right| \le \xi^*;\\
\left|\frac{w_3}{w_9} - 8\right| \le \xi^*;\ \left|\frac{w_4}{w_9} - 3\right| \le \xi^*;\\
\left|\frac{w_6}{w_9} - 6\right| \le \xi^*;\ \left|\frac{w_7}{w_9} - 5\right| \le \xi^*;\\
\left|\frac{w_8}{w_9} - 7\right| \le \xi^*;\\
\sum_{j=1}^{9} w_j = 1\\
w_j \ge 0,\ \ \forall j = 1,2,...,9
\end{cases}
$$

In the same way, non-linear mathematical models for the remaining criteria (C2-C9) are constructed, with limitations. By solving these limitations interval values of weight coefficients of the remaining criteria are acquired. The obtained intervals, the lower boundary (LB) and the higher boundary (HB), are shown in Table 5

Table 5: Boundary values of weight coefficient intervals

w_j	LB	HB
w_1	0.02535418	0.04736751
w_2	0.05185670	0.07025333
w_3	0.15435290	0.24982500
w_4	0.02941330	0.05611102
w_5	0.24318140	0.30230740
w_6	0.09790565	0.13126080
w_7	0.07425574	0.09230993
w_8	0.12876410	0.21785330
w_9	0.02267408	0.02818695

Since evaluation of menu dishes (alternative) could be done in the next stage using the selected MCDM model, the obtained interval values of weight coefficients will be considered as interval or rough numbers.

The concept of rough numbers introduced by Zhai (Zhai et al., 2008) was derived from the theory of rough (Pawlak, 1982).

4. CONCLUSION

The evaluation of menu is based on an objective and precise understanding of relevant factors that affect the satisfaction of users and restaurant employees.
User satisfaction is reflected in sensory perception and subjective feeling during and after the meal, while employee satisfaction reflects the synthesis of various impressions such as personal income, working conditions, working atmosphere and other feedback effects that imply user satisfaction. In a stimulating working environment, users and employees in the restaurant stimulate each other by raising the aspiration level over a longer period of time (Arsic, S., 2014).
BWM based approach allows the elimination of uncertainty of subjective assessment about importance of criteria of experts (Pamucar, D., et al., 2018) in various areas related to nutrition (nutrition, food technology, nutrition organization, quality of life) and precise positioning of dishes according to value rank which was acquired by evaluation. During the testing of the introduced approach 9 relevant experts have influenced on forming the weight coefficients of three groups of criteria: 1.group of criteria related to the subscribers (C6-C8) was evaluated by 35 users; 2.group of criteria related to food preparation (C1-C3 and C9) was evaluated by 15 experts involved in the food preparation process; 3.group consists of criteria related to the price of fresh foods required for food preparation (C4) acquired from market analysis and the caloric value of a ready meal (C5) measured in a renowned state institution.
The model is adequate for analysis and predictions in the following time period for the purpose of quality business decision-making by top management (Suknović, M., et al., 2012). The approach can be very effectively applied when it is necessary to form a menu based on the defined effects that nutrition should manifest on the target group of subscribers (favoring the quantity of nutrients and their digestibility, elan for physical work after the meal, preparation in unforeseen circumstances, etc.) especially in restaurants for collective nutrition of students, athletes, security forces and rekonvalescents, so future research should be aimed in that direction. In educational terms, the approach helps decision makers to better understand the complexity of process of identifying relevant criteria, dish evaluation and creating an optimal menu in given time, space, social, economic and other circumstances.

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ANALYSIS AND PREDICTION OF VIEWS IN YOUTUBE INTERVIEWS

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Abstract: *YouTube videos carry great number of data about the viewers habits, topics of interest and attention catchers. Several YouTube channels in Serbia stream specialized content in form of interviews. By analyzing channel content, it can be seen that there are some impacts that lead to popularity of a certain video. This paper is written in order to show correlation between video guests popularity on Wikipedia and view count on YouTube, as well as a connection between the words used in the title of the video and view count.*

Keywords*: YouTube, Wikipedia, interviews, correlation, popularity, analysis*

1. INTRODUCTION

In the last few years, YouTube as a video streaming service gained more television channel formed content. According to YouTube fact sheet, there are over 300 hours of content being uploaded every minute, many of them being interviews, weekly shows that are only available on YouTube. There are many channels in Serbia with specialized content, such as one to one interviews. These videos carry a large number of data within which gives the opportunity to understand content popularity, trends in online marketing and change of habits of the targeted audience.

Analyzing the content of Serbia's most popular YouTube interview focused channel, the purpose of this paper is to answer following questions: Is the view count influenced by the guest interview and/or the title of the video? Are there any "trigger" words that influence the popularity of a video and are there any trends in selection of guests? The questions will be answered through detailed analysis of statistics collected from YouTube API, information about guests obtained from Wikipedia and by exploring information about guests in DBpedia.

First part of the analysis will cover pure statistics and try to mine the correlations between popularity of the video on the characteristics of the guest, such as guest's gender and profession. Second part of the analysis will focus on the topic of the interview, keywords that are mentioned in the title and to correlate it with the video's popularity. Finally, information about the guests, the topic and the popularity of the video will be put into clustering algorithm in order to generate clusters of guests that might implicate the popularity of future videos.

The main goal of the analysis should lead to concrete advice to YouTube channel owners on how to improve their statistics and popularity.

2. RELATED WORK

Several papers in the last 5 years have written about impact on popularity of YouTube videos. Mekouar, Zrura and Bouyakhf (2017) had used two simple regression models for applying machine learning in predicting the popularity of videos based on videos parameters and they proposed a popularity function with good performance over the tested set of videos. Shuxina, Chenyu and Xueming (2017) applied more in depth techniques for analysis of similar video service provider, Youku, where they defined popularity patterns based on initial popularity of the video. Similar approach was taken in Pinto, Almeida and Goncalves (2013) where authors created models to advise users on actions needed for reaching a greater number of views. Initially, idea of defining popularity patterns of videos over time was used in Figueriedo, Benevenuto and Almeida (2011) for the first time. Slightly different approach was taken in Brodersen Scellato and Wattenhofer (2012) by analyzing content of the video, its geographical origin and geographical popularity.

Slightly different goal, but the same means was used recently in Woo, BKP, & Chung, JOP (2018). The authors used YouTube statistics to create a model for evaluation of an educational video. In Tackett et al. (2018) YouTube statistics was used for predicting viewing pattern for popular medical YouTube videos.

Over the years, targeted audiences had grew, but also had changed. The need to have personal relationship with a viewer, to target specific needs resulted in appearance of a great number of vlogs - video blogging

channels, interview specialized channels and similar content. It is now more than the view count in preceding days that impacts the popularity of the video. In Cheng, Dale and Liu (2008) similar statements from the overall YouTube statistics were taken out, but even though the approach to analyzing content to find the connections between videos and popular content is great idea, over the 10 years period the statistics had changed, and so did the statements concluded. 10 years later, in Bärtl, M (2018), decent analysis of YouTube videos was done, but the paper was solely focused on analysis, without creating any conclusions about the connection between popularity and the content.

3. DATA EXPLORATION

3.1. Data structure

The initial data was obtained by using YouTube API from Balkan Info channel. Titles of videos on this channel are well structured and it was easy to collect guest names from the interviews. This way, it was possible to collect the main characteristics of a published video clip such as video title, number of views, number of comments, number of likes and other.

Some columns of the dataset obtained in this way are the following: title, published, tags, comments, likes, dislikes, favourites, views, guest_name, quote and page_name. The gender of interviewed guests was extracted using an automated approach combining name-based and image-based gender inference methods, as done in Karimi, Wagner, Lemmerich, Jadidi, & Strohmaier (2016).

The existing data set was then expanded with data from the Wikipedia api. For each guest, a number of reviews of their wiki pages have been collected, if their page exists, for 2018, 2017. and 2016. from Serbian wikipedia and English as well. It was necessary to collect this data to find out more about the popularity of the guest and thus compare it with the number of views of his clip. In order to get more information about guests, their professions were collected for a later analysis of the impact of what they do on number of views of their videos. Eleven different profession groupings were identified, and data were obtained from dbpedia, writing Sparql queries. The collection of the entire data set is done using the Python programming language due to easy manipulation of the data and corresponding libraries that it offers, and all data values are saved in the CSV (comma separated file) after collection. Data was collected for every published video clip in the period from July 15, 2015. to March 6, 2018.

3.2. Guest statistics

The number of unique guests is 284 of the total number of interviews collected - 474, and the total number of different data columns is 38. Further analysis of data shows that women appear much less frequently as speakers in the show, only 11 of them were guests, and they appeared in total 24 times in the observed period. Furthermore, it can be argued that their interviews are significantly less frequently reviewed, on average 60 449 times per video clip, and that same average for men is 80 716. On average, male guests average 91 likes more than female per video clip. Clips in which men appear on average have more dislikes and comments, but those differences are much less compared to the number of views. Men have 152 dislikes per clip, and women 139, on average. The number of comments where the guest is a male is an average of 235, and for women 225. It is interesting to visualize some of these data that is available after the initial collection phase. Comparison of male and female guests is shown in the Figure 1.

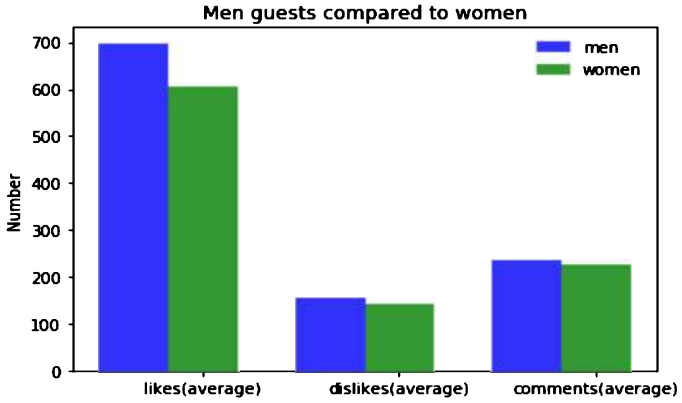

Figure 1: Female and male guests compared

Comparison of average views by gender is shown in the Figure 2.

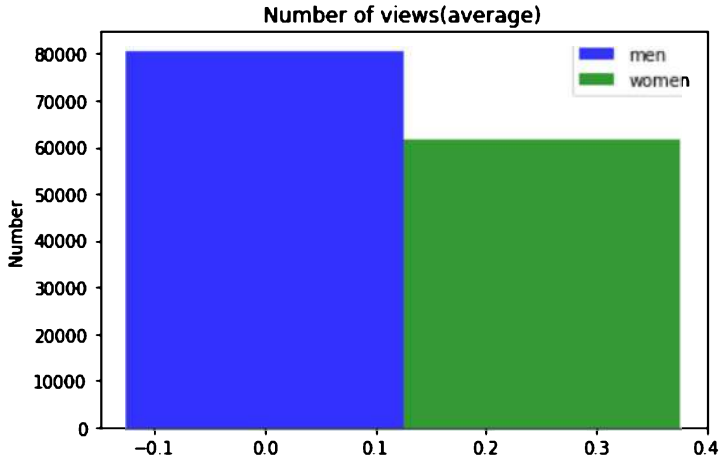

Figure 2: Views compared by gender

As for the professions differentiation of guests, The largest part of guests comes from scientists and politics. Profession with most views per video clip on average is Artist, and Music and Performer professions are positioned high also. Politics is the profession with least number of views on average. It is interesting to note that guests from the sphere of politics are the second most often welcomed to the show despite of the lack of people viewing their clips. On the other side, there is a small number of guests that are artists by profession despite to the fact that their clips are viewed the most.

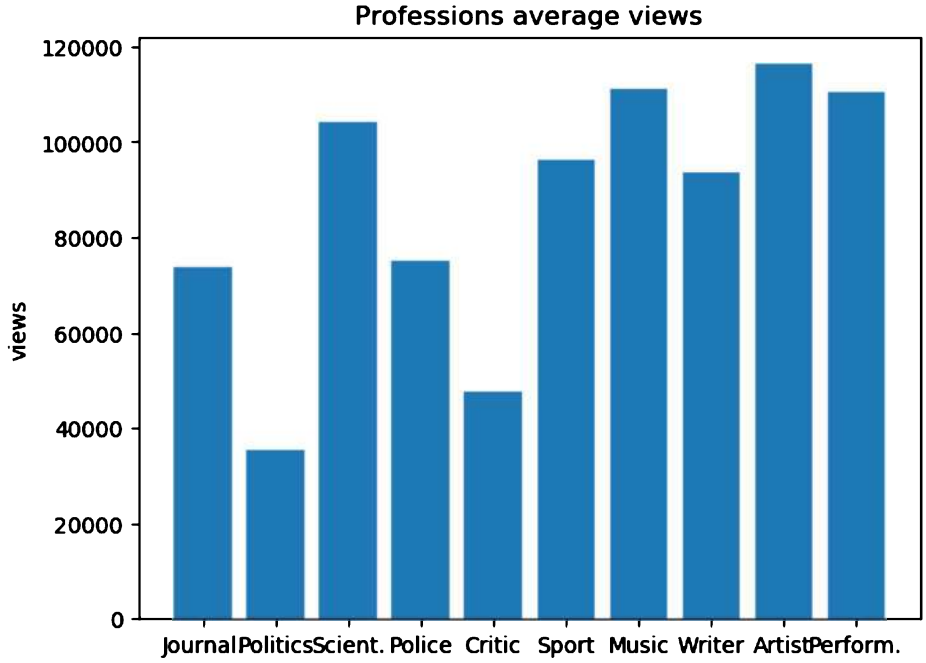

Figure 3: Average views by professions

The guest who is most often invited to the show in the observed period is Jugoslav Petrušić and this number is 14 times. The average number of views of his interviews is 115 054 per clip. In Figure 4 you can see how many views on average have five guests who were most often invited to give interview.

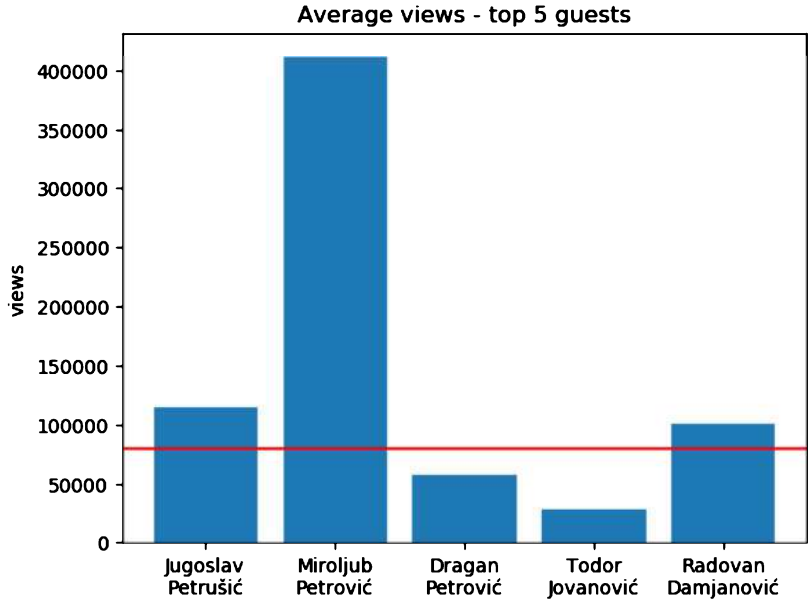

Figure 4: Average views of five most often guests

Red line in Figure 4 represents average views of all video clips collected in the observed period - 79 744. Three of five most frequent guests are above the average views line, and other two are significantly below. A person who certainly justifies a large number of invites to the show is Miroljub Petrovic with an average number of views with over 300 000 above average. This guest also has the most cumulated views - 5 007 144, more than next four guests combined together.

Of the total number of guests, only 89 of them have a page on en.wikipedia in all three observed years 2016, 2017, and 2018. The number of views of these guests interviews is above average - 73 902 which is in contrast to the assumption that guests who have wiki pages are more popular and will have more views on their show appearances. The number of guest pages is considerably smaller when looking at sr.wikipedia where only 19 guests have their own wiki pages in the observed years. There is only 10 different guests that have wiki pages both on en.wikipedia as well as on sr.wikipedia through these 3 years. The average number of views that these guests get is 45 790 per video. Also, guests that are not present in wikipedia pages, do not have any SparQL knots, which made profession based analysis unreliable from this source. That is why our profession based classification of guest was made solely on YouTube data.

In the Figure 5 is shown correlation between guest pages yearly searches on Wikipedia and views of their videos. Guests that do not have wiki page are excluded from consideration. There is a strong correlation between the number of views on Youtube and sr.wikipedia searches and very little between en.wikipedia and video clip views. This is a good indicator that en.wikipedia can be excluded in some future work for our particular case.

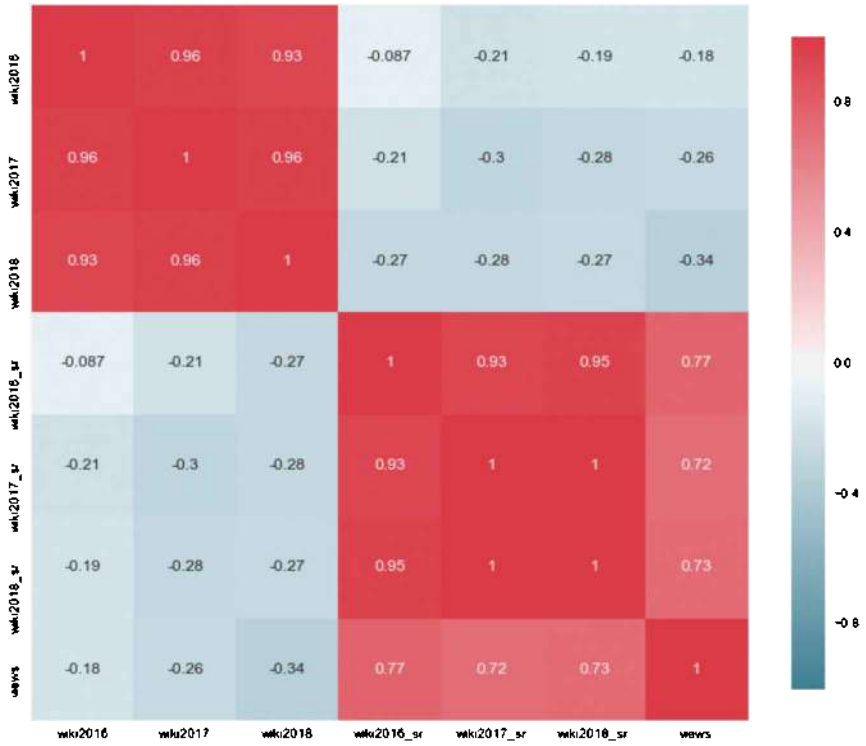

Figure 5: Correlation between views and wiki searches

3.3. Title statistics

Text processing focused on title of videos and tags, related to each of the video. Using text processing libraries in Python and extensions in RapidMiner, a set of most used words and phrases was created. Analysing most popular words, it can be concluded which are the most popular words and phrases in videos (Figure 6 and 7).

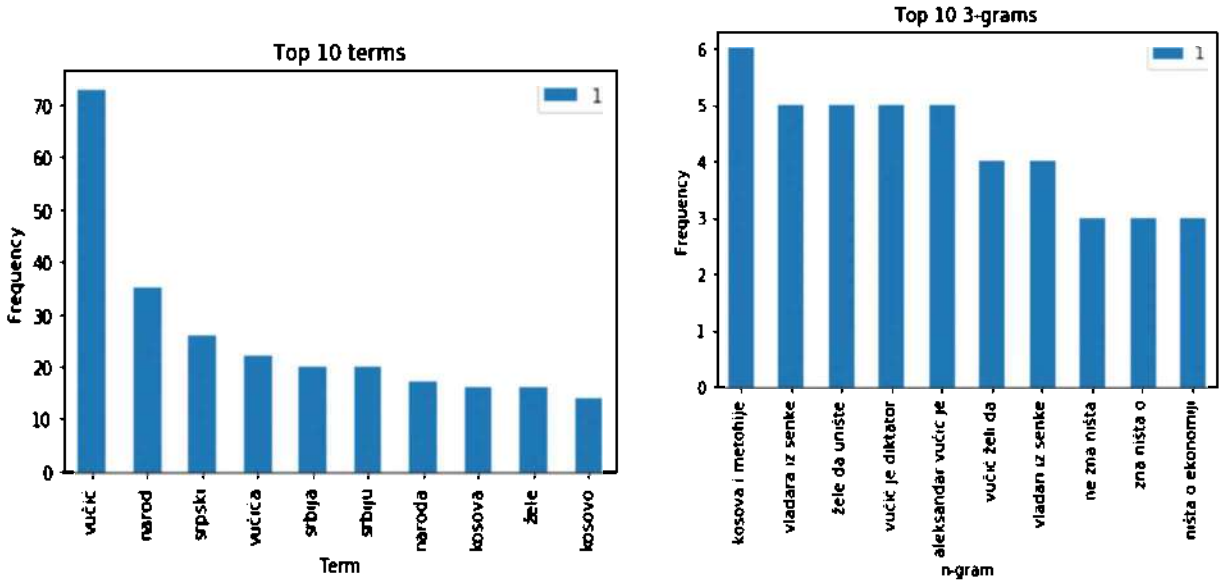

Figure 6: Top 10 terms (left) and Figure 7: Top 10 phrases (right)

Above mentioned words are connected to the popularity of videos, which is shown on the following figure:

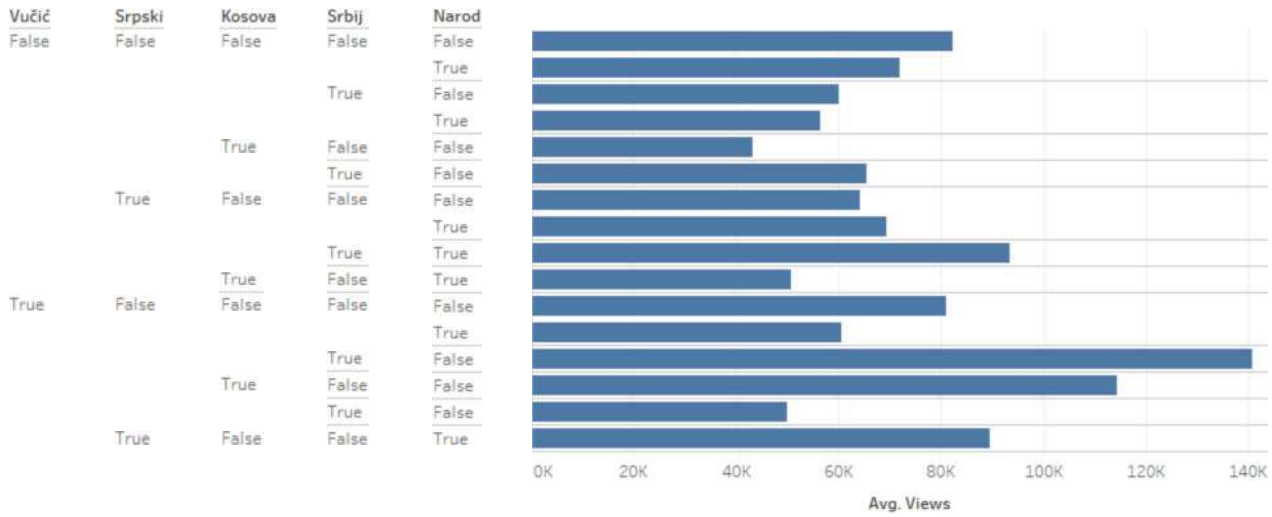

Figure 8: Correlation between views and use of keywords

It can be concluded that use of words “Vučić” and “Srbija” in the video title attract more attention than use of other words. Also, “Vučić” and “Kosovo” have the same influence on the reach of the video.

3.4. Clustering Guests

As claimed in the channel description, “Balkan Info strives to provide unbiased reporting and has opened its doors to all guests and all political parties”. As presented above (Figure 3), the interviewed guests come from different professional backgrounds and they discuss about different topics. However, some guests could be considered more ‘serious’ than others, as some guests tend to share information that could be described as conspiracy theories. An interest application of clustering would be to divide guests into the ‘serious’ ones and the ‘conspiracy theorists’. Having assumed that this could save time for the viewers when making the decision to watch the video or not (as they tend to be between 1 and 3 hours long), an attempt for clustering was made.

As features for clustering, we used the following predictors, out of the earlier mentioned set attributes: comments, likes, dislikes, favourites, views, wiki2016, wiki2017, wiki2018 and the name of the guest. We used k-means algorithm to train the clustering model. However, just around 8 percent of them were assigned to the ‘conspiracy’ cluster, which we do not consider as a proper distribution. It is worth mentioning that a higher number of dislikes could be considered as a signal of a guest being a ‘conspiracy theorist’, but there are exceptions where the guest is perceived negatively by the audience even though being ‘serious’.

In the following figure, it can be seen that the characteristics of the first cluster is high number of dislikes, while the second cluster has a high number of popular words with a lower number of dislikes.

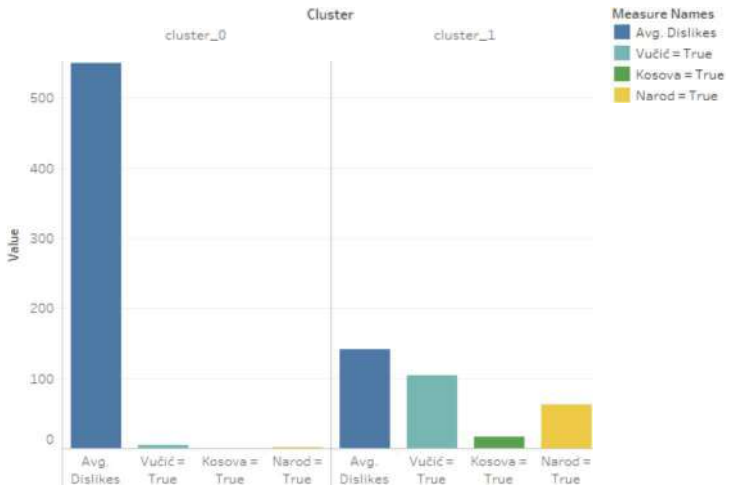

Figure 9: Main characteristics of the clusters

4. CONCLUSIONS AND FUTURE WORK

From the explorative analysis done, several conclusions can be outlined. First, guest from the sphere of politics are not interesting content for viewers. On the other hand, performers and artists are interesting and attractive content. Taking into consideration that people without any information on wikipedia pages are more view than others, lead to conclusion that locally familiar people that do not have the chance to appear on other media do have greater popularity online, on YouTube. Certain guests in Serbia have great popularity and can bring a lot of popularity to the channel if invited.

As for the timing, it can be recommended to publish video clips on Sundays, since that is the day with the largest number of views cumulative.

Topics which need to be covered in the interview need to contain several of the popular words such as: vučić, kosovo, srbija, žele, narod etc. in order to attract viewers and it needs to be mentioned in the title of the video.

We have seen that en.wikipedia gives very small correlation with views of published video and can be excluded from consideration. Sr.wikipedia gives strong correlation and in some future work data searches will be collected not only for the past 3 years, but also for years before 2016.

For the purpose of this research it was only taken into consideration title of the video in the part of text processing. Next step would be to dig deeper into semantics of the whole conversation. Another idea for future work is to include other sources for data collecting, besides dbpedia and wikipedia.

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NEURAL NETWORKS IN MARKET SENTIMENT ANALYSIS FOR AUTOMATED TRADING: THE CASE OF BITCOIN

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Abstract: *Cryptocurrency mining and trading have attracted much attention lately. There are numerous studies and experiments performed to predict the future prices of cryptocurrencies and identify factors that influence the cryptocurrencies' price movement. The aim of this research is to investigate the potential relationship between market sentiment and Bitcoin price movement. The market sentiment analysis is performed on Reddit social network using neural networks. Furthermore, we propose an intelligent system for automated cryptocurrency trading based on neural network outputs. The proposed intelligent trading system is tested over a 4-month period (December 2017 – April 2018), with daily records. The trading simulations are performed multiple times in order to obtain credible results. It is shown that the proposed system achieves a positive average profit that significantly outperforms Bitcoin performance. The results may be seen as a confirmation of the assumption that market psychology is an important factor in the still emerging cryptocurrency market.*

Keywords*: neural networks, automated trading, market sentiment, cryptocurrency, Bitcoin, Reddit.*

1. INTRODUCTION

The price movements of cryptocurrencies have attracted much attention in the year 2017 and 2018 from both practitioners and academia. The problem of prompt estimation whether the prices will go up or down, i.e. should investors buy or sell assets from their portfolio, has been in the spotlight. These kinds of researches have been conducted for a very long time in different markets. Numerous studies have been done in order to predict movements of the stock or foreign exchange markets. These markets are characterized with relatively low volatility compared to the cryptocurrency market where the price can either suddenly go down or rapidly rise by more than 100 percent on a weekly or even daily basis. Being this unpredictable, the factor that has been added to the formation of the prices and has become one of the most dominant is the factor of faith of investors. Bearing this in mind, the aim of this paper was to show how investors' approval and interaction within the social network can affect the future price movements of cryptocurrencies.

Cryptocurrency trading is currently a hot topic. Numerous researches have been conducting experiments to predict the future prices of cryptocurrencies. Brauneis and Mestel (2018) showed that cryptocurrency prices become less predictable as liquidity increases. Gandal, Hamrick, Moore and Oberman (2018) dealt with the problem ofsuspicious trading activities identification, and the estimation of their impact on the price. Gangwal and Longin (2018) examine doscillations of Bitcoin prices based on extreme value theory. Dynamic investment strategies based on the rational expectations bubble model of prices were proposed by Kreuser and Sornette (2018). Detzel, Liu, Strauss, Zhou, and Zhu (2018) documented that Bitcoin returns are predictable by moving the average technical indicator. On the other hand, the influence of the social media on cryptocurrencies' price movements was thoroughly analyzed by Bollen, Mao and Zeng (2011), Garcia, Tessone, Mavrodiev, and Perony (2014) and Garcia and Schweitzer (2015). Their results imposed a new perspective on researchers and practitioners. Further, Kim, Kim, Kim, Im, Kim, Kang and Kim (2016) estimated the fluctuations in the prices and the number of transactions of cryptocurrencies based on user comments in online cryptocurrency communities. Phillips and Gorse (2017) proposed a class of novel online social media indicators to deal with the price prediction problem.

In this paper, we used social media data generated on the Reddit network. The Reddit network has a large number of subscribers who generate an even larger number of posts and comments each day about many subjects. This network has become especially popular among investors as a place for discussing the cryptocurrency market. We saw a potential in analyzing posts and comments from Reddit network to extract trading signals for Bitcoin. Similarly, this was done by Garcia and Schweitzer (2015) who presented a framework to derive general knowledge from social network data. To do this, they combined economic signals related to market growth, trading volume, and the use of Bitcoin as a means of exchange, with social signals (including search volumes), word-of-mouth levels, emotional valence and opinion polarization.

In order to predict trends in the cryptocurrency price movement, we used an artificial neural network. For the purpose of this paper, we used astandard one-layered feed-forward neural network with back-propagation learning algorithm and the inputs that describe the sentiment of the Reddit network and technical indicators of price movement. In fact, the sentiment of the Reddit network is depicted using the daily difference of ups and downs and the number of posts on Reddit. On the other hand, daily Relative Strength Index and Volume-to-Market-Capitalization are technical indicators used in the experiment. The trading signal obtained from neural network is further extracted using another technical indicator, i.e. ZigZag. The experiment is performed on the dataset of daily records collected during the period of 4 months.

The paper is arranged as follows. In Section 2 we provide a detailed overview of the literature. In Section 3 we present the research methodology. Results are presented in Section 4. Finally, Section 5 concludes the paper and gives a brief discussion of future research direction.

2. LITERATURE REVIEW

This section briefly explains the components relevant to this research, including basic terms related to Bitcoin trading, the problem of Bitcoin price predicting and the predictions based on sentiment tracking.

2.1. Bitcoin

In 2008 a mysterious person, whose identity has yet to be discovered, named Satoshi Nakamoto released a paper “A Peer-to-Peer Electronic Cash System”. In addition, he also implemented open source blockchain software ushering in a cryptocurrency by the name of Bitcoin. The blockchain technology, on which the Bitcoin is based, has enabled a flow of money through online payments directly from one side to another without using a third party, in this case a financial institution (Nakamoto, 2008). This may be considered revolutionary, and it has had a great influence on the current financial system.

Since then, numerous cryptocurrencies and blockchain platforms have emerged. They brought a different perspective to financial markets, despite raising many questions and doubts. Numerous debates and discussions sprang up about the validity of cryptocurrencies and whether they should be banned or even criminalized and how the government could regulate them. Even though the rise of cryptocurrencies was followed by many negative effects and frauds, there are also a lot of benefits that they have brought. Some of them are:

- a faster settlement process,
- lower transaction fees,
- decentralization.

Nowadays, there are more than 1600 known cryptocurrencies. Even though they are different in nature and purpose and independently priced on the crypto market, their prices are mostly correlated to the price of Bitcoin. This fact allows the market to be easily influenced by the effects of “the herd” and “big players”. Gandal et al. (2018) analyzed the impact of suspicious trading activity on price manipulations in the Bitcoin market. The herd effect and market bubble creation were the subject covered by Gangwal and Longin (2018) and Kreuser and Sornette (2018).

2.2. Predictability and profitability

If one had invested in Bitcoin back in the 2010 it would have generated an astonishing return of more than 15.000.000% by the end of the year 2017. At the same time, investment in S&P500 stock index would have grown by a rate of 130% over the same period of time. Being this volatile is the main reason why people decide to either invest in Bitcoin or steer clear from it. Without the fundamental information (such as interest payments, book values, dividends etc.) investors are relying solely on price charts when it comes to investment decision making.

Numerous researches have been done to try to predict the Bitcoin price and to make those predictions profitable. Brauneis and Mestel (2018) tried to investigate the predictability and efficiency of several cryptocurrencies using the statistical testing methodology. They concluded the Bitcoin is the least predictable and most efficient in terms of the efficient market hypothesis. Prediction of fluctuations in cryptocurrencies has been researched by Kim et al. (2016) and Phillips and Gorse (2017), who showed great results and provided excellent trading guidelines. However, this topic needs to be further revised in the shortest possible time span because changes are occurring on an hourly/daily/weekly level.

2.3. Market sentiment analysis based on social media data

Using social media, people are generating a huge amount of information on a daily basis. If handled in a proper way, this information may be used to determine and understand the public opinion about a certain topic. One such topic is the price movement of cryptocurrencies. This topic can either be discussed directly by saying that the price is going to rise/fall for a certain reason; or indirectly by mentioning that you are going to invest in the near future, ask around about the cryptocurrency itself or show any kind of interest in it. All of the aforementioned can give us an indication of how the observed price could move in the future, which was underlined by Garcia et al. (2014).

Price predictions for Bitcoin cannot be obtained in an easy way. Contrary to the stock price predictions, which are based on company's business insights, the price of a certain cryptocurrency is formed based on the level of its usage in society, the level of the faith community has built, the mood of the people such as their skepticism, risk awareness and other feelings/emotions. By using these subjective factors, one can try to predict the future price movement like Bollen et al. (2011) did for American stock market using Twitter data.

3. METHODOLOGY

In this section, we introduce the methodology used to construct and test the proposed trading system based on artificial neural networks.

3.1. Trading system

In this paper, we build and test an automated trading system (ATS) for cryptocurrency trading using artificial neural networks as a machine learning component within the system. The proposed trading system is a continuation of the previous work by Rakićević, Milovanović and Aničić (2016), who build a similar ATS for stock market trading. The proposed system consists of two components (Figure 1): the pre-processing component and trading logic component. In pre-processing component there are three modules that work in parallel. Market analysis module gathers cryptocurrency market data and calculates different technical indicators. The second module is for social network data analysis. It crawls data from Reddit service and quantifies it using different indicators. Finally, there is a trading signal extraction module that uses the price data to extract trading signals used as target data for training neural networks. The second part of the system is reserved for trading logic. It consists of the learning part (implemented as a neural network) and a trading algorithm that uses neural network forecasts to decide whether to buy, sell or hold Bitcoin.

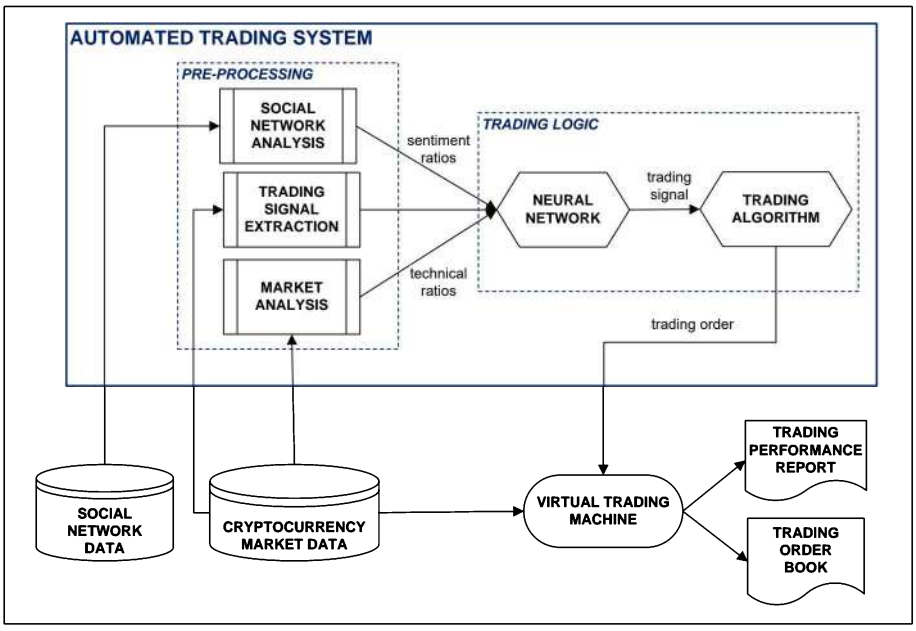

Figure 1: The structure of the proposed ATS

3.2. Artificial neural network

Our system uses a standard feed-forward neural network (FFNN) as a learning component to obtain intelligent system design. In this type of network, each network node aggregates all input variables as a

weighted sum and then uses an activation function to obtain nonlinear output from the node. Our network model has three layers:

- input layer with four input variables,
- one hidden layer with 15 nodes,
- an output layer with one output variable.

The proposed FFNN is trained using aback-propagation algorithm. Further, log-sigmoid function is used as an activation function in all network nodes:

$$\sigma(x) = \frac{1}{1+e^{-x}}. \tag{1}$$

When the ATS starts operating, the first time periods of data *t* are used for training FFNN. The neural network uses technical and market sentiment indicators as input variables to learn how to predict the trading signal (extracted using a special pre-processing component). When the underlying model in the data is discovered, trading starts from the *t+1* time period. In this operating segment, the system is using a neural network to predict the trading signal based on input variables. Afterwards, the obtained trading signal prediction is used in a trading algorithm for the decision making process and creating the corresponding trading orders. Trading is done until the stopping criterion is met (the end of data series or another condition). If a stopping criterion is met, the ATS stops trading and starts training the neural network again (from the beginning of dataset until the stopping point). After the learning process is done, trading is resumed again (until the stopping criterion is met again).

3.3. Input variables

Our trading system uses four input variables obtained with two pre-processing modules. The market analysis module is based on technical analysis and uses market data to calculate indicator values. In this paper, we use two indicators: Relative Strength Index (RSI) and Volume-to-Market-Capitalization (Vol2MCap) indicator. The RSI indicator is one of the most common indicators in technical analysis used to analyze trend momentum. It is derived from the market price in the following way:

$$RSI = 100 - \frac{100}{1+RS}, \tag{2}$$

where RS is the ratio of average gain of up periods during the specified time frame to the average loss of down periods during the specified time frame.

The Vol2MCap indicator is used for market volume analysis, to provide us with an easy interpretation whether the current trading volume is high, low or average. We calculate this indicator with the following formula:

$$Vol2MCap = \frac{tradingVolume \cdot marketPrice}{marketCapilatization}. \tag{3}$$

To analyze the market sentiment through social networks, we use two additional indicators. The first one we call Sentiment Score (SS). It is calculated as a simple difference between positive reactions on the Reddit social network (ups) and negative reactions (downs) calculated on a daily basis:

$$SS = ups - downs. \tag{4}$$

The SS indicator should track investors' feelings and give us an insight into psychology of cryptocurrency market. Another indicator that was used as an indicator of behavior on the social network is the number of comments on a daily basis. This indicator is aimed to detect "herd behavior" in the market. We assume that when the irrational euphoria hits the market, investors are tempted to talk more about markets on the web. These four indicators are input variables that are used by neural network to learn trading.

3.4. Trading signal extraction

In order to learn our system to trade on the market, we use FFNN as a learning mechanism. The output/target variable for completing that task is a trading signal. Trading signal is a value in [0,1] range that can be easily interpreted in the trading action (buy, sell, hold/do nothing). We use the well-known ZigZag technical indicator to extract values from price data.

The ZigZag indicator uses a general definition of a trend, a tendency in the data that creates a positive or a negative change in data level over a certain period of time, to construct the lines on charts that represent

trends in data. The indicator tracks the change in price from the previous maximum/minimum value changes its direction should the current return cross the set threshold indicator. The smaller the threshold value is, the more sensitive the ZigZag indicator is to changes in price. In Figure 2 we show an example of trend identification and trading signal extraction.

To extract the trading signal from the ZigZag indicator we use a simple linear transformation which transforms ZigZag trend data into [0,1] value range. The values of 0 and 1 are assigned to be the reversal points in the trend. When the trading signal takes a value 0 it signals the market bottom to our system, while the value of 1 signals the market top.

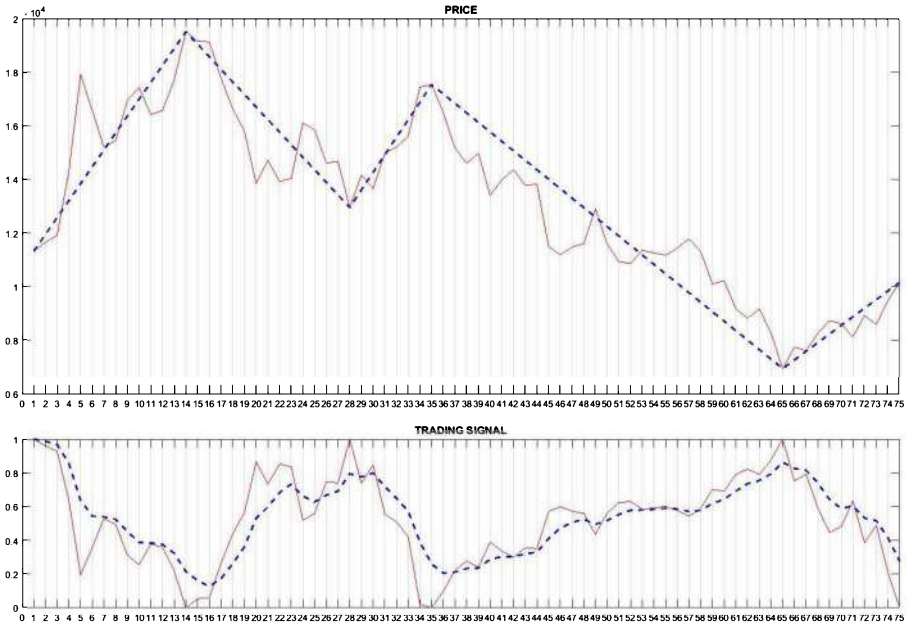

Figure 2: An example of trend identification and trading signal extraction

3.5. Trading algorithm and virtual trading machine

To enable automated trading based on neural network's trading signal prediction we build a simple trading algorithm. We build three simple rules in order to convert trading signal into the corresponding trading action:

1. IF trading_signal > threshold_value THEN trading_action = buy
2. IF trading_signal < (1 - threshold_value) THEN trading_action = sell
3. IF (1 - threshold_value) < trading_signal < threshold_value THEN trading_action = hold

Furthermore, the trading algorithm splits the investment funds into trading lots, which are calculated as the certain percentage of the current account balance. Whenever the trading algorithm receives buy/sell trading signal it keeps purchasing/selling Bitcon until all the investment funds are spent.

Finally, to make trading simulation possible, we built a simple virtual trading machine (VTM) that uses real Bitcoin prices from the market. VTM manages trading orders, records transactions and does all the necessary accounting on trading accounts. It also delivers the trading report when the trading simulation is done.

4. RESULTS

In this section we preset trading simulation results followed by the corresponding discussion. Before results are shown, we describe our dataset, present specific parameter settings for our trading system and list the measures that we used to evaluate trading system performances.

4.1. Data

For this research, we collected data from two sources: cryptocurrency market and the social network Reddit. The market data includes standard prices (open, high, low and close), volume and market capitalization data. Social network data includes posts and comments on the subject of Bitcoin collected on the Reddit network. We chose this data source for two reasons: easily accessible data which we gained by scraping the "Daily discussion" posts about Bitcoin and because of almost one million subscribers of this network. We

collected this data on a daily basis within the four-month time period (from December 2017 to April 2018) including 137 observations.

4.2. Parameter settings and performance measures

In Section 3 we presented a general methodology used for building our ATS. Here, we give detailed parameter specification which is used to obtain results presented in Section 4.3.

In Table 1 we summarize specific system parameters used in this study:

Table 1: Automated trading system parameters

Parameter	Value
Initial investment funds	$ 1.000.000
Lot size (as a percentage of current investment funds)	33%
ZigZag threshold	±10%
Trading signal threshold	0,7
Stopping criterion (for position)	5% loss
Stopping criterion (for trading)	3 consecutive losing trades

To measure the system performance, we use several standard performance measures: percentage of winning trades, return on investment (ROI), profit factor (PF) and maximal drawdown. To obtain a more detailed look at ATS results, we also calculate some of these measures for long and short positions separately.

The percentage of winning trades is often utilized to assess the performance of trading strategy. This indicator is focused only on the number of winning transactions and it does not take into account the amount that was earned/lost. ROI and PF are the most common indicators used to evaluate the efficiency of an investment. ROI is a ratio of the amount of return on an investment to the investment's cost, while PF indicates the number of monetary units earned over units lost. On the other hand, maximal drawdown is an indicator of the downside risk over a certain time period. It represents the relative difference between the highest and lowest account balance values.

4.3. Results and discussion

Experiments with neural networks showed that forecasting results of network can differ significantly when the experiment is repeated several times under the same conditions. This phenomenon is a direct consequence of how a neural network works. In order to obtain as accurate as possible approximations of network performances, researches repeat experiments several times and then calculate the average results. In this study, we did 10 simulations of trading with the same initial conditions. Simulation results are presented in Table 2.

As we can see from the results, our trading system proved to be quite a dynamic one. Considering all 10 simulations, it makes 13 daily trades on average during the four month period. Furthermore, the system was able to achieve an average ROI of 6% and average PF of 1,52 even though it has less than 50% of winning trades. It is worth noting that during the same period of time Bitcoin has lost 26% of its value. This can be used as a benchmark result to determine whether the proposed system is successful or not. Having all this in mind, we can conclude that we successfully beat the market.

If we look deeper and analyze long and short trades separately, we obtain interesting results. The results show that the proposed ATS performs much better when shorting (selling without previously buying the currency). This is probably the consequence of the predominant downward Bitcoin trend that happened after the market bubble burst in December of 2017. The following Figure 3 presents one of the simulated trading scenarios with the profit performance trajectory.

Table 2: Summary results

PERFORMANCE MEASURE	SIMULATIONS										AVG
	1	2	3	4	5	6	7	8	9	10	
Total trades	11	17	16	13	11	12	16	10	9	16	**13**
Percentage of win	45%	29%	44%	31%	27%	50%	25%	60%	44%	44%	**40%**
ROI	14%	-8%	14%	-3%	1%	14%	-17%	22%	23%	-5%	**6%**
PF	1,8	0,78	1,66	0,9	1,02	1,74	0,42	3,42	2,59	0,81	**1,52**
Max. drawdown	-13%	-9%	-9%	-8%	-20%	-9%	-8%	-13%	-9%	-8%	**-11%**
Long trades	8	11	11	11	9	10	10	5	6	10	**9**
Percentage of win	25	27	36	27	11	40	10	60	50	40	**33%**
Avg. ROI per long trade	0,7%	-0,2%	0,8%	-0,3%	-0,9%	0.7%	-1,4%	0,8%	1,1%	-0,3%	**0,1%**
Avg. PF per long trade	1,31	0,9	1,54	0,87	0,74	1,38	0,37	2,01	1,77	0,82	**1,17**
Short trades	3	6	5	2	2	2	6	5	3	6	**4**
Percentage of win	100%	33%	60%	50%	100%	100%	50%	60%	33%	50%	**64%**
Avg. ROI per short trade	2,9%	-0,9%	1%	0,4%	4,4%	3,5%	-0,6%	3,6%	5,5%	-0,3%	**2%**
Avg. PF per short trade	Inf.	0,58	2,03	1,32	Inf.	Inf.	0,54	4,47	3,82	0,8	-

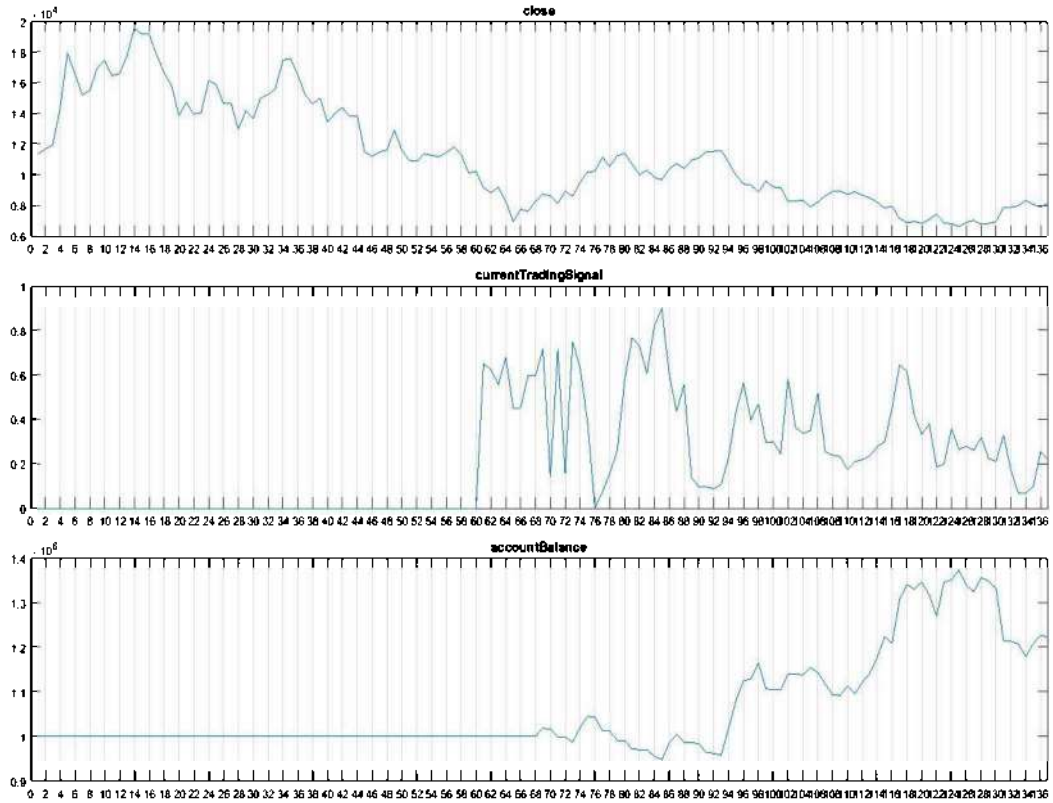

Figure 3: An example of trend identification and trading signal extraction

5. CONCLUSION

In this research, we presented an intelligent system for automated cryptocurrency trading based on neural networks. The system uses a neural network to analyze the market sentiment and learn to trade Bitcoin. For that purpose, it uses two technical indicators (Relative Strength Index and Volume-to-Market-Capitalization) in combination with two social network indicators (Sentiment Score and number of comments on the Reddit network). Another important aspect of the system is the way it extracts price trends from raw market data. In

this paper, we use the well-known ZigZag indicator to extract trends. We then used a simple linear transformation to convert the obtained trend values into trading signals. Based on the trading signals, we trained the neural network to learn how to trade.

To obtain and verify results, we performed multiple trading simulations. Summary results show positive average profit performance that significantly outperforms Bitcoin performance. These results may be perceived as a confirmation of the assumption that market psychology is an important factor in still emerging cryptocurrency market. This assumption is embedded in our system indirectly, i.e. through the choice of input variables. Another interesting fact is that our system performs significantly better when trading short position, which is in accordance with the downward trend that has dominated the Bitcoin market since the euphoria bubble burst in the middle of December 2017. These encouraging results give us a motivation to further improve the proposed methodology and to continue to investigate intelligent systems for automated trading in cryptocurrency markets. Some possible further improvements would involve the implementation of some other type of neural network (such as NARX), the development of some intelligent classifier to accurately separate between positive and negative comments on the Reddit network, and the development of a more complex trading algorithm to improve the investment decision making process within our system.

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EXPERIMENTAL COMPARISON OF MULTI-LABEL LEARNING METHODS

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Abstract: *Multi-label learning has gotten noteworthy consideration in the research community over the recent years. This has led to the enhancement of diverse multi-label classification methods. This paper presented an experimental comparison of 5 multi-label classification techniques using 10 evaluation measures over 4 benchmark datasets from different application domains. Furthermore, additional efficiency analysis of the methods, in terms of time necessary to learn a classifier and time expected to predict a set of labels for an unseen example, was conducted to determine the most beneficial ones. The results of the analysis show that the best-performing multi-label learning methods are distinct RAndom k-labELsets (RAkELd) and Label power-set (LP).*

Keywords*: machine learning, classification, predictive modeling, multi-label, multi-label learning methods*

1. INTRODUCTION

In plenty application domains where single-label classification failed to solve a problem, multi-label classification succeeded. For example, single-label classification can classify a song as either “rap” or “pop” and not both, where in fact it could belong to both genres simultaneously. (Alazaidah & Ahmad, 2016). Similarly, in text classification issue, an article can belong to more than one conceptual class at the same time, for instance, a news article can be labeled with both “Politics” and “International Relations” (Nayak et al., 2013).

In the traditional single-label classification method, training instances are associated with a single label λ from a set of disjoint labels L, $|L| > 1$, where $|L|$ represents the number of possible values of a label. However, genuinely more complex classification issues exist in the real world, where an instance can belong to more than one class at the same time. If $|L| = 2$, then the learning issue is called a binary classification issue, while if $|L| > 2$ it is called a multi-class classification issue. If the instances are associated with a previously predefined set of labels $Y \subseteq L$, then the issue is called multi-label classification. If it is possible that multiple target labels can be assigned to an example from the test set then it is concerning a multi-label classification issue, unlike the multi-class classification where only one label is assigned to each instance (Tsoumakas & Katakis, 2007).

The number of techniques accessible for solving the multi-label data issues is constantly on the rise. (Read & Hollmén, 2017). Latest application areas involve text, image and e-mail classification, functional genomics, music categorization into emotions and others (Madjarov et al., 2012). Many different approaches that were developed in order to solve multi-label problems can be grouped into three methods. On the one hand, existing methods, which attempt to adapt multi-class algorithms, in such manner to directly solve the multi-label issue, are called algorithm adaptation methods. On the other hand, exist problem transformation methods, which attempt to transform the problem of multi-label classification. They can transform it into multiple binary problems or multi-class classification issues (Probst et al., 2017). Furthermore, there are ensemble methods for multi-label learning. Ensembles are being used in this set of methods to make predictions, whereby classifiers they work with are part of problem transformation or algorithm adaptation techniques.

In this paper, five methods for multi-label learning were compared and evaluated. The multi-label methods comprise three different problem transformation methods, one algorithm adaptation and one ensemble method. Namely, those methods are Binary Relevance (BR), Classifier Chain (CC), Label power-set (LP), Multi-Label k-Nearest Neighbor (MLkNN) and RAndom k-labELsets (RAkEL), respectively. The main aim of the research is to compare these methods and give an estimation of their performance. By making a conclusion which method has achieved better performance it would be easier to decide which one to use in some future research. Without having any previous knowledge about utilized algorithms in the process of solving multi-label issues it would be possible to choose the best proven method or technique similar to it, just by using the results of this research as a guideline.

The remainder of the paper is organized as follows. Section 2 defines the main objective of multi-label classification and presents methods that were tested and evaluated in this study. Section 3 analyses research methodology and section 4 presents the results of the experiment. Finally, conclusion and future work are described in Section 5.

2. MULTI-LABEL LEARNING METHODS

Multi-label learning is instance-based, whereby each instance is associated with a subset of labels, which belong to an already predefined set of labels. The main objective of multi-label classification is to build a predictive model based on the training data. Next step is testing if the model is adequate. The result of this phase will be a list of labels that are relevant for a given, previously unseen instance (Madjarov et al., 2012).

Multi-label learning methods are divided into three categories: problem transformation, algorithm adaptation and ensemble methods. In the first category, whose methods are algorithm independent, any single-label learning algorithm can be used to solve multi-label classification issue. It consists of methods which transform the multi-label classification problem into either a few binary classification problems, such as the BR approach, or one multi-class classification issue, such as the LP approach. The second category is algorithm adaptation methods that consist of methods which extend existing learning algorithms to deal with multi-label data directly. The MLkNN algorithm used in this work belongs to this category (SpolaôR et al., 2013). The third group of methods is called ensemble methods. This group consists of methods that use ensembles to make multi-label predictions and their base classifiers belong to either problem transformation or algorithm adaptation methods, such as the RAkEL, which uses LP as a base classifier.

The multi-label learning methods used and evaluated in this experimental study are shown in Figure 1.

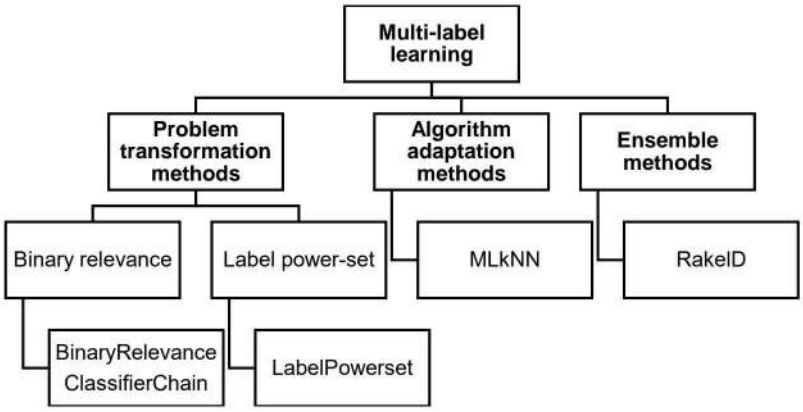

Figure 1: The multi-label learning methods used in this study

In this study five multi-label learning methods were used:

- Binary Relevance (BR) is the notable one-against-all strategy. It addresses the multi-label learning issue by learning one classifier for each class, using every one of the examples labeled with that class as positive cases and all remaining examples as negative. In order to make a set of labels that are relevant for a previously unseen example, each of the binary classifiers, when making a prediction, has to predict whether its label is important or not for that given example. BR technique has been actively analyzed and criticized because of its insufficiency of dealing with label dependency. In fact, the BR technique makes an assumption that every single label is independent of the others, which makes it easy to implement and generally effective, although unequipped of handling any sort of label relationship. (Cherman et al., 2011). During its transformation process, BR completely overlooks label relationships that exist in the training data. (Read et al., 2009)
- Classifier Chain (CC) is a technique firmly identified with the BR strategy. The fundamental idea of this algorithm is to transform the multi-label learning issue into a chain of binary classification issues, where consecutive binary classifiers in the chain are built upon the predictions of preceding ones (Zhang and Zhou, 2014). The CC model includes |L| binary classifiers as in BR, where |L| is the total number of labels. Classifiers are connected along a chain where every classifier handles the BR issue related with label $l_j \in L$, $j = \{1, ..., L\}$. (Read et al., 2009)
- Label power-set (LP) belongs to the group of the label power-set methods. The LP approach directly transforms the multi-label dataset into one single-label dataset, whereby each label is a unique combination of labels appearing on the training set, which was previously transformed to a single-label dataset, in which any method for the multi-class issue can be directly applied to. Moreover, this approach implicitly considers label dependence (SpolaôR et al., 2013). However, problem is that the space of

possible label subsets can be very large. If the number of meta-classes is large that can be an extremely difficult issue to resolve because it makes probability estimation challenging. Additionally, most LP-based method implementations essentially overlook label combinations that are not present in the training set. (Dembszynski et al., 2010)

- Multi-Label k-Nearest Neighbor (MLkNN) is the multi-label version of the well-known kNN algorithm. First, for each instance from the test set, the MLkNN determines its k nearest neighbors in the training set. At that point, according to statistical information gathered from the label sets of these nearest neighbors, namely the number of neighboring instances belonging to each of the possible labels, the maximum a posteriori principle is used to determine the relevant set of labels for an unseen instance from the test set. (Zhang & Zhou, 2007)
- Distinct RAndom k-labELsets multi-label classifier (RAkELd) is an ensemble technique for multi-label learning developed on top of the common problem transformation method (LP). RAkEL, as its name would suggest, constructs an ensemble of LP classifiers. It performs LP methods on M different, random subsets of size k, whereby subsets$\subset$ {1, ..., L}, and k is a small number, k < L. Those chosen subsets are called k-label sets. Each performed LP method, trains an LP classifier by using randomly chosen subsets. (Modi & Panchal, 2012). Thus, RAkEL takes in consideration label relationships and avoids the disadvantage of the LP method by applying single-label classifiers on k-label subsets with a satisfactory number of labels and a sufficient number of instances per label (Tsoumakas et al., 2011). Predictive power enhances by using ensembles of LP algorithms, in comparison to using only LP method.

3. RESEARCH METHODOLOGY

The basic idea of this research is to compare tested multi-label learning methods and identify the best ones based on their predictive performance and time complexity. The experiment was implemented in the Jupyter Notebook.

In this paper, an experimental assessment of methods for multi-label learning is presented. Five of the most popular methods for multi-label learning were evaluated using a wide range of evaluation measures. Datasets used in the experiment were acquired from UCI Machine Learning repository (Dua & Karra, 2017) and MULAN (Tsoumakas et al., 2011). List of datasets with basic details is shown in Table 1.

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

Dataset	Classes	Attributes	Size
student performance	6	53	382
yeast	14	117	2417
emotions	6	78	593
scene	6	300	2407

First, five of the most popular multi-label methods that were recently proposed in the literature were selected. The chosen methods are divided into three main groups: problem transformation (three methods), algorithm adaptation (one method) and ensembles (one method). The methods use two types of basic algorithms for machine learning: SVM (problem transformation methods), random forest (an ensemble method) and k-nearest neighbors (an algorithm adaptation method). Moreover, 10 different evaluation measures that are typically used in the context of multi-label learning were considered. A better and more detailed view of the algorithm performance can be shown by using a variety of evaluation measures.

The evaluation measures are divided into three groups: example-based (Accuracy and Hamming loss), label-based (Macro-precision, Micro-precision, Macro-recall, Micro-recall, Macro-F1, Micro-F1 and Roc AUC score) and ranking-based (One error). Every multi-label method was trained on 70% of the data. Final testing and evaluation were performed on 30% of the data. Furthermore, the efficiency of the methods is evaluated by measuring the time necessary to learn the classifier and the time needed to create a prediction for an unseen example. Additionally, the methods were evaluated on four multi-label benchmark datasets from different application domains: social science, protein, image and music classification.

As far as the BR, LP and RAkEL techniques, they can use any learning algorithm for classifier training. The chosen methods were using two kinds of base classifiers for resolving the partial binary classification issues in all problem transformation methods and the ensemble method: support vector machines (SVM) and Random Forest (RF), respectively. The SVM with the Radial Basis Function kernel was used for training in all problem transformation methods and RF classifier was used for an ensemble method.

4. RESULTS

Evaluation measures (Accuracy, Macro-Precision, Micro-Precision, Macro-Recall, Micro-Recall, Macro-F1, Micro-F1, 0/1 Loss, Hamming Loss, Roc auc score) and efficiency measures of the tested methods (Train

and Test time) are shown in Table 2 and Table 3. The best performance was bolded for each dataset, and the second best was presented in italic.
Further analyzing the predictive method performance across all ten evaluation measures and two efficiency measures: the very best performing methods on all measures are either RAkELd or LP. RAkELd is the best performing method, closely followed by LP. Performance of the BR was inferior over all evaluation measures, aside from precision, meaning that the labels predicted as relevant were truly relevant in the original examples (small number of false positives results in high precision). However, BR is leaving out some of the relevant labels when making predictions (larger number of false negatives results in low recall).

Table 2: Evaluation and efficiency measures for Student performance and Yeast dataset

Measures	Student performance					Yeast				
	BR	CC	LP	MLkNN	RAkELd	BR	CC	LP	MLkNN	RAkELd
Accuracy	*0.496*	**0.513**	*0.496*	0.4	0.487	0.011	0.014	0.134	*0.176*	**0.202**
Macro-Precision	0.786	*0.789*	0.765	0.779	**0.817**	**0.755**	*0.73*	0.581	0.717	0.623
Micro-Precision	0.781	*0.784*	0.764	0.776	**0.81**	0.243	0.18	0.222	**0.56**	*0.444*
Macro-Recall	0.976	*0.978*	**0.993**	0.969	0.953	0.146	0.169	0.298	*0.367*	**0.381**
Micro-Recall	0.979	*0.981*	**0.994**	0.973	0.96	0.356	0.378	0.543	**0.591**	*0.578*
Macro-F1	0.866	*0.869*	0.86	0.859	**0.875**	0.128	0.161	0.226	**0.397**	*0.391*
Micro-F1	0.872	*0.874*	0.865	0.865	**0.883**	0.484	0.498	0.561	**0.647**	*0.6*
0/1 loss	*0.504*	**0.487**	*0.504*	0.6	0.513	0.989	0.986	0.866	*0.824*	**0.798**
Hamming loss	0.217	*0.213*	0.235	0.229	**0.193**	*0.232*	0.233	0.259	**0.197**	0.236
Roc auc score	0.548	*0.554*	0.515	0.544	**0.635**	*0.501*	0.508	0.509	**0.589**	0.571
Train time	0.096	0.077	*0.076*	0.586	**0.07**	5.102	5.399	*2.774*	6.233	**1.475**
Test time	0.035	0.04	**0.023**	0.118	*0.027*	1.814	1.74	*1.481*	1.577	**0.156**

Table 3: Evaluation and efficiency measures for Emotions and Scene dataset

Measures	Emotions					Scene				
	BR	CC	LP	MLkNN	RAkELd	BR	CC	LP	MLkNN	RAkELd
Accuracy	0.157	0.157	**0.309**	0.135	*0.27*	0.27	0.335	**0.705**	0.633	*0.682*
Macro-Precision	**0.678**	**0.678**	0.581	*0.639*	0.61	**0.955**	*0.929*	0.765	0.771	0.736
Micro-Precision	**0.611**	**0.611**	0.554	0.577	*0.588*	0.645	**0.774**	*0.773*	0.769	0.745
Macro-Recall	0.398	0.405	*0.586*	0.403	**0.626**	0.286	0.351	**0.719**	0.696	*0.704*
Micro-Recall	0.423	0.429	*0.613*	0.435	**0.634**	0.276	0.339	**0.714**	0.69	*0.696*
Macro-F1	0.46	0.466	*0.567*	0.455	**0.602**	0.362	0.442	**0.743**	*0.728*	0.719
Micro-F1	0.521	0.526	*0.596*	0.518	**0.622**	0.429	0.496	**0.739**	*0.728*	0.716
0/1 loss	0.843	0.843	**0.691**	0.865	*0.73*	0.73	0.665	**0.295**	0.367	*0.318*
Hamming loss	0.243	*0.242*	0.258	0.253	**0.241**	0.131	0.123	**0.09**	*0.092*	0.099
Roc auc score	0.652	0.654	*0.691*	0.644	**0.719**	0.641	0.673	**0.835**	*0.826*	0.825
Train time	0.18	0.199	*0.161*	0.636	**0.066**	7.186	3.915	*2.866*	*6.455*	**0.513**
Test time	0.069	0.066	*0.045*	0.209	**0.031**	1.588	1.745	*0.862*	2.515	**0.125**

Table 4: Best and second-best performances of multi-label learning methods

	BR	CC	LP	MLkNN	RAkELd
First	4	5	13	6	22
Second	3	11	15	8	13

Table 4 shows number of best and second-best performances of each multi-label learning method through all four datasets. The best multi-label learning method was RAkELd, which performed best 22 times, and was second 13 times. LP has also shown great performances and BR performed worst of tested multi-label learning methods. It was first 4 times, and second only for 3 times. BR is the simplest problem transformation method. However, lately, it is sidelined on the grounds of assuming label independence. BR disregards label relationships that exist in the training data.

LP-based methods directly consider the label correlations. However, the main problem is the size of the set, which consists of possible label subsets, because that set can be quite large in LP. RAkELd is a tactic that creates a group of LP classifiers, or in other words an ensemble of them. During the classifier training process, each LP classifier is being trained on a different and random subset of the labels. This approach aims at considering label correlations and at the same time avoiding the problems of LP. Results of performance comparison against the BR and LP methods are in favor of the LP-based methods (RakelD and LP).

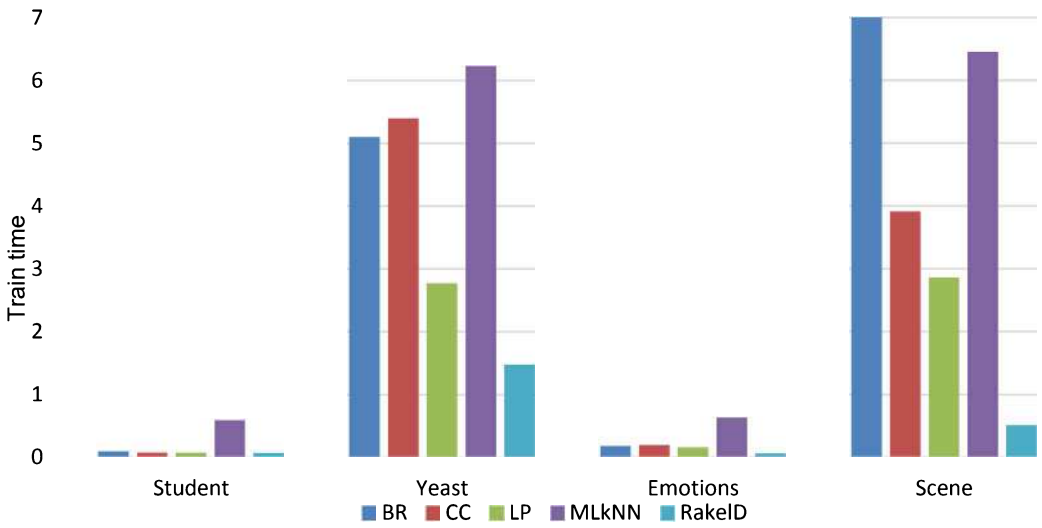

Figure 2: Multi-label learning methods - Train time (seconds)

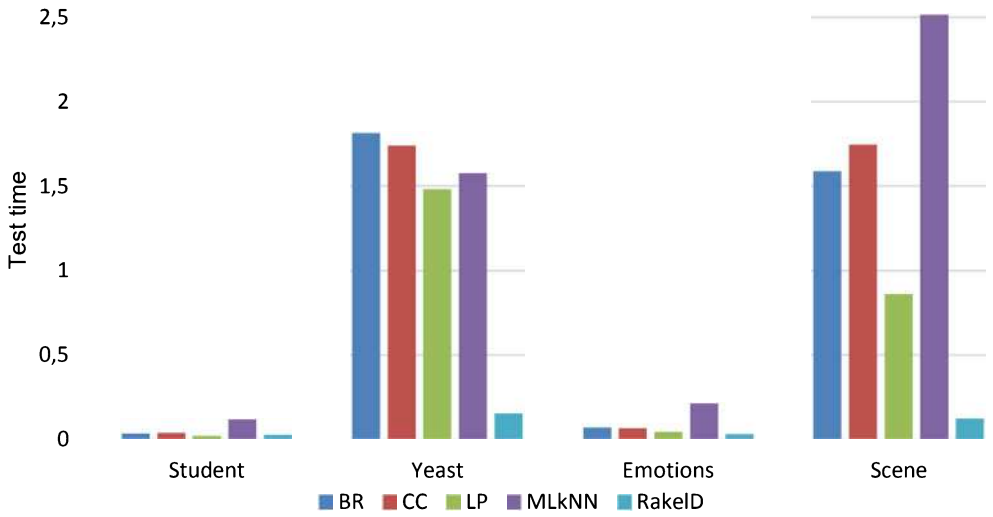

Figure 3: Multi-label learning methods - Test time (seconds)

As mentioned earlier, each dataset was randomly split into two sets: 70% for training and 30% for a test. For comparison, the charts in Fig. 2 and Fig. 3 show the efficiency of five tested methods, in terms of time complexity (test and train time of the classifiers). Considering efficiency, RAkELd (using the tree-based method as a base classifier) was generally faster to train a classifier and make a prediction for an unseen example than the SVM-based methods. The results show that RAkELd is faster than LP on testing time (on average 2.8 times) and on training time (on average 7.11 times). Furthermore, RAkELd is faster than MLkNN on testing time (on average 6.5 times) and on training time (on average 13 times).

When comparing only problem transformation methods among each other, LP performed better than BR and CC. The multi-label variant of k-nearest neighbors (ML-kNN) performed poor and had the worst train and test time. MLkNN is the most time-consuming algorithm.

5. CONCLUSION

This paper presented results of five different methods for multi-label classification. The goal was to show comparative experimental results of certain multi-label classification methods that were previously chosen from various research papers and to determine the greatest ones. This work also gave an organized presentation of those methods and provided empirical evaluation over four different multi-label datasets with a variety of evaluation and efficiency metrics.

All in all, considering the performance and the efficiency of the evaluated methods RAkELd, an ensemble method used in this paper, proved superior among other tested methods. Empirical evaluation demonstrates the competitiveness of RAkELd against other multi-label learning methods, which were tested, both in terms of predictive performance and time complexity.

Furthermore, RAkELd and LP proved to be the best in terms of predictive performance and demonstrated better competence than the remaining methods. Both of this method are LP-based, which prove that label dependency is important when it comes to predictive modeling in multi-label classification problems. On the other hand, it depends upon the concrete objective of the learning issue whether label dependencies can be used to enhance predictive performance (Dembszynski et al., 2010). Researchers have been working on the plan of designing multi-label methods competent for handling the diverse relationships between labels, particularly label dependency, correlation and co-occurrence. For example, in the LP method, inter-relationships between labels are mapped straightforwardly from the data, since all the existing combinations of single-labels present in the training examples are used as one of the possible labels in the given multi-class classification issue (Cherman et al., 2011).

Future work will include performing more extensive experiments with more datasets and extending this experimental study by including more multi-label learning methods, especially ensemble and algorithm adaptation methods. Moreover, including Grid search for hyperparameter optimization and investigating the issue of selecting appropriate parameters for all multi-label classifiers to improve performances.

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DATA MINING USING ORACLE DATA MINER AND ANALYTIC FUNCTIONS WITH HADOOP

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Abstract: *In this paper we have described how a large amount of data can be processed in Oracle Database using different algorithms and functions. After training data mining algorithms, their performance on new datasets can be measured and examined. We have focused on the comparison of specific algorithms in order to decide which of them gives more reliable data processing results. To make sure that more efficient algorithm is chosen, Oracle analytic functions can be used for data preparation before using the algorithms and for processing the results obtained after the execution of the algorithms. Hadoop framework and Hive, as part of it, have been used to improve access to data being processed.*

Keywords*: Data Mining, Oracle, Hadoop, classification, clustering, analytic functions*

1. INTRODUCTION

One of the biggest challenges that people who deal with information technology today face is how to handle large amount of data generated by users of different systems every day. (Thearling, 2017)

Lately, Data Mining is very important part of computer science that investigates data in order to discover and describe patterns. Because we live in a world where huge amounts of data are generated every day, it is imperative to find a way to extract useful information from this data, to classify it and to make certain conclusions (Thearling, 2017).

At the beginning, in the second chapter we described the problem of data analysis that we tried to solve in this paper.
In the third chapter is given a brief overview of what a Big Data and Data Mining represents, and after that is described the model which is usually used in Big data processing techniques as well as technologies and tools used for the realization of the demonstration case studies. Also, we make some review about the most useful Data Mining algorithms for classification and clustering, such as Decision tree, Naive Bayes, Hierarchical clustering and K-means algorithms. And finally, we present some of the most frequently used analytical functions, in this case used for data preparation and analysis of results of Data Mining algorithms. An example of using these algorithms and functions in Oracle Database is shown in the fourth chapter. In the end, in the fifth chapter we give our vision of further application of Data Mining algorithms.

2. PROBLEM STATEMENT

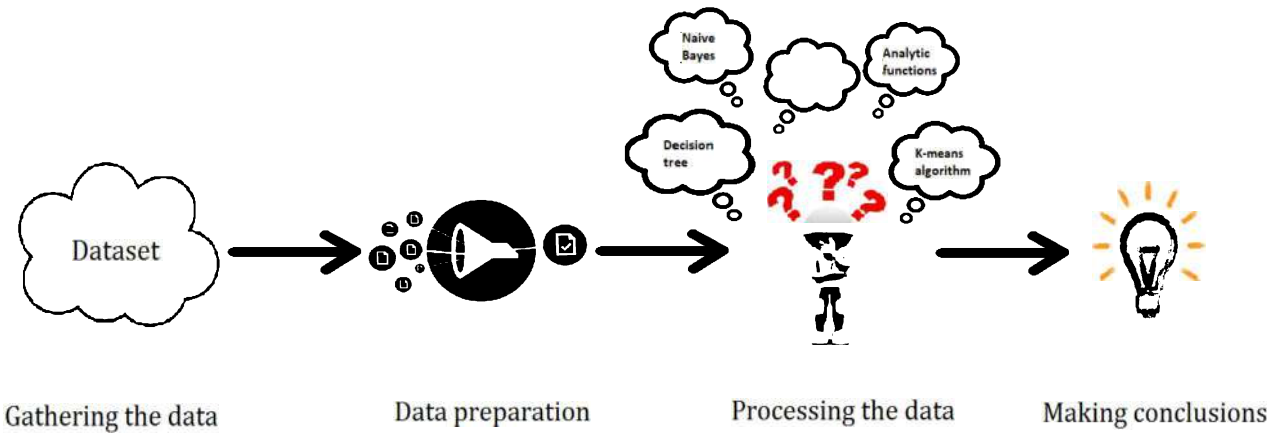

Figure 1: Problem statement

Nowadays, large amounts of data are piling up from various sources and the amount of this data has a constant tendency of growth. New ways to analyze this data need to be discovered, in order to find the best way to extract important information from it. Data in the original form represents only the noisy data that needs to be prepared for the application of various techniques and algorithms. Various techniques and algorithms can be applied to the data which is obtained as a result of prior data cleansing. In order to make a certain conclusion which of these techniques give the most reliable results depending on the context of the problem, it is necessary to apply several techniques separately or a combination of several techniques, functions and algorithms. If combination of techniques is applied, it is important to plan the sequence in which they will be used. Out of all these steps, choosing appropriate algorithm for given domain is still mostly unspecified, since there is no universal approach to this problem, and solutions vary from case to case.

3. THEORETICAL BACKGROUND

In this chapter are given main theoretical concepts concerning Big Data, Data Mining and corresponding algorithms, as well as required Oracle functionalities, such as analytic functions.

3.1. Big Data

Big data can be defined as “The storage and analysis of large and/or complex data sets using a series of techniques including, but not limited to, NoSQL, MapReduce and machine learning”. (De Mauro, 2016) The term “Big Data” is used to identify amounts of data which size is bigger than software capacity that is usually used for storage, processing and data management. (Elgendy & Elragal, 2016)

3.1.1. Hadoop

MapReduce is one of the earliest and most popular programming models created by Google in 2004 and based on C++ language. This model is used for parallel processing and generating Big Data sets. (Yahya, Hegazy, & Ezat, 2012)

The MapReduce model is based on two basic functions: **Map** and **Reduce**. At first, the **Map function** is used to process the input records into a sequence of key-value pairs, and then generate a set of intermediate key-value pairs. The method key-value pairs, which are derived from the input data is defined by user for the Map function. The **Reduce function** merges all the key-value pairs with the same key into the same Reduce task. Reduce task processes one key at the time and combine all values associated with that key. The mode of combination of values is determined by the user for the Reduce function. (Jeffrey Dean, 2008)

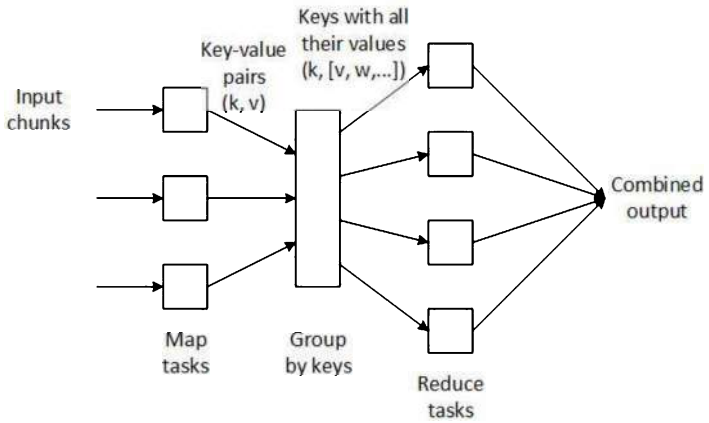

Figure 2: Schematic of MapReduce computation (Leskovec, Rajaraman, & Ullman, 2014)

There are many implementations of MapReduce model, but the most commonly used is a **Hadoop framework**. (Venner, 2009)

The big companies like Facebook, Google, Amazon and Yahoo were first to face rapid increase in the amount of data. They have to execute terabytes and petabytes of data by the day, in order to interpret the requirements, they receive from users and respond to them. The problem of handling and processing all of this data is resolved by Hadoop which has replaced scarce, existing tools. (Ghazi & Gangodkar, 2015)

3.1.2. Hive

One of the most common problems that Hadoop users encounter is creating queries over data with Hadoop as in traditional RDBMS infrastructure. **Hadoop Hive** is an open source SQL-based shared warehouse system which is suggested to solve mentioned problem by supplying an SQL-like abstraction above the Hadoop framework. Hive is translator which represents a combination of SQL language and MapReduce model. It uses HiveQL, in order to create queries over data stored in a cluster. Hive is used to bridge barriers between traditional applications which are implemented using SQL-based RDBMSs and Hadoop framework. (Dokeroglu, Ozal, Bayir, Cinar, & Cosar, 2014)

3.2. Data Mining and Data Mining algorithms

"**Data Mining** is a collection of techniques for efficient automated discovery of previously unknown, valid, novel, useful and understandable patterns in large databases. The patterns must be actionable so they may be used in an enterprise's decision making." (Gupta, 2014)

Some of techniques which are used for Data Mining are very similar to the machine learning techniques, but on the other hand, a lot of them are closely related to techniques that are deployed for statistical analysis. (Gupta, 2014)

Data Mining uses advanced mathematical algorithms for automatically searching data warehouse in order to predict some future events based on past events. Although being a powerful tool, it is very important to remember that it is not able to recognize the value of the information which is derived from the data. (Data Mining Concepts, 2018)

Data Mining algorithms have various purposes today, ranging from fraud detection and bankruptcy prediction to target marketing and customer retention as, perhaps, its most commonly used purpose. However, results of such techniques depend largely on complex nature of data to be processed and choice of adequate Data Mining algorithm, since there is no established practice related to use of specific algorithm on specific problem domain. More traditional approach is represented by statistical algorithms, which rely heavily on mathematical models and assumptions such as data normality. Opposed to them, machine learning algorithms are assumption free, and tend to outperform above mentioned algorithms when mining business datasets. (Becker, 2001)

3.2.1. Classification

The aim of **classification** is to develop a classification rule, which can later be used to categorize given objects based only on their vector of features. Training dataset is necessary for classification, and it contains collection of object, their vector of features, as well as their correct classes. Most reliable way to determine correct classes is by consulting domain expert. In other words, the goal of classification is to distribute given objects into *m* distinct categories, with highest precision as possible. (Alpaydin, 2014) Classification is part of supervised learning scenario, in which "the learner receives a set of labeled examples as training data and makes predictions for all unseen points". (Mohri, Rostamizadeh, & Talwalkar, 2012) Some of the most used classification algorithms are:

- **Decision Tree** - a decision tree represents a binary tree in which leaves render decisions (classes) and interior nodes conditions on the object being classified. The classification process starts at the root of the tree where predicate is evaluated, and algorithm moves to one of the children based on the result of the evaluation. These steps are repeated for each interior node, until one of the leaves is reached. Reached leave represents object's class. Important task in this process is the choice of predicates for each of the interior nodes. (Leskovec, Rajaraman, & Ullman, 2014)

- **Naive Bayes** classifier is used to assign most likely class to a given object which is described by its feature vectors, with the assumption that given features are independent given class. The base of this classifier is Bayes' theorem, which describes probability of an event, based on conditions related to that event with "naive" assumptions about feature independency. These assumptions are not realistic, but despite that, Naive Bayes has shown exceptionally good results in practice. (Rish, 2001)

3.2.2. Clustering

Clustering is defined as process of examining a collection of certain "points" and grouping them into "clusters" according to some distance measure, in such manner that the distance between points in the same cluster is small and the distance between points in different clusters is large. The distance between two points can be defined in various ways, and most often it is traditional Euclidian distance. (Leskovec, Rajaraman, & Ullman, 2014)

Clustering is part of unsupervised learning scenario, where, based on an unlabeled dataset, learner makes predictions for all unseen points. Due to this, it is hard to evaluate the performance of a learner. (Leskovec, Rajaraman, & Ullman, 2014) Mostly used clustering algorithms are:

- **Hierarchical clustering -** each point starts as separate cluster, and in every iteration, new, larger clusters are built by merging two smaller clusters. The most common way to represent a cluster is by using centroids, and centroids to be merged are usually ones which have the shortest distance between each other. (Leskovec, Rajaraman, & Ullman, 2014)

- **K-means algorithms** require that the final number of clusters, *k*, is known in advance. In initial step *k* points which will represent clusters are selected. After that, each point, other than *k* selected points, are considered and assigned to the closest cluster. The distance between a point and a cluster is usually measured by distance between a point and the centroid of a cluster. There are several options for determining initial points, such as picking the points that are as far away from another as possible, clustering a sample of the data using some other algorithm, etc. (Leskovec, Rajaraman, & Ullman, 2014)

3.3. Oracle database support for data processing

Oracle Data Mining represents a powerful ability to analyze data inside of Oracle Database. It can be used for developing predictive Data Mining applications, adding smart possibilities in existing applications, or generating predictive queries to research data. Oracle Data Mining is a component of the Oracle Advanced Analytics Option of Oracle Database Enterprise Edition. One of the essential features of this component is the ability to work with Big Data sets in different forms. (Data Mining Concepts, 2018)

A development environment that can be used to execute Data Mining algorithms in Oracle databases is Oracle SQL Developer which has the appropriate extension called **Oracle Data Miner**. This tool is based on workflow paradigm which allows catching, documenting and automating the process of building, evaluating and using Data Mining algorithms. Inside of a workflow, it is possible to specify data transformations, build and evaluate more algorithms, and score more data sets. It is possible to create predictive models in Oracle Data Miner, which developers can integrate into applications to automate the discovery new business intelligence-predictions, patterns and discoveries-throughout the enterprise. (Data Mining Concepts, 2018)

3.3.1. Oracle analytic and aggregate functions

Data Miner can operate on data stored in tables and views in database, and results of tested algorithms can also be stored in such manner, which gives a lot of flexibility and potentiality by combining Data Mining process and big relational database, such as Oracle database. One of such advantages is the opportunity of using aggregate and analytic functions on datasets and results of Data Mining algorithms.

An aggregate function is used for aggregating data from several rows into a single result row. Analytic functions also operate on subsets of rows, but they do not decrease the number of rows returned by the query. Analytic functions calculate an aggregate value based on a group of rows. They differ from aggregate functions in that they return multiple rows for each group. (Analytic Functions, 2018)

Some of the most used aggregate and analytic functions are **MAX**, **MIN**, **VARIANCE**, **STDDEV**, etc. (Analytic Functions, 2018)

4. SELECTING DATA MINING ALGORITHMS USING ORACLE DATA MINER, HADOOP AND ORACLE ANALYTIC FUNCTIONS

In this chapter will be described the example of using Oracle Data Miner extension and Oracle analytic functions for classification and clustering of datasets stored in Hadoop file system. This example was implemented using Oracle Big Data Appliance, which contains all necessary services and software.

The process of selecting the most appropriate data mining algorithm for given dataset is described using following BPMN 2.0 diagram.

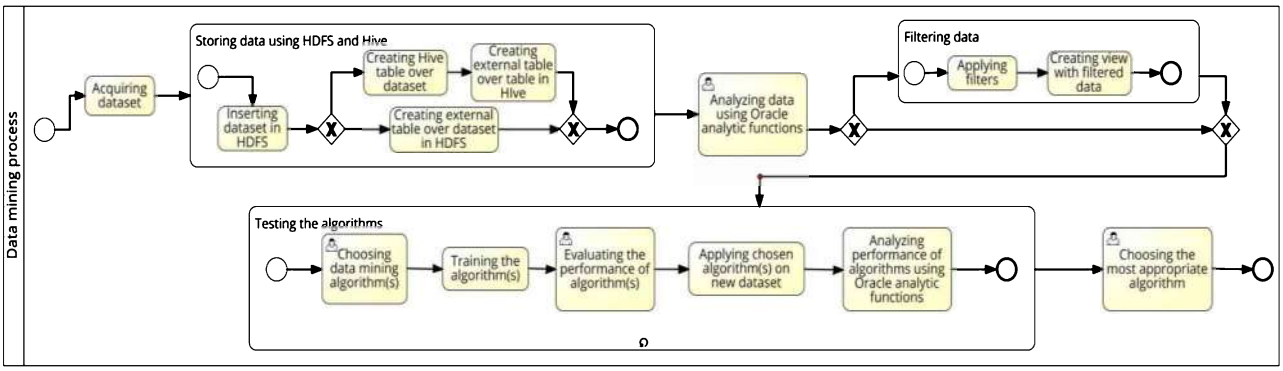

Figure 3: BPMN diagram describing the selection of data mining algorithm

Process shown in diagram above starts with finding suitable dataset for desired mining area. After that it is necessary to store acquired dataset in some manner. One of the most popular ways to do that today is by using Hadoop and HDFS. After inserting dataset in HDFS, Hive can be used to access imported data, or data can be accessed directly in HDFS. Since this example shows data mining in Oracle database, this step also includes creating external tables over previously imported data. This is followed by data analysis, which includes detecting and eliminating inconsistent and "dirty" data, possibly done with Oracle analytic functions. If inconsistencies are found, data should be filtered and result of that filtering should be stored in some way, possibly by creating a view. Next step is about testing data mining algorithms, and this includes choosing algorithms to be tested, training as well as evaluating results of that training. After that, chosen algorithms can be applied on new dataset and their performance on this dataset can be analyzed, again with Oracle analytic functions. Last few steps are repeated until a decision can be made, choosing the right algorithm.

4.1. CLASSIFICATION EXAMPLE

Dataset used for classification is about detection of credit card frauds. First step described in Figure 3 is acquiring dataset and **storing it using HDFS and Hive**. After starting all necessary services, dataset file is imported in Hadoop file system via terminal commands. Since the format in which the files are stored is .csv format, it is stated that all fields are separated by comma. Next step is about creating external table in Oracle database over the previously created Hive table.

No missing or "dirty" data were found after **analyzing the data**, so there is no need for **filtering**.

Next step is about **testing and evaluating algorithms**. Before all, Data Miner connection must be created, and that connection must be created over the same schema that was used for creating external tables in previous steps. After that, workflows can be added.

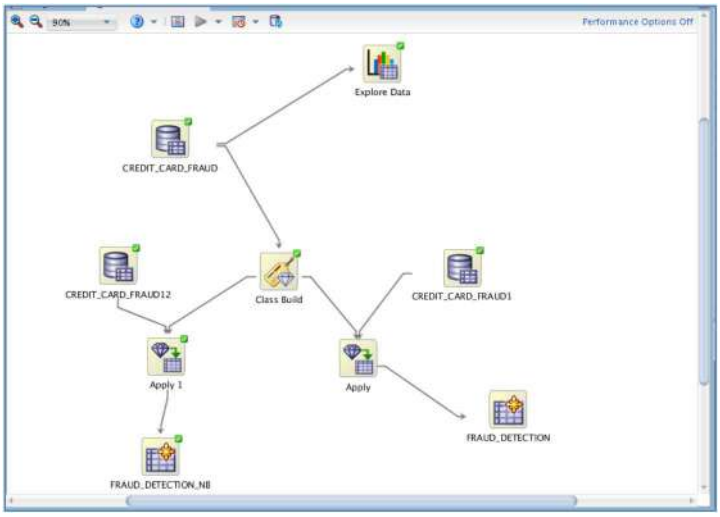

Figure 4: Workflow for classification in Data Miner

After adding node that represents data source and connecting it with appropriate table, different operations can be performed with it. Wide range of statistics is at disposal, such as minimum and maximum value, median, variance, standard deviation, etc. Data can be also visualized, using many different graphs, as shown in pictures below.

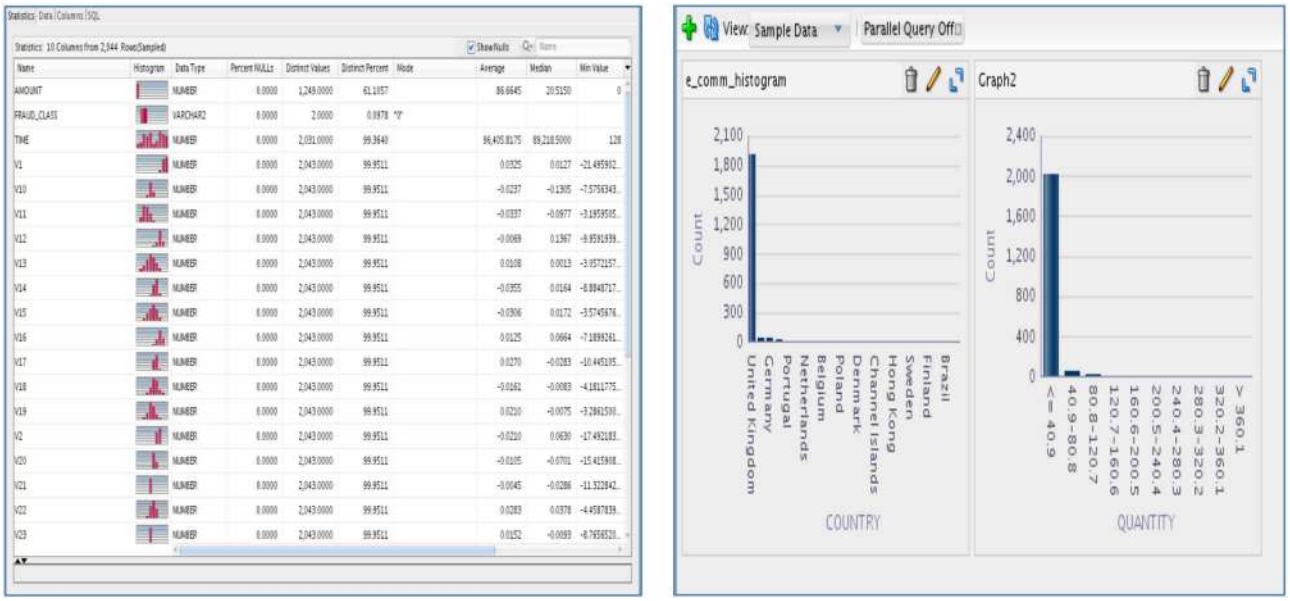

Figure 5: An example of statistical functions and graphs applied on data sets

Four classification algorithms are available: Decision Tree, Naive Bayes, Generalized Linear Model and Support Vector Machine. After the selection of the algorithms (in this example Decision Tree and Naive Bayes algorithms are used), connecting classification node with data source and setup of parameters (such as percent of dataset to be used for training and testing), classification process can be started. When this is complete, performance of chosen algorithm can be examined, and different algorithms can be compared using many criteria, such as predictive confidence, average accuracy, overall accuracy, cost, or using visual representation, as shown on pictures below.

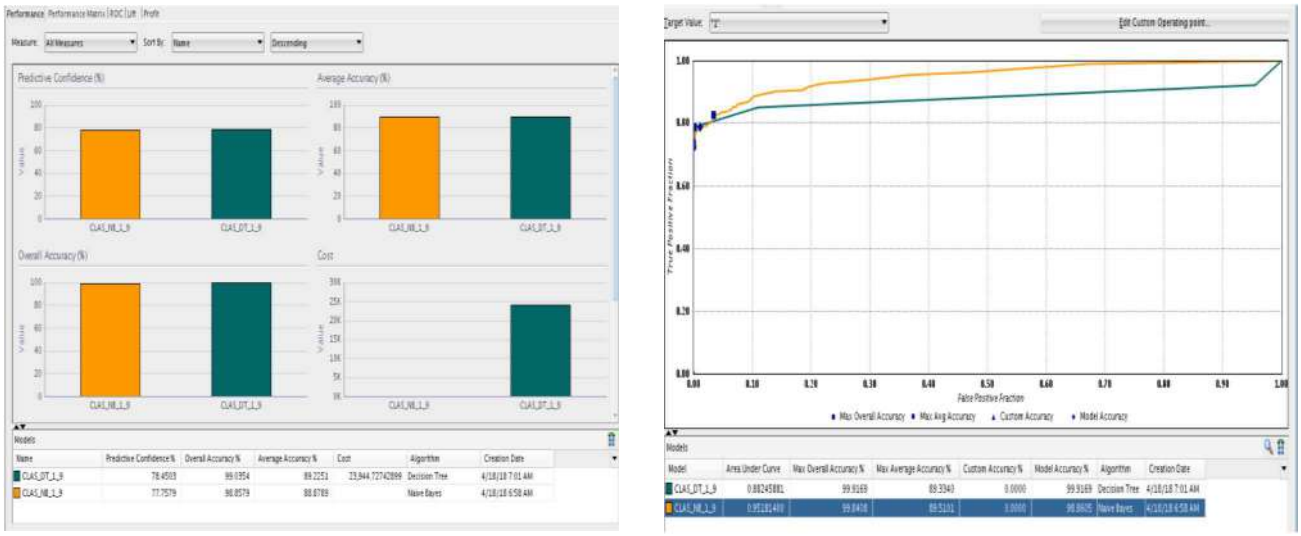

Figure 6: Compared performances of algorithms and ROC curve

In this example, Naive Bayes algorithm (orange bar) and Decision Tree algorithm (green bar) are almost equally precise, with less than a percent of difference. Because of that, it is hard to tell which of these two algorithms will fare better in classification of new data. This is where Oracle analytic functions come in handy. Each of trained algorithms can be separately applied on test data set (as shown in Figure 3), and results of each appliance can be stored in Oracle tables. These tables by default contain information about predicted class for each row and probability with which the algorithm designated class for a given row. Now, wide range of queries can be applied on created tables. For example, we can compare variance and standard deviation for prediction probabilities of both of algorithms, and minimal and maximal probability can also be of interest.

In last step described in Figure 3, a **choice** must be made which algorithm suits better for a given problem. After using VARIANCE, STDDEV, MIN and MAX functions to examine mentioned probabilities, we can conclude that that Naive Bayes algorithm, although a percent less accurate than Decision Tree algorithm, has significantly less variance and standard deviation when it comes to predicting positive fraud cases (class with label “1”). We can also note that Naive Bayes algorithm have minimal probability of approximately 0.5 against approximately 0.007 for Decision Tree algorithm. Based on these analyses, conclusion can be made that Naive Bayes algorithm is far more confident when it comes to credit card fraud detection.

	CLAS_DT_1_9_PRED	VARIANCE(CLAS_DT_1_9_PROB)	STDDEV(CLAS_DT_1_9_PROB)	MIN(CLAS_DT_1_9_PROB)	MAX(CLAS_DT_1_9_PROB)
1	"1"	0.08236722401694024	0.2869969059361795	0.007309941520467836	0.8859649122807017
2	"0"	0.00000001375271395193088 7	0.00011727196575452672	0.999424405218726	1.0

Figure 7: Analyses of prediction probability for Decision Tree algorithm

	CLAS_NB_1_9_PRED	VARIANCE(CLAS_NB_1_9_PROB)	STDDEV(CLAS_NB_1_9_PROB)	MIN(CLAS_NB_1_9_PROB)	MAX(CLAS_NB_1_9_PROB)
1	"1"	0.016124141604841	0.12698087101938227	0.5004225373268127	1.0
2	"0"	0.00030646346310722735	0.017506097883515544	0.5001327991485596	1.0

Figure 8: Analyses of prediction probability for Naive Bayes algorithm

4.2. CLUSTERING EXAMPLE

Among other models, Data Miner also supports clustering. In this section will be described process of **filtering the data,** since the rest of the steps are the same as in classification example.

Acquired datasets usually contain inconsistent data, which should be eliminated before data mining algorithms are trained on them. Examples of inconsistent data include negative quantities of products, negative prices, missing values for identifiers and other important fields and so on. This is where Oracle analytic functions might become useful again. Using these functions, anomalies in datasets can be easily identified and eliminated. Another advantage of using Oracle relational database management system is that there is no need to delete inconsistent rows from the original table. Simply, a view can be created with filtered data, and this view will be later used for clustering. That way, original data can be kept, and data mining algorithms can be applied on filtered data.

Dataset used for clustering contains e-commerce data, such as data about products bought, their prices, quantity of bought products, date of purchase, and so on. Analyzing the data with MIN and MAX functions, we can detect negative values for quantity and price of purchased products and also missing values for description of products. Since these rows make only a small percentage of the entire dataset (about 0.03%), they can be eliminated without fear that this will jeopardize the training process. Now, a view can be created that will contain only valid data, and it will be used for clustering algorithms.

```
CREATE OR REPLACE VIEW E_COMMERCE_VIEW
("INVOICE_NO", "STOCK_CODE", "DESCRIPTION", "QUANTITY", "INVOICE_DATE", "UNIT_PRICE", "CUSTOMER_ID", "COUNTRY") AS
select invoice_no, stock_code, description,
quantity, invoice_date, unit_price, customer_id, country
from e_commerce
where quantity > 0 and unit_price != 0 and description is not null;
```

Figure 9: A view containing filtered data

Clustering node also requires data source for its execution, and three algorithms are available: Expectation Maximization, K-Means and O-Cluster, an Oracle proprietary algorithm similar to hierarchical clustering. In this example K-Means and O-Cluster will be compared. After the selection of algorithms, desired number of clusters and other parameters, clustering process can be started. When it is done, received clusters from both algorithms can be examined with information such as number of instances in each cluster, information about centroid, percent of all instances in given cluster, etc. Both algorithms divided rows in five clusters, as can be seen in pictures.

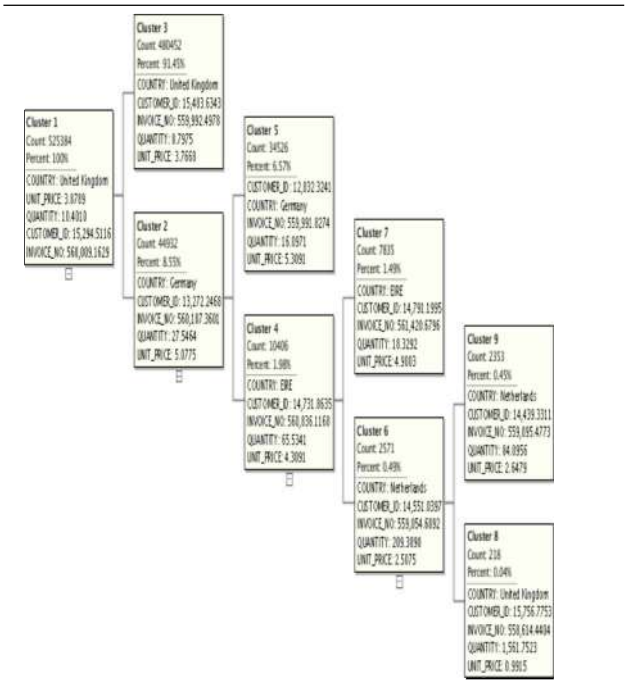

Figure 11: Clusters obtained using O-Cluster algorithm

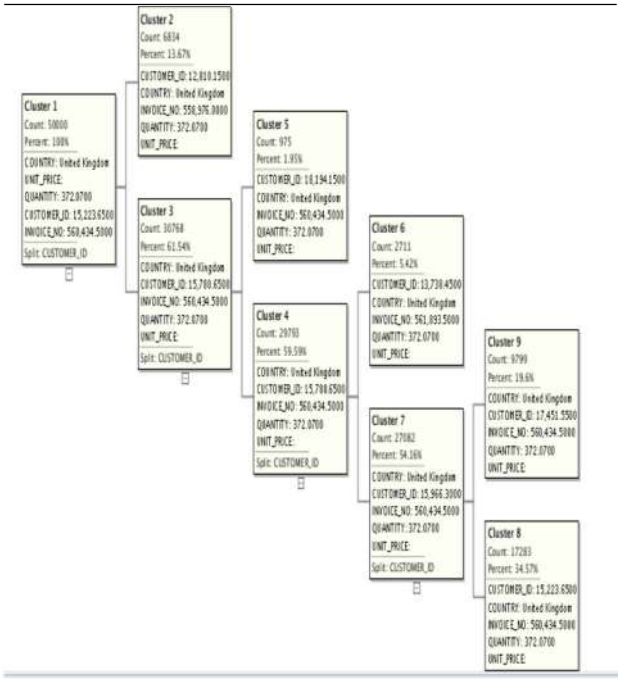

Figure 10: Clusters obtained using K-Means algorithm

One of, or both algorithms, can be used for clustering of a new data source, and results of that operation can be saved in separate table as described in classification.

5. CONCLUSION

There has been a rapid growth in Data Mining usage in different areas like business, education, medicine, science, etc. It is not possible to examine all the data that users generate through various applications in these areas, therefore it is crucial to use different algorithms and techniques for their processing and making certain conclusions from them.

In this paper, the accent was on the very process of Data Mining and selection of the most appropriate algorithm for given domain. Being one of the most rapidly developing disciplines, Data Mining has been integrated in all aspects of IT world, using their advantages to produce more effective solutions, generated faster. One of such examples is using Data Mining algorithms in combination with relational databases and

all the benefits they provide. These benefits can be used to complement and aid mentioned algorithms and eliminate eventual flaws. There are numerous ways, perhaps yet undiscovered, to achieve this, and using analytic functions to additionally analyze Data Mining algorithms is just one of them.

The process of applying certain algorithm on dataset can be divided in steps, and largest part of these steps is independent of the type of algorithm applied. This implies that it can be abstracted to some degree, which could lead to its automation. This could further lead to acceleration of Data Mining process, and its standardization. This also represent course of further development of the subject depicted in this paper.

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BIG DATA ANALYSIS IN SOCIAL MEDIA

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Abstract: *The Internet community has changed a lot in the past few years. Social media has changed the way of communication and connected millions of people. With the increase of information that is being generated in these communication channels, there is a new problem: storing all the data. Relational databases are no longer most suitable storage for social media data. Two technical entities have come together. First is big data for massive amounts of data. Second, there's advanced analytics, which is a collection of different tool types for getting meaningful information from the data. Together they make big data analytics, a new practice in BI today.*
This paper presents big data, social media, and social media data infrastructure. It also shows tools for analyzing big data. The contribution of this paper is to provide an overview of tools and techniques for analyzing social media data either for research or business purposes.

Keywords*: big data, big data analysis, social media, social media data, social media data infrastructure*

1. INTRODUCTION

Information overload and the limits of human cognition in dealing with information are much older than new technologies and Internet network. As hardware technology has improved, software technology has improved as well. It's never been that easy to communicate and stay connected with other people. But, the information and data overload have also increased. A brand new way of communication and new technologies have brought massive amounts of various data and a new problem: How to store it? The answer is big data. It is not regular, structured data and can be explained through three dimensions: volumes, variety, and velocity.

Companies are recognizing the potential value of this data and they are putting great efforts in order to extract some useful and meaningful information from it. The only way to derive value from big data is the use of analytics. It must be analyzed and the results should be used by decision makers and organizational processes in order to generate value. The type of information extracted from social media is constantly in motion. Analyzing social media data can contribute to better understanding people's behavior, their needs and habits. New data sources bring new challenges and new challenging questions.

2. BIG DATA

Big data is a very popular buzzword used by IT companies to increase their sales. However, it is more than just a word. It is real and extremely important technology trend with huge business potential. Big data can often be associated with social media. Rather, it is a combination of data-management technologies that have evolved over time. Big data enables organizations to store, manage and manipulate vast amounts of data. Over time, size and type of data that needs to be stored have changed and new ways of storing data appeared. Big data does not represent regular, structured data. It can be explained through three dimensions: volumes, velocity, and variety, so-called three Vs (Xiang, Du, Ma, and Fan, 2017).

Volume is also known as the big part. It represents the amount of data that is being generated in everyday use. As we generate more and more data, this point of big data will keep growing. Some experts consider that the size of memory that is used for storing data is measured in Petabytes.

Velocity represents the speed of generating new data or the frequency of delivering data. It shows how fast that data is processed. Big data improves real-time data analyzing and enables fast access to a large amount of data.

Variety is about the different type of data and file types available in everyday use. For example there are tweets (500 million per day), video files on YouTube (3.25 billion hours of watching video each month), posts on Facebook (510,000 per second), profiles on LinkedIn (over 5 millions) and then there are also all the different log files and other data produced by any computer system we use. So the explanation of big data could be that it is dealing with high-velocity and high-volume data streams while data types are highly diverse.

Big data requires methods and tools that can be used for analyzing and extracting patterns from large-scale data. The large Volume of data poses a challenge to conventional computing environments. It requires scalable storage and a strategy to data querying and analysis (Choi, Chan, and Yue, 2017). The Volume of data is also a major advantage of big data. Dealing with the Variety among different data is a unique challenge for Big Data, which requires preprocessing of unstructured data in order to extract structured information. The importance of dealing with Velocity in big data is the quickness of the feedback, translating data input into usable information (Bello-Orgaz, Jung, and Camacho, 2016).

3. SOCIAL MEDIA

Social media was originally intended for people who want to interact with friends and family but later many companies started using it as a very powerful tool for communication with customers. Now we can define it as a technology based on computers and Internet that is meant for facilitating the sharing of information and ideas. A huge advantage that social media has is the ability to connect with anyone and share information as long as they also use social media. Some of the most popular social media services are Facebook, Twitter, LinkedIn, Instagram, Pinterest, YouTube etc.

Twitter is a real-time service that allows users to post short messages of 140 or fewer characters. Messages posted on Twitter are called tweets. The network infrastructure of “friends“ and “followers“ on Twitter is asymmetric. User’s friends are the accounts that user is following and user’s followers are the accounts that are following the user. Very important dimension of Twitter is the ability to analyze and track user activity. Retweet function is a form of data sharing. It is a way for Twitter users to participate in discussion without starting it. Twitter offers Apps for various mobile phones and tablets. Interactions or integrations with Twitter are done using the Twitter APIs (Newman, 2017).

Facebook is social networking site. Originally it was designed by Mark Zuckerberg for college students at Harward University. Today, Facebook is the largest social network with more than 1 billion users all over the world. Facebook allows users to send messages, post pictures, videos, links, share information and like content posted by other users.

LinkedIn is a social network for business people. LinkedIn started in 2003 and had only 2,700 members the first week. Today, it has more than 350 million members. It provides a way to connect with other professionals. LinkedIn is used for exchanging knowledge, ideas, as well as finding a job.

4. SOCIAL MEDIA DATA INFRASTRUCTURE

Next three chapters show data analytics infrastructure at Facebook, LinkedIn, and Twitter.

4.1. DATA INFRASTRUCTURE AT FACEBOOK

There are two sources that Facebook collects data from. These are federated MySQL tier and web servers tier.Web servers generate event-based log data and the data is collected to Scribe servers which are executed in Hadoop clusters. The Scribe servers aggregate log data, which is written to Hadoop Distributed File System (HDFS) (Kamar Sahu, 2015). Data from HDFS is compressed and transferred to Production Hive-Hadoop clusters for processing. Federated MySQL tier contains user data.

There are two different clusters for data analysis. Tasks that have a higher priority are executed in the Production Hive-Hadoop cluster. Tasks with lower priority and ad hoc analysis tasks are executed in Ad-hoc Hive-Hadoop cluster. Data from Production cluster is replicated to the Ad hoc cluster. Data analysis results are saved in Hive-Hadoop cluster or to MySQL tier. The graphical user interface (HiPal) or Hive command-line interface (Hive CLI) are used for specifying queries for Ad hoc analysis.

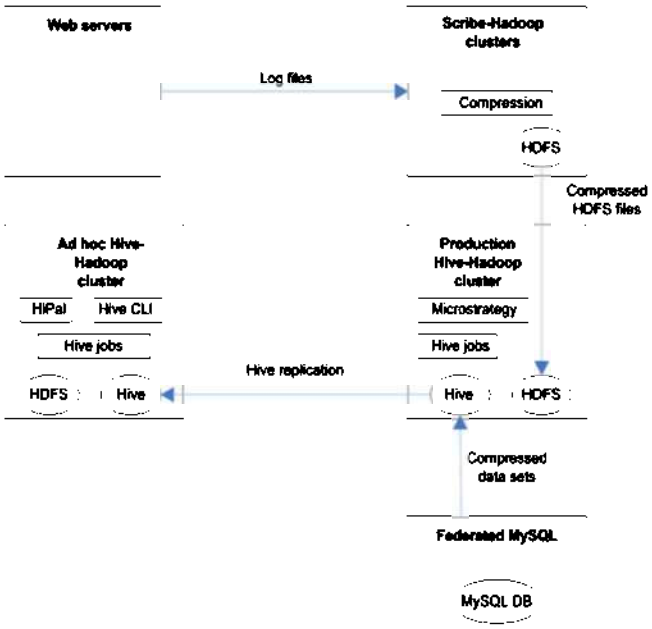

Figure 1. Data analytics infrastructure at Facebook
(Source: Pääkkönen, P., & Pakkala, D. (2015). Reference architecture and classification of technologies, products and services for big data systems)

4.2. DATA INFRASTRUCTURE AT LINKEDIN

LinkedIn started as a single monolithic application called Leo. As the site began to grow, it was necessary to "Kill Leo" and break it up into many services. As the amount of data that needed to be collected also grew, LinkedIn developed many custom data pipelines for streaming and querying data. The site needed to scale and each pipeline needed to scale. The result was the development of Kafka, distributed messaging platform which is used for collection of streaming events.

Data is collected from two sources: activity data that includes streaming events based on usage of LinkedIn's services and database snapshots. Kafka producers report events to topics at a Kafka broker, and Kafka consumers read data at their own pace. Kafka's event data is transferred to Hadoop ETL cluster for further processing. Data from the ETL cluster is copied into production cluster and development cluster.

Azkaban is a workload scheduler for supporting various types of tasks. It is realized as MapReduce, Pig, Hive jobs or shell script. Workloads are tested in the development cluster and transferred to production after testing. Analysis results are moved to an offline debugging database or to an online database. It can also be back to Kafka cluster.

Avatara is used for the preparation of OLAP data. Analysed data is read from the Voldemort database, pre-processed, and aggregated for OLAP, and saved to another Voldemort read-only database (Clemm J. 2015).

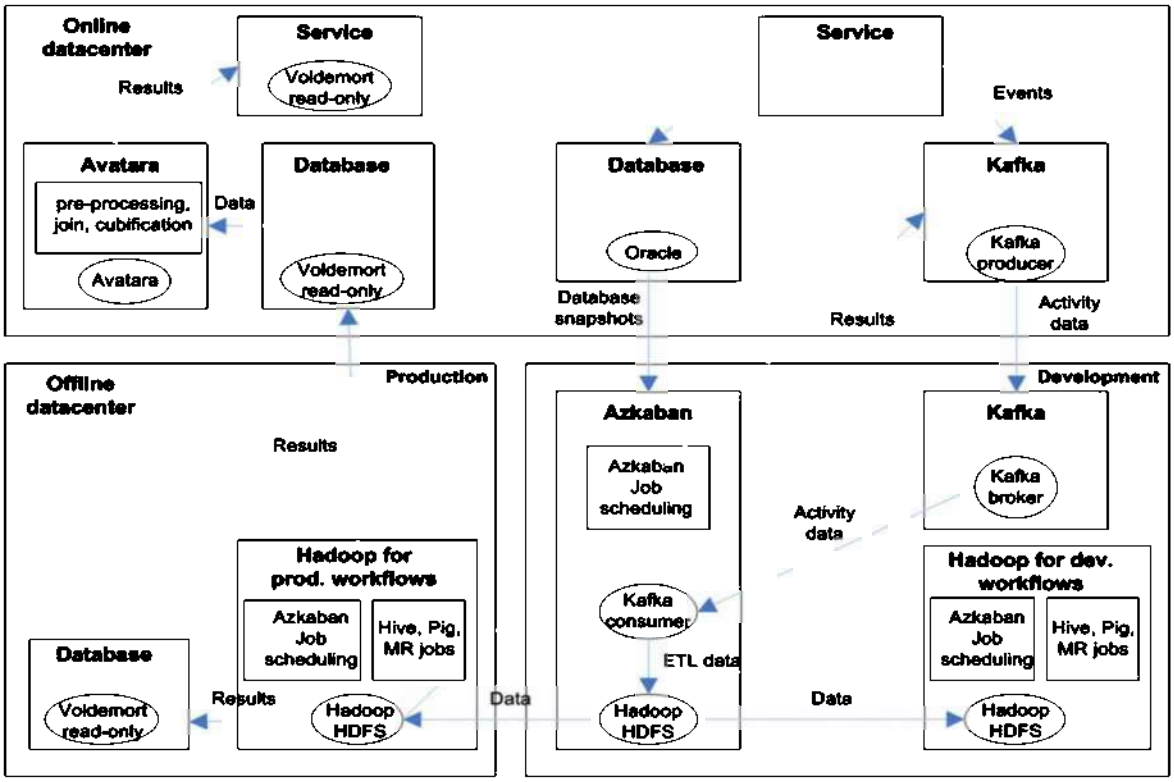

Figure 2. Data analytics infrastructure on LinkedIn
(Source: Pääkkönen, P., & Pakkala, D. (2015). Reference architecture and classification of technologies, products and services for big data systems)

4.3. DATA INFRASTRUCTURE AT TWITTER

Twitter has published two different implementation architectures of their infrastructure: one based on Hadoop batch processing which processes streaming data and the other custom-made solution that meets real-time requirements.

In infrastructure for real-time services, all requests (searching for tweets or user accounts via a QueryHose service) coming from Twitter are managed by Blender. The EarlyBird is a real-time engine designed for providing low latency and high throughput for search queries. FireHose service uses tweets as an input. After receiving tweets, EarlyBird servers filter data, personalize and index data. The EarlyBird servers also serve incoming requests from the QueryHose/Blender.
When tweet or a query is served, search assistance engine saves statistics into one of three in-memory stores. Session store saves user sessions, Query statistics store saves individual queries information, and Query co-occurrence store saves information about pairs of co-occurring queries. The results of the analysis are saved into Hadoop HDFS. In the end, Front-end cache takes results of analysis from the HDFS and presents them to Twitter users.

Twitter has three streaming sources from which data is extracted: tweets, Updater, and queries. REST API transforms tweets and queries in JSON format. Data format from Updater is not known. Blender and ingestion pipeline work as Stream temp data stores. The data is being processed. EarlyBird servers contain processed stream-based data (Stream data store). Hadoop HDFS storing the analysis results is modeled as a Stream analysis data store. Front-end cache (Serving data store) provides data to a Twitter app.

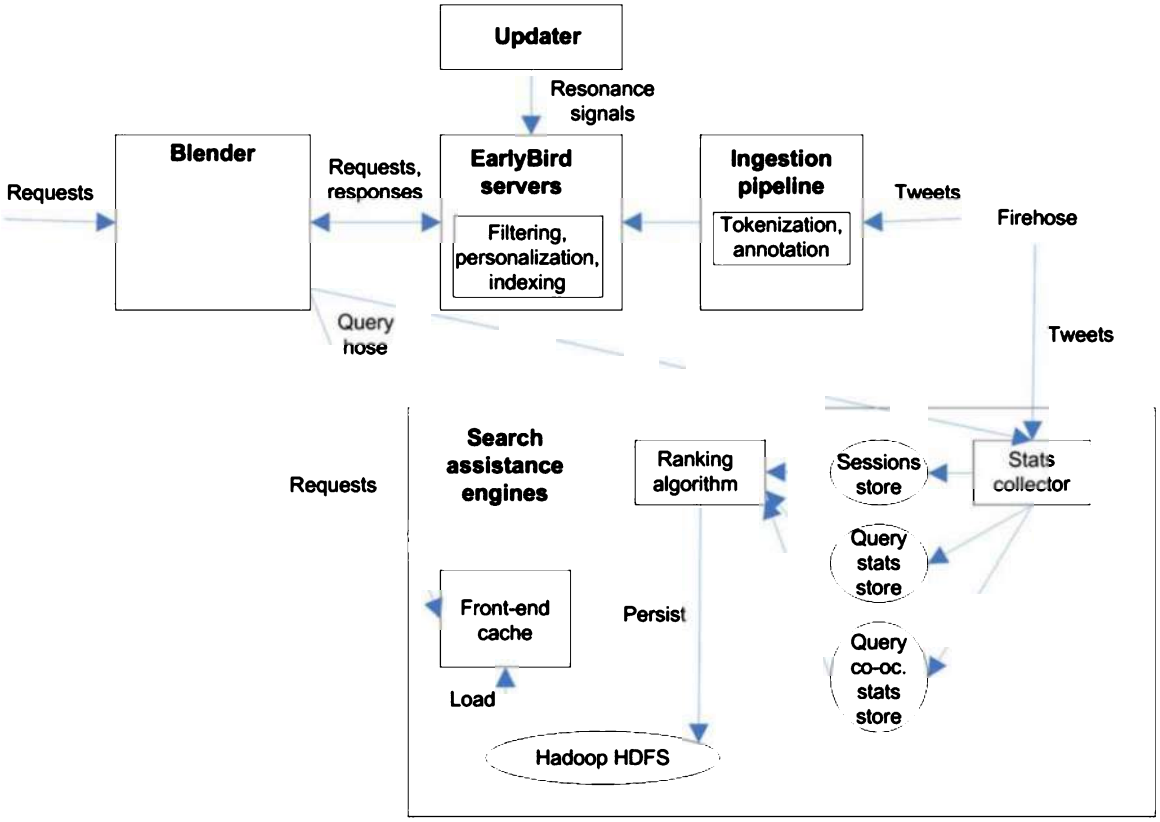

Figure 3. Data analytics infrastructure on Twitter
(Source: Pääkkönen, P., &Pakkala, D. (2015). Reference architecture and classification of technologies, products and services for big data systems)

5. ANALYSING BIG DATA IN SOCIAL MEDIA

Social media store a great amount of data. Underneath the surface of a Facebook profile, Facebook page, Instagram business profile or just tweets on Twitter, there is a huge information potential that is still just mostly unstructured data. Social media analysis is the analysis of structured and unstructured data from its channels.

At the moment, data in social media is available either via simple routines or require analysis in some research programs that use programming languages such as MATLAB, Java or Python. Researchers require:
• **Analytics dashboards** — non-programming interfaces for 'deep' access to 'raw' data.
• **Holistic data analysis** — tools required for combining multiple social media and other data sets.
• **Data visualization**—researchers also require visualization tools so information can be visualized in some schematic form.

There is a number of tools for big data text analyzing that can be used for analyzing social media data. Attensity's software is one of them. Attensity is one of the original text analytics companies. It uses a Hadoop framework (MapReduce, HDFS, and HBase) to store data. Another text analytics vendor is Calarbridge. Clarabridge CX Social is its tool specialized for exploring social media data.IBM offers several solutions such as Watson, SPSS, IBM Content Analytics with Enterprise Search (ICAES). IBM BigInsights for Apache Hadoop is an industry standard Hadoop. It is a data management platform. SAS is also solving big data problems. The SAS High Performance Analytics Server is an in-memory solution that allows a user to analyze complete data. It uses Hadoop Distributed File System (HDFS).

There are also custom applications for big data analysis. The purpose of these applications is to increase the speed of decision making or action taking. For example, the "R" environment is based on the "S" statistics and analysis language. It is an integrated suite of software tools and technologies designed to create applications that are used to ease data manipulation and analysis. It supports effective data-handling, operations for arrays and other ordered data types and tools to a wide variety of data analyses.
The Google Prediction API is an example of an emerging class of big data analysis application tools. It functions by looking for patterns and matching proscriptive, prescriptive or the other existing patterns. While

doing this matching, it also learns. The source can be postings from Facebook, Twitter, Amazon, LinkedIn and the goal finding specific patterns of behavior. That can be very useful in business for a consumer products company. Based on the gathered information, the company might launch a new product or upgrade the old one. It is implemented as a RESTful API and supports .NET, Java, PHP, JavaScript, Python, Ruby, and many other programming languages. It also provides scripts for accessing the API as well as a client library for R.

Hadoop is an open source framework which is designed to solve problems associated with distributed data storage, analysis, and retrieval of big data. A distributed file system (HDFS) stores data and replicates it so it is always available. MapReduce is a distributed processing system for parallelizable problems. The idea is to design map functions that are used for generating a set of key/value pairs after which the reduce function will merge all the values associated with the same key. In the first step (Map), a problem is divided into many small problems and sent to servers for processing. In the second step (Reduce) the results of the previous step are combined to create the final results of the problem. Reduce can't begin until all the mapping is done, and it isn't finished until all instances are complete. The output of mapping and reduce are key-value pairs. Hive is a data warehouse system in which the user can specify instructions convert them to MapReduce tasks. Pig is another member of Hadoop family. It has similar functions like Hive, but it uses a programming language called Pig Latin, which is more oriented to data flows. HBase is another component of the Hadoop ecosystem, which implements Google's BigTable data store. Bigtable is a multidimensional sorted map. Elements in the map are an array of bytes. They are indexed by a row key, a column key, and a timestamp. The official Hadoop project is Apache. Hadoop solutions are also offered by companies such as Cloudera and Hortonworks. There is also a company MapR. It offers a commercial implementation of Hadoop (Zadrozny and Kodali, 2013).

6. COMPARISON OF SOCIAL MEDIA DATA INFRASTRUCTURE

With large incoming data and the fact that more and more data needs to be properly stored in order to allow data analysis, many social media platforms use Hadoop tools. Hive-Hadoop is an ad hoc cluster. It is a data warehousing framework built on Hadoop. It was created by Facebook and then given to Hadoop as a subproject of Hadoop ecosystem. Hive allows users to query and analyze data using SQL which makes data processing easier. In LinkedIn event data from Kafka cluster is transferred to Hadoop ELT (Extract – Transform - Load). ELT on Hadoop is a data integration process that provides flexibility in data processing environment. Also, Azkaban, a workload scheduler for supporting various types of tasks, is realized as MapReduce, Pig, Hive jobs or shell script. All the three social media networks, Facebook, Twitter and LinkedIn use Hadoop HDFS typically for storing structured data or storing the results of the analysis.

LinkedIn data is collected from two sources: activity data and database snapshots. Facebook also collects data from two sources. From federated MySQL tier it collects structured and stream-based user data. From web servers tier it generates event–based log data. The data is applied for batch-based data analysis. Every time user sends a Facebook message, add a contact on LinkedIn or tweets on Twitter digital data is being generated. These platforms are able to gather real-time data. All these events are captured, streamed and processed in digital form as they occur (Pigni, Piccoli, and Watson, 2016). Twitter uses a new stream processing system called Heron. It provides significant performance improvements and other advantages such as debugging-ability, manageability, and scalability. If something goes wrong, the design of Heron makes it transparent as to which part is failing. Each Heron Instance is executing a single task, so it is easier to debug that instance (Kulkarni, Bhagat, Fu, Kedigehalli, Kellogg, Mittal, and Taneja, 2015).

Relational databases are still applied for storing important user data as MySQL for Facebook and Oracle for LinkedIn. For storing data analysis results NoSQL databases or in-memory stores are used (LinkedIn's Voldemort). Log facilities are used for storing stream-based data. For Facebook it is Scribe, For LinkedIn Kafka. Technologies for data processing can be classified as a batch and stream processing. Real-time jobs require special technologies and algorithms (Twitter's ranking algorithm and the EarlyBird architecture). Batch processing is used for jobs with less strict timing requirements (Facebook's and LinkedIn's MapReduce, Hive and Pig scripts). Jobs for batch processing in LinkedIn are scheduled with Azkaban, in Facebook's with Databee. Processed data can also be presented with commercial Business Intelligence tools. Facebook uses MicroStrategy (Pääkkönen and Pakkala, 2015).

7. CONCLUSION

Big data analysis is a very powerful way to get right insights, information, and meaningful data from a huge volume of various data on social media platforms. It is now easier to collect data than it has ever been before. But extracting and utilizing useful information is not easy at all. From the business viewpoint, online reviews, photos, and the reviewer's personal information are very important in order to understand and influence user behavior. Social media isn't just used by marketers to find out about the position of their brand on the market or about customers opinion. It is used by healthcare institutions to discover health threats all around the world. The government is using it to predict terrorist attacks. Business intelligence can benefit from big data analytics. Social media data hides great informational potential. With the right tools and the right techniques, data can be transformed into valuable information. As big data evolves, software vendors are competing to make the best tool for all sorts of analysis. There are numbers of programs designed to meet the needs of data analyzing. It's up to analyzer to choose the one that is most suitable for the given problem.

In this paper, various definitions of big data and social networks have been presented. A primary focus has been on big data analytics tools and social media data infrastructure for three different social media platforms: Facebook, LinkedIn, and Twitter. The paper can be a good starting point for further social media data exploring.

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QUERY PROCESSING ASPECT IN HETEROGENEOUS DBMS

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Abstract: *This paper presents the method of realization of query processing in two heterogeneous database management systems. There is NoSQL and SQL query processing aspect that are integrated into different ways depending on the architecture. Integrated results are displayed to the user. In HQPS, Resource Description Framework (RDF) is used for data integration from heterogeneous databases. The CloudMdsQL uses a functional SQL-language, capable of querying multiple heterogeneous data stores.*

Keywords: *NoSQL database, relational database, HQPS system, CloudMdsQL system*

1. INTRODUCTION

Until a few years ago relational databases played a leading role in storing data. They provide great precision, consistency, and availability of data. Relational databases store data using SQL query language (Bergamaschi, Guerra, Interlandi, Trillo-Lado, & Velegrakis, 2016). Characteristic for the SQL database is that they are based on ACID properties (Đurđevac, 2012). The ACID properties are the acronym for:
• **A**tomicity
• **C**onsistency
• **I**solation
• **D**urability

The ACID model is in the database layer, which means that all operations that are performed must be executed in one transaction and all operations are performed at the database level. However, relational databases are not the best solution for storing a large amount of data or when it is necessary to manipulate data at high speed. Then NoSQL databases appeared. NoSQL do not use the SQL query language, but support it. NoSQL databases are much more flexible than relational because they do not have a strictly defined schema in data storage and consume much fewer resources. Also, the NoSQL databases sacrifice the consistency that is the property of ACID in order to provide better research performance. NoSQL is short for Not Only SQL (Oluwafemi, Sahalu, & Abdullahi, 2016).
These databases support a set of BASE features that are the acronym for:
• **B**asically **A**vailable
• **S**oft state
• **E**ventually consistent

The BASE property model is in the application layer and it is good for use in storing data on the web, where it is necessary not to block transactions, while others are still not executed. NoSQL databases work with structured, semi-structured and unstructured data (Nikolaus, 2015). Eric Brewer (Brewer, 2012) has devised CAP theorem in response to the fact that there is a conflict in the availability of data in distributed systems. The CAP theorem shows that in distributed systems cannot be simultaneously available more than two of the following properties: (Nayak, Poriya, & Poojary, 2013)
• **C**onsistency
• **A**vailability
• **P**artition tolerance

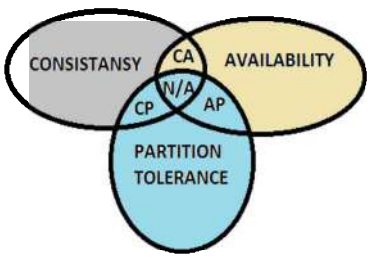


Figure 1: *CAP theorem*

The second chapter gives a brief overview of the types of NoSQL databases. The third chapter deals with the integration of SQL and NoSQL data; the architecture view shows how the data is transformed from one form to another and through which layers they pass through the transformation. The fourth chapter presents two HQPS and CloudMdsQL architectures that analyze the query and give a plan for its execution. Mapping functions between different data formats are also given. In the fifth chapter, we give our vision for further research on heterogeneous systems, in order to improve and maximize their performance.

2. TYPES OF NOSQL DATABASES

1. Key/value database

The key/value do not have a strictly defined schema. This model can be presented as a single table in a relational model with two columns, where one column represents a key and the other value. Three operations that can be performed over the database are: PUT, GET and DELETE (Luković, 2015).

2. Document oriented databases

The central part of these databases is a document. With such databases, each JSON document represents a separate object.

3. Column oriented database

With this database, the data is arranged by columns, unlike RDBMS, where data is stored in rows. Such warehouses do not require a complete schema, but pre-defined column families, which are mutually independent. Apart from the concept of a family of columns, there is a notion of super columns. A super column may contain other columns, but not other super columns.

4. Graphic databases

Graphic databases are based on graph theory, using graphic structures with nodes (entities), branches (connecting nodes), and properties (attributes) for displaying and storing data. Each node can have an unlimited number of attributes that describe nodes (Veljković, 2013).

3. PROBLEM OF INTEGRATION OF RELATIONAL AND NOSQL DATABASES

Although in recent years there is rapid growth and development, as well as the popularization of NoSQL databases, there are still situations when it is more convenient to use relational databases. For example, when it is necessary to provide ACID properties that reduce anomalies and protect the integrity of the database by defining the way in which transactions communicate with the database. NoSQL databases sacrifice these properties for flexibility and speed of execution. In NoSQL databases, there is also no inner join or transaction (Varughese & Rajeswari, 2009).

NoSQL databases prevent the occurrence of bottlenecks or congestion due to volume. They also reduce storage costs and easily deploy data to multiple servers, allowing simultaneous access to a large number of different users. The big problem is the selection of relational databases that ensure consistency and usefulness in combination with NoSQL databases that provide benefits in terms of scalability and partition tolerance. The problem occurs when one software product needs to provide data storage, where one part is ideally stored in the NoSQL database, while the other data is ideally stored in a relational database (Adeyi, Abdullahi, & Junaidu, 2013). Indian scientist Ali (Ali, 2009) proposed a solution that creates a global scheme instead of multiple local schemes. One access to all components of a heterogeneous database, or heterogeneous system, is formed. Ali believes that in this way there is an integration of several different local systems, and it can be called MDBS (Multidatabase system). To the end user, this system is presented as a single database that they can use, while on the lower layers it consists of several local databases (Haber, et al., 2015).

The problem that occurs when storing data is that one part is stored in the SQL database, while the other is stored in the NoSQL database, so the user needs to extract data from different sources. To avoid writing a different code for each type of database in which the data is located, the Roijackers suggested using a hybrid database. It requires the construction of an abstraction layer at the top of SQL and the NoSQL database. The abstraction layer is responsible for translating data from NoSQL into a triple format and incorporating the resulting format into an SQL database as a virtual relationship. In this way, using one query language, data can be downloaded regardless of the database, because this layer is responsible for collecting relevant data, but also combining received data in one query (Katsov, 2012).

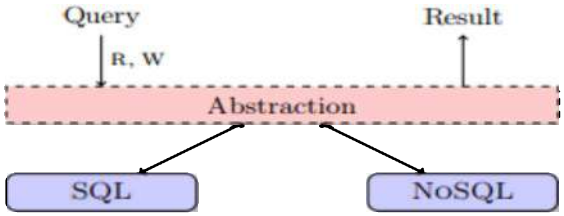


Figure 2: An example of the architecture of the hybrid base proposed by Roijdzakers (Roijackers & Fletcher, 2012).

To virtualize data from different databases (MySQL and MongoDB), RDF is used as a data format for relational and NoSQL data. RDF (*Resource Description Framework*) is a language for displaying resource information and metadata on the World Wide Web. The RDF is designed to store and model information as well as to provide interoperability between applications that exchange information that is understandable for machines on the web. Distributed NoSQL data is in the form of a triple format in the RDF (subject, predicate, object), so that they can be embedded in the SQL database (Thant & Naing, 2014). Triple notation represents arbitrary data that facilitate the work of the hybrid base. The problem that arises with NoSQL data is that there is no standard that can be compared with SQL data from a relational database. All SQL databases use the same SQL query language, while in the NoSQL database, there are different NoSQL query languages that can be used (Roijackers & Fletcher, 2012).

The picture shows that the triple format is represented by F (id, key, value), where different data can be described in triple format. The data to be found in the F relation are derived from the outside world, or from the NoSQL database. All nodes that actually represent NoSQL data must have a unique ID value according to a set of key/value pairs. All keys at the same level of nesting, with the same "parent", must be unique. The combination of id and key is unique, so it refers to one value of NoSQL data (Roijackers & Fletcher, 2012).

Table 1: *Relational representation*

ID	Name	Age
1	Ana	18
2	Boba	35

Table 2: *Representation of triple format*

ID	Name	Value
i1	id	1
i2	Name	Ana
i3	Age	18
i4	Id	2
i5	Name	Boba
i6	age	35

Table 3: Nested data

ID	Name	Value
i1	name	Boba
i1	grades	i2
i2	0	8
i2	1	6

If NoSQL data is nested within another NoSQL data, a transformation function must be performed so that all nested elements in the triple format can have the same id value. SPARQL is used to represent the NoSQL query. It is the W3C standardized query language for RDF. The most important part of the SPARQL query is the basic graphic representation (Roijackers & Fletcher, 2012). The picture shows the nesting object, the SQL query and the nested NoSQL query within it. The process of translating NoSQL into the corresponding

SQL fragment is shown in the section of the architecture in the following image, which is colored in yellow. The translation should be executed automatically, before executing the query itself, but this transformation still does not represent a final SQL query, it is yet to come (Mijalkovic, 2013).

```
SELECT
  r.name
FROM
  NoSQL(
    name: ?name,
    grades: (
      0: ?f,
      1: ?s
    )
  ) AS r
WHERE
  r.f = 8
```

Figure 3: *SQL query and nested NoSQL query within it.*

Each transformation is unique depending on the type of the NoSQL database, which means that for different NoSQL solutions it is necessary to make new transformations in triple RDF formats. This part of the architecture is shown in the green part of the image. Only after this transformation, the obtained RDF triple format is embedded in the SQL base and is merged with the SQL query set by the user, if the user wrote the SQL query at all. The last blue section represents SQL query that is a result of user's query and NoSQL query which was previously transformed into a triple format. In the end, this new query is sent to the relational database and executed as a normal SQL query. The result is an output made from SQL query as s response to a user's request.

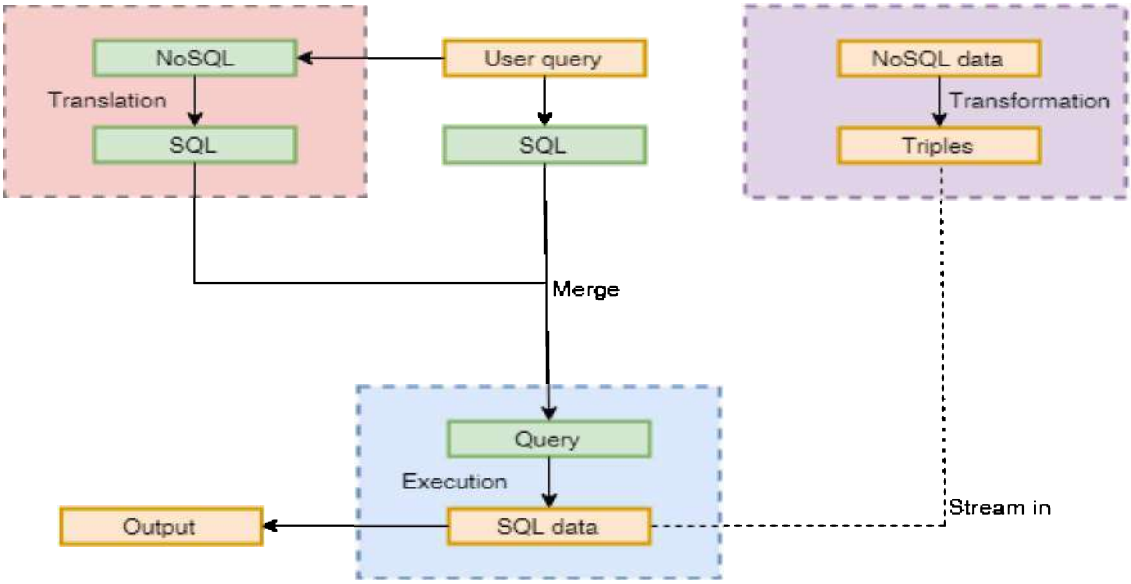


Figure 4: Architecture that illustrates execution and query transformation (Roijackers & Fletcher, 2012).

4. ARCHITECTURE OF INTEGRATED SOLUTION

4.1. Hybrid Query Processing System (HQPS)

Hybrid Query Processing System–HQPS was created to use and manage data from the SQL database, as well as data from the NoSQL database, or to handle both types of user queries.
HQPS consists of two components, which are:

1) Query Analyzer &Generator (Control SQL and NoSQL Queries)
2) Result Preparation (Preparation of results where results are prepared and presented to users)

In the picture below is given a graphical representation of the HQPS system. The user writes a query in Query Analyzer &Generator, then the same query is sent to the SQL or NoSQL query processing unit, depending on the type of query. In query processing units, queries are executed with the help of the database the query belongs to (SQL or NoSQL), and in the end the result is sent to Result Preparation. In Result Preparation integration of data from heterogeneous databases, SQL or NoSQL is performed. Integration is done using the RDF format, and if the data is from the NoSQL database it is translated into a triple RDF format. Then the data is integrated with the data from the SQL database, and the result of integration is sent to the user as a response to a user's query. (Thant & Naing, 2014).

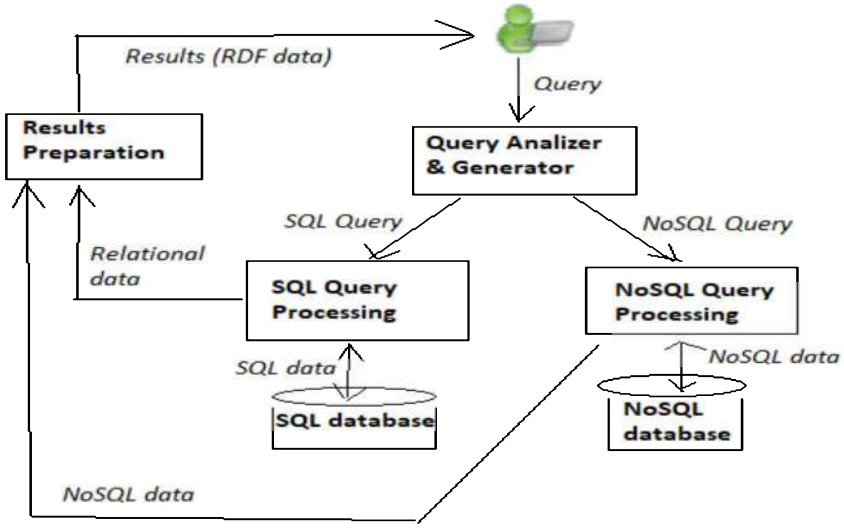


Figure 5: Architecture of the HQPS system

When a query is sent to Result Preparation, it first enters the query layer and then into the virtual database that is in the target layer. From a virtual database, the data is sent to a Relational or NoSQL database depending on the type of query. Sending the response backward goes through the same layers only in the opposite order. In the picture below is given a summary of the Result Preparation architecture.

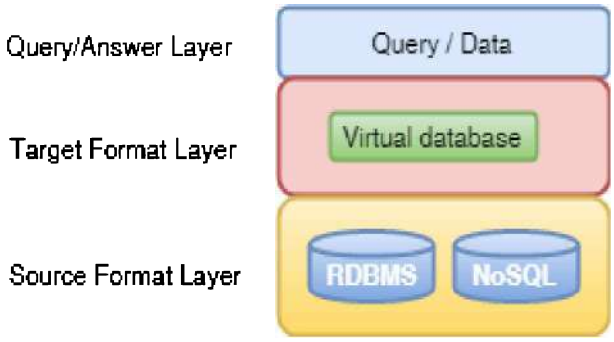


Figure 6: Architecture of Result Preparation (Thant & Naing, 2014).

To integrate data, NoSQL data must be transformed into an RDF triple format, which is easy when the NoSQL data is normalized. However, when the data is nested one within another, a more complex mapping is required. In order to transform the nested key-value structure into a triple format, it is important that all nested elements have the same ID value that will define them and which will be found in triple format.

4.1.1. Mapping between NoSQL and RDF triple format is given in the following lines:

Let

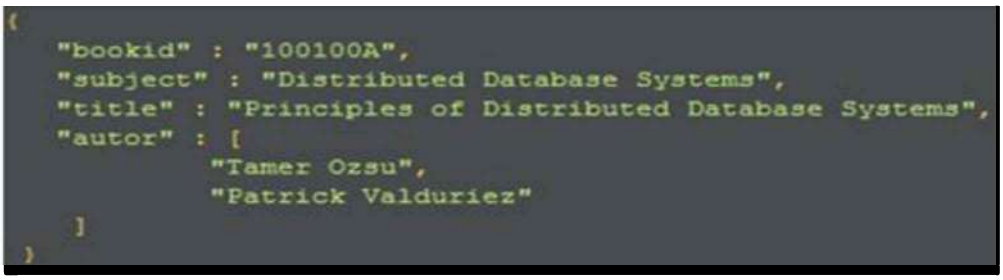
α = transformation function for a key value pair

δ = transformation function for set of key value pairs

i = subscript for given equal id values

$$\propto i(N) = \begin{Bmatrix} \{(i,\ Nk,\ Nv)\},\ if\ Nv\ is\ not\ a\ set \\ \{(i,\ Nk,\ j) \cup \delta j(Nv),\ if\ Nv\ is\ a\ set\} \end{Bmatrix}$$

$$\delta i(S) = U\ n \in s\ \alpha i(N)$$



$$\delta i\ (S)\ = \cup n \in s\ \alpha i\ (N)$$

$$= \{(i1,\ BookId,\ 1000100A)\} \cup \{(i1,\ Subject,\ Distributed\ Database\ Systems)\}$$

$$\cup \{(i1,\ Title,\ Principles\ of\ Distributed\ Database\ Systems)\}$$

$$\cup \{(i1,\ Author,\ i2)\}$$

$$\cup \{(i2,\ 0,\ M.\ Tamer\ Ozsu)\} \cup \{(i2,\ 1,\ Patrick\ Valduriez)\}$$

Figure 7: An example of a transformation function from NoSQL to a RFD triple format with a nesting document Author (Thant & Naing, 2014).

4.1.2. Mapping between Relation Model and RDF Triple Format:

Let

β = transformation function for a relational record

φ = transformation function for relational records

i = subscript for given equal id values

$$\beta i(R)\ = \{(\ i,\ Ak,\ Vj\ )\forall j\ ,Vj \in Nj\ \}\quad \varnothing i(S) = \cup \beta i(R)$$

Table 4: Example of mapping between Relation Model and RDF triple format

Member ID	Name	Password	Email	Major
000001	MonMon	345mon	mon@gmail.com	Computer Science

$$\varnothing i\ (S)\ = \cup r \in s\ \beta i(R)$$
$$= \beta i2\ (MemberID,\ 000001) \cup \beta i1\ (Name,\ Mon\ Mon)$$
$$\cup \beta i1(Password,\ 345mon) \cup \beta i1\ (Email,\ mon@gmail.com)$$
$$\cup \beta i1(Major,\ Computer\ Science)$$
$$= \{(i1,\ MemberID,\ 000001)\} \cup \{(i1,\ Name,\ Mon\ Mon)\}$$
$$\cup \{(i1,\ Password,\ 345mon)\} \cup \{(i1,\ Email,\ mon@gmail.com)\}$$
$$\cup \{(i1,\ Major,\ Computer\ Science)\}$$

Figure 8: An example of a transformation function from SQL to an RFD triple format. *(Source: Hybrid Query Processing System (HQPS) for Heterogeneous Database (Relational and NoSQL))*

4.1.3. Mapping algorithm from NoSQL to RDF and from SQL to RDF format

Using the mapping algorithm, you can see what the inputs are and what is the outcome, as well as all the steps that are executed until an RDF format is obtained. The mapping algorithm from NoSQL to RDF receives the query and db properties as inputs, and as the output has an RDF format. In the first step, a database is loaded, then a query is executed as long as the cursor reports that there are still queries or entities for execution and converting to objects. Converting is done in RDF format (key, name, value) and in the end, the RDF format is obtained.

The mapping algorithm from the relational database to the RDF format is similar. The data from the database is loaded, the query executed and a set of results is obtained. As long as there are results or data in the list, the data from the relational base is converted to RDF format (key, name, value) and the result in RDF format is printed. When it is necessary to return to the user the results of a query from two databases, one relational (MySQL) and one non-relational (MongoDB), the system itself integrates data from MySQL and JSON data from MongoDB and then shows integrated data to the user. The implementation of relational data in RDF mapping is done using a free database called Sakila, a product of MySQL Corporation. For mapping operations, the HQPS system needs to provide SQL expression, while the result will be displayed in the RDF format (Thant & Naing, 2014).

4.2. CloudMdsQL System

CloudMdsQL is a specific DBMS that is categorized as web-based data. CloudMdsQL uses different sizes for displaying different data and databases. It uses relational properties for data exchange, such as ACID, transaction independence, SQL query language. It provides scalability, schemaless databases, and good performance. CloudMdsQL has provided a solution to the problem of data storage in three different databases. It is necessary to write a program that will have access to three different databases through their APIs and which will integrate their solutions.

The query engine is part of the platform that allows deployment over one or more data centers. The picture below shows the architecture of a single data center. The architecture of the query engine is fully distributed, so that query engine nodes can directly communicate with each other. The query engine does not follow the traditional mediator/wrapper architectural model where mediator and wrappers are centralized. Each query node consists of two parts of the master and the workers, and they are located on each data hub in a computer cluster. Every master or worker has a communication processor that supports the sending and receiving of data exchange operators and commands between nodes.

If there are multiple masters, the client chooses one of them to send a query to. A master takes as input a query and produces a query plan, which it sends to one chosen query engine node for execution. The query planner performs query analysis and optimization and produces a query plan serialized in a JSON form. All operations in the plan have the identifier of the query engine node that is in charge of performing it. The operation determines the first worker, which the master should send the query plan to. Query execution controller controls the execution of a query plan by interacting with the operator engine for local execution with one or more workers. The query execution controller will synchronize the execution of the operators that require the intermediate results produced by the distant workers, once they are received back.

Operator engine executes the query plan operators on data retrieved from the wrapper, from another worker, or from the table storage. These operators include CloudMdsQL operators to execute table expressions in the query and communication operators to exchange data with other workers. Table storage provides efficient, uniform storage for result data in the form of tables. Wrapper with its data store interacts through its API to retrieve data, transforms the result in the form of a table, and writes the result in table storage or delivers it to the operator engine.

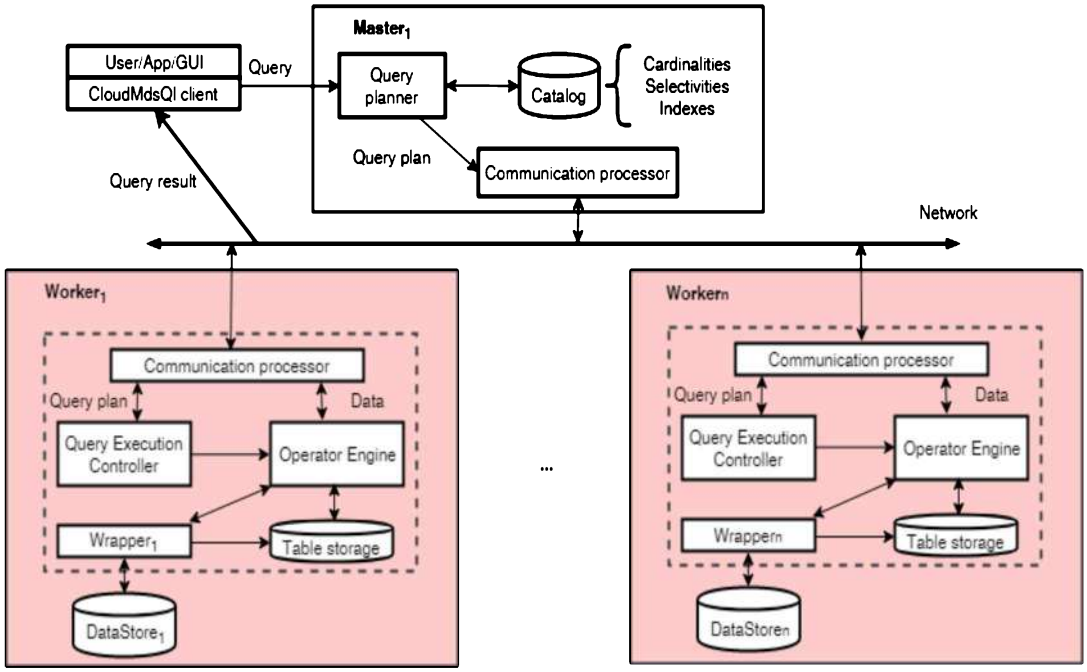


Figure 9: Architecture of the query engine (Kolev, Valduriez, Bondiombouy, Jiménez, Pau, & Pereira, 2016).

The architecture that uses the CloudMdsQL language consists of a mediator and a wrapper and it is given in the picture below (Kolev, Valduriez, Bondiombouy, Jiménez, Pau, & Pereira, 2016). The mediator collects the information found in the global schema. Transforms queries set in common language for the wrapper and integrates query results. The wrapper displays information about source schemes and provides mapping functions that translate data between source schemas and schema mediators. The wrapper transforms queries written in a common language into queries for different DBs. Transforms query results into a common data model. The characteristic of this architecture is that one query that represents output from one database can be input to another database (Kolev, Valduriez, Bondiombouy, Jiménez, Pau, & Pereira, 2016).

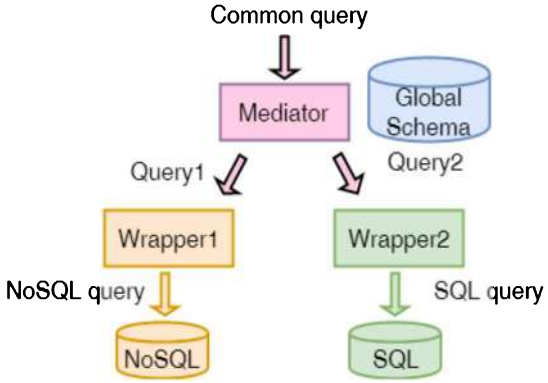


Figure 10: Mediator/wrapper Architecture (Kolev, Valduriez, Bondiombouy, Jiménez, Pau, & Pereira, 2016).

CloudMdsQL is not built to integrate web data. CloudMdsQL sticks to the relational data model for data representation, integration of data and the benefits of relational algebras operations.

Below are examples of relational, non-relational and common queries:

*1**/ show from document db all reviews made in 2018*

```
reviews_2018 ( pub_id int, reviewer string )@DB2 = {*
  db.reviews.find(  {'date': {'$gte': '2018-01-01', '$lte': '2018-12-31'} }, {'pub_id': 1, 'reviewer': 1, '_id': 0} )
                                                                                                    *}
```

*2**/ show from relational db the publications of scientists from Africa*

```
pubs_Africa ( id int, title string, author string )@DB1 = (
 SELECT pubs.id, pubs.title, pubs.author
 FROM pubs   JOIN scientists ON (pubs.author = scientists.name)
 WHERE scientists.affiliation = 'AFRICA' )
```

*3**/ joining the previous two queries*

```
SELECT pubs_ Africa.id, pubs_ Africa.title, pubs_ Africa.author, reviews_2018.reviewer
FROM   pubs_ Africa   JOIN reviews_2018 ON (pubs_ Africa.id = reviews_2018.pub_id) ;
```

Table 5: Joining the previous two queries

ID	Title	Author	Reviewer
6	Principles…	Mark	Peter
6	Principles…	Mark	Rui

5. CONCLUSION

Researching and analyzing HQPS system and CloudMdsQL system reveals some differences between them, as differences in data transformation. In the HQPS system, a user prints a query that is sent to the Query Analizer&Generator, which checks if the last query is relational or not, and sends it to the corresponding database (SQL or NoSQL). When a query is executed in the database, it is sent in the Result Preparation for the integration of the results from different databases. In the Result Preparation, the transformation of the NoSQL data into the RDF triple format is executed and that result is shown to the user.

In CloudMdsQL architectures that are fully distributed, nodes can communicate with each other, which enables optimization, or minimization of data transfer between nodes. CloudMdsQL sticks to the relational data model, because of its intuitive data representation and integration datasets by applying joins, unions and other relational algebra operations (Kolev, Valduriez, Bondiombouy, Jiménez, Pau, & Pereira, 2016). In CloudMdsQL System nesting is allowed in both SQL and native expressions. CloudMdsQL allows for optimizing the query execution by rewriting queries according to bind joins and, planning optimal join execution orders, and the delivery of intermediate data is optimal. CloudMdsQL query can exploit the full power of local data stores.

Architecture based on CloudMdsQL has little advantage over HQPS architecture if the criteria of comparison are the speed of transforming data. The conclusion is based on the CloudMdsQL architecture which allows nodes to communicate with each other which makes transforming data faster. We examine factors that influence query result performance, including databases with different sizes and different table sizes. The results show size affects the time of executing queriess. In the future, other criteria for comparing different databases should be considered, in order to better identify the benefits of both with the optimization of query execution.

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ORGANIZATION AND BUSINESS MODELS IN THE DIGITAL AGE 347

Dušan Mežnar
RESTRUCTURING THE COMPANIES BY IMPLEMENTING PROCESS OF DIGITALIZATION 348

Bojan Jovanović, Momčilo Kujačić, Nikola Trubint
POSTAL OPERATORS IN A DIGITAL WORLD 354

Matjaž Roblek, Benjamin Urh
LINKING PROCESS COMPLEXITY INDICATORS AND PROCESS PERFORMANCE INDICATORS 360

Nina Đurica, Maja Đurica, Ivan Todorović
THE ROLE OF FACEBOOK IN BUSINESS MODELS ANDINCREASING COMPETITIVENESS OF HIGHER EDUCATION INSTITUTIONS 365

Tea Dabetić, Mladen Čudanov, Ondrej Jaško
MATRIX ORGANIZATIONAL STRUCTURE AND MULTI-SIDED PLATFORM BUSINESS MODEL IN DIGITAL MARKETING 371

Tihomir Spremo, Momir Lazarević
THE IMPORTANCE OF THE NETWORK ORGANIZATIONAL MODEL FOR BUSINESS OF COMPANIES IN THE REPUBLIC OF SRPSKA 379

Jovan Krivokapić, Miloš Jevtić, Stefan Komazec
CONSULTING APPROACHES TO THE ORGANIZATIONAL CHANGE PROCESS 387

Vuk Mirčetić
AUTHENTIC LEADERSHIP: CONCEPTUALIZING AND DEVELOPMENT 394

RESTRUCTURING THE COMPANIES BY IMPLEMENTING PROCESS OF DIGITALIZATION

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Abstract: *Digital era is not just a great opportunity for the companies, but also brings some threats by its implementation. One of the greatest challenges of digital transformation is the internal transformation of the company. The problems that are usually facing the companies are redundant business and technological processes, bad responsiveness, inadequate managerial skills and rigid human resources management. The basic purpose of this article is to present the model of digitalization process of the company, which can be used for transforming the company structure to increase productivity and flexibility. The model is primarily based on process optimization which consists of the implementation of lean management, human resources management, employee competence management and the implementation of new more flexible organizational forms.*

Keywords*: digitalization, restructuring, lean management, process optimization*

1.INTRODUCTION

Business problems and presence of crisis are often a good opportunity for a complete business restructuring and successful growth of a company (Mežnar, 2015). The major problem that companies now face is how to sustain their competitive advantage. Becoming digital may be a complex undertaking due to the magnitude and the complex nature of the systems. Digital transformation should be designed to establish a profitable and sustainable position against the forces that determine industry competition.

Digital transformation brings new business opportunities enabled by technology and technological innovation, which triggers and stimulates business innovation, innovation in business processes, business models. The biggest opportunities for digital transformation are in particular internal company transformations.

To be a digital master, companies must excel in two dimensions: digital capability and leadership capability. Becoming digital depends on the ability of leaders to get everyone on board and moving in the same direction."The what" needed to succeed at becoming digital requires significant investment in three key strategic priorities: customer experience, operational processes, and business model innovation (Westerman G., Bonnet D., McAfee, 2014).

Most of the economy is still represented by traditional industry sectors that can use digital transformation for faster work, lower costs, innovation, better customer relations. The described approach and model in this article is one of the options how to become digital.

2. DIGITALIZATION AND RESTRUCTURING OF BUSINESS PROCESSES

The technological and information revolution undoubtedly brings an enormous number of new opportunities and potential. Digitalization is also changing the economic sector because it enables companies to operate more easily on a global scale, while others pose a path to ruin. The introduction of digitalization certainly does not eliminate jobs, but it creates new jobs. Production is increasingly moving back to rich countries, not because salaries in less developed regions of the world are growing, but due to the fact that companies want to be closer to their customers to be able to respond faster to changes in demand.

The inevitable fact is that certain industries experience a drastic decline in revenues, while the flow of money is slightly redirected and opens up space for new business models. The companies should not be worried about this fact, but they should see new opportunities. Opportunities for restructuring and adjusting business processes.

The main purpose of business processes digitalization is integration and cooperation with partners, optimization, lowering the costs of processes, increasing the competitiveness of products and services, faster responsiveness and easier access to the customers and integration with business partners. This makes companies more efficient, they achieve better business results and higher profits. Easier access to information also affects the final customer who, when flooding advertisements of various products and services, very difficult separate grain from weeds. At the same time, the availability of information and a wide range of offers represent a new challenge for companies that they should be even more innovative and responsive if they want to keep customers. Business partners, either buyers or suppliers, do not just expect, but also require fast and impeccable service. The consequence is, that companies will have to adapt, be in step with time, should constantly analyze the market and adapt to it effectively. Digitalization means a very effective response to all of these requirements.

3. THREATS OF DIGITALIZATION

With digitalization, however, certain dangers occur. The greatest danger is the protection of sensitive information, espionage, and manipulation of them. Particular attention must, therefore, have to be put on security and potential hazards. It could happen that the benefits of redesigning business processes through digitalization can quickly outgrow and leave a devastation that can seriously jeopardize the existence and development of a company or organization.

Consumers will quickly adapt to the changes. A major problem will be the establishment of an appropriate infrastructure, which is a prerequisite for digitalization. For this, the state is responsible, which will also have to provide better schools for skilled labor, clear rules and a level playing field for companies of all kinds.

If there is no digitalization, you are simply not on the market. Trends are as they are. The companies simply need to adapt to the situation, otherwise, they will simply disappear from the market after a while. The problem that arises here is the dependence on communication tools, the dependence on the monopoly positions of the developers of the digitilization equipment, and the possibility of their interference within the structure of the company. In the process of digitalization, we can not avoid the surprising growth of the data quantity, computational power, and connectivity. New forms of human-machine interaction appear, such as touch interfaces; improvements in the transmission of digital content to the physical world, which, in certain circumstances, can also represent unimaginable disruptions.

Like all revolutions, this will be disruptive as well (Whitehurst, 2014). Many people feel fear of the factories of the future. There will be any more classic machines, production facilities. Most of the jobs will not be in factories, but in offices where designers, engineers, IT professionals, logistics experts and other experts will work. Digitalization means that the culture and climate of a company have to change.

The fact that we encounter in the process of digitizing the company is the management of different generations, at least three in the organization;

- (1945-1960) baby boom generation,
- (1960-1978) generation x,
- (1978-1995) generation Y,
- (1995-) generation Z

4.DIGITALIZATION OF THE COMPANY AS A RESTRUCTURING TOOL

The digital age in the industry is best represented by the massive use of the Internet in the industrial and at the same time in the entire social environment. The industrial internet provides a digital information link between automated machines, development, sales, purchasing, financial, marketing departments in companies, the situation on the market, financial institutions, etc. Digitalization is a process that forces the management teams to rethink some basic structures. Progress in technology causes that companies need to restructure their organizational structure, transform their departments, and develop new management models. Most of these changes start as a result of the implementation of new basic software, which, however, must be followed by preparations for organizational renovation. The model is based on and takes into account the essential factors to achieve a better return on assets, namely:

- employees
- business processes
- optimization of processes and processes (customer expectations, product improvement, ...)
- database management.

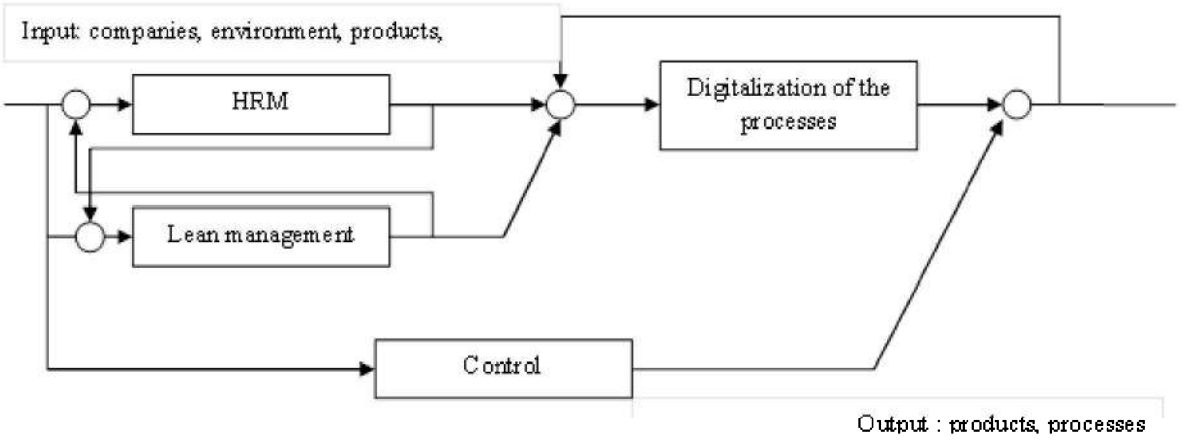

Figure 1: Digitilization model as a restructuring tool

The model of restructuring is based on lean management (lean management) and human resource management (human resources management). Parallel to this, it is necessary to develop existing ones and to implement new innovative business models:

- to know exactly the processes and to introduce them into all the processes of the lean concept;
- exploit new technologies for after-sales activities and the launch of new services;
- introduce the concepts of autonomy in production and use;
- robotise and automate machines;
- adjust production lines to maximize flexibility and enable the production of small and large batches of different products with similar operations.

An essential guideline is: digitalization needs to be implemented comprehensively.

The most common mistakes that need to be avoided by the successful digitalization of business processes are:

- bottom-up digitalization,
- the management of the project is entrusted to someone who restructuring by digitalization do not understand,
- allow the existing culture of the organization and the attitude of the management to prevent a quality and profound implementation of the digitalization process,
- too narrow definition of the scope of restructuring,
- very quick finishing of the project, digitalization is a continuous and continuous process,
- neglecting the values and beliefs of people in the company,
- design strategies while project implementation is a problem,
- try to restructure so that no one is affected.

The basic restructuring guide is to create new digitally supported systems without the parallel use of the old non-digitalized system.

The process of redesign means finding highly effective solutions to reducing ballast in business and improving production cycles and the capacity of the process has forced manufacturers to adopt the principles of lean manufacturing. By increasing the number of business solutions, companies can automate tasks related to effective production management, while managing the quality process and gaining a better overview of capabilities, design, and demand. The principle of lean management has become the guiding principle throughout the entire production network (Mežnar, 2017).

The company's focus on cost reduction is reflected in the following main points:

- Reduction of the necessary resources for the existing business volume,
- increasing the volume of business for the existing volume of necessary resources,
- the speed of internal and external response in the purchasing and sales markets,
- connectivity with the business environment.

5. MANAGEMENT AND HRM IN THE PROCESS OF DIGITALIZATION

Leadership and managing have an important role to play in achieving company goals, working with customers and meeting their demands. Depending on the requirements of the market, the management styles and adaptation of production processes are changing.

Digitalization, using new concepts, models, and technologies, enables faster and more efficient work, and on the other hand, helps managers to better and more intelligent leadership.

One of the essential conditions for a successful digitalization of the company is that managers understand the strategic opportunities and dangers of the digital age. Digital leadership starts at the top (Whitehurst, 2014). The problem that most often occurs is that they are weak in digital leadership, that is, in the construction and enthusiasm of employees in the implementation of the business vision in the digital age. The vision of digitizing the company must become a daily reality in achieving the goals of each employee. Vision and engagement are just part of the story of leadership capabilities. An energized workforce, believing strongly in a shared vision, may still proceed in many directions. Governance provides the guardrails and steering wheel to keep the transformation on the right track. (Westerman G., Bonnet D., McAfee, 2014):
.
Management is no different than it was a few years ago. IT is not everyone's job. Functional leaders do not need to become IT, experts. Rather, they need to know how to use the technology and what it can do for the company (Whitehurst, 2014). The only change is that leadership in the digital age is taking on topical changes, such as globalization, connectivity, innovative technologies, mobility, autonomy, and personalization. A dynamic combination of thoughts, behaviors, and skills required for change or improvement through technology is required.

Digitalization, deployment of digital technologies and increasing demand for digitalization force organizations to re-evaluate and study a number of established strategies, business models. Instead of employing the most formally educated person for a specific task, many companies now put more emphasis on cultural skills and flexibility, as they know that individual functions will need to be developed along with the implementation of digitalization. On one hand, there is a need to count on existing staff, and on the other hand, companies must prepare for digital transformation. Demand will decrease for workers who perform simple, repetitive tasks because these activities can be standardized and performed by machines. Most of the job losses will result from the introduction of robotics on the shop floor and the computerization of routine jobs (Lorenz, M., Rusmann, M., Rainer, S., Lasse L., Knudd., Bolle, 2015) One of the main tasks is that at the same time thinking about how to set up their digital organization, they start hunting for the best digital talents.

The coming digital age also brings a lot of labor shortages. The new business models brought by digitalization are based on the fact that employees will have to develop in particular efficiency and productivity. As a result, employees will need to be properly guided and motivated, which means that all organizations need professionally qualified leaders who will be able to achieve the goals of the organization and can connect different generations. The main potential uncertainty that we encounter in the process of digitizing the company is the management of at least three different generations in the organization.

6. CHANGE IN ORGANIZATIONAL STRUCTURES

Due to the specifics of digitalization, a hierarchical organization in a global and rapidly changing digital economy is no longer optimal. Successful companies succeed in the cultural shift from "Mad Men" to "Math Men", where decision-making is based more on data rather than on - the wrong ones - management's opinions (https://www.i-scoop.eu/ digitalization-digital-transformation-disruption, 2017).

In the digitalization of the company, a transition from a classical hierarchical business-functional organizational structure (Figure 2) to a network organizational structure and a decentralized performance of business functions is necessary (Figure 3) or in a virtual organizational structure
(Figure 4) depends on the nature of the industry in which the company operates, its size and intensity of presence in the global market.

6.1. The hierarchical structure

The characteristics of the business-functional organizational structure are the division of the second hierarchical level based on business functions and the centralization of decisions with the help of line type management. The business-functional organizational structure is suitable for small and medium-sized enterprises that have one product or program of similar products, predominantly routine technology and

operate in a stable and not too complex environment. This type of organizational structure is totally unsuitable for the digitized company because it is insufficiently flexible and because of the high level of employee specialization it is difficult to adapt to changes, communication is slow, decisions are taken extremely slowly.

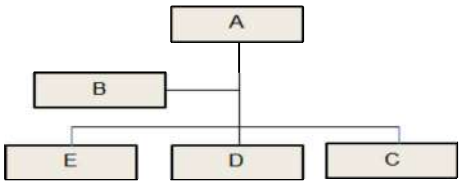

Figure 2: Hierarchical business functionality of business functions

6.2. Network decentralized organizational structure

Network organizational structure and decentralized performance of business functions is a much more appropriate organizational form for a company that is digitized and in some ways illustrates the principle of outsourcing. Management in the company chooses to carry out only that part of the activity, which represents the key advantages, but everything else is put into the implementation of external experts. The advantage of this type of organizational structure is high flexibility, the use of human resources, greater efficiency, lower costs, allowing the restructuring of fixed costs into variable and increased product quality. The main disadvantage is dependence on other network partners

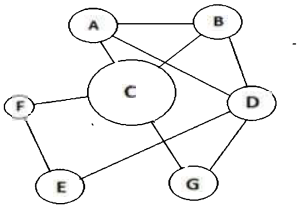

Figure 3: Decentralized management of business functions

6.3. VIRTUAL organizational STRUCTURE OF BUSINESS FUNCTIONS

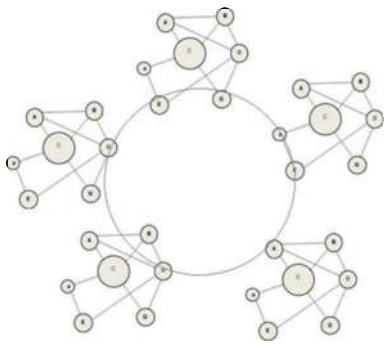

Figure 4: Virtual organizational structure and flexible decentralization of business functions

Looking at the possibilities offered by digitalization, the virtual organizational structure that represents the form of a constantly evolving network of independent organizations is the most suitable for the company, with the purpose of sharing the capabilities, costs, and access to common markets. Every company that

connects with other companies to a virtual network organization must determine its key capabilities and connections with the key capabilities of other companies. It is a form of connecting specific joint knowledge of different companies to a common task. The creation of virtual organizational structures enables modern information technology, communication is carried out through a computer network, including suppliers and customers, which enables the provision of deliveries at the right time and the participation of customers in the development of the desired product. The advantages of a virtual organizational structure are flexibility and dynamism, risk diversification, specialization by key competencies of individual members, lower operating costs and quality service. Weaknesses are too much specialization, which can lead to rigidity, the possibility of abusing business secrets and excessive centralization around the affiliate.

7. CONCLUSION

The main purpose of this paper is to demonstrate that the digitalization process can be very usefully used as a tool for the renewal and restructuring of enterprises. In the context of crisis management, it can be very useful for the organizational renovation of the company. The organization's crisis and business problems often turn out to be opportunities for comprehensive business refurbishment and successful organization growth.

The presented model of digitalization of the company does not provide an absolute algorithm for increasing the competitiveness of companies and their survival, but it is certainly a fairly good response to the emerging situation and provides a good basis for organizational renovation, the existence and further development of companies that are facing the impact of globalization and increasing pressure on the competitiveness and flexibility of the company.

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POSTAL OPERATORS IN A DIGITAL WORLD

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Abstract: *The development of digital technologies brings forth the rise of digital communications, which causes continual decline of mail volumes. This creates numerous changes in the use of postal traffic as a means of communication, package delivery, as well as pricing. In the time of digitalization, postal operators face a lot of challenges, which opens new possibilities for digital transformation of the postal sector, that is, creating postal services suitable for future generations of users. Of course, there is no unique solution for all postal operators, but they have to adjust their solutions to this problem according to their business environment.*

Keywords: *postal operators, digitalization, e-commerce, customers*

1. INTRODUCTION

Postal services are the cornerstone for numerous economic activities. Their development is influenced by the development of technology and customers' behavior. The evolution of customers' behavior, characterized by customers' growing expectations, is an outcome of all-around digitalization, as well as market changes that have appeared with the processes of liberalization and privatization in the postal sector. The field of postal sector has extended over the areas of once marginal activities of national postal operators, such as logistics and finances (UPU, 2014). Basic segments of the postal sector today are: letters, packages and logistics, financial and other services. In all these segments postal operators have intensive competition. Nevertheless, comparative advantage of national postal operators lies in the fact that in most countries they are viewed as highly trustworthy, which allows them to perform a wide range of services necessary in the age of e-commerce (from placing orders to shipping to payment).

Basic customers' requirements are: choosing a place and time of delivery, with the possibility of changing both parameters during shipping, monitoring package status using different applications, and returning a package in the most convenient way.

2. MARKET CONDITION

In the last few years there have been have major changes in the postal sector. The development of new technologies has brought about significant progress in the domain of e-commerce (prerequisites for its easier utilization have been created). The growth of e-commerce has led to a greater number of parcels handled by postal operators. A continual decline of letter volumes, caused by new technologies development, is compensated by a stable increase of parcels (Figure 1). This situation on the postal market calls for adjustment of postal operators' infrastructure, different employees' skills, as well as different forms of employment.

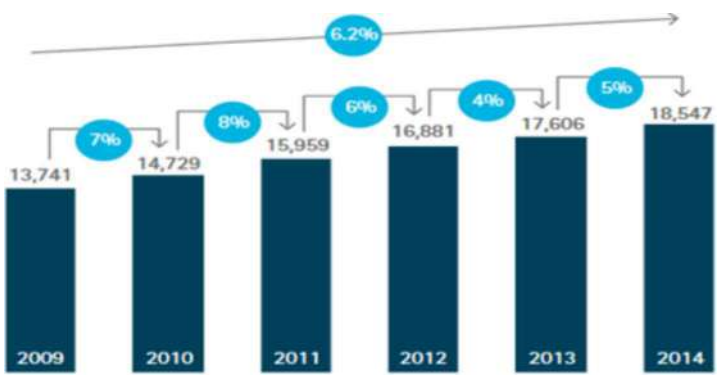

Figure 1: Growth of parcel market (Accenture Consulting, 2016)

Entities on the parcel market are cost-driven, with flexible models of employment, especially in the delivery phase. On the other hand, customers are demanding flexible, innovative and adjusted delivery, as well as parcel returning options. In order to meet customers' needs and survive on the highly competitive market, postal operators have to make adjustments (which, apart from meeting customers' needs, means providing adequate working conditions).

3. DIGITALIZATION

The interaction between customers and economy has been drastically changed with the development of digital technologies and mobile access (especially notable in buying goods and services). This resulted in a rapid increase of online shopping. Globally, online retail commerce has been growing 20% per year since 2005, coming to €901,6 billion in 2015 (IPC, 2016). Digitalization has a crucial influence on every domain of the postal sector, from changes in customers' needs and behaviour to last mile changes. With the rise of digital technologies, the number of letters is dropping (Crew and Brennan, 2014).

Postal operators have been transformed through optimization, diversification and redistribution of employees' duties. Modifying the main business activity was done in order to lessen the decline of letter volumes. Some postal operators managed to come up with solutions to increase the number of letters items using digital platforms (Asher, Callan and Marsh, 2012). Still being trusted, postal operators can improve various digital applications which successfully deal with safety issues.

Factors that shape the postal sector are (IPC, 2017): economic conditions, urbanization and digitalization. Due to enhanced migration from rural to urban areas, urbanization will be facing new challenges (infrastructure, environment and social matters). With regard to digital connections, it is expected that by 2021 more than half of the world will be using the Internet (IPC, 2017). By 2012, m-commerce is expected to account for more than 50% of total online commerce. (Figure 2).

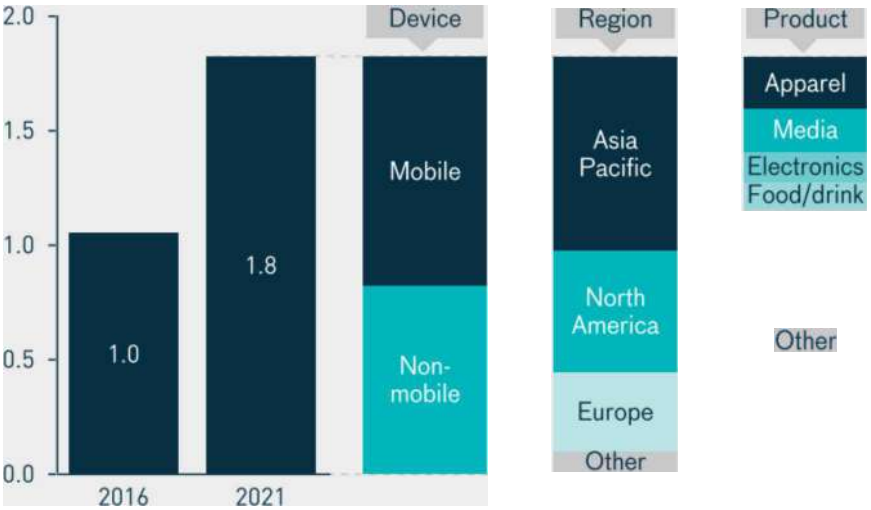

Figure 2: E-commerce growth in billions of euros (IPC, 2017)

In its evolution, parcel market is facing various challenges (demands for greater productivity, automatization, etc.). In some cases, diversification and innovation processes brought forth advanced solutions in the field of digital services, such as a digital signature. Creation of digital business models and platforms provides the base for establishing a closer relationship with customers. The importance of implementing digital platforms is not easily measured, since customers consider digital improvements as an integral part of entry level postal services (from advanced options for e-commerce to digital identity for products).

4. FUTURE DEVELOPMENT

The significant growth of e-commerce is an outcome of increased internet access (Lawrence and Tar, 2010). As a result of a greater number of goods bought online, parcel marketing started expanding. Further expansion of the market can be expected due to a wider choice of goods and lower prices comparing to traditional commerce. Due to ever more intense competition in e-commerce, vendors are challenged to find more efficient business solutions. Technologies used for collecting data can be of great importance (analysis of collected data is used for optimizing supply chains, optimizing the number of employees, etc.). In order to

reach its full potential, it is necessary to build an adequate network infrastructure, as well as sophisticated analytical tools.

For improving the existing and introducing new postal services, postal operators are relying on new technologies (as a result of customers' demand for a faster and more convenient parcel delivery). Technologies which have already been used in the postal sector are: sensors, RFID chips, personal digital assistants, GPS technologies. Some of the technologies, like 3D printing, big data, Internet of Things are yet expected to have a significant role in the postal sector. A review of sensor technologies is given in Table 1.

Table 1: Sensor technologies (OIG, 2015)

Technology	Key Features
RFID	▪ A sensor technology that uses electromagnetic fields to transfer data ▪ Allows unique identification of moving objects ▪ RFID tags can be either passive or active ▪ Is a widely accepted standard, used in a variety of industries ▪ Has read distances of 1-60 feet (for passive tags) or up to 1600 feet (for active tags) ▪ Fairly inexpensive, although active RFID tags cost more than passive ones ($20-80 vs. ten cents per tag, respectively)
Beacons	▪ A low-powered sensor that communicates with mobile devices, notifying a mobile app ▪ when it is within a specified radius ▪ Beacons tend be larger than other technologies: current size and weight are similar to a ▪ computer mouse, but future beacons could be much smaller ▪ Beacons can transmit signals as far as 200 feet away, but signal strength is reduced ▪ when traveling through objects (such as walls) ▪ Beacons range in cost from $10-150, depending on the size and strength, but beacons ▪ are currently dropping in cost
Wi-Fi	▪ A standard for wireless connectivity through radio bands ▪ Wi-Fi is perhaps the most pervasive type of connectivity, in use in many people’s homes ▪ Read distance is about 60 feet
Bluetooth	▪ A wireless connective technology for exchanging information over short distances ▪ Read distance is about 150 feet ▪ Can connect and synchronize multiple devices ▪ Lower-power consumption
ZigBee	▪ A high-level communication protocol that uses low-power digital radios ▪ Communications through ZigBee are able to pass through intermediary devices, but must ▪ be within the mesh network to be read ▪ Connectivity ranges up to about 300 feet ▪ Offers low power consumption because the device is not “on” all the time ▪ A ZigBee chip costs about $30-70 per tag
Near Field Communication (NFC)	▪ NFC allows data to be communicated by touching together two NFC-enabled data collection devices, or bringing them into close proximity ▪ As such, read distances are only a couple of inches ▪ Utilizes electromagnetic radio fields ▪ Similar to RFID, NFC tags can be active or passive

The development of technology brings forth some changes regarding parcel transfer, in the way that services are adapting to customers' needs and behaviour. Smart phones and accompanying applications offer the customers a possibility of personalizing delivery time and place. This way, the parcel delivery is improved and there is a lower risk of an unsuccessful delivery attempt in the case that the receiver is not at the address of delivery.

One of the key logistic elements is ensuring data visibility. This concept can be fully realized by innovatively using the available data. Although the option of parcel tracking is set as a standard, the parcel status is updated at a certain period of time. Using sensors that have the Internet connection, with an adequate

technology (such as GPS), it is possible to provide a continual data transfer (thus, the receiver can track the parcel in real time, which offers him new possibilities, such as subsequent change of the delivery address). This degree of data availability enables the optimization of each stage of parcel delivery (collecting, sorting, transport and delivery).

Possible strategic solutions as a reaction to digitalization are (Jaag and Finger, 2017):

1. post as a provider of physical infrastructure: can sell the access to its network to various forms of service providers; as such, a postal operator usually holds a strong market position; in this way, a postal operator is restricted to defending its main business;
2. post as a hybrid mediator: in this way, a postal operator manages the discontinuity between the physical and digital domain; the access to digital services can be allowed through physical infrastructure;
3. post as a purely digital services provider: a postal operator redirects its activities into the digital domain, providing services such as e-government or e-health; this approach can be developed due to gained reputation for its physical infrastructure and physical presence; this leads to gradual transition from physical to digital networks.

Customers' expectations are on a constant increase. Whether it be physical or legal entities, they expect to get the goods as soon as possible, and a flexible delivery with low or no costs at all. There is a trend of product personalization (to meet the needs of an individual), which is very appealing for customers, but causes multiple logistic problems. On the other hand, there is a constant pressure in the postal sector to provide the best possible service at the lowest possible price. Introducing innovations is often a real challenge in big organizations. This is especially emphasized in organizations such as national postal operators, which have historically been associated with the government. However, a lot of postal operators manage to successfully steer their companies so that some of them even set standards for innovations and meeting the needs of customers.

One of the technologies that can be significant for the improvement of the postal sector is the Internet of Things. The Internet of Postal Things (Figure 3) adjusts a postal infrastructure with low cost sensors, enabling a wide range of data, and thus offering support for improving operative efficiency, customer experience, evolution of new services and business models (OIG, 2015). Various interconnections and data collection is enabled by postal infrastructure. Based on the analysis of collected data, postal operators can reduce costs, optimize processes and meet growing customers' demands (improving the main business, generating new revenue and developing new business models).

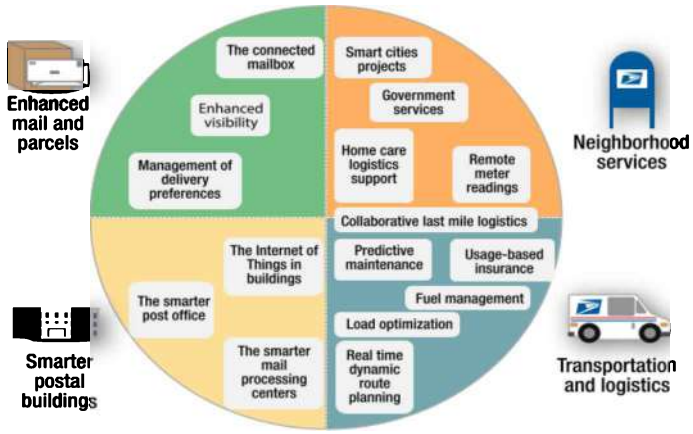

Figure 3: Areas of application of the Internet of Things (OIG, 2015)

The evolution of e-commerce has led to significant changes in customers' behaviour and demands (Morganti et al., 2014). On the other hand, work environment has also changed, requiring employees to adapt to new circumstances. In this situation, postal operators try to get a synergistic effect from network reintegration, with a special attention on quality and improving automatic sorting. Circumstances on the parcel market bring new challenges before postal operators. This is manifested in the organization trying to move from static towards dynamic organization models. Parcel services are characterized by distinct variations regarding the volume, and as such open up a question of hiring two part-time employees in order to manage peaks.

National postal operators, as members of the UPU (Universal Postal Union), form a global postal network which allows them to take part in international postal traffic and have a certain competitive advantage in the postal sector. Furthermore, since national postal operators are often state institutions or companies, they are somewhat privileged in exploitation of domestic markets (specific regulation, financial support, a different

tax system, etc.). Considering that they have control over resources and processes on the domestic market, they get more freedom to come up with solutions for e-commerce that meet the needs of local economy. Key features of e-commerce which are necessary for better understanding and recognizing opportunities for postal operators are (UPU, 2016):

- web hosting: elements associated with stores on web sites, including technical tools and support, content management, search and price comparison engines;
- payments: money flow model and payment options;
- logistics: main business activity of postal operators, which includes basic services and tools related to postage, delivery and information;
- CRM: elements of the customer relationship (vendors and buyers);
- Promotion channels: for increased visibility of vendors and sales, including direct marketing, web advertising, traditional media;
- Data exchange: standards and tools for exchange data about products, customs and taxes, customers, orders and other data shared by parties in e-commerce;
- Elements of support: safe identification and message exchange, market evolution and secure framework.

5. EXPERIENCES

By bringing together physical and digital services, postal operators create prerequisites for comparative advantages on the market. The success in digital services development is tightly connected with the level of trust that customers have for postal operators. As global market is changing quickly, postal operators need to adapt quickly to customers' requirements. Therefore, their business is shifting towards a greater volume of parcel mail generated in e-commerce and towards the development of digital services.

*Posti Group Corporation (*the national postal operator in Finland) developed a concept of secure digital mailboxes – NetPosti. Physical mail is opened, scanned and sent as a PDF file in secure digital mailboxes. Citizens have accounts with their social security numbers and e-mail addresses. Recipients receive an e-mail or a text message notification of an incoming mail item. NetPosti enables its customers to use the invoice option and get receipts for their online purchases directly to their secure NetPosti account.

*Post Danmark (*Denmark) managed to make up for a radical decline in letter-post volume by developing digital services. Post Danmark is still holding its position of the leading sender-receiver interface in Denmark. This is a result of the government's approach to actively encourage progressive digital strategy, a high level of digitalization in the financial sector and a high level of digital take-up (Post Danmark, 2016). In order to adapt to new circumstances, Post Denmark had to do the following:

1. reduce costs, as a reflection of a dramatic decline in volume and revenue,
2. introduce a three-day parcel delivery outside the USO,
3. invest in digital services,
4. use the government resolution to encourage digital communication channels

These activities resulted in developing digital services including B2C & B2B e-Invoices and e-Archiving, Hybrid Mail, remote printing and scanning services. The most significant service is e-Boks, electronic mail box (Figure 4).

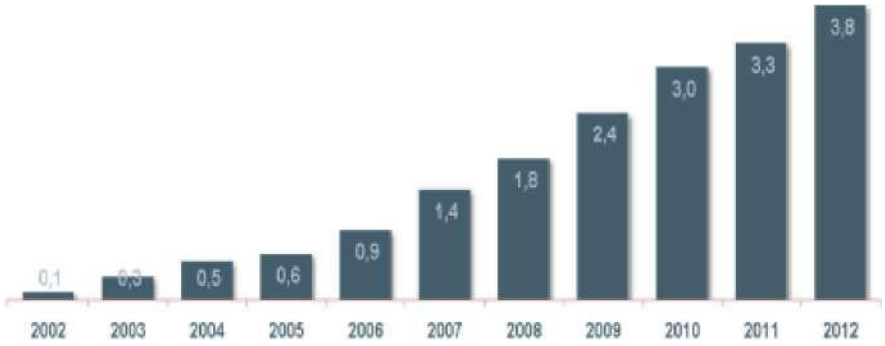

Figure 4: Citizens receiving digital mail using e-Boks (Post Danmark, 2016)

Poste Italiane has invested greatly in technology and thus made the gap between physical and digital domain smaller (Poste Italiane, 2017). It has developed an advanced infrastructure which, regarding technological operations, sorts out a large amount of parcels using automated systems. Poste Italiane has

also upgraded already existing and introduced new services, using various channels: scanning and electronic archives, electronic invoicing for state contractors, mobile virtual network operators, etc.

Swiss Post emphasizes a high level of trust from customers, which is crucial for new possibilities in the domain of digital services. A successful example of the development of digital services is "My Consignments", which automatically, via an e-mail or a text message, informs a customer of an incoming registered mail (this way, the customers can control the place and the time of delivery). Swiss Post has also engaged in the process of electronic voting infrastructure. E-voting allows voters to vote using computers, tablets or smartphones (Swiss Post, 2018).

SingPost is one of the leaders in Asia-Pacific region. The main reason for its high ranking is high quality and a wide range of its services. Services related to e-commerce stand out. Their network of parcel lockers (POPStations), where customers pick up their own mail, is also very significant. A relatively new service called Rent-A-POP allows customers to drop off their mail directly in a rented locker (SingPost, 2016).

6. CONCLUSION

Postal operators, whether it be public or private companies, face a big pressure in trying to ensure new revenues and offer cost efficient services. Considering that postal operators generate a big amount of data (regarding the number of employees, the number of postal units, processing a large amount of mail, postal network structure, etc.), there is an opportunity for using certain digital technologies in order to overcome existing problems.

It is necessary that postal operators put their customers in the center, and model their activities to meet customers' demands (a closer relationship with customers is needed in order to understand their requirements). This calls for an upgrade of existing services, as well as creating new ones. Therefore, innovations are very important for postal operators. Keeping up with the digital technologies evolution is an imperative for the survival and successful development of postal operators, as is for utilizing the available resources effectively.

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LINKING PROCESS COMPLEXITY INDICATORS AND PROCESS PERFORMANCE INDICATORS

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Abstract: *Purpose - We are presenting research in progress about how changes of process complexity indicators in models relate to changes of process performance indicators in real business processes. Commonly we use process models to model planned changes and anticipate their impact on the company's operations. We try to find process complexity indicators that are more important to subject of improving process performance indicators. Research method - In this article, we present first findings. We researched the literature, and summarized all available measurable process complexity indicators. Then we consolidated them into a single set with the use of comparative method. Hereafter we present the idea of survey with which we will research the link between both types of indicators. Important findings - We contribute to the theory of process model structural analysis with a comprehensive overview of useful process complexity indicators.*

Keywords*: business processes, process complexity indicators, process performance indicators*

1. INTRODUCTION

Companies operate exclusively on the basis of their business processes. Apart from a few actions that are carried out by a single employee, the company consists mainly of larger or smaller processes. Each process has defined flow and a sequence of activities. The defined sequence of activities must be understood and guided as a whole (Vila, 1999). Business processes are composed of employees, information technology, business rules and organizational activities. The development and rapid expansion of the use of information technology, leads to an ever-increasing and more frequent change of business processes (Cheng, 2008). Some changes can significantly improve the efficiency and effectiveness of the business process. Others can increase the complexity of process, reduce the flexibility and cause problems of interconnected processes (Bose, 2002; Jarrar, Al-Mudimigh & Zairi, 2000; Davis, 2002).

1.1. Business processes and business process models

We describe business systems with different models. With computer-based models, we examine the effects of process changes in the virtual environment in advance (Indulska et al., 2009). Models are more or less precise, depending on the purpose of the model, the available time and the desired information (Pavlović, Kern, Miklavčič, 2009). With models, we can anticipate, prevent and minimize the risks of incorrect changes in the business environment (Škrinjar et al., 2008). We describe the operation of business system with business process models. Their purpose is to document the business due to standards, change management, information support. In the business environment, graphic techniques of modelling business processes are popular, with which we visualize the process and make it understandable to the large number of interested users (Johannsen et al., 2014).

1.2. Process complexity indicator (PCI) and process performance indicator (PPI)

We can analyse business process models numerically and structurally. Numerical analyses can be static calculations or dynamic simulations. They require time and business data to perform measurements or estimates. Otherwise, we are trying to predict the effects of changes in business system only from the structure of the model (Charette, 2005). Each process modelling technique has a set of design elements that reflect certain elements of the real business process. The links between different elements form the structure of process model.The structure of business process model can be analysed in various ways and measured through process complexity indicators (PCIs), e.g. we can count elements and relationships between elements of the process models (Cardoso, 2006). Based on the values of PCI of each process model, it is possible to compare the models of processes structurally (Aguilar, et al., 2006). We found out, that there are different PCIs in the literature for structural analysis of process models. Various authors propose a different set of PCIs (Aguilar, et al., 2006; Cardoso, 2006; Mendling, 2008). Analyse of specific PCIs depends on the

existence of referring element in a modelling technique. Therefore, the modelling technique has important influence on availability and on selection of the specific PCIs. When the process is implemented, we measure its operational capabilities with process performance indicators (PPI). They are of different types: financial, operational etc. We define planned values and measure real values of PPIs of specific process and perform control activities on this basis (APICS, 2017).

1.3. Research gap: the impact of PCIs on process performance indicators (PPIs)

The effect of complex business changes (output of digitization project or reengineering project) is that the benefits occur sometime after completion of the project. In order to solve the problem of anticipating the effect of complex business changes, we first need to establish the connection between PCIs and PPIs (Figure 1). With this preliminary research, we want to obtain information which change of PCIs in certain business process of a particular industry gives the highest impact on PPIs.

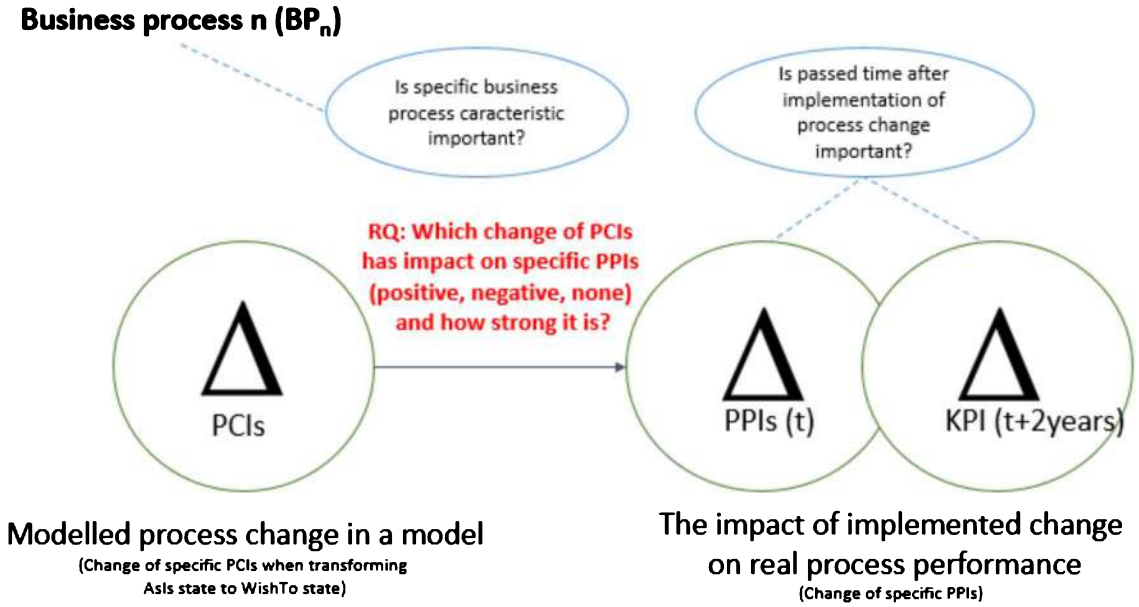

Figure 1: Research model of measuring the impact of PCIs on PPIs

2. METHOD

Urh (2011) described findings of the relationship between the PCIs and PPIs with descriptive statistical methods. He found groups of PCIs (clusters) that affect specific PPIs. In a detailed analysis of his results, we found that all representatives of a particular PCI group are of the same type (e.g. personnel PCIs only, or logical PCIs only, or information PCIs only). We assume that real situation groups should be formed differently. There are likely to be groups of more or less important PCIs and in each group there should be representatives of different PCI types. To answer this dilemma, we carried out next steps in this research:

1. First, we developed a set of process characteristics. We used them to assess different business processes whether they have similarities between PCI change and PPI change.
2. We prepared a set of process performance indicators (PPIs), which represent the success of the implemented changes in real processes. To determine the PPIs set, we decided to take the top level of PPIs according to the SCOR model (APICS, 2017). They are independent from the type of business process and are broadly recognizable. We have verified their suitability and existence in balance score cards (Kaplan, & Norton, 2008) and APQC (APQC, 2017).
3. We found that it is difficult to define the effects of PCIs on PPIs with the technique of performing measurements of real processes. Therefore, we decided to perform the survey. We found that process managers and process owners are the best target groups of respondents, because they know best the process characteristics and the influence of specific change in their processes (Pavlović, Kern, Miklavčič, 2009).
4. In the literature, we researched known PPIs. Then we prepared a set of absolute PPIs for survey (that we can count). We excluded all relative PPIs that we can derivate from the absolute PPIs.
5. For absolute PPIs, we prepared for process owners understandable questions and a simple description of a real business change that has connection to the change of a particular PPI in the background (translation table).

6. Than we asked process owners to evaluate how a specific process change effects specific PPI: what impact it has immediately and after 2 years (Mc Afee, 2002). This research phase is still running.
7. After the survey will terminate, the answers will be statistically analysed with comparative and correspondence analyses. We will try to prove which PCI change of specific process model has the main impact on a change of specific PPI in the real process, according to answers of process owners.

3. RESULTS

3.1. Explored set of process characteristics

Based on the APQC model (American Productivity & Quality Centre), we developed a set of generalized business process characteristics that apply to all business processes. That means that according to these characteristics it is possible to evaluate any process independently of the business area and the industry. We classified characteristics into groups according to APQC process areas (Table 1).

Table 1: APQC process areas (groups) and belonging characteristics

Num.	Process characteristic group	Business process characteristics
1	General aspect of the process	Frequency
		Structuring
		Standardization
2	Operational aspect of the process	Automation
		Creativity
		Analytics
		Technological uniqueness
3	Developmental aspect of the process	The uniqueness of the output
		The complexity of the output
4	Customer aspect of the process	Determination of demands
		Dislocated execution
		Exclusivity for customer
5	Supply aspect of the process	The specialty of the inputs
		Changing of the inputs
6	Financial aspect of the process	Operating costs
7	Risky aspect of the process	Impact on organizational performance
		Difficulty of implementing process changes
8	Current excellence of the process	Reliability
		Responsiveness
		Agility
		Cost
		Asset Management Efficiency

For each process that will be the subject of the survey, we also need its initial excellence (Table 1, num. 8). We found that is important to exclude or to confirm the influence of this factor in the search for the impact of PCIs change on PPIs change.

3.2. Explored set of process performance indicators (PPIs)

We used PPIs categories of evaluation from the SCOR model (Table 2). These categories represent the top level of process performance indicators, to which we will compare their impact of a PCI change.

Table 2: Process performance indicators and their definition SCOR (APICS, 2017)

Num.	PPI	Definition
1	Reliability	The ability to perform tasks of a process as expected. Reliability focuses on the predictability of the outcome of a process. Typical metrics for the reliability attribute include: on-time, the right quantity, the right quality
2	Responsiveness	The speed at which tasks of a process are performed. The speed at which a process provides outcome to the customer. Examples include cycle-time metrics.
3	Agility	The ability to respond to external influences, the ability to respond to changes in the process environment to gain or maintain competitive advantage. Agility metrics include adaptability and overall value at risk
4	Costs	The cost of operating the process. This includes labour costs, material costs, and management and/or transportation costs. A typical cost metric is cost of goods sold.
5	Asset Management Efficiency (Assets)	The ability to utilize assets. Asset management strategies in a process include inventory reduction and insourcing vs. outsourcing. Metrics include Inventory days of supply and capacity utilization.

3.2. Explored set of process complexity indicators (PCIs)

In Table 3, we introduce explored PCIs, which were derived from the literature review (Aguilar, et al., 2006; Cardoso, 2006; Mendling, 2008). We grouped PCIs into individual sets according to the element of modelling. It is important if new element of modelling a specific process change is an exclusively new element in relation to other elements in the process (definition copy – def.), or it is a known element in relation to other processes (occurrence copy – occ.).

Table 3: Process complexity indicators

Num.	PCI set	PCI
1	New events in the process	Number of events or. states (occ.)
		Number of start or entry events (occ.)
		Number of end or closing events (occ.)
2	New activities in the process	Number of different activities in the process (def.)
		Number of activities that do not add value
3	New elements of process logic in the process	Number of AND switches (def.)
		Number of AND mergers (def.)
		Number of OR switches (def.)
		Number of OR mergers (def.)
		Number of XOR switches (def.)
		Number of XOR mergers (def.)
4	New connections in the process	Number of alternate parallel paths in the process
		Minimum number of transitions between process activities (occ.)
		Maximum number of transitions between process activities (occ.)
		Number of feedback loops within process (occ.)
		Number of feedback loops back to the previous processes
		Number of connection types Must execute (occ.)
		Number of connection types Must be informed (occ.)
		Number of connection types Must participate (occ.)
5	New jobs / work roles in the process	Number of job positions (occ.)
		Number of transitions between different organizational units
		Number of transitions between different hierarchical levels
6	New information carriers in the process	Number of documents or information carriers (occ.)
		Number of different documents or information carriers (def.)
7	New ICT (information & communication technologies) solutions in the process	Number of supported activities with at least one ICT system
		Number of ICT solutions (occ.)
		Number of different ICT solutions (def.)
8	New links to other processes	Number of input processes
		Number of output processes

4. DISCUSION

Based on the explored sources, we found that the presented set of PCIs is sufficiently independent according to modelling technique (e.g., EPC, BPMN, ISO flowchart). We also found that the differences in sets of PCIs between the different authors (Aguilar, et al., 2006; Cardoso, 2006; Mendling, 2008) are mainly due to the purpose of the represented process model: reorganization of the process, IKT support of the process, ISO documentation of the process, process simulation. Our choice is the union of those modelling elements that are common to all purposes. We emphasized those PCIs, the change of which is understandable by the process owners. In Figure 2, we present an example of a question that is part of prepared survey. It shows how we retrieved data to prove PCIs impact on PPIs change. In the literature, we did not find this comprehensive review. Therefore, these sets of PCIs are our contribution to the area of process management and analytics.

23. If process change requires that we automate with information&communication technology (ICT) additional, currently un-supported activity (the type of ICT does not matter)?
Related PCI: Number of supported activities with at least one ICT system

	Immediately after implementation					2 years after implementation				
The change has impact on PPI:	very negative	negative	no impact	positive	very positive	very negative	negative	no impact	positive	very positive
Reliability of the process	1	2	3	4	5	1	2	3	4	5
Responsiveness of the process	1	2	3	4	5	1	2	3	4	5
Agility procesa	1	2	3	4	5	1	2	3	4	5
Reduction of operational costs	1	2	3	4	5	1	2	3	4	5
Asset Management Efficiency	1	2	3	4	5	1	2	3	4	5

Figure 2: An example of the descriptive question

5. CONCLUSION

This research is currently in phase, where we are testing the questionnaire with randomly selected process owners in the form of guided interviews. Based on the experience, comments and suggestions of process owners, we will adjust the questionnaire and proceed with the final survey.

When we prove the importance of specific PCIs, we will measure the change of selected key PCIs and the change of PPIs in real processes of companies. We will follow which purpose initiated the change of the process and how successfully this change is implemented in the real process. In this way, we will be able to ensure calculation of the benefits and reduce the risks of performing different types of changes in advance. After that, we will be able to demonstrate to companies on basis of current PCIs how much potential is hidden in the process for possible improvements.

This research is set to avoid most possible constraints: it is not limited to the type of business, type of business process, modelling technique and is not limited to the cause of changing the process. In the first part of this research, we do not expect problems. We will obtain those PCIs (key PCIs), which are important from view of process owners. It will be interesting to see whether PCIs from a particular area (informatics, organization, personnel) dominate against other areas.

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THE ROLE OF FACEBOOK IN BUSINESS MODELS AND INCREASING COMPETITIVENESS OF HIGHER EDUCATION INSTITUTIONS

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Abstract: *In recent years, many studies concerning the use of social networks among students indicate that social networks promote educational communication and cooperation between faculties and students. The trend of using social networks in higher education is relatively new, but it points to their numerous advantages, acceptance and use in education. The aim of the study is to examine the purpose of using Facebook among students, as well as their observations, benefits and attitudes about educational use. The research was conducted among students of the Belgrade Business School - Higher Education Institution for Applied Studies and 430 students at bachelor and master studies were surveyed in October 2017. In the analysis of the obtained data the following methods were used: t-test and factor analysis. The results show that students use Facebook for educational purposes to exchange materials and information from lectures, communication with colleagues, and the creation of academic groups, and that higher education institutions should adopt their business models to the changed communication trends and include e-learning platforms and social networks in their official channels towards students, potential candidates and alumni in order to increase their competitiveness.*

Keywords: *educational use, Facebook, social networks, digitalization, e-learning, student, higher education*

1. INTRODUCTION

The popularity of social networks and their global presence in the everyday life of students is growing, who use them not only as a means of networking, but also for educational purposes. The research on social and educational institutions is trying to answer a series of questions – how is social media used in education, what are the goals of social media, what are the experiences, what are the barriers to effective use and what is the future of social media in education (Hebrang, Grgić, Mučnjak, 2015: 234). Students have different learning styles (Marič, Penger, Todorović & Đurica, 2015) and the use of social networks provides the basis for social, emotional and cognitive development of young people who spend most of their time on the Internet (Hayes, Van Stolk-Cooke, Muench, 2015: 508).

Numerous studies have shown that social networks have led to significant changes in communication and interaction between students and professors, as well as learning methods. The use of social media in the university classroom is gaining in its popularity and is transforming learning and teaching in significant ways (Foster, Farshid, Juena, Wallström, 2016: 789). Social networks provide students with more opportunities to communicate, learn, discuss, exchange information, reflect, judge and rate downloaded materials, give feedback and acquire new knowledge on the Internet (Volungevičienė, Teresevičienė, Mejerytė-Narkevičienė, 2015: 19).

The existence of the Web has changed the nature of the educational process, and modern network technology has improved the ability to communicate of people around the world and become a necessary educational tool (Soleša, Rajsman, Juričić, 2014: 1403). Today, higher education institutions have recognized the potential benefits of social networks and use them to improve their own business, communication and promotion. Students are offered with a variety of useful tools for easier sharing of teaching materials and interaction with colleagues and professors. Because of the increasing number of Facebook users among students, educational research shows that Facebook can be used to provide educational content and can be used as a successful learning tool (Buragga, Dhir, Boreqqah, 2013: 21).

Numerous studies deal with Facebook as the most popular social network from various aspects. Facebook is well-known for the purpose of daily entertainment and getting information: playing games, watching videos, expressing opinion, sharing files, tracking events in someone's social circles, dating, etc. (Kabilan, Ahmad, Abidin, 2010: 180; Sharma, Joshi, Sharma, 2016: 342). Although it was originally created for social use, according to some studies (Bosch 2009, Mazman & Usluel, 2010; Sharma, Joshi, & Sharma, 2016) Facebook is also successfully used for educational purposes. According to a study conducted by McCarthy

(McCarthy, 2012), students consider Facebook an important tool for studying that improves the development of academic links and promotes academic criticism, discussions and networking (McCarthy, 2012: 760).

According to the study conducted by Latib, Bolong and Ghazali, the purpose of using Facebook is divided into seven functional areas: the creation of personal identity; distribution of content; communication with friends; creating personal reputation; the creation of groups of people with similar interests; constant tracking of new information and the development of personal, friendly and business relations (Latib, Bolong, Ghazali, 2014: 290). Social networks provide the opportunity to create same-interest groups. Professors create *online* groups on the topic of their subject and upload teaching materials and important information for the exam. Students join groups on social networks and in that way they can establish contact with colleagues and professors, exchange opinions, comments and information.

It has been found that most students use social networks for educational purposes to perform group projects and assignments. Furthermore, research has showed that social networksare very useful in conducting group work (Zanamwe, Rupere, Kufandirimbwa, 2013: 15). Therefore, the use of social networks for educational purposes is recommended to overcome problems, such as the feeling of isolation from the group, which often occurs in learning processes and has a negative impact on learning and "inability to express themselves in public" due to shyness (Ozturk, 2015:22).

Universities as educational institutions are concerned about the growing lack of interest of university students toward the traditional way of learning (Manasijević, Živković, Arsić, Milošević, 2016: 443). Professors should, through attractive teaching content, innovative and interactive models of work, involve students to participate in lectures and make education more effective. Facebook provides a social environment, enabling the student to interact with instructors and peers and facilitates the process of knowledge construction (Çoklar, 2012: 49). Resource and material sharing consists of activities such as exchanging multimedia resources, videos, audio materials, animated videos, resources and documents (Manasijević, Živković, Arsić, Milošević, 2016: 443).

2. METHODOLOGY OF RESEARCH

Higher education institutions have realized that the implementation of new technologies and the following of trends significantly influence the achievement of competitive advantage and adaptation to changing market conditions. Nowadays, higher education institutions are focused on being present on each platform and updating information at any time.

The basic research instrument is a structured questionnaire, which consists of two parts. The first part of the questionnaire refers to control variables (whether you use Facebook, how long you have a profile on Facebook and how often you access Facebook). The second part of the questionnaire consists of 14 items for testing the purpose of using Facebook, using Likert's five-point scale, and special attention is paid to examining the educational use of Facebook. Today's student population uses social networks, in addition to entertainment and communication, also for the exchange of relevant information about their studies. A high percentage of students use Facebook, about 97.2% of them. Most students have a profile on Facebook for more than 5 years, 67.4%, and 20% of students have a profile for a period of between 3 and 5 years. When it comes to the frequency of accessing Facebook, 60% of students approach several times during the day and 18% of students once a day.

The collected data, obtained by student questionnaires, were processed and analyzed using software for statistical analysis SPSS 22.0 (Statistical Package for Social Science). In the analysis of the obtained data the following methods were used: t-test and factor analysis.

3. RESULTS OF RESEARCH

Table 1 presents descriptive statistical dimensions for the second part of the questionnaire. Based on the obtained results, *the Purpose of Using Facebook* contains two main factors defined as *Social Relations and Everyday Activities* and *Educational Use of Facebook*. The assumed model of two factors *The Purpose of Using Facebook* was examined on an existing sample of students using factor analysis.

Table 1: Descriptive statistics for items related to Social Relationships and Everyday Activities on Facebook and Educational Use of Facebook (n=430)

Social Relationships and Everyday Activities on Facebook	Mean	Median	Std. deviation
I use *Facebook* to establish and maintain contact with friends I have not been in contact with for some time.	4,06	4	1,052
I use *Facebook* for acquiring new friends.	2,67	2	1,407
I use *Facebook* to communicate and share information with my friends.	4,19	4	,950
Facebook allows me to create and access groups of people with whom I have the same interests and needs.	3,99	4	1,169
I use *Facebook* to track the latest information, news and events of my friends.	3,84	4	1,122
I use *Facebook* to track innovation.	3,55	4	1,255
Educational Use of Facebook	Mean	Median	Std. deviation
I use *Facebook* to communicate with my friends from the faculty regarding test tasks, group projects, recommendations and experiences.	4,25	5	1,004
Facebook improves communication with professors and facilitates receiving all the necessary information about teaching content, all issues essential for passing exams, designing projects and final papers.	3,10	3	1,364
The use of *Facebook* makes it easy to transfer information, teaching content and notifications about classes, lessons, exams, and extra-curricular activities.	3,90	4	1,149
Facebook allows creating and accessing academic groups of people with the same interests and needs.	3,89	4	1,021
The use of Facebook enhances the team work of students.	3,84	4	1,151
I use *Facebook* as a means to increase the performance on the lectures.	3,14	3	1,348
Facebook enables the exchange of different materials from lectures between professors and students and students among themselves.	3,54	4	1,277
Facebook provides me with multimedia contents (videos, audio materials, documents, etc.) that are relevant to learning.	3,53	4	1,293

As for the first factor, S*ocial Relationships and Everyday Activities* give the students put the utmost importance on items "I use *Facebook* to communicate and share information with my friends" (M = 4,19; SD = 0,95) and "I use *Facebook* to establish and maintain contact with friends I have not been in contact with for some time" (M = 4, 06; SD = 1,052). The results indicate that students consider *Facebook* an important means of social networking because the items have a high score, or a mean value above 3. The item "I use *Facebook* for acquiring new friends" has a very low mean value (M = 2,67; SD = 1,407) and the lowest for the whole dimension *Social Relations and Everyday Activities*. This result shows that students attach little importance to using Facebook for gain new friends.

All items related to *Educational Use of Facebook* have mean values greater than 3, which show that students understand the importance of Facebook for educational purposes. The highest mean value has the phrase "I use *Facebook* to communicate with my friends from the faculty in relation to test tasks, group projects, recommendations and experiences" (M = 4,25; SD = 1,004), "The use of *Facebook* makes it easy to transfer information, teaching content and notifications about classes, lessons, exams, and extra-curricular activities" (M = 3,90; SD = 1,021), and "*Facebook* allows creating and accessing academic groups of people with the same interests and needs" (M = 3,89; SD = 1,021) and enhances the team work of students"(M = 3,84; SD = 1,151). The results show that the main advantages of using Facebook for educational purposes are quick and easy communication between students regarding test tasks, passing recommendations, experiences, information and notifications regarding teaching and extra-curricular activities. Also, the results show that students understand the importance of accessing academic groups, as well as the significance of social networks in the realization of group projects and teamwork.

The results of factor analysis are presented in Table 2.

Table 2: Results of factor analysis of 14 items and 2 separate factors

	Characteristic value	Factor loadings	Variance (%)	Cumulative variance (%)
Educational Use of Facebook *(Cronbach alfa=0.889)*	6,130		31,05	31,05
Facebook enables the exchange of different materials from lectures between professors and students and students among themselves.		,815		
I use Facebook as a means to increase the performance on the lectures.		,758		
Facebook provides me with multimedia contents (videos, audio materials, documents, etc.) that are relevant to learning.		,752		
Facebook improves communication with professors and facilitates receiving all the necessary information about teaching content, all issues essential for passing exams, designing projects and final papers.		,746		
The use of *Facebook* makes it easy to transfer information, teaching content and notifications about classes, lessons, exams, and extra-curricular activities.		,728		
The use of *Facebook* enhances the team work of students.		,658		
Facebook allows creating and accessing academic groups of people with the same interests and needs.		,632		
I use *Facebook* to communicate with my friends from the faculty regarding test tasks, group projects, recommendations and experiences.		,507		
Social Relationships and Everyday Activities on Facebook *(Cronbach alfa=0.781)*	1,390		22,66	53,71
I use *Facebook* to track the latest information, news and events of my friends.		,811		
I use *Facebook* to track innovation.		,745		
I use *Facebook* to establish and maintain contact with friends I have not been in contact with for some time		. ,606		
I use *Facebook* for acquiring new friends.		,599		
I use *Facebook* to communicate and share information with my friends.		,560		
Facebook allows me to create and access groups of people with whom I have the same interests and needs.		,552		

The sampling adequacy for factor analysis was verified by the value of the Kaiser-Meyer-Olkin index of 0,914 and exceeds the recommended (critical) value of 0,6. Also, Bartlett's spherical test has reached statistical significance (p <0,001). In the further analysis, the factors whose characteristic value was greater than 1 (Kaiser's criterion) were retained and thus retained two factors. These two retained factors explain 53,71% variance, with the first factor contributing 31,05% and the second 22,66%. In order to facilitate the explanation of the factors Varimax rotation was carried out, and in the further analysis only those variables whose factor loadings increased by an absolute value of 0,5 were retained.

By using the factor analysis in this survey, 14 observed variables (questions) were reduced to two dimensions, or two factors of *the Purpose of Using Facebook*. These two dimensions correspond to the following factors: *Social Relationships and Everyday Activities* and *Educational use of Facebook*, whose names have emerged as a common denominator of a set of correlated variables (questions) within them.

The overall alpha-coefficient of reliability analysis is 0,899 and the results of the reliability test for the two resulting sub-clusters are as follows: *Social Relations and Everyday Activities*- Cronbach alpha = 0,781; *Educational use of Facebook* - Cronbach alpha = 0,889. In the relevant literature it is considered that the confidence coefficient greater than 0,7 confirms the hypothesis that the questions that make up each dimension (factor) are interconnected.

The total number of retained factors is significantly lower than the number of observed variables (questions), thus justifying one of the basic objectives of the factor analysis that the initial set consisting of a large number of original, interconnected variables (questions in the questionnaire), which measure similar characteristics, reduce to a smaller number of new, mutually unreleased variables - factors (the principle of dimensional reduction). These factors summarize the essential concepts behind the use of *Facebook*.

4. DISCUSSION

Many studies investigate the phenomenon of social networks and their impact in many areas of life. Facebook, as the most popular social network, has found great application among higher education institutions and students. The results show that students mostly use Facebook for social purposes. As for the use for educational purposes, Facebook is the most valuable platform for sharing materials and information from lectures, communication with colleagues and the creation of academic groups. The phenomenon of Facebook has influenced the changing way of communication among students and others, the exchange of information and the broadening of knowledge (Volungevičienė, Teresevičienė, Mejerytė-Narkevičienė, 2015: 2).

The results show that the greatest importance regarding the use of Facebook for educational purposes, students see in easier communication with their friends from the faculty in relation to test tasks, group projects, recommendations and experiences. Also, Facebook facilitates the transmission of information, teaching content and notifications about teaching, classes, exams, and extracurricular activities (Hamid, Waycott, Kurnia, and Chang, 2015) have found that students using social technologies show more interaction with other students at lectures. The results of this study greatly support the involvement of students in academic groups, collaboration through academic groups and the improvement of group work (Hamid, Waycott, Kurnia, Chang, 2015).

Higher education institutions use social networks in order to provide information about students, improve communication and learning methods. Also, social networks can also be used as part of a corporate strategy for managing and maintaining lasting relationships with students. In the latest academic programs, networking technology has become an essential educational tool (Soleša, Mateljan, Juričić, 2012: 1562).

5. CONCLUSION

Higher education institutions have realized that the implementation of new technologies and the monitoring of trends significantly influence the achievement of competitive advantage and adaptation to changing market conditions. Nowadays, higher education institutions are focused on being present on each platform and updating information at any time. Employees and students have recognized the numerous advantages of adopting and using social networks for educational purposes. Facebook, as the most popular social network, has found great application among higher education institutions and students.

The results of this study show that students mainly use Facebook for social purposes, but that this social network has a significant application for educational purposes. Compared to other social networks, Facebook is the most valuable platform for sharing materials and information from lectures, communication with colleagues and the creation of academic groups. The results of this research also show that the greatest importance of using Facebook for educational purposes is that it facilitates students' communication with colleagues in relation to test tasks, group projects, recommendations and experiences. Also, Facebook facilitates the transmission of information, teaching content and notifications about classes, lessons, exams, and extra-curricular activities.

Higher education institutions should use social networks to provide information on students, improving communication and learning methods. Also, social networks can also be used as part of a corporate strategy for managing and maintaining lasting relationships with students. The results also indicate that higher education institution ought to accept digitalization and incorporate modern technologies in teaching methods by including e-learning platforms and enabling the usage and share of learning materials in digital form.

Main limitation of this research is the sample, which covered only one higher education institution from Serbia, so further research should test the use of social networks for educational purposes in various academic fields, and different universities from Serbia. Another direction for further research in this area might be a comparative analysis of multiple countries regarding the use of social networks by students, but also about the level of implementation of digital platforms in business models of higher education institutions.

ACKNOWLEDGEMENT

Authors' engagement on this research was partially supported by the Ministry of Education and Science of the Republic of Serbia through the Project No. 179081: Researching Contemporary Tendencies of Strategic Management Using Specialized Management Disciplines in Function of Competitiveness of Serbian Economy.

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MATRIX ORGANIZATIONAL STRUCTURE AND MULTI-SIDED PLATFORM BUSINESS MODEL IN DIGITAL MARKETING

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Abstract: *This paper analyses organizational structure and business model appropriate for a digital marketing agency. Our goal is to help facilitate development and the maintenance of the Digital Agencies business through the successful implementation of corporate culture, business organization model and organization structure. We have presented business model of the organization through the canvas scheme and structure by the organizational chart. Our theoretical framework was Mintzberg's approach of three hypotheses of configuration, congruence and extended configuration. We have used his partial assumptions and qualitative approach to determine if our structure and business model is aligned with internal and external factors in this particular business context.*

Keywords*: digital marketing, business model, matrix organization, organization structure, organization culture*

1. INTRODUCTION

Digital marketing includes the process of use of modern digital technology to place goods and services on the market through the system of traffic increase using web sites and social networks. e.g., (Lamberton & Stephen, 2016). Main focus in a digital marketing is placed on creating quality content that will draw attention and encourage the readers to share it through their social platforms. Additionally, the stated digital marketing is a general term used for promoting products or services using digital technology platforms, mostly through the Internet. Their placement is performed via computers, mobile phones, tablets or other digital devices. One of the main advantages of using social platforms in marketing is the option of placing content to a narrow target market which is an inevitable advantage compared to other marketing channels. Business systems of the digital marketing are usually called Digital Agencies, Marketing Agencies or Advertising Agencies that include digital departments. Activities of digital agencies cover: creating marketing content and its placement online, SEO of web sites, SEM optimization, influencer marketing, creating marketing campaigns, managing social network pages, e-mail marketing, social network ads, Google ads, SMS ads, re-marketing, banners, preparing SEO friendly articles for digital media, etc.

Lower budgeting is among main advantages of digital marketing compared to the traditional marketing mix. This is why a growing number of companies focuses their promotions on using modern technology and platforms such as Google, Facebook, Twitter, Youtube, Instagram, LinkedIn etc. The growth of demand dictates the increase of providing services. The industry of digital agencies grows rapidly and is very large (Ibisworld, 2018). ''Statistics show that only in the United States of America in 2018 year, digital agencies employ 68,059 employees and whose industry collects $ 12 billion a year with a projected annual growth rate of 14.4%''. This trend is visible in the western Europe, but, for the last couple of years, the east of Europe, as well.

Digital marketing enables the advertiser to exit the local and regional communication with consumers and customers and to enter the global market and promote its goods or services all around the world for a relatively low budget. This chance is equally given to service providers, i.e. digital agencies that can operate from a local level to national and international markets with minimum capital investments. In this manner, an agency located in Serbia can operate on the market of United Arab Emirates, Serbia and China, at the same time. As of 01 April 2018, a new law comes into effect proposed by the Ministry of Finance of the Republic of Serbia related to the income tax of non-resident legal entities, that is, Withholding Tax. A Rulebook was adopted on the type of services based on which a non-resident may acquire income that is subject to withholding tax. According to this Rulebook the services of marketing, propaganda, and advertising are not subject to taxation. e.g., (Official Gazette of the Republic of Serbia 113/2017, 2017). ''Accurate list of non-taxable services is: marketing, media setting, advertising on the Internet and over social networks, in public media, lease of media space, development and videos and advertising, event organization regardless of the location, provision or use. The activity codes are 7311 and 7312 – Advertising agencies activities.'' Digital

agencies in Serbia operate under this code. This new law enables invoicing the service of managing digital channels for a foreign client without VAT, thus making this invoiced amount not subject of further taxation by the Ministry of Finance of the Republic of Serbia. This certainly facilitates the work with clients that are not Serbia residents and stimulates the development of digital agencies in the region. Namely, the price and quality ratio of domestic digital agencies compared to foreign competition is certainly promoted in this manner, for the benefit of domestic agencies.

As the technology and the development of different platforms, software and tools grow, it is increasingly easier to monitor the consumer demographics, behavior and measuring the amount of income per user. This promotes the development of digital marketing industry and shows us that it will significantly grow in the following five years. The prediction for technological development certainly impacts the development of digital agencies and the service they provide. The interaction between the advertiser and consumer is now, owing to social media platforms, much more transparent motivating the improvement of such communication, causing opening of new positions within the digital agency organizational structure. As synthesized in the review by Marquis and Tilcsik (2013) under the influence of the idea of relations between social structures and organization (Stinchcombe 1965), wider social context can imprint its form into the structure of the organizations. Our research question if there are modern forms of organizational structures and business models which are fit for the digital marketing agencies. We focus on the analysis of fit between digital marketing business on one side and matrix organizational structure, as well as multi-sided platform as the business model, on the other. To do that, we have formulated following hypothesis:

H1: Matrix organizational structure and multi-sided platform are appropriate solutions for the digital marketing agency business

Our main hypothesis will be elaborated according to Mintzberg's (1995) framework, where effective structuring of organization is bounded by configuration, congruence and extended configuration, presented in the following hypotheses:

- H 1.1. Matrix organizational structure and multi-sided platform are aligned with the Mintzberg's configuration hypothesis
- H 1.2. Matrix organizational structure and multi-sided platform are aligned with the Mintzberg's congruence hypothesis
- H 1.3. Matrix organizational structure and multi-sided platform are aligned with the Mintzberg's extended configuration hypothesis

2. METHODS AND LITERATURE REVIEW

For our research we have used qualitative business analysis methods, common in the business research (Saunders, Thornhill and Lewis 2009). Organizational structure and business model are complex phenomena (Jaško, Čudanov, Jevtić and Krivokapić, 2017), with large number of non-numerical attributes and characteristics, and thus are not subject to complete or even significant quantification. Analysis is thus aimed at coding themes and assigning meaning to the data, which are usually words or images, according to the Gliner, Morgan and Leech (2011). Our results will not be illustrated by the statistical analysis, but instead by the study of individual cases and traits of the observed phenomena. According to the Healey and Rawlinson (1994), our approach is based on meanings expressed through words, collected data is not standardized and is classified into categories, as well as conceptualization of observed phenomena.

2.1. Changing organizational context for digital marketing

Technological changes are bringing disruptive innovation (Christensen, Raynor and McDonald, 2015) into established industries. Digital disruption is already present in publishing (Gilbert, 2015; Karimi and Walter 2015), banking (Tornjanski, Marinković, Săvoiu & Čudanov 2015), education (Dellarocas & Van Alstyne, 2013) and entertainment (Rombes 2017), but our focus is on marketing changes in a digital age (Ahonen and Moore, 2005; Ryan, 2016; Begum, 2017; Jovanović, Vlastelica, & Cicvarić Kostić, 2017; McCosker, 2017). As stated by Bolman and Deal (2008) '' Business models, management models and organizations that were successful in the last two decades are outdated now. This period is called the organizational big bang. Information revolution, globalization of economies, immediate information sharing on global events, collapse of big ideology, establishment of large media companies that turn the world into a huge planetary village promote the acceptance of general culture values that results in new business models and new organization structures, turning the yesterday ones into antiquities." This brought along business models that include the industry of digital marketing.

2.2. Corporate culture in digital age organizations

As a groundwork for a successful business model and sound organization structure we should take a look at another important success factor for digital agencies – corporate culture. The culture in the context of the organization is defined as mutual presumption, values, beliefs, language, symbols and systems of meaning that are an integral part of an organization. When the cultures are strong employees in the entire organization on all levels share the same goals, have the same type of feeling on the organization and interpretation of its culture in the same manner (Gottlieb, 2007). Services provided by digital agencies require identification with clients and their values in the form of best and more relative content creating that will present the client to the market, followed by the continuous communication with consumers for and in the name of the client. Considering the diversity of activities performed and identified with for a longer period, for digital agencies, there is a danger of employee service quality drop due to losing focus from the culture and adopted values of the original employer.

Also, considering the option of managing digital channels of a global client from a local level, acceptance of global culture and maintenance of local subculture is a must. When we are a part of a business system culture we become codependent to other members of this business system, we manage stress better and have better productivity. It is very important to maintain the motivation of employees and provide the conditions of work that support creativity. The essence of activities of digital agencies is seen in the creativity of its employees. To achieve this Galbraith (2009) states: "the task is challenging, since you need the best leaders in the company for motivating employees and maintaining corporate culture, and what the Council for Corporate Leadership identified as the key role in the matrix is a strong communication skill of the leader, the way of motivating for teamwork, adjustability and calling for mutual goal and introducing the reward system." We will present a successful example of the organization culture of Google, from author e.g., (Smithson, 2017) ''Google organizational culture is not a typical one, partly due to the effect of the organization structure of the company. In principle, the structure and culture interact to impact the capacity of the organization. Openness is achieved through the matrix organization structure. Within the Google context of organization structure, employees are free to share their ideas and opinions''.

On the domestic market, the company that develops a successful culture of a business system is surely the Serbian technological company Nordeus. The success of Nordeus was initiated by a pioneer cross-platform gaming concept including online games you can play from any platform and device at any moment. Nordeus operates since 2010 and successfully nurtures the startup culture of its organization to this day. Also, similar to Google, it applies the matrix organizational structure.

The examples of Google and Nordeus organizational culture and satisfaction of the employees that give maximum in these conditions and do not lose focus from company values gives us enough valuable information on the importance of maintaining this aspect in the essence of existence of a digital agency. For the mere essence of operations of a digital agency is similar to Google platform. It connects two sides providing content. Google uses its platform for placement as well as Nordeus, while the digital agency uses others. This leads to a conclusion that a business model of a digital agency in a lower volume but with similar description could be defined as multi-sided business model.

3. BUSINESS SYSTEM BUSINESS MODEL IN DIGITAL MARKETING

Osterwalder & Pigneur (2010) define business model by "how an organization creates, delivers and maintains value" and describe patterns of unbundled, long tail, free, open business models, as well as multi-sided platforms model. Synthesis of how the research on business models shows that it can also be perceived as the statement, description, architecture, conceptual tool, structural template, method, framework, pattern and set (Zott, Amit and Massa, 2011). In order to generate all information and define under which business model a digital agency operates we will review the definition of the multi-sided platforms model from e.g., (Osterwalder&Pigneur, 2010): "Multi-sided platform business model collects several different but mutually dependent groups of buyers. Such platforms are valuable for one group of buyers only if other groups of buyers are present. The platform creates value by facilitating interactions between these two groups. Multi-sided platform grows in the sense it draws more users, which is a phenomenon known as the network." Using the canvas provided by Osterwalder and Pigneur (2010), we can describe business of the average digital marketing agency through the figure 1.

Multi-sided platforms existed in the past but have developed in the last two decades with the significant development of informational technologies. In addition to Google, Facebook, we can also include Microsoft Windows as an example of successful multi-sided platform business models. Since digital agencies connect the client with end users of such a platform engaging the third parties in the form of lease of ad space online we can say that digital agencies operate on the multi-sided platform business model as well. The task of a

digital agency is to attract and serve all these groups at the same time to create value through creating quality content. The success of the project that the digital agency is leading is seen in the number of users on the "other side" of the platform and their activities. Namely, to manage and retain a client the digital agency must engage one of the platforms to place the marketing content that will attract visitors and followers. To do that, it will have to allocate certain budget for a better promotion on a given platform. Since the company investing the budget expects a fast return on invested funds (ROI) as well as profit, digital agency has the task of envisaging sufficiently interesting and quality marketing content to motivate a customer group for the given subject. Using different marketing tools in the form of good design, text, slogans, vlogs and activations the task of a digital agency is to create a buyer from a user. This model includes some of the free business model as well.

Key partners	***Key activities***	***Value proposition***	***Customer relationships***	***Customer segments***
Project associates, free lancers Social networks (Google, FB, Youtube) Influencers, bloggers	Development of digital strategies and plans Development of campaigns on digital networks Development of web and mobile applications	Providing services from digital marketing (SEO, SEM, Google optimization) Providing IT Services, support	Managing projects for clients Maintaining good relationships with target groups – community management	Big and small companies Companies Marketing agencies
	Key resources		***Channels***	
	Designer, creatives Digital account managers Media planners Developers		Social networks Platforms – Google, Facebook Web sites	

Cost structure	***Revenue streams***
Salaries, space lease	Agency fee – compensation for services
Material costs for the company	Discounts

Figure 1: Generic business model of a digital marketing agency

Namely, the free business model enables free offer pattern. In includes the option of continuous usage of a free offer by at least one segment of buyers. Financing in this case comes from another segment of the business model or another segment of buyers. One side of the platform is designed to attract users free of charge to follow content, see products and services while the platform itself generates income from selling advertising space and the advertiser created profit from sales of products to this segment of buyers that uses the platform for free. All three groups are organized and managed by the digital agency.

One of the most popular multi-sided business models is certainly Google. The core of its business model is the value proposal, ad or text Google provides to a very targeted group on a global level, over Internet. Through the service the advertisers publish sponsored announcements that appear on the Google browser along with other non-sponsored announcements but not at the top of the page. The service is attractive for advertisers since it enables filtrated demographic categories of target groups. However, the model is successful only if a lot of people use the Google browser. The more people use it, the more ads it can show. In addition to aforementioned, the value f the Google browser lies in the dependence of clients from Google, where their web page appears. The advantage is given to those that optimize their site, but certainly to those that use Google Web Tools such as Google Map, Gmail, etc. Additionally, Google introduced a new service, Adsense, that is called re-marketing also, enabling presentation of the Google ad on other Google web locations, that is, sites, portals, etc. of others. This service is useful for third parties, that is, owners of these web pages and portals, resulting in income from advertising of Google clients.

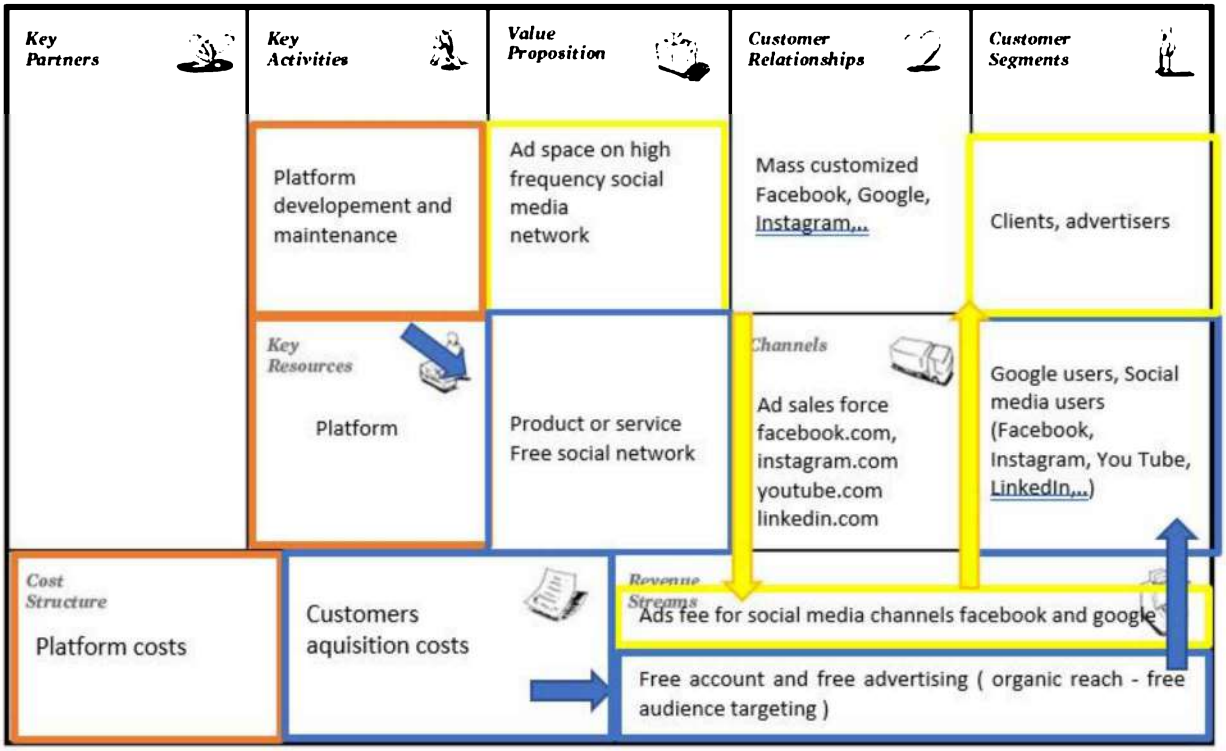

Figure 2: Free advertising pattern of multisided platforms - business model - digital advertising agency

4. ORGANIZATIONAL STRUCTURE IN THE DIGITAL MARKETING

As it is important to clearly define the business model, culture of the organization, the business system organizational structure is of equal importance. Business system includes a group of people organized for the performance of tasks. Thus, it is necessary for them to be efficient, flexible and dynamic. These conditions can be met only through appropriate organization structure. Each structure is managed by management. The role of the management is to plan and execute activities, therefore, organization is a process of envisaging activities, rules for conducting such activities, execution and performance measurement. Organization and organizing do not mean the same, organization is a group of people that execute certain tasks led by the management while the organization is a process as the word organization can represent entity, attribute, process or scientific discipline (Jaško, Čudanov, Jevtić and Krivokapić 2013).

When designing organization, top management must align several key factors, such as: well envisaged hierarchy structure, clear function diversification, standardization of behavior in task performance, decision adoption on function level, etc. Better or worse organizational solution depends on the design and the structure of the organization that includes: division of jobs performed, division by departments, coordination mechanisms, dispersion of formal authority and control mechanisms, among other factors. As a basis for structuring we can have functions, processes, products/services, location, matrix of collaboration, project model, innovation centres or strategic business units

Tasks of digital marketing agencies are primarily organized per functions and on the second level per products, that is, brands it manages. Combination of the two results in the general matrix organizational form. Basic functions that need to be covered include creative department, account department, IT department and Accounting Department. Second line of job division, as well as authority is related to the brand that is managed by the dedicated team. So, for example, Coca Cola that is a client of a digital agency within such agency may have its own creative, account and IT team. Such organization enables teams to be directly responsible for the project they lead and in direct communication with the director of the functional department.

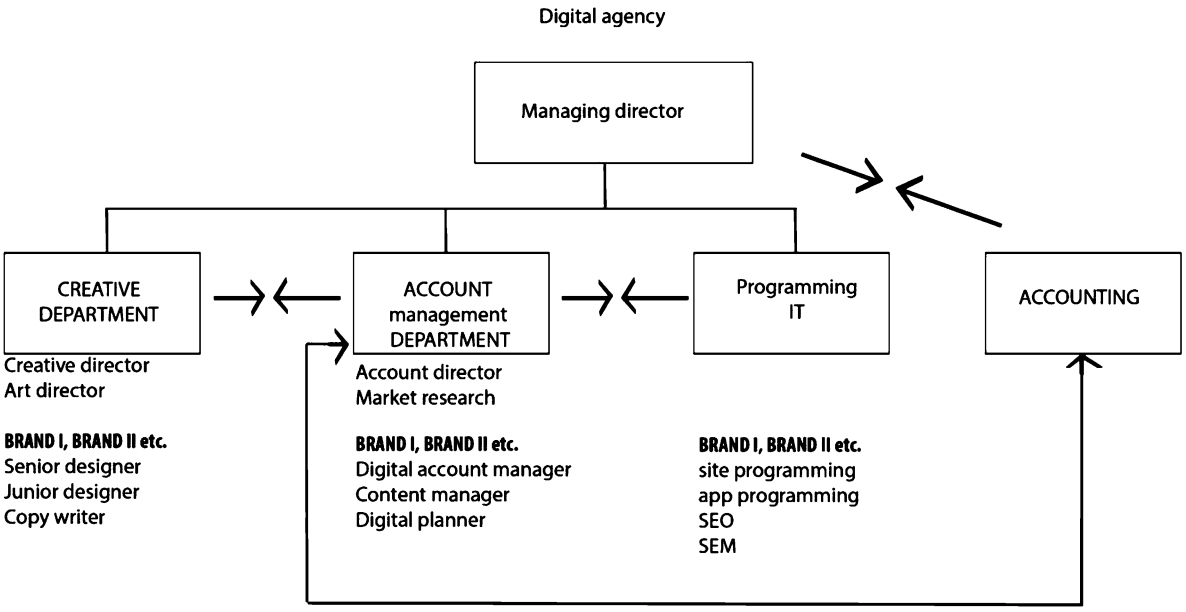

Figure 3: Job division and departmentalization basis of the digital marketing agency organizational structure

Each department of the digital agency has its clearly defined role as well as the responsibility for the part of the project it manages. Creative Department is in charge of envisaging creative campaigns and their visual and textual shaping. Creative Director is at the top of the hierarchy of the creative department, which is responsible for setting main creative concept, which is, afterwards, delivered to Art Director that will shape the idea visually through given communication channels and then supervise Graphical Designers whether the given brief is in accordance with visual elements. Graphical Designers create key visuals of the campaign and their implementation to given format while Copy Writers create slogans, and all required key words and texts necessary for campaign launch. Within the creative department organization of business is divided to projects, that is, brands that require so, through the volume of other requirements, so, large clients, within the Creative Department, may have their own Art Director, Graphical Designer and their own Copy Writer. This is repeated in all other departments of the digital agency. For example, Account Management Department is responsible for communication with clients, market analysis preparation, proposal of financial investments by the clients, performance analysis as well as delegating jobs to the creative and programming department. Account Director is responsible for the work of Digital Account Managers, whose clear responsibility is visible in daily communication with clients, managing their tasks and organization of them within the digital agency. Digital Account Managers have close cooperation and perform delegation with Content Managers that envisage daily content that is part of the comprehensive campaign but that must be communicated daily with new information by social networks to end users as well as designers that design for the project that is led by such Digital Account Manager. Additionally, the Digital Account Manager supervises the work of the Digital Planner whose responsibility is the investment plan into the online advertising type and channel. Digital Planner develops the plan, invests money into different forms of online ads and analyzes costs and results.

IT or programming department is the department in which sites are programmed, SEO is performed, SEM also, which programs and develops software that is part of a digital campaign. Employed programmers and developers are overseen and managed by Digital Account Managers headed by the Account Director. These three basic departments of each digital agency have teams that are managed under one client. Their interaction is frequent and daily. Accounting (Finance) Department is in charge of all financial transactions within a company, accounting, procuring purchase invoices, residence certificates as well as preparing sales invoices. It is in constant communication with the Account Department including payment and collection plans.

5. CONCLUSION

After the analysis, we will elaborate specific configuration traits to conclude configuration hypothesis. Digital marketing agencies are young organizations by definition of the industry which had emerged less than two decades ago. Thus, formalization of behavior is at the minimum, which is in line with the matrix organizational structure. Elaboration of structure is also minimal – just the basic division of work on account, creative, IT and auxiliary jobs defines the organization. Next, average unit size is small, fitting agile teams

demanded by the organization's mission. According to the recent data in the USA (Ibisworld, 2018), 19 406 digital marketing agencies employ 68 059 workers, giving mean value of 3.51 employees per agency. We can find parallel with the multi-sided platform, which is in general network broker organization aimed at investigator or analyst strategies (Miles, Snow, Meyer and Coleman 1978; Snow, Miles and Coleman 1992), acting as a center which outsources most activities. Due to large number of one-employee digital marketing agencies. Technical system is not too regulated, which is aligned with more organic and less mechanic organizational forms and business model described above, however it is sophisticated, which explains large influence of IT staff. Also, operating core is not automated as in Mintzberg's internal assumptions, but crowdsource, leaving organization able to work in flexible organic, forms. Based on analysis of eight assumptions of internal fit given above, we can assume that H1 is correct, based on the Mintzberg's framework. After the analysis of the organization we can conclude that multisided platform and the matrix structure satisfy the Mintzberg's hypothesis of configuration for effective organizational design, because of the internal consistency of the parameters.

External factors are also fit with eight Mintzberg's assumptions on external alignment. Dynamic environment fits organic form of matrix structure and dynamics of the multi-sided platform. Environment is complex, so the decentralization immanent to the matrix teams is more than desirable. Diversified environment asks for dedicated departments, but here we have collision with the internal factor, because digital marketing agencies are small organizations, with average mean of 3.51 employees and slightly higher modus. This is solved dually – matrix organization facilitates dynamic teams with multiple assignments, and multi-sided platform places digital marketing agency in the role of the broker in the continuum of stable to dynamic network, which promotes decentralization of network members and keeps the small size of the organization. There are no significant hostile impulses, but more elaborate analysis on that, using the Michael Porter (1998) structural analysis framework is a guideline for the future research. Selective decentralization is present as a solution of non-homogeneous task, resulting in general division on creative, account management, IT and auxiliary tasks. There are no significant external entities which control the organization, as can be illustrated by the liberal legal framework, and environment does not imply need for additional power, thus the forms presented in this paper are not centralized, confirming sixth assumption of external fit. We can conclude that this general solution satisfies congruence hypothesis, and that it can become starting point for organizational design as a in-vogue structure in the field. Since the congruence hypothesis is satisfied, we can confirm our hypothesis 1.2, and bearing in mind that there are no collisions between external and internal factors, we can conclude that Mintzberg's extended configuration exists, because both configuration and congruence fit at the same time, confirming our hypothesis 1.3, and finally general hypothesis that matrix organizational structure and multi-sided platform are appropriate solutions for the digital marketing agency business.

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THE IMPORTANCE OF THE NETWORK ORGANIZATIONAL MODEL FOR BUSINESS OF COMPANIES IN THE REPUBLIC OF SRPSKA

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Abstract: *This paper analyses network models, as a form of network organisation in recent times in the efficiency function of the company's organisational restructuring. It considers their behaviour to changes in business environments that are becoming faster, more turbulent and more unpredictable. The aim is to provide a concise way to explain the possible advantages and disadvantages of network organisation model, which can be used in the process of restructuring the companies, as a priority step towards a more efficient recovery of the companies in the Republic of Srpska and B&H as a whole. Empirical theoretical research and case studies analysis indicate that strategic changes have gone in the direction of network organizations and thus have become a significant source of competitive advantage for companies. Companies in Republic of Srpska most often have a massive and irrational organization, so it is necessary to redesign their organizational structures.*

Keywords*: internal, stable, dynamic networks, company, risk*

1. INTRODUCTION

The survival and success in the environment characterised by risk, sudden and radical changes are accomplished only by those organisations who adapt to new conditions successfully and on time. In such uncertain and high-risk environment, models of organisation that were effective in relatively stable conditions have now become inadequate (Nelson, 2011).

Managers in modern organisations realise that traditional hierarchical designs are often inadequate for dynamic and complex environment they are facing. Responding to market demands in terms of flexibility and innovation managers find creative ways of structuring and organising work and creating organisations that respond better to, employees and other organisational factors. In the mid 80's years of the last century, organisations around the world, responding to stronger influences of global competitive environment, left the central coordinated approach accepting the structure with different hierarchical levels as more flexible, and who are more similar to the networks than to the traditional pyramids (Achrol, 1997; Powell, 1990; Snow, Miles & Coleman, 1992; Rice & Gattiker, 2000).

One of the important characteristics of modern business is related to the efficient process of business restructuring. The main objective of restructuring is to better market positioning in the context of constant changes in the business environment. With the increasing and unpredictable changes in market environment, the company management is expected to adjust fast and on time, and to realise the possibility of these changes forehand and to react properly. Although today a network organisation, as a form of the network connected companies, is quite successful, especially as it stimulates development of new products by engaging suppliers whose talents and skills are often better than those of the employees in the company and with relatively little capital and small management team can achieve high business performance, managers have to consider the possible losses of key skills and control over suppliers as one of the potential business risks.

Flexibility, innovation and continuous improvement of business are the elements that are becoming the part of a strategic approach in building the competitive advantage. Great scientific and technological achievements in recent decades have turned the world into a global village in which the production methods and techniques are becoming more uniform. Companies are facing an increasingly common problem of finding a way to adapt to the new, altered business conditions. Due to these characteristics the process of transformation of companies is inevitable and unstoppable. Despite the fact that the network organisation in various forms exists in practice for a number of years, the concept of network business is still very important.

The previous period in the Republic of Srpska, as well as in B&H showed that privatisation was not enough for succesfull transformation of public companies into joint stock companies, without changing their organisational structure. That is confirmed by the bad business results and company's productivity indicators measured by total income per employee. In the process of revitalising large companies it is essential that managers create models of organisational structure that will be adequate with the environment and compatible with organisational design of company's market economy. Accumulated activities in the value chain in large companies, especially in public companies are giving the importance to the study of network forms, which are created using the concept of the value chain.

2. INTER-ORGANISATIONAL DESIGN AND EFFECTIVE ORGANISATIONAL STRUCTURE

The organisational design should be viewed as an element of strategic capability of the company. It is an essential element of strategic competence or the potential of the company that chooses its strategic position. During the last two decades the highest level managers in many companies have been working on the development of the new structural opportunities to help their companies be more competitive (Robbins & Judge, 2017). When an organisation is developing or changing the structure it makes an organisational design, with decisions about six key elements: specialisation, departmentalisation, commands, the control, centralisation, decentralisation and formalisation (Daft, 2015). The Network organisation is a form of inter-organisational design with a specific purpose. In this sense, the organisational design must be aligned with the strategies as a possibility of achieving the objectives of company's business (Oliveira & Takahashi, 2012; Lunenburg, 2012).

In order to realise the contribution of the organisational structure to successful adaptation and impact on the environment, it is necessary to define the key dimensions of the company's reactions to changes in the business environment. Decisions on the organisational structure must be made in the light of the company's strategic position, as the application of the strategy will be unsuccessful if the organisational structure is not designed to fit the strategic needs and constraints. Managers in modern organisations realise that traditional hierarchical designs are often inadequate for the dynamic and complex environment they are facing (Lin, Tsai & Wu, 2013). Reacting to the market demands in terms of flexibility and innovation managers find creative ways of structuring and organising work and creating organisations that will be able to respond better to the needs of customers, employees and other organisational factors (Twomey, 2002).

New forms of organisational structures are different network approaches of organisational structure. The network structure implies that the company divides its activities into separate entities that are associated with organisational core of the parent organisation. The network structure as a new structuring approach indicates greater competitive advantage, greater flexibility, faster response to changes and the use of information technology as an effective form of organisational structure.

The company managements in the Republic of Srpska, in both private and public sectors, should initiate a reorganisation to reduce the size and "thinning" of the organisation in order to increase the efficiency and market competitiveness. Resistance to the reorganisation exists on many levels because it has resulted in layoffs of employees. However, the transformation is a radical change that entails sacrifices and managements of large and public companies are left with no choice. Managers of large companies in the Republic of Srpska of whom a number are in public companies: Railways RS Stock Company Doboj, Mixed Holding "Electric" Republic of Srpska, Stock company Trebinje and Public Enterprise "The forests of the Republic of Srpska" Sokolac need reject a strategy known in literature as " all under own it's own roof "and a hierarchical organisation. Folowing the example of companies in other transition economies, it is necessary to adopt an organisation based on the principles of competency-based firms and inter-organisational design which hold the interdependent companies together. Network models can serve businesses to be revitalised and to introduce the principles of market business within larger systems, rather than introducing administrative relations. The network is a group of independent companies that specialise in particular stages in the business chain. The network consists of the central company (core) and peripheral companies where the central company coordinates their activities and takes the role of a broker by connecting the other participants in the network.

Professional and academic communities have a strong and consistent view of how new organisation logic should be predicted according to the capabilities offered by current and upcoming trends in information technology and information systems. In the Republic of Srpska, as well as in B&H, most companies do not keep up with the development trend of information technology as a possibility to influence the economic and organisational performance. That presents a limiting factor for the new approach of introducing technical and technological base for the implementation of organisational change.

3. NETWORK ORGANISATION AS A FORM OF NETWORK FORMS

Classical forms of organisations are becoming increasingly dysfunctional influenced by environmental factors that management should effectively respond to. The search of managers for high flexibility resulted in the creation of new forms of organisational design which is called the network structure (Donaldson, 2001; Markides, 2013; Snow, Miles & Coleman, 1992). The basis of the network structure means that the organisation divides the most important functions into separate companies that are connected with organisational core of the parent organisation. The presence of a strong organisational core is significant for this structure, which is surrounded by other organisations, vendors, suppliers, traders, brokers and financial institutions (Snow & Fjeldstad, 2015).

Network organisation as a network form is a flexible structure, which should answer demands with speedy response, high competitiveness and high risk (Hall &Tolbert, 2009). Today, the companies in a restructuring process, as a form of business-technical cooperation often use the network concept developed by Miles and Snow. According to the degree of dislocation, they sorted all the network forms into: internal, stable and dynamic types of networks (Miles & Snow, 1992).

The specific purpose for which the organisations are connecting into the network is the access to the efficient production, distribution, marketing and any other essential business function under the contract. The network structure is inconsistent with parts of the structure that have accentuated vertical level of management and with organisations that seek to control their own development through ownership. In such organisations, research and development are carried out at headquarters, production takes place in the manufacturing facilities owned by the company and sales and marketing are performed by its employees. It is a set of organizations with multilateral relationships that work with one another to achieve common goals (Ahuja, Soda &Zaher,2012). In the network structure most of these functions are performed outside the organisation and coordination are connected by the computer. That provides managers with a high level of flexibility and allows the organisation to focus on what it does best.

Modern companies are responding to the new dynamic of market conditions and increased uncertainty with insurance risk strategies, entering into cooperative relations with other companies or restructuring the existing organisational structures by creating strategic networks of more tightly or loosely related companies. Such a potential structural possibility for managers who want to reduce or eliminate organisational restrictions is the network organisation. This is a small organisation that performs key business functions with the external supply. (Vega-Redondo, 2013). Quinn (1992) notices that more and more managers are trying out seemingly radical organisation structures in order to implement their strategy of providing "knowledge and services" (p.172). Services and technology of providing services have created a variety of opportunities for new organisational forms driven by knowledge based on fragmentation concept. An example of fragmentation is the relocation practice of production into other organisations. In past times, relocation was considered a sign of weakness, with the organisation admitting it was not able to do a specific task. Quinn (1992) is emphasizing that now the relocation may be a key element of managing an "intelligent company" (p.173). This approach enables organisations to concentrate on what they do best and to bring other activities to companies that are best able to perform such activities. Many large organisations apply the network structure in their production. The form of network structure also suits the production companies whose productive activities require cheap labour, and which can be best used under a contract with foreign suppliers (Robbins, 1992).

Companies like Nike, Reebok and Cisco System realised that they can engage in a big business, without being the owners of production facilities. Ericsson gave its production and even some research and development capacities to the more productive contractors in New Delhi, Singapore, California and in other locations around the world (Reed, Reinhardt & Sains, 2002). The essence of the network organisation is to distinguish the old forms of creating the organisational structures that carry a certain degree of bureaucracy. Organisations are required to be both flexible and stable at the same time with the extreme efficiency. The need for adaptation and concept innovation of business, initiated by a wave of global economic crises is inevitable for most companies. In such circumstances, managers are forced to re-examine the existing and seek new forms of organisational structures to resist the complex and continuous changes in the environment. The idea that comes from this environment is to keep the basic strategic functions as its own, while the rest of the business is given to the most competent suppliers (Carpenter, Banner & Erdogan, 2009).

Moving towards the network form becomes visible in the 80's, last century. With a new model of organisation companies are reducing their competition and managerial hierarchy in the company's core creating a wide range of external activities. New companies have abandoned the growth model through vertical integration and instead tried to make alliances with independent suppliers and / or distributors.

In a search for more efficient organisational structure the managers experimented with different organisational arrangements. As illustrated by figures 1, 2 and 3 some networks have linked suppliers, manufacturers and distributors into long term and stable business relations. Other networks were much more dynamic; with components along the value chain connected under a contract for possible individual or separate projects. Later, managers within firms have created internal network architecture for business units to gradually become competitive in the market and outside the company (Snow, Miles&Coleman, 1992).

In the past, companies used the old structure trying to keep all the components on the organisation level that were necessary for production of a given product or a service. Opposite to that the network organisations are using the components from several companies in the value chain (Quinn &Paquette, 1990).

Although the network organisations show characteristics that are different from the old forms, stable, dynamic and internal network (Figure 1.2 and 3) in addition it still includes elements of earlier organisational forms as their basic elements. Stable network organisation of these changes has: core of the company is associated with numerous limited and carefully selected partners. On the other hand, large multinational matrix organisation with different production units, design and distribution, could replace centrally determined price transfers with originally sales ratio among these units, resulting in creation of an internal network (Kirkpatrick, 1992).

4. FORMS OF NETWORK ORGANISATION: THE ASSUMPTIONS AND LIMITATIONS

In some economic sectors a significant number of companies are accepting the network model of organisational structure. These activities originate from both; small companies that are trying to connect in order to create favourable market conditions, and from large companies that want to achieve greater flexibility through disintegration, with often used concept of three basic network forms, such as: stable, internal and dynamic network types (Miles & Snow, 2001).

Stable network consists of central (core) organisations whose great number of activities is performed by other companies. It changes the components of firm that is linked with the firm's core by contractual package, trying to increase its flexibility and the competitive ability through the network. The company Nike has become the highly efficient stable network. That way, Nike is specialised in research and development, while the rest of the organisation is in the manufacturing, distribution and sales (Miles & Snow, 2001). Partners who produce exclusively for Nike have a program under the strict tutorship of Nike, which plans to turn them into top-level suppliers.

A stable network comes as the result of a strategic management decision to dislocate the activities to the more competent ones, who can more quickly and at lower costs do the job, while keeping the activities for which is more competent. Instead of producing on its own, company establishes cooperative relations and business and technical cooperation with other organisations. Its stability is based on trust, firm and stable business cooperation between the headquarters of the company and its branches. The company that runs a network form of organisational structure seeks to recruit a certain number of mostly small businesses that perform delegated activities with its support (Fig. 1). However, if there is a radical departure from established standards and if the core of the company can not change their behaviour, there is a reorientation to new subcontractors, which changes the layout of the network. By networking, companies are trying to reduce their centralised functions by dislocating them to the other organisations. Stable type of network allows the company to achieve seemingly unreachable strategic goals with little capital, mobilising small managerial teams (Gottfredson, Puryear & Phillips, 2005).

The parent companies are interested in network members to market-operate outside of existing businesses, considering that in this way it will strengthen those components that support innovation with flexibility. Suppliers are in relation with innovations and services related to design and they develop their adaptive skills through a variety of clients.

Additionally, stable network can be damaged by reckless and careless modifications. Seeking to ensure that suppliers, some leading companies are trying to determine processes that network partner should use. Within limits, it is useful to have close cooperation to ensure effective connections. However, the leading firm may ultimately be found to manage the property of its partners and to accept the responsibility for their products. In addition, when a independence of a member in network is restricted, creativity come from their managers and staff can bee reduced, Really in its zeal to ensure compliance with its requirements, leading company again transforms the network into a vertically organisation, with all its associated rigidities (Miles&Snow, 1992).

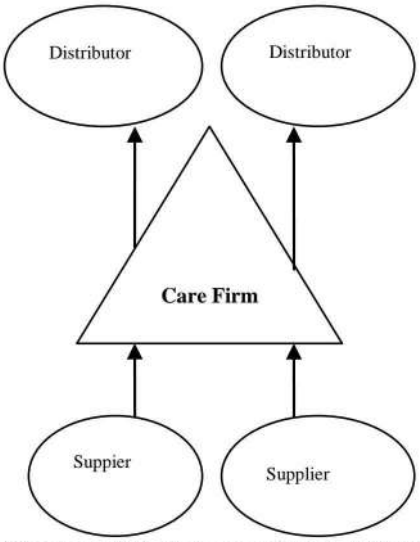

Figure 1: Stable network (according to Miles & Snow, 1992).

Internal network is a model of organisational network form where new organisational units are created within the existing model, as separate profit centres. It is often the result of the management's strategic orientation in answering this question: whether to produce or to purchase? It seeks to make a decision to retain the existing and to introduce new activities necessary for completing the product or services forming the network within the organisation by creating more stable and more secure way of supplying the spare parts of semi-finished products, raw materials etc.

These organisational entities are trying with their competitiveness to also produce services that work for both, the company and the market, creating the possibility to improve existing performance. The company management often goes for this model of organisational network because of more efficient quality control of components that are incorporated into the final product. The company management assumes the role of a broker and specialised organisational units become members of the network (Figure 2). Organisational subjects interact with each other as well as with the parent company with established contractual relations based on market principles. The point of an internal network is for company to gain competitive advantage through stable and more secure way of supplying the key components of the parent company and continuous know-how. Internal network can be a bad approach of forming the structure by excessive engagement or by lack of efficiency of internal organisational units (Taylor, 1991).

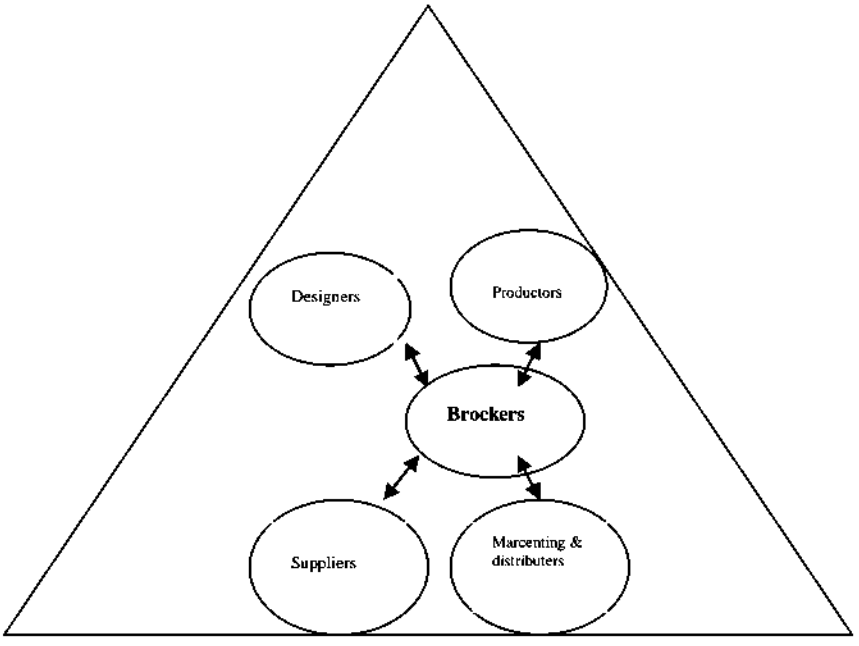

Figure 2: Internal network (according to Miles & Snow, 1992).

In such way the internal networks can experience failure due to excessive expansion and badly managed modifications. A rather frequent managerial error in internal networks is in determining the price level and in the supply of resources. Such prices can be accepted because of the greater benefit for the company by creating the stability and more secure way of supplying with more efficient results.

Despite the possible problems, the switch from centrally hierarchy to the internal structure of the market is a new trend of most companies in an effort to change their major units in self-organised businesses, who have a freedom in business (Magidson&Polcha, 1992). Often cited potential risks of internal network model of organisation are: a) that they lead to a potential loss of operational control among partners; b) they are a common cause of losing the strategic control over new technologies; c) that it is hard to acquire new managerial skills that company needs with such organisational form (Miles & Snow, 1999).

Dynamic network is the most flexible form of organisation networking. In competitive environments characterised by rapid and unpredictable changes, companies form networks that are very dynamic. In order for dynamic network to achieve its full potential, it is necessary to have a sufficient number of companies which operate at each point along the value chain and who are willing to work together for a certain job or project. After the job is finished, this network form of organisation is dismissed, so it can later become a part of another strategic alliance. By finding a contractor and by engaging the experts, leading company as network initiator takes the role of a broker (Figure 3).

Dynamic network is created when leading companies, based on a business idea in a specific activity, hire the most competent firms under the best conditions to implement that idea as a project task. It is a temporary form of organisational connectivity suitable for business collaboration based on the contractual relations with a purpose of realising an innovation and making a quick profit. This network form allows organisations to achieve significant results by investing a small capital and by having a small number of permanent staff, with basic competence, knowledge and management abilities. In such circumstances, the main company sees the chance and collects funds that are for the most part or wholly owned by other companies. Company management typically relies on a limited set of basic skills such as: manufacturing, design and marketing services (Sollosy & Parboteeah, 2015).

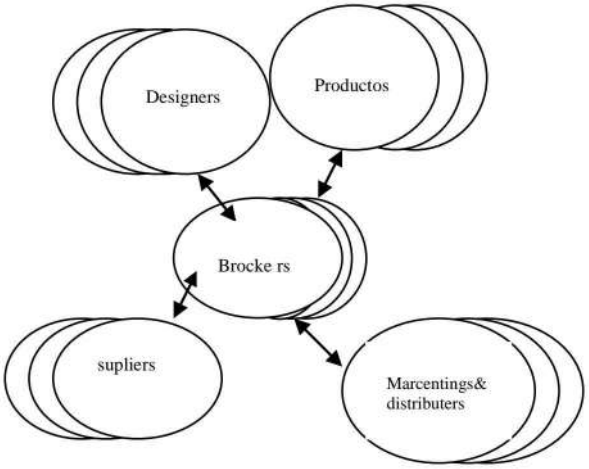

Figure 3: Dynamic network (according to Miles & Snow, 1992).

A dynamic network organisation is focused on efficiency. The efficiency of the network organisation can bring the structuring companies into operating units with a small number of employees or work teams who manage themselves. It is a convenient form for those companies with innovative and entrepreneurial behaviour.

Besides tangible assets being a limiting factor for the development of network organisation for many companies, today more and more pronounced limiting factor in developed economies are the human resources. Companies are basing their business success in a modern business on the know-how rather than on the technical and technological superiority. Thus the economies of developed countries do not have the problem of technology as a limiting factor of business compared to the organisational culture which represents one of the major barriers for development of network structures.

Despite numerous advantages of network form it is important that managers recognise the possible risks of this type of organisational structure. Important strategic issues could be loss of key skills and loss of control of the supplier. Lack of network organisation occurs when products produced by external associates give

suppliers too much power over producers. This situation is possible when a certain manufacturer of key components depends on only one supplier, or a few of them (Quinn & Hilmer, 1994; Cesarani, 2014).

5. CONCLUSION

Previous observations show that the network organisational models are generated by strategy changes in companies and large enterprises, which have been faced in recent years with the appearance of rapid, often unpredictable changes in the global environment. A powerful wave of changes caused by the development of sophisticated technology, and new categories of customers with high demands, marked the modern business. In such circumstances, company management chooses new strategies that enable companies to compete in a rapidly changing and unpredictable environment. Theoretical studies and practical examples show that strategic changes went in direction of network organisations and thus became a significant source of company's competitive benefits.

All assumptions regarding the new model of network organisation as a network form of organisational structure suggest that the choice of organisational structure model must meet several criteria and conditions. Network organisation has significant advantages and disadvantages for the successful implementation of this structure. Despite the benefits, company management must reckon with the risk that accompanies the online organisation. The presented examples of companies known in the theory and practice to have successfully applied a form of network organisational structure can not be understood as regularity, but rather as a system of consideration in the selection of appropriate solutions.

It could be argued that the theoretical assumptions presented in this paper should be guidelines for decision making about problems of structure for analysis and adequate access for validation. In this regard, any particular organisation should review its structure, it should study the theoretical models and to eventually find a solution that is appropriate for particular case. Selecting a specific model should be based on the situational approach. This means that when designing the organisation a whole set of heterogeneous variables of organisational design that characterise the global business environment should be on mind. The best organisational structure is the one that allows the company to successfully achieve goals and that is at the same time favourable to its size, technology and competitive environment.

Companies and large corporations in the Republic of Srpska, as well as in B&H have massive, inefficient and costly organisation because the conditions that they are in are favourable for it, and changing the conditions must inevitably lead to changes in their organisational structure As a possible solution for redesign of the organisation model of the network form, despite the hazards and risks, is one of the acceptable solutions. Proximity to the developed European markets is a priority for faster delivery of goods, and also allows the transfer of knowledge, technology and production. It is also convenient to connect the companies from the Republic of Srpska with foreign partners and spread the inter-organisational learning through modular form of networking. In addition, companies can use the convenience of an internal network to attract investments, and this is an opportunity for investors to invest in a distinct and attractive technologies and productions. Stable network is changing the organisational design and allows more efficient decentralised decision making, while implementation of a dynamic network as a temporary form of connectivity allows convenient way of cooperation in the realisation of business ideas between companies and entrepreneurs.

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CONSULTING APPROACHES TO THE ORGANIZATIONAL CHANGE PROCESS

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Abstract: *Organizations are forced to adapt to impulses from the environment in order to develop their business performances. The aggravating circumstance is that they often lack the knowledge to determine the direction of these changes, so sometimes they seek help from consultants who can create a framework for successful organizational adaptation or even restructuring, thanks to their expertise and experience. However, it is never an easy task, since consultants have to take into account all the specificities of their clients and create solutions that are suitable for them. Also, these experts must be prepared to cope with all kinds of the resistance that they will face during these projects. This paper presents approaches that they use to identify appropriate suggestions, as well as to help top management in overcoming the barriers that could jeopardize the successful implementation of these projects.*

Keywords*: consulting, organizational change, organizational restructuring, resistance*

1. INTRODUCTION

The consulting industry in the 21st century is experiencing great expansion (Orr & Orr, 2013), and its current value at the global level is over 250 billion US dollars (Consultancy.uk, 2018). As such, it has managed to find its place in a large number of different business areas (Krivokapić, Savić, & Čudanov, 2016). The consultants' assistance is of particular importance in designing and implementing organizational changes (Kubr, 2002). Organizational restructuring is based on organizational changes, and can be projected in many ways, which depends on the specificities of the client's problems. Regardless of the modality of organizational restructuring, the role of consultants is to provide guidance through the successful implementation of this project, and to help with the easiest possible implementation of the proposed changes. They analyze the problems through the prism of their previous experiences (Perchthold & Sutton, 2010) and then try to determine how these problems can be solved in the most effective manner.

Despite the unquestionable awareness that the help of experts is needed to get out of the crisis, managers are reluctant to opt for their engagement because they do not want to jeopardize their own expertise, integrity or authority, and sometimes they want to protect some of their interests, so they can be afraid of the arrival of external and objective participants who could threaten them. Also, recommendations from the consultants can be considered as a critique of their work, so it is not uncommon situation where the proposed solutions are bit adjusted in order to be in line with the views of top management. On the other hand, consultants' skills will reduce the effort the organization has to invest in order to reach the desired effects of this transformation (Sperry, 2013). They are expected to propose a restructuring direction, taking into account the specificities of a particular organization and considering its real possibilities.

The consultants often try to re-sell the solutions they have used on previous similar jobs, in order to make as little effort as possible, although there is the fact that each organization is different and that something that has brought success in one does not guarantee the same result in another organization. The client, on the other hand, may have different opinions on such solutions. Sometimes he opposes them because he thinks that the consultant will not give proper attention to his problem, but there are also situations in which he insists on these tried and tested solutions that have previously yielded results because new alternatives carry some sort of uncertainty (Baaij, 2013). Earlier solutions can be a good starting point that needs to be further developed into a model that will be suitable and compatible with the key characteristics of a client's organization, so it is necessary for consultants to become familiar with its problems, experiences and knowledge (Lilja & Poulfelt, 2001), which will be the basis for successful cooperation and generation of enhanced solutions that will help in solving identified problems.

2. FOCUS OF CONSULTING EFFORTS

If the proposed changes are more radical, it should be expected that the client organization does not have enough resources, knowledge, or ability for their adequate implementation. In such situations, it is suggested

that the problem is not accessed at once, but through a series of smaller improvement projects that can be achieved in iterations. That way client gradually adjusts to the necessary modifications, with less clutter in its structure (Scott & Barnes, 2011). On the other hand, this approach requires more time for final implementation, given the fact that restructuring takes place in several phases and that each of these partial solutions needs to be brought to life in order to move to the next step. Special attention should be paid to the relationship between these smaller projects and their coordination, in order to achieve full restructuring effects.

Generally, at the beginning consultants first suggest some simplification in the structure and create preconditions in the form of (Kubr, 2002):

- Removing organizational units that do not have good results or simply are no longer necessary;
- Experimenting with the structure, in order to find the right - the one that best fits into the situation and has the proper interaction with the environment;
- Choosing a new perspective to influence employees' attitudes and thinking about the situation that should be achieved;
- Aligning the efforts of employees and creating a friendly atmosphere that will produce mutual trust between the employees who need to deliver the transformation.

When determining the direction of organizational restructuring, consultants use a range of different methods and models in order to identify main causes for weaker results (Phillips, Trotter, & Phillips, 2015), if they have already appeared in the organization, or potential factors that could endanger those results in the future, if the company still has outputs that are on a satisfactory level. Special attention is paid to key activities, in an attempt to rationalize them in order to achieve maximum efficiency, while the auxiliary activities are reduced to a minimum, which is also rational if one takes into account that their function is to provide support to those that directly affect creation of product or services, and which actually generate revenues for the organization.

In general, organizational transformation is always a delicate and complex process. When companies consider option of hiring experts who can help in planning and implementing organizational changes, many factors should be taken into account. Consultants must assist the client organization by simultaneously taking care of (Kubr, 2002):

- Preparation for organizational transformation, and
- Identification and overcoming resistance to change.

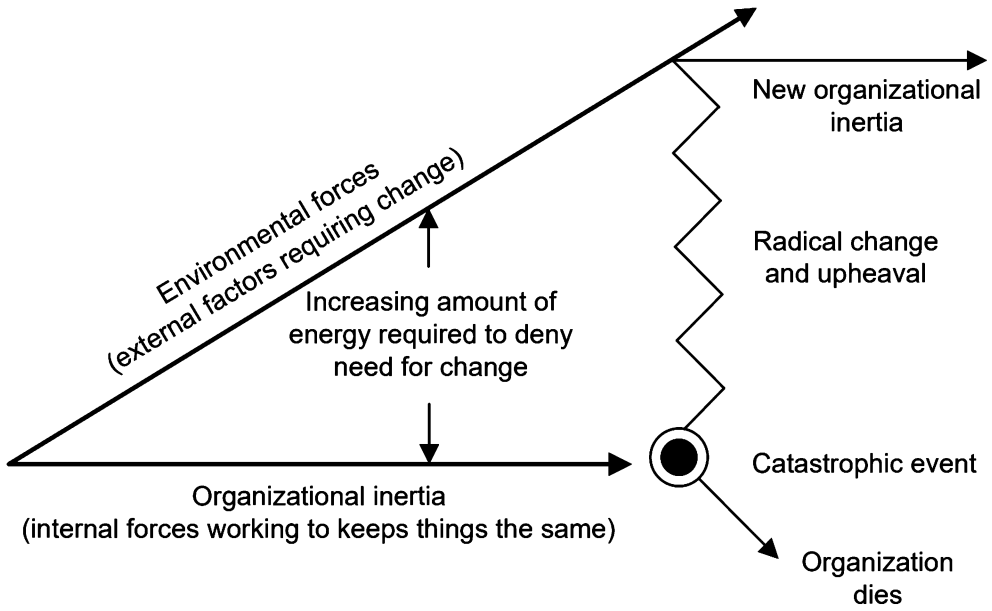

Figure 1: The change-resistant organization (Kubr, 2002)

When it comes to preparing an organization for this kind of project, then it is important to analyze its attitude toward change. There are organizations that are highly adaptable, where it is relatively easy to carry transformation processes, but practice shows that there are a far greater number of those who, for some reason, oppose these processes, so they significantly impede the implementation of organizational changes.

These inert organizations do not respond quickly enough to the external influences that endanger their results, and even when they decide to do something, it usually means that they will take some actions that helped and solved problems in the past. However, given the change of the context and environment in which the organization operates, it is very certain that this kind of reaction will not be of great help and will not allow the organization to adapt to the new situation. If management accepts this fact too late, the recovery of the organization and the return to the right path will become even more difficult because the difference between the required and the actual behaviour continues to increase, which means that more effort will be needed to reduce that gap. Consequently, at some point, catastrophic results will be achieved, and then it becomes clear that major changes are necessary in order to avoid the disaster for the organization.

Organizations that are sensitive to organizational change, on the other hand, are better in finding out when such encounters come from the environment. They constantly monitor the situation and continually make some incremental organizational changes in order to adapt to it (Cawsey, Deszca, & Ingols, 2012). This approach requires much greater attention and focus from top management, but at the same time provides better opportunities, given that these organizations have the chance to have a greater influence on changing the environment than the organizations that are inert or just reactive. However, the willingness of the organization to cope with these changes will depend on a number of factors, such as type of management, organizational culture, organizational flexibility, type of change to be implemented, stakeholder requirements, and so on. If management decides that it is better to opt for constant adaptation, it will also affect other elements of the organization.

3. OVERCOMING RESISTANCE OF EMPLOYEES

Resistance to organizational change manifests through the resistance of employees in the organization (Cummings & Worley, 2015). Research shows that people generally oppose changes because of uncertainty, since they are afraid for their future. Same situation is with organizational changes - employees fear that they will be left out of work, that their positions will be compromised, their wages will be reduced, they will lose their benefits, and so on (Harris & Gresch, 2010). This fact greatly hampers organizational transformation and puts management and consultants into a situation where it is necessary to create the conditions for a successful implementation of organizational changes. This is primarily related to the change of the awareness and attitudes so that employees realize that such changes will bring progress and that otherwise the existence will be questioned, and everyone will feel the negative consequences. There is also a paradox that lies in the fact that employees are more aware of the need for change when the situation becomes very critical, so that greater problems actually facilitate psychological preparation for the transformation itself.

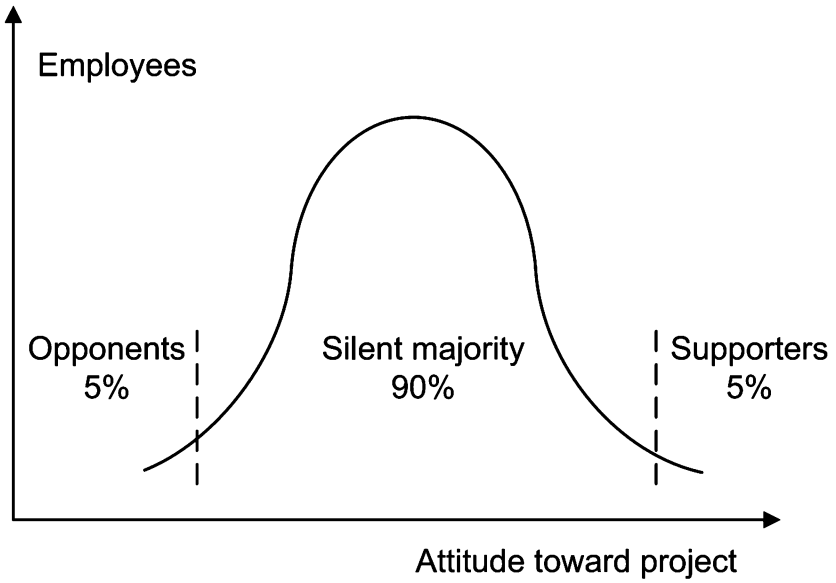

Figure 2: Employees' attitudes toward change (Dulanović & Jaško, 2005)

Employees are not easily convinced of why they should work differently, even if they really start doing it. It is crucial that they understand the need for it, not only to mechanically adopt new principles because of fear of punishment. Research shows that their willingness to change depends on the frequency of change, their involvement in planning these actions, as well as on the impacts and effects that these changes carry (Rafferty & Griffin, 2006).

In general, there are three factors that are considered to affect the behaviour change of employees, but only one of them essentially leads to the desired results. These factors are (Weiss, 2002):

- Power,
- Normative pressures, and
- Awareness of the satisfaction of one's own interests.

Management through the power of its authority can require certain behaviour in the workplace. If employees really act the way they are expected, then they can be rewarded, otherwise they may face a certain kind of punishment. Accordingly, they are trying to comply with the requirements, which can lead to the desired changes, but these are often short-term and do not encourage essential motivation. It should also be remembered that the punishment and elimination of those who oppose change can cause opposite effects and even greater problems in the organization (Lines, 2004).

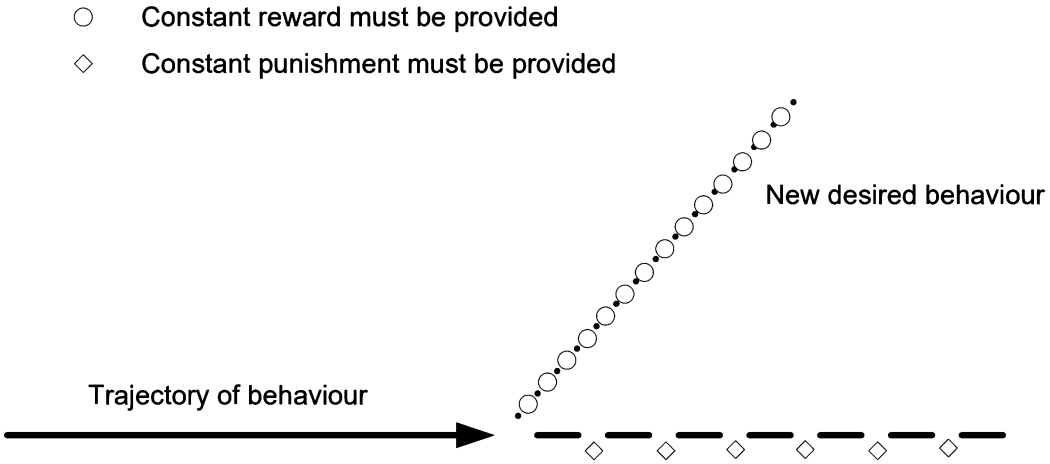

Figure 3: Impact of reward and punishment on behaviour (Weiss, 2002)

Similar, mainly short-term results are obtained by normative pressures. These pressures influence the psychology of employees, in an attempt to convince them that the targeted behaviour is actually accepted as the best approach for solving the problem, although in practice this does not have to be the case (Jaško, Čudanov, Jevtić, & Krivokapić, 2013). Employees comply with these pressures and act in accordance with them, but they are still not motivated to find something that will benefit them in this new behaviour. The awareness of satisfying one's own interests is in fact the only real trigger for change. Employees need to be familiar with the essence of these changes, and find something that will have a positive impact on them, so they will accept them and sometimes even affect other employees in order to make these changes easier to live.

Sometimes it happens that some key persons from the client organization disagree with the proposed solutions, which reduces the possibility that the other employees will behave in accordance with them. In these situations it is necessary for consultants to pay attention to the conditions that need to be met in order to implement those changes. First of all it involves (Weiss, 2002):

- *Identifying key people who can support the requirements* - they are mostly those who have a strong impact in an organization, respected by other employees, significant for the implementation itself or who have already had experience in similar situations in the past;
- *Prioritization* - with the help of management, it is necessary to recognize who are the most opposed to change, what are the reasons for such behaviour and how to act on them in order to accept changes, especially if these people have a strong influence on other employees;
- *Planning a specific approach that is tailored to each key person* - people will accept changes if they expect them to improve their situation, so presenting a change plan to each of key people who do not support them can be good solution, because it will be the way to explain the benefits that will be reflected in tackling specific problems they are facing;
- *Client involvement in decision making* - representatives of the client organization should certainly be involved in the work of the consultants in finding an adequate solution, and for later implementation it is especially good to provide them with open criticism and suggestions, as this creates confidence and conditions for the ultimate solution of a higher quality;
- *Setting and monitoring accountability* - defining specific responsibilities in both planning and implementing stages creates conditions for each involved party to focus better on its part of the work, thus making cooperation more successful.

However, changing behaviour and thinking is a very complex and difficult process. Research shows that the change in human thinking occurs through different phases (Chitale, Mohanty, & Dubey, 2012). In the first step, the key is the acceptance that in the organization things should be done differently than before, and this is the moment where it should be clear why management is insisting on it. In the next step this will affect the change of employee's attitudes on specific issues, because he will accept the change as something that is necessary for the survival and further development of the organization. (Un)Consciously, his behaviour becomes different; he begins to work in a new manner, as requested from him. Finally, when more employees reach this stage, then there will be changes in behaviour at organizational or group level, which increases the chances of successful organizational restructuring. Each of these phases requires a certain time investment, but is necessary in order to meet the goals that are set.

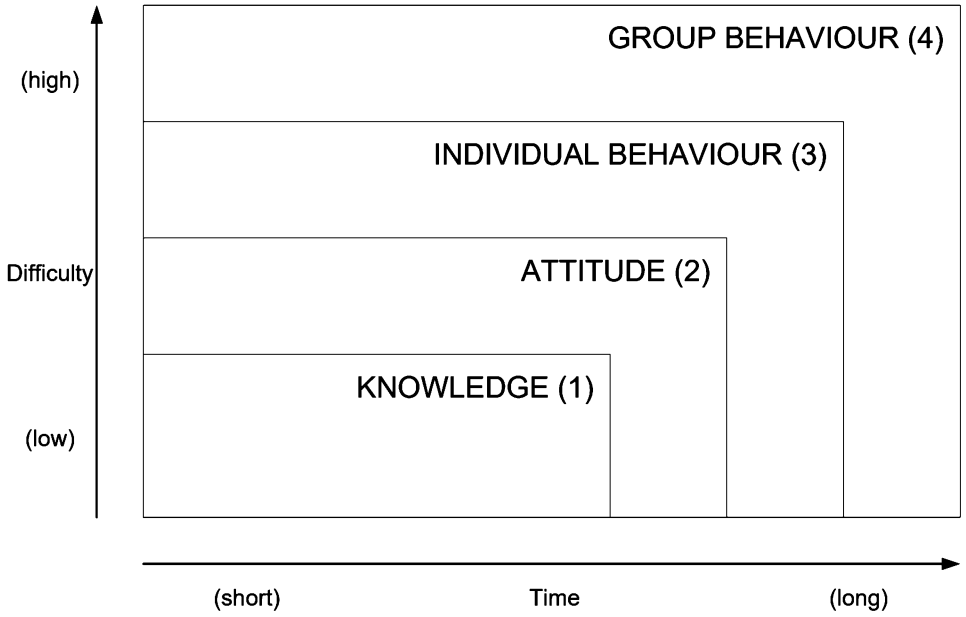

Figure 4: A model for creating planned change (Chitale, Mohanty, & Dubey, 2012)

In general, key barriers to organizational change are (Dulanović & Jaško, 2005):

- *Retirement schemes that support the old way of work* - employees are afraid to change their behaviour and ways of doing work if the salary systems are not designed so that they follow and reward those efforts appropriately;
- *Threats to the established balance of power* - in the organization at any moment there is an established hierarchy of authority and power, and organizational changes can impair this existing system, thereby exacerbating individuals or groups from the influence they had before, so they are firmly opposed to any kind of change;
- *Intra-bulk conflicts that hinder cooperation between employees* - given the degree of competition that exists between employees or between organizational units, which arises from personal goals or resource constraints that are necessary for carrying out activities, it is not uncommon for organizations to encounter conflicts that can significantly impede the implementation of organizational changes, especially if one takes into account that the successful implementation of such ventures requires the cooperation of all employees at all levels;
- *Incompatibility of changes with the existing organizational culture* - employees in the organization have a common, generally accepted set of values and beliefs that are difficult to change, and problems can arise when organizational changes bring something that is not in line with the existing organizational culture, and requires from them to behave according to other norms that differ considerably from those they are used to;
- *A large amount of financial resources needed for the implementation of changes* – it happens that none of the above-mentioned obstacles occurs - the need for change is obvious and the employees are aware and willing to carry the burden of organizational transformation, but that the organization does not have enough financial or other resources which are necessary for the implementation of these kind of ventures, so in such situations restructuring practically becomes impossible.

Employees often do not accept the inevitability of changes as long as the organization achieves results that are on a satisfactory level. Even when the results start to get worse, many of employees do not want to accept changes, especially if the measures that are taken at the very beginning affect them in some way.

There is also a group of people that is not affected with the decline of the results, because it does not concern their part of the job or they already have an alternative plan in the form of moving to another organization or starting their own business. However, if transformation is the only solution, employees must accept the necessity of organizational changes (Mitchell, 2015). In the long run, it can be the only real way out of the problems which the organization has. Experts believe that managers and consultants must work on it together with the employees, and it is recommended that they introduce the experiences of other organizations that have found themselves in similar situations.

4. CONCLUSION

Consulting has a very important role in designing and creating a new look for the organization. The impact of consulting is multiple and can be reflected in changing the organization's strategy, its structure, culture, relationships among employees, reward systems, processes and activities being implemented, personnel development, and so on. Depending on the specific focus of the consulting activity, it is possible to consider consulting at the level of the whole organization and consulting specialized in its particular field. Sometimes the needed focus is very obvious - if problems arise in a large number of processes and activities, then it is quite clear that it is necessary to make changes throughout the organization. However, the more common situation is that the symptoms are not so visible, so the diagnosis cannot be precise without looking at the wider picture, in order to determine what is bothering the organization in its attempts to achieve better business results.

Considering the character of the organization on the one hand, and the complexity of the environment and the interaction with it on the other, these rounds cannot be made without major organizational changes. In practice, such transformation is generally very difficult to implement (Ahlstrom & Bruton, 2010). The reasons are different, but are mostly related to the fear of what the future brings (Cummings & Worley, 2015), because it is not certain how the organization will perform in these new circumstances, with the aggravating fact that the employees usually resist change. If there are a number of factors that hinder business and generally have a negative impact on the business performance of the organization, then top management is in a very unfavourable situation because it is unable to determine where the organization actually is going and what the goals it aims for are. Strategic goals are brought into question, and then through the hierarchy they drop to the operational level, so the problems and uncertainties appear throughout the whole organization. Then it becomes clear that the help of the experts is necessary, because further development is threatened, and over time existence can be endangered.

In general, it is considered that organizational restructuring actually creates a framework for effectively running the process within the organization, as well as for the functioning of the entire organizational systems, but there are also rapid and major changes in this field that transform previously established structures into rigid entities that do not match new demands in the right way (Kubr, 2002). What makes this type of restructuring very delicate is the fact that it is impossible to find a model that will fit into any situation without any minor or greater adaptation, and it is imperative to set every new consultant task in the appropriate context and to perceive its specificities and key elements. The consultant's experience, however, is of great help, and serves to set the starting assumptions, and the recognition of symptoms and potential directions of action (Baaij, 2013), but it should in no way ignore the specificities of the organization itself and its environment, so even solutions that were once applied with successful results no longer guarantee a positive outcome, nor can be a pattern for success. For this reason, in the process of organizational restructuring consultants pay special attention to the situation analysis and try to identify the critical points so they can generate a model that will, as an output, have a solution that corresponds to the specific situation and lead to an improvement of the client organization's performance.

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AUTHENTIC LEADERSHIP: CONCEPTUALIZING AND DEVELOPMENT

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Abstract: *This article addresses authentic leadership and examines it's conceptualizing and development. Numerous data regarding leadership effectiveness can be found in literature and some of it single out authentic leadership as the most effective leadership approach of contemporary time. In modern time, changes occur due to digitalization and uprising of techniques, technologies and globalization. Effectiveness of a modern leader is reflected not only through developing and reaching goals, but also in having motivated followers. Individual must have knowledge regarding activities that he should undertake in order to become effective leader. This paper examines and sublimates rich theoretical approaches on authentic leadership into simple steps and proposes guide on becoming authentic leader, which can be used as a tool by a reader who wants to become effective authentic leaders. Reading this article will give individual an opportunity to nurture his authenticity and become an authentic leader by using tool and following simple steps.*

Keywords*: Leadership, Authenticity, Modern Leaders, Authentic Leadership Development, Leadership Effectiveness*

1. INTRODUCTION

The corporate world is changing more rapidly. Digitalization and uprising of techniques, technologies and globalization are calls for a renewed focus on what constitutes genuine leadership. The world economic crisis began in 2007 and it is still one of the current issues facing public, private, governmental and other organizations. Business environment has witnessed numerous cases of fraud and governance failures, especially over last few decades (Detert, Trevino, & Sweitzer, 2008; Sumanth & Hannah, 2014). In addition to that, constant changes of contextual factors are making negative influence to the business environment.

Numerous authors struggled to single out the most effective type of a leader of contemporary time and for some of them. This paper analyzes George's (2003, 2007) authentic leadership theory, expands on similar approaches and sublimates them contributing to leadership literature by offering readers guide on becoming authentic leader. As George (2003) stated, there is a need for leaders who lead with purpose, values, and integrity; leaders who build enduring organizations, motivate their employees to provide superior customer service, and create long-term value for shareholders. Leader should have established values, nurture and share them with subordinates. Some pools suggest that twenty percent of workers in United States of America share feeling that their senior managers do not live the values they espouse (Bates, 2002) and authors (Simons, 2002; Simons, Friedman, Liu, & McLean Parks, 2007) share opinion that inconsistency between espoused and enacted values has serious implications for organizations' viability and employees' health and well-being.

Avolio and Gardner (2005) suggested that such challenges have precipitated a renewed focus on restoring confidence, hope, and optimism; being able to rapidly bounce back from catastrophic events and display resiliency; helping people in their search for meaning and connection by fostering a new self-awareness; and genuinely relating to all stakeholders (associates, customers, suppliers, owners, and communities). Leader is observed as an individual who brings people together to pursue a shared purpose. In order to learn about effective authentic leadership, first we have to define leadership itself.

2. DEFINING LEADERSHIP

Leadership is a complex process that is difficult to characterize. In the years of studying leadership so far, numerous theoretical approaches to the complexity of the leadership process have arisen. Stogdill (1974) points out that there are as much leadership definitions as authors that tried to define those. Rost (1991) analyzed more than two hundred leadership definitions conducted in period 1900 to 1990. His work gave us insights of leadership approaches in that period and its development. A significant number of authors, such as Burns (1978), Jago (1982), Heller & Van Til (1983) and Hollander (1992) share opinion that leaders need followers and that followers need leaders. Analogously to that, leadership does not exist without leaders or followers. One of the first leadership scholars More (1927) considered leadership as ability of a leader to transfer his will to followers and encourage obedience, respect, loyalty and cooperation. Other authors in that time also define leadership as making followers act as leader wants. Follet (1924) determined leadership as a possibility to increase feeling of power existence rather than demonstrating power to followers.

Nowadays, leadership is observed through mutual relations of leader and followers. New concept is called group dynamics and it puts group members in focus. Tannenbaum & Schmidt (1973) in their research regarding directive leadership came to the evidence that there is a need for acknowledging motivation and interpersonal relationships. In years to come, Burns (1978) defined leadership as a process of mobilizing followers by an individual with certain motives and values, in context of competing and conflict and in order to achieve common or individual goals. One of the modern approaches to leadership that puts group and group members in focus is authentic leadership.

3. CONCEPTUALIZING OF AUTHENTIC LEADERSHIP

Until present days, there is no consensus reached regarding unique authentic leadership style. If there is only one approach to authentic leadership, that would not be authentic leadership because leadership would be all the same everywhere. Having different approaches to authentic leadership and being different as a leader makes authentic leadership truly authentic.

There is no unique definition of authentic leadership and Chan (2005) points out that there are several different approaches to this leadership style and its' models of development. According to different leadership scholars such as Bass (1990), Bass & Steidlmeier (1999), Burns (1978), Howell & Avolio (1993) authentic leadership was identified in transformational leadership research but never fully articulated and exploring of it continues today. Branson (2007) proposed authentic leaderhip development is more than just having explicit knowledge of values and acting of individual. Berkovich (2014) finds that authentic leadership development theory can be explained by functionalist discourse paradigm. Mabey (2013) introduces this paradigm and defined it through improving organizational performance through developing leadership capabilities. Some authors analyzed life story approach to authentic leadership. Accordingly, in work of Shamir and Eilam (2005) life stories have great role in development of authentic leaders as they reflect upon and attach meanings to their life events. Sparrowe (2005) found that process of life story telling is very convenient to authentic leadership development. Authentic leaders are unique, honest to themselves and their close friends and they do what they believe in. They have positive and negative characteristics. Although they make mistakes, by accepting their imperfections and admitting their mistakes, leaders connect to followers and empower them. There is no unique way of becoming authentic leader, but there are several segments of authentic leadership development: becoming self-aware, creating values and principles, finding motivation, building support team, making and having integrated life, as illustrated in Figure 1.

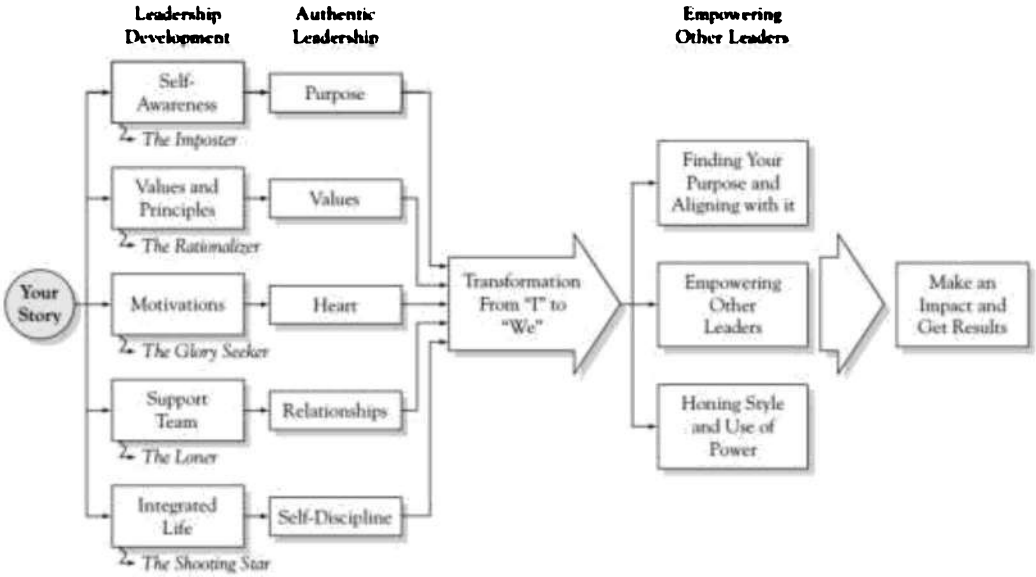

Figure 1: Getting to Results and Making an Impact
Source: George & Sims, 2007.

Additionally, Northouse (2016) outlines three perspectives of authentic leadership: intrapersonal, interpersonal and developmental. Intrapersonal perspective incorporates the leader's self-knowledge, self-regulation, and self-concept. Shamir and Eilam (2005) elucidate that leader is an original not copy. Eagly (2005) described interpersonal perspective as relational, created by leaders and followers together. Avolio analyzed authentic leadership through developmental perspective with several associates (Avolio & Gardner, 2005; Gardner, Avolio, & Walumbwa, 2005; Walumbwa, Avolio, Gardner, Wernsing, & Peterson, 2008). They conceptualized authentic leadership as a pattern of leader behavior that develops in people in time and can be triggered by major life events.

Authentic leaders inspire and empower followers to lead. George and Sims (2007) analyzed this approach to authentic leadership and proposed new definition of leadership: *The authentic leader brings people together around a shared purpose and empowers them to step up and lead authentically in order to create value for all stakeholders.* Having authentic leadership development segments in mind George (2007) stated there are five dimensions of authentic leadership: *pursuing purpose with passion, practicing solid values, leading with heart, establishing connected relationships and demonstrating self-discipline.*

3.1. Becoming self-aware

Self-awareness is defined as conscious knowledge of individual's own character, feelings, motives, and desires.

As individuals, we are complex human beings, constantly evolving and adapting to environment changes that makes knowing ourselves very difficult. George (2007) stated that it is very important for a leader to be self-aware because that would make him feel comfortable. There is possibility to get caught up in chasing external symbols of success if leader is not self-aware.

It is easier for individual to lead effectively when he develops consciousness about his needs, desires, values, strengths and weaknesses, vulnerabilities, motivation and other segments that makes him who he really is. If leader is being mindful about himself, he can develop a pattern of behavior. If behavior template exists, it is easier for a leader to lead because he knows how to act in a certain situation before it happened.

Being self-aware enables authentic leaders to analyze their life stories, passions, values and principles and to use that knowledge to make an impact or effect change. Acknowledging vulnerabilities and accepting weaknesses allows leaders to work and build on their strengths. Once leader has consciousness about himself, it enables him to correct his course direction when he founds that he is not on the right path.

3.2. Creating Values and Principles

Values present person's principles or standards of behavior; individual's judgment of what is important in life.

Maio, Olson, Bernard & Luke (2003) define values as *abstract ideals that function as important guiding principles*. For the purpose of this paper, values and principles are observed as guides for leadership. Although in different part of the world values are ordered and prioritized differently, there are researches on managerial behavior which strongly suggest that value categories for managers remain the same (Hofstede, 1991; Schwartz, 1992).

Getting to know what is important in a life for a leader, he can use that knowledge to guide his acts. George (2007) discussed that values are derived from individual's beliefs and convictions. There are different sets of values such as making an impact or a change, devoting life to family or helping someone. There is not one right set of values, because it is individual's judgment of what is important.

Leadership principles are values translated into action. Having mindful about values and what is important in his life allows leader to establish principles by which he intends to lead and share it with subordinates. Established principles should include role ethicality and role morality. Role morality is a term that has been discussed mostly in philosophy (Andre, 1991; Gibson, 2003), and it was defined by Applbaum (1999) as *claim[ing] a moral permission to harm others in ways that, if not for the role, would be wrong.* Radtke (2008) stated that this term has principally referred to entire professions and different to that term, role ethicality is organization specific. It is important do have in mind difference between role-based determination of ethicality and personal ethics that are based on individual's personal ethics. Gibson (2003) defined this difference as *genuine and useful moral distinction*.
Having clear understanding of ethical boundaries is very important for an authentic leader. These are limits of leader's actions that are based on his values. Ethical boundaries restricts leader of taking actions that are not based on his standards and values. Set of these boundaries help leader decide what actions to undertake in times of uncertainty or when he is under pressure.

Unethical behavior is frequently present in contemporary time and it is considered as violating norms of society for moral behavior (Appelbaum, Iaconi & Matousek, 2007). George (2007) argues that having ethical boundaries coordinated with moral compass, allows leader to let his leadership autopilot to take charge in less important activities. When leader is self-aware and have developed values and principles, he knows how he would react in certain situation before it happened and stakeholders do not see hesitance. This also allows him to be himself no matter if people he deals with at the moment are unethical. Current business environment could be corrupted but that will not make leader adapt to negative system. He will maintain to be true to himself and his values.

3.3. Finding Motivations

Motivation is defined as a general desire, need or want that generates the energy required for someone to behave in a particular way. Authentic leaders need to sustain motivated, it is very important to understand what motivates them. There are two types of motivations, extrinsic and intrinsic, as presented in Table 1.

Table 1. Extrinsic and Intrinsic Motivations (George, 2007)

Extrinsic Motivations	Intrinsic Motivations
• Monetary compensation	• Personal growth
• Having power	• Satisfaction of doing a good job
• Having a title	• Helping others develop
• Public recognition	• Finding meaning from efforts
• Social status	• Being true to one's beliefs
• Winning over others	• Making a difference in the world

Extrinsic motivations are measured by other people. This type of motivation takes the form of power, title, earnings, social status, fame and prestige. Intrinsic motivation represents own internal satisfaction or fulfillment and it refers to behavior that is driven by internal rewards. The key to developing as an authentic leader is balancing extrinsic with intrinsic motivations.

3.4. Building Support Team

Support team is defined as a solid network of trusted people who are available to counsel and care for an individual. This trusted network may include individual's spouse or partner, family members, best or close friends, mentors, or even a small personal group.

George (2007) highlights that having a close network of friends on whom they can call when in doubt or in need of help has proven to be extremely important for many authentic leaders. Life is full of unexpected turns and opportunities that can put leader in an unenviable situation. Having built support system that cares for leader and can hold him accountable to his values is important in order to leader stay on the right path. Christansen (2010) struggled to answer his own question - *How can I ensure that my relationship with my family proves to be an enduring source of happiness?* Answering this question is important because family members sometimes are not supporting leader enough or at all. Support team should provide leader with honest feedback, so in times of doubt and uncertainty, leader can rely on his trusted network, but also celebrate with them in times of success. George (2007) share opinion that strong support teams provide affirmation, advice, perspective, calls for course corrections when needed, and, above all, love. Without trustworthy relationships to provide perspective and call for course corrections, leader can be pressured by external forces to respond to their needs and seduced by rewards for fulfilling them and it is easy to go the astray. When leader has developed self-awareness and knows what his values are, role of support team is also to keep him grounded in reality and in course. It is very easy to lose right way without trusted network that provides perspective and guidance and the support leader needs as you venture on your leadership journey.

3.5. Making and Having Integrated Life

Having an integrated life means bringing together major elements of individual's personal life and professional life, including work, family, community and friends. Integrated life allows individual to be the same person in each environment.

Authentic leaders are their true selves at all time and in every environment. Making integrated life means bringing together all major events in leader's life, both personal and professional life. No matter if leader is surrounded by family, friends work colleagues or strangers, he is at all time the same person. Leader should first identify and prioritize personal goals including spending time with family or friends. It is equally important for a leader to find time for realization of scheduled tasks as well as prioritizing them. Harvard Business School literature (2006) provided a practical time-management methodology which consists of several steps:

1. Articulation of critical and enabling goals;
2. Prioritizing goals and breaking them into tasks;
3. Using daily log to understand how individual currently spends time and what are unimportant activities that crowd out the things that really matter to individual;
4. Scheduling priority tasks, leaving enough time open for unanticipated situations and opportunities.

George (2007) stated that authentic leaders are constantly aware of the importance of staying grounded. They need to stay grounded during the high points and not forgetting who they are during the low points.

4. EFFECTIVE AUTHENTIC LEADERSHIP

It is very important for authentic leader to find his locus of action because that gives him opportunity to perform effectively and enjoy doing that. As illustrated in Figure 2, there are three phases in developing authentic leadership effectiveness: preparing for leadership, leading and giving back.

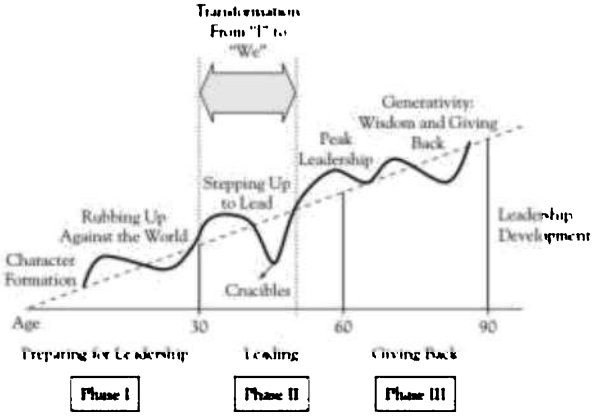

Figure 2. The Transformation from "I" to "We"
Source: George & Sims, 2007

Being self-aware, knowing what motivates him, understanding his strengths and weaknesses allows leader to discover his sweet spot. George (2007) first introduces sweet spot as a term and it represented the intersection of leader's motivations and his capabilities. Authentic leaders lead effectively if he achieves good results and have a great feeling doing that. The transformation from "I" to "We" is made and his subordinates are mentored, motivated and empowered to lead. Followers can be empowered by many different actions, from listening to them, helping and guiding them to engaging them, but also by simply showing up and supporting. At different times, different forms of empowerments should be used. It is important for a leader to use appropriate action depending on situation but also follower's characteristics. For authentic leaders is crucially important to hone his leadership style and make it as unique as possible.

5. CONCLUSION

Differences are what make authentic leadership truly unique and authentic. Developing leadership style by learning from own and someone's experiences and not copying is what makes an authentic leader. Therefore, the purpose of this study was to analyze George's authentic leadership approach, expand on research of other authors and to offer reader guide on becoming authentic leader with simple steps. In order to develop authentic leadership style, individual needs to go through all principal areas that were analyzed in this paper: gaining self-awareness; knowing and practicing your values and principles; knowing what drives him and balancing extrinsic and intrinsic motivations; building and maintaining support team; staying grounded by having integrated life; and understanding passions and purpose of his leadership.

Self-aware leader has developed consciousness about segments that makes him who he really is. Having developed values ensure guiding principles for leadership of an individual, that is important also for staying grounded. Another important segment of authentic leadership is having knowledge regarding what drives leader as a person, what are his intrinsic and extrinsic motivations. Because life is full of challenging situations that can be misleading, it is important for authentic leaders to have strong support system, network consisted of trustworthy and important persons in their life, such as family and close friends. Accordingly, leaders should integrate all stated segments into his life and lead authentically, because he is the same in every situation. Followers trust authentic leaders and that motivate them to achieve superior results. Having relation like this with subordinates empowers them to take control and lead.

All leaders work on optimizing their effectiveness in order to achieve superior results. Authentic leader are more effective because they achieve desired results, enjoy while leading and motivate and empower followers. Development of authentic leadership results in getting the best from leaders, their subordinates and organization. Success of authentic leaders is to be lead by their passion and to lead effectively doing what they enjoy doing. Achieving high levels of performance permanently, maintaining motivation of followers and empower them are the ultimate mark of authentic leaders.

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QUALITY AND BUSINESS EXCELLENCE 401

Ivana Mijatović, Biljana Tošić, Milan Jovanović
ACQUIRING THE KNOWLEDGE ABOUT STANDARDS IN THE DIGITAL ERA – CASE OF SMEs OPERATING IN SERBIA 402

Milan Dronjak
SMART STANDARDIZATION 408

Dragana Rošulj, Gordana Pejović
MODEL FOR APPLICATION OF THE BUSINESS CONTINUITY MANAGEMENT SYSTEM IN HIGHER EDUCATION INSTITUTIONS 414

Đorđe Lazić, Tamara Mitrović
INFLUENCE OF SOME ASPECTS OF DISTANCE LEARNING ON QUALITY OF STUDYING 422

Jovan Stokić, Aleksa Sekulović, Mladen Đurić
OVERVIEW AND FUTURE OF QUALITY MANAGEMENT CONCEPTS IN ADDITIONAL AIRLINE SERVICES IMPROVEMENT 430

Ana Čobrenović, Milica Rajković, Mladen Đurić
RISK MANAGEMENT INTEGRATION THROUGH ISO 9001:2015, ISO/IEC 27001:2013 AND ISO 22301:2012 STANDARD REQUIREMENTS 438

Dejan Hadži-Milosavljević, Jovan Filipović
THE SOFTWARE IMPLEMENTATION OF THE PROTECTION MEASURES OF INFORMATION IN THE BANKING INFORMATION SYSTEM 446

Gordana Pejović, Biljana Tošić, Jelena Ruso
BENCHMARKING AS THE QUALITY MANAGEMENT TOOL FOR THE EXCELLENCE ASSESSMENT OF MEDICINES REGULATORY AUTHORITIES IN EUROPE 456

Tamara Jakovljević
QUALITY OF LIFE AND DIGITAL TRANSFORMATION IN HEALTHCARE 463

Nedeljko Živković, Maja Glogovac, Ana Horvat
PUBLIC ADMINISTRATION QUALITY DETERMINED BY CUSTOMER-RELATED CAF MODEL 472

ACQUIRING THE KNOWLEDGE ABOUT STANDARDS IN THE DIGITAL ERA – CASE OF SMES OPERATING IN SERBIA

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Abstract: *In European Union only 0.2% and in Serbia only 0.6% of all enterprises are not Small and Medium Enterprises (SMEs). Improving capabilities of SMEs to be competitive in the global market in a knowledge economy is an important, specific and complex task. How can SMEs be helped to acquire needed information and knowledge? What sources of knowledge in the digital era are most suitable to SMEs? The aim of this paper is to explore main factors which affect SMEs' choice of a dominant source for acquiring information and the knowledge about standards. The questionnaire survey research method was used to seek the response from representatives of 130 SMEs operating in Serbia. Our findings indicate four sources – relevant Web sites, service of consultants, customers and business and other partners. The larger SMEs with the long tradition in business will have more chances to use Websites as the primary source for gaining knowledge about standards. Domestic SMEs shape their decisions to hire consultants services predominantly because of the negative perception of standards. The usage of customer inputs as the dominant source for gaining information and transfer of knowledge about standards are influenced by SMEs' experience in business (years) and negative perception of benefits of standards. In the digital era, SMEs still suffer from lack of resources or capabilities to use the WEB and the Internet for acquiring information and knowledge about standards.*

Keywords*: Standards, SMEs, Certification, Knowledge, Digital Era*

1. INTRODUCTION

In the European Union, 99.8% of all enterprises are SMEs and about 23 million SMEs provide around 75 million jobs accounting for 67% of total employment in a non-financial business sector (European Commission, 2018). According to the Annual Report on European SMEs (2017), SMEs are a major source of entrepreneurial skills, innovation, and employment. In Serbia, 99.4% of all enterprises are SMEs. SMEs in Serbia contribute a share of roughly 60% of employment and less than 50% of value added, compared with the respective EU averages of 67% and 57%. Micro-firms make a particularly small contribution, providing only 10% of value added, 11 percentage points lower than in the EU (SBA, 2016).

Capabilities of SMEs to be competitive on the global market in a knowledge economy are high in agendas of many actors – governments, international organizations, chambers of commerce, professional and industry associations. In emerging economies, the contribution of SMEs is to drive the development of a knowledge-based economy and on the other side, in developed countries, SMEs support is seen as crucial for the recovery after the global financial crisis (Massaro et al., 2016). However, SMEs are most vulnerable to – lack of information, knowledge, and incentive; skill shortages; limited market power; high dependence on partners; market behavior of competitors and information asymmetry affect them in many ways (La Rocca et al., 2011; Chong et al., 2016). Study of Chong et al. (2016), based on data collected from owners and managers of SMEs, showed that "external knowledge is believed to be an important need by the enterprises". In many cases, the ability of SMEs to acquire new knowledge is dominant prerequisite to develop and sustain competitive advantage.

The aim of this paper is to explore main factors which affect SMEs' choice of a dominant source for acquiring information and the knowledge about standards. In the digital era, it would be logical that the answer can be found on the Web and the Internet. However, information and knowledge about standards, standardization, and related activities might be quite specific. In the next part of this paper, the literature review is given in order to explain needs of SMEs for knowledge about standards, standardization, and certification. Part 3 is dedicated to research methodology (study design, data analysis, and study participants). At the part 4, results of research are given with the summary statistics for discriminant function analysis (DFA). In the part 5, and are given discussion and conclusion remarks.

2. LITERATURE REVIEW

According to the European Committee for Electrotechnical Standardization (CENELEC) (2018), a standard is "a document that sets out requirements for a specific item, material, component, system or service or describes, in detail, a particular method or procedure". A standard can be defined as "an agreed way of doing something" (BSI, 2018). Essentially, standards are base for the functioning of industries on global levels. Not only that standards facilitate the global economy, they are base for the global trade. Standards can help or hinder entrance on specific markets. One of the roles of standards on the global market is to lower an informational asymmetry – fact that producers have much more information than B2B customers and end-users. Standards are commonly accepted benchmarks that transmit information to customers and about a product's quality and safety characteristics (Nadvi, 2008).

Do you know what is common for DVD, Bluetooth and Wi-Fi? Generally nothing, except that the DVD Forum, the Bluetooth Special Interest Group and the Wi-Fi Alliance are standards development organizations (SDOs). The global economy is shaped, not only by power and competitiveness related to prices, "but increasingly by technological and organizational innovations that are codified in a series of global standards" (Coe and Hess, 2007). Standardization is booming discipline; many organizations develop standards – special agencies of the United Nations, formal standardization development organizations (e.g. ISO, IEC or ITU-T), professional associations (e.g. IEEE), industry associations (e.g. API) and companies. Standards can be very different in their nature. Some of them are generic and applicable to many organizations, no matter their size, area of business or other features. "Product standards include specific designs, technical characteristics, and attributes of a given product, as well as sector-specific technical standards and product safety standards. Such standards are of critical importance, especially to well functioning global production networks without which globally dispersed supply chains could not function" (Nadvi, 2008). Many standards for systems, processes or products define requirements that can be used as a base for certifications.

According to the International Organization for Standardization (ISO), certification is "the provision by an independent body of written assurance (a certificate) that the product, service or system in question meets specific requirements" (ISO, 2018). There are many specific types of certifications, some of them are provided by first parties (e.g. organizations provide objective evidence that can be used in quality assurance), others by second parties (e.g. B2B consumers), or by third parties (by neutral organizations) (Loconto and Busch, 2010). Nowadays, companies perceive certification as a mechanism to signal credibility, build a reputation and provide objective evidence to their B2B customers, partners or actors in the processes of public procurements. Study of Rillo & Mijatovic, (2016), based on data from 5632 small and large manufacturing and service firms of 26 Eastern European countries, shoved positive influence of quality certifications of quality management systems as well as that larger, more experienced companies and companies with good ICT capabilities are more likely to be certified. International certification is more important to the companies from developing countries and it is connected with "building of reputation" (Rillo & Mijatovic, 2016).

Li at al. (2018) argue about signaling effect of certification in innovative SMEs in China, finding many issues related to the strength of SMEs to provide certificates to signal to outside potential capital providers, reducing information asymmetry without increase of cost. In the specific economy of China, same authors underline the role of government as a provider of certification which can send a signal to outside capital providers, reduce information asymmetry and cut cost. Study of Heinz and Guldenberg (2010) concludes that modern technologies and management practices such as quality management and flexible production technologies allow SMEs to simultaneously reduce costs and differentiate products. In that way, SMEs can improve their competitiveness on the global market. Same study findings indicated that SMEs with an ambition to grow have higher growth and profitability which support claims that the attitudes and values of SMEs owners and managers impact development and performance.

One of the myths in standardization is that standards are applicable only to large companies, that implementation of standards can cause high expenses and that SMEs cannot benefit from standards (BSI, 2018). While SMEs may be underrepresented in standard writing groups and their interests may thus not be sufficiently taken into account (CEN/CENELEC, 2018), SMEs can definitely benefit from standardization itself. Standards can help them reduce costs, improve their innovative capacity and enhance their competitiveness (European Commission, 2018). That is why it is important to explore the interests of SMEs as potential users of standards. "Through addressing their needs, the use of standards may be significantly increased. Furthermore, if standards take more account of the SMEs perspective, considerable benefits would accrue to all stakeholders in standardization" (European Commission, 2018).

European non-profit association Small Business Standards (SBS) was established to – represent and defend SMEs interests in standardization at the EU and international level; raise SMEs awareness of the benefits of

standards and get more SMEs involved in the standardization process (European Commission, 2018). The SBS is collaborating with all the European organizations for standardization, such as CEN, CENELEC, and ETSI, national standardization bodies as well as the ISO. Amongst one of its main activities, SBS is committed to "raise the awareness of SMEs interests within the European Standardization System through its cooperation with standardization stakeholders and its representation in committees, working groups and task forces related to standardization" (SBS, 2018). This way, SMEs are "given a voice in the standardization process and are given the opportunity to actively shape the outcome of standards" (SBS, 2018).

Based on experience of South Korea, study of Choung et al. (2011) revealed that transition to the technological frontier is increasingly related to standardization; latecomer countries improve their technological capabilities from mature towards new technologies; and successful technological catch-up is related to abilities of companies to take part in global (ICT) standardization – "... slow progress can be expected, but once a minimum level of capabilities is achieved, a nation pro-active in standards from the beginning may attain higher rates of catch-up near the technology frontier." Knowledge about standardization is important because of the role of standards and standardization in global and knowledge economy –, especially for less developed countries.

The ability of SMEs to acquire new knowledge is dominant prerequisite to develop and sustain competitive advantage. Based on our literature review we found that an information and a knowledge about standards as a base for certification is an important asset of the SMEs, especially in developing countries. In this study, we would like to explore dominant sources for acquiring knowledge about standards. Our research questions are:

RQ 1: What are the main predictors of the usage of the relevant Web sites as a dominant source for information and knowledge about standards in the case of SMEs operating in Serbia?

RQ 2: What are the main predictors of the usage of the services of consultants as a dominant source for information and knowledge about standards in the case of SMEs operating in Serbia?

RQ 3: What are the main predictors of the consumers as a dominant source for information and knowledge about standards in the case of SMEs operating in Serbia?

RQ 4: What are the main predictors of partners and others as a dominant source for information and knowledge about standards in the case of SMEs operating in Serbia?

3. RESEARCH METHODOLOGY

3.1. Study Design

In order to find answers for our research questions, a questionnaire survey research method was used to seek a response from representatives from SMEs which operate in Serbia. We used several sources for reaching representatives of SMEs – database of companies of the Chamber of Commerce of Republic of Serbia (publicly available contact and basic information on the website of Chamber of Commerce), LinkedIn profiles of companies and direct e-mail contacts. In order to receive as many as possible responds, we created relatively short and compact questionnaire, taking into account recommendation for defining a questionnaire and a survey design of Czaja and Blair (2005). In order to find out what influence choice of SMEs operating in Serbia, to use predominantly one source for seeking the information and the knowledge about standards, examinees are asked to choose only one dominant source for gaining knowledge. We observed four sources – relevant Web sites, service of consultants, customers and business and other partners (dependent variables, coded as dummy use=1 and no use=0).

3.2. Data Analysis

For the data analysis and answering our RQs we used descriptive statistics and we conducted a two-group Discriminant Function Analysis (DFA) based on the Wilks' lambda. Interpretation of the DFA is based on discriminant loading because it is less affected by multi co-linearity and more suitable for interpretation in explorative research (Hair et al., 2009). According to the same author, discriminate loadings above ±0.40 should be used to identify substantive discriminant (independent) variables even when they are not included in DFA analysis. The Canonical Correlation (CC) coefficient is used to define the percentage of variance in the dependent variable explained by the mutual influence of independent variables. Based on the study of Harlow (2005), the substantial value of canonical correlation is 0.30 or higher, for example, the value of 0.30 corresponding to about 10% of the variance explained.

3.3. Study Participants

Questionnaires were sent via LinkedIn and E-mail to 540 companies and we received 143 responds (26.5%), 13 questionnaires being invalid for the reason of not being SMEs or incomplete data and a total of 130 or 24 % questionnaires have been taken into account. Characteristics of the responding companies are presented in Table 1.

Table 1. Characteristics of Responding SMEs

	Total		Ownership				Ownership2			
	Number	%	Public		Private		Foreign		Domestic	
			Number	%	Number	%	Number	%	Number	%
	130	100	10	7.7	120	92.3	30	23.1	100	76.9
Industry										
Manufacturing	31	23.8	2	6.5	29	93.5	10	32.3	21	67.7
Service	72	55.4	8	11.1	64	88.9	18	25	54	75
Trade	22	16.9	0	0	22	100	1	4.5	21	95.5
Other	5	3.8	0	0	5	100	1	20	4	80
Number of employees										
0-10	49	37.7	1	2	48	90	1	2	48	98
11-50	41	31.5	1	2.4	40	97.6	9	22	32	78
50-250	40	30.8	8	20	32	80	20	50	20	50
Experience in certification of processes or products										
Experience in certification with process and products	42	32.3	6	14.3	36	85.7	14	33.3	28	66.7
Experience in certification with process or products	27	20.8	1	3.7	26	96.3	6	22.2	21	77.8
No experience	61	46.9	3	4.9	58	95.1	10	16.4	51	51

4. RESULTS

4.1. Reliability Analysis

In order to analyze the reliability of the used items, we used reliability coefficient of Cronbach's alpha. According to Hair et al. (2009), the lower limit for Cronbach's alpha is 0.70, although it may also be decreased to 0.60 in exploratory research. The reliability analysis showed an adequate consistency of the entire scale, wherein it is possible to form a summated scale for: 1) perceived benefits from certification (α = 0.807) and 2) perceived reputation benefits of application of standards (α = 0.738).

4.2. RQ 1: WHAT ARE THE MAIN PREDICTORS OF THE USAGE RELEVANT WEBSITES AS A DOMINANT SOURCE FOR INFORMATION AND KNOWLEDGE ABOUT STANDARDS IN THE CASE OF SMES OPERATING IN SERBIA?

The dominant variable that influences usage of Web sites at observed SMEs, as the dominant source for gaining information and transfer of knowledge about standards, is the number of employees (Table 2). Only variable x2: Experience in business (years) have discriminant loadings higher than 0.4 (0.43) and can be discussed in this results. The larger SMEs with the long tradition in business will have more chances to use Websites as the primary source for gaining knowledge about standards. Values of squared canonical correlations suggested that influence of the number of employees is positive and significant, but it corresponded only about 4% to variation between SMEs that use Web sites and SMEs that do not use Web Sites as the dominant source of knowledge about standards.

Table 2. Summary Statistics for Discriminant Function Analysis

Dependent variable	Wilks' Lambda	p	Discriminant loadings (structure correlations)									Canonical correlation
			X1	X2	X3	X4	X5	X6	X7	X8	X9	
Websites	0.967	0.04	**1.00**	**0.43**	0.28	0.11	0.12	-0.38	-0.27	0.23	0.09	0.18
Consultants	0.909	0.02	-0.34	-0.06	-0.195	**-0.516**	**-0.70**	**0.71**	-0.07	-0.21	0.19	0.34
Customers	0.924	0.01	0.19	**0.70**	0.101	**-0.440**	**-0.623**	0.04	-0.30	-0.11	-0.02	0.28

Legend: x1 – Number of employees; x2 – Experience in business (years); x3 – Experience with certification of processes or products; x4 – Perceived benefits from certifications; x5 – Perceived benefits from standards;

x6 – Domestic or foreign ownership; x7 – Public or private ownership; x8 – Industry (manufacturing or service and others) and x9 – Connections with other smes in same industry.

4.3. RQ 2: What are the main predictors of the usage of services of consultants as a dominant source for information and knowledge about standards in the case of SMEs operating in Serbia?

Variables that have a statistically significant influence on the usage of consultants' services as a dominant source for gaining information and transfer of knowledge about standards are the negative perception of standard and domestic ownership (Table 2). The variables that have discriminant loadings higher than 0.4, but are not included in function, are the negative perception of benefits of certifications perceived benefits from certification. Those results suggest that domestic SMEs shape their decisions on hire consultants services predominantly because of the negative perception of standards and standardization. Values of squared canonical correlations suggested that influence of the negative perception of benefits from standards and domestic ownership is significant, but it corresponded only about 12 % to variation between SMEs that hire consultants and SMEs that do not use services of consultants for the purpose of gaining knowledge about standards.

4.4. RQ 3: What are the main predictors of the consumers as a dominant source for information and knowledge about standards in the case of SMEs operating in Serbia?

Variables that have a statistically significant influence on the usage of customer inputs as the dominant source for gaining information and transfer of knowledge about standards are: experience in business (years) and negative perception of benefits of standards (Table 2). The negative perception of certifications has discriminant loadings higher than 0.4 (-0.44). Those results suggest that domestic SMEs are pressured by their B2B customers, trough requirements for standards adoption and second part certifications but SMEs have the negative perception of standards and certification. Values of squared canonical correlations suggested that influence of experience in business, negative perception of benefits from standards and domestic ownership are significant, but it corresponded only about 9 % to variation between SMEs that see customers and SMEs that do not see customers as the dominant source for gaining information and knowledge about standards.

4.5. RQ 4: What are the main predictors of partners and others as a dominant source for information and knowledge about standards in the case of SMEs operating in Serbia?

Our data analysis failed to find any statistically significant influence of observed dependent variables on the choice of observed SMEs to have business partners and other partners as the dominant source for information and gaining knowledge about standards.

5. DISCUSSION AND CONCLUSION

More than ever before, global and regional initiatives for education about standardization are intensive and actual. The Joint Initiative on Standardization under the Single Market Strategy of European Commission, which started at June 13th, 2016, gives high priority on education about standardization (Action 3) and position of SMEs in standardization in supporting European competitiveness in the global market. The International Cooperation on Education about Standardization (ICES) together with ISO, IEC and ITU organize back to back events for exchanging experience related to education about standardization. University Jiliang from China initiated the establishment of The Universities and Academics Alliance for Standardization Education and membership were accepted globally.

The main intention of this article was to explore key factors which affect SMEs' choice of a dominant source for acquiring the information and the knowledge about standards. In the digital era, SMEs still suffer from lack of resources or capabilities to use the WEB and the Internet for acquiring information and knowledge about standards. Our results showed that observed SMEs operating in Serbia use Websites as the main source for acquiring information and knowledge only if they are larger (medium) and more experienced. In the broader sense, our results agree with findings of the study of Neirotti et al. (2018) that adoption of Information and Communication Technology (ICT) in SMEs “has some peculiarities that may depend on the combined effect of size and competitive environment” and that ICT-based capabilities are more diffused among larger SMEs.

Our results showed that domestic SMEs, due negative perception about standards, use services of consultants for the purpose of gaining knowledge about standards. Two problems that have roots in the

negative perception of standards are already visible in practice – the inability of domestic SMEs for successful technological catch-up and lowering quality and effects of consultants' work. The best consultants cannot help SMEs with negative quality culture and cannot do anything if owners and/or managers have negative perceptions towards standards. Consumers, predominantly B2B consumers, are: choice of a dominant source for acquiring information and the knowledge about standards of experienced SMEs' and negative perception of benefits of standards. Those results might be influenced by requirements of B2B buyers or consumers, who require from their suppliers to fulfill requirements of specific company standards.

Richard Stallman's, scientist and one of the pioneers of free software movement said: "Sharing is good, and with digital technology, sharing is easy" (note 1). However, our research results suggest that more attention should be paid to improve capabilities of SMEs for more active use of digital technologies in order to acquire the knowledge about standards, standardization, and related activities. On the other side, the task of many actors: governments, universities, organizations for standardization, consultants and others is to explore why domestic SMEs are missing a chance to benefit from the implementation of standards due to their lack of abilities to use technology-enhanced learning in the digital era.

NOTE

[1] The quote was retrieved 12.3.2018. from: https://www.brainyquote.com/quotes/richard_stallman_473487
More about Richard Stallman's work and activism can be found at the www.stallman.org.

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SMART STANDARDIZATION

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Abstract:*The third industrial revolution is behind us. We are on the doorstep of a new technological revolution whose key elements are Cyber-Physical Systems and the Internet of Things, and this revolution is known as the Fourth Industrial Revolution. This study was conducted using the methods of analysis and synthesis, in order to explore the meaning of smart standardization and to review its place and role related to the Industrie 4.0. The research was done using relevant academic and scientific books and papers during a four-month period of time. The results of this paper suggest that the smart standardization, at this moment, poses the highest level of social awareness related to the importance of technical integration. The role of standardization supporting the emergence of Industrie 4.0 is discussed. It was concluded that the standardization is ubiquitous and has very important place in the development of Industrie 4.0 model and associated technologies.*

Keywords*:Smart standardization, Fourth Industrial Revolution, Smart Factory, CPS, IoT*

1. INTRODUCTION

We are living in a very dynamic environment. The world around us is evolving very fast, the production of data and information is so high so we are not aware of changes in many cases. One of things that are happening right now is something that many people call the fourth industrial revolution (Industrie 4.0). Steam power was the main characteristics of The First industrial revolution. The Second was related to electric power. The Third was digital revolution and this Fourth is continuation of previous revolution and comprises of many advanced technologies, mainly focused on the Internet (Hatzakis, 2016, p.1). Now, we have Cyber-Physical Systems (CPS) that represent some kind of smart systems. In the world of CPS, standardization is a must and it should be smart.

The objective of the current study was to explore the meaning of the term “smart standardization” and to see its impact in the modern world that is distinguished by the Fourth industrial revolution. This paper is divided into 5 logical blocks. The first part is the Introduction which announces the topic. The second part introduces terms “smart” and “smart standardization” and it also presents related standardization efforts. Nowadays, term “smart” is used for many things from our daily life. Probably, the first association is smartphones but there are also Smart Cities, Smart Farming, Smart Grids or Smart Factories. In this paper focus is on Smart Factory concept which is described with emphasize on the Internet of Things (IoT), as a base, and this is presented in the third part of the paper. The importance of integration of CPS and IoT in Smart Factory concept as well as the ways for achieving high flexibility and efficiency are very important. The main sections of smart factory are listed, while self-awareness and self-comparison of machines are underlined. IoT technology is explained and the growth of connected things is noticed. Additionally, current reality with dominant concept of digital factory is presented. The importance of standardization is accentuated. Architecture Model for Industry 4.0 (named: RAMI 4.0) is shown as the most important reference standard for Industrie 4.0. Finally, there are discussion and conclusion sections, respectively.

2. SMART STANDARDIZATION

The term “smart“has a very broad use, and if we look at dictionary, there can be found about its formal and informal meaning. In formal way, it is some fashionable and upmarket place or some clean, tidy, and well-dressed person or rather bright object and fresh in appearance. In informal meaning, we are speaking about something that has or shows a quick-witted intelligence. If we have a device in our mind, it must be programmed so as to be capable of some independent action (Smart, 2018).

If we look at standardization, NATO defines “smart standardization“as a voluntarily creation of standards, their institutionalization in a Standardization Agreement (STANAG) and making them a habit (Cihangir, 2014, p.1). And, if we try to google the Internet for any formal definition, it will not be found.

Bearing this in mind, we can look at the world of standards. Very often, we can find something „smart”. A good example is ISO 37100 series of standards, which helps communities, including cities to define their sustainability objectives and put strategies in place to achieve them. Behind this series of standards, we can recognize Smart city concept. There are also other standards related to this Smart city concept, as ISO

17742:2015 (Energy efficiency and savings calculation for countries, regions and cities), ISO 39001:2012 (Road traffic safety management systems - Requirements with guidance for use), ISO 24510:2007 (Activities relating to drinking water and wastewater services, Guidelines), ISO/IEC 30182:2017 (Smart city concept model - Guidance for establishing a model for data interoperability) etc. In the last-mentioned standard, it can be found the definition of a smart city as „ an effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its citizens". This ISO/IEC standard referenced a term from the BSI PAS 180 which provides common language about Smart cities in the United Kingdom (BSI, 2014).

Not only cities can be smart, but also farming can be smart. Recently renewed standard for serial data control and communications networks in forestry or agriculture, ISO 11783-1:2017, provides open system interconnect (OSI) for electronic systems in this industry (ISO, 2017). In ISO Focus, it can be found that the AGCO Corporation, American agricultural equipment manufacturer, participates in the development of ISO standards because of their importance to overall company strategy (ISO Focus, 2017, p.9). More specifically, AGCO uses ISO 11783 to connect devices and to exchange data between tractors. As we can suppose, Smart farming concept is behind.

In the energy domain, one of the most often used words is the term Smart Grid. In this case, we have international standard ISO/IEC 30101:2014 which characterizes the requirements for sensor networks to support "smart grid technologies for power generation, distribution, networks, energy storage, load efficiency, control and communications, and associated environmental challenges" (ISO, 2014). As we can see, smart concept is behind, again. Smart Grid can be interpreted as a complex system that is capable to operate at different operation modes, ranging from sensing and actuation to command and control (ISO, 2014).

Nowadays, much more attention is paid to the Smart manufacturing, which is process that is capable to use advanced information and manufacturing technologies in order to improve manufacturing efficiency, enabling at the same time flexibility of physical processes. Smart manufacturing is seen as the next Industrial Revolution or Industry 4.0 (Trade Magazine, 2018). Behind this we can also see the Smart Factory concept. For those who work in this area, it is well known ISO 10303 standard for the computer-interpretable representation and exchange of product manufacturing information or IEC TS 62832 for Digital Factories. We can go even further, and find Smart infrastructure concept, Smart energy concept, Smart transportation concept etc.

3. SMART FACTORY CONCEPT

Presently, one of the most demanding projects is the Factory of the future (known as Smart Factory concept), which is also described in IEC White Paper. There are many local initiatives directed towards creating Smart Factory: Advanced manufacturing (in USA), e-Factory (in Japan), Industrie 4.0 (in Germany) and Intelligent manufacturing (in China). Behind those concepts there is the Smart Manufacturing Leadership Coalition (SMLC) or the Industrial Internet Consortium (IIC) in USA, and industrial associations including VDMA, Bitkom and Zvei in Germany, for example (IEC, 2015, p.25).

It is important to emphasize that there is no unique definition of the term named Smart Factory. This term is used both by specialists from the industry and academic writers (Radziwon&Bilberg, 2014, p.1185). Probably, the optimal definition of Smart Factory for the purpose of this study is that it is as a Factory that "context-aware assists people and machines in execution of their tasks". In the backward definition, "context-aware" means that the systems running in background (so-called "Calm-systems" and "context-aware applications") can access to context information (position or status, for example) during processing of tasks (Lucke et al., 2008, p.116). Calm systems, previously mentioned, are the hardware of a Smart Factory with ability to communicate and interact with its environment.

In Smart Factory concept, it is possible to collect, distribute and access to manufacturing relevant information anytime and anywhere. Horizontal and vertical integration of information systems, the assignment of material and flow of information within an enterprise is condicio sine qua non for this concept. If we take Industrie 4.0 as example, it includes horizontal integration, through value networks, of data flow among partners, suppliers and customers, and also vertical integration within organization (from development to final product) (Hozdic, 2015, p.29). The vertical integration is referring to Cyber-Physical Systems (CPS) or Internet of Things (IoT). By this type of integration of hierarchical subsystems, it is possible to form flexible and reconfigurable manufacturing system inside a factory. There is an another integration. It is engineering integration from one end to another, which extends through the entire value chain in order to support product customization (Wang et al., 2016).

On the other hand, in the process the Smart Factory concept implementation, smart objects should be combined with big data analytics. Those objects can be reconfigured dynamically in order to achieve high flexibility. Achieving high efficiency via global feedback and coordination can be provided by big data analytics (Wang et al., 2016, p.159). This leads to the profitable and efficient production of products that are tailored to the user needs and in small lots.

There is only one responsibility of the Smart Factory during production of finished products, and that is to process raw materials and semi-finished products. The Smart Factory, as well as any other real today's factory, consists of many subsystems which can be either physical or informational. In today's factories, disruption of the information flow can occur for a variety of reasons. Therefore, it is very difficult to provide the continuity and consistency in those factories. At the same time, there is a flexibility problem of material flow because of reasons related to the fixed production lines (Wang et al., 2016).

Overall framework of smart factories can be divided into three major sections: components, machines and production systems. Smart machines use real-time data from their own components and other machines which brings self-awareness and self-comparison. This enables machines to assess their own performance in order to prevent potential failure and to adjust their settings and performance properly through the knowledge they gained from their working history (Lee, 2015, p.231).

3.1. Internet of Things (IoT)

Some individual authors believe the Internet of Things, wireless sensor networks (WSN), big data, cloud computing, embedded systems, and mobile Internet will be emerging technologies (Wang et al., 2016, p.159) that will make the backbone of the Smart Factory. Currently, IoT turned out to be more powerful.

The Internet of Things can be interpreted as the interconnection of things in real time in purpose of sense and report. According to definition of International Telecommunications Union (ITU), IoT is a "global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies" (ITU-T, 2012, p.1). IoT is also one of the core technologies for the *5G* network 5G communications.

Every sensor in a factory and also every actuator is a participant in the IoT. All of them have IP address and are networked. In order to achieve Smart Factory concept, it is needed to develop and make available standardized connectors and connection protocols and allow exchange of information between device and connector without loss (IEC, 2015, p.48).

In ISO FOCUS (2016), it can be found estimation (p.8) from Technology consulting firm Gartner, Inc. that 6.4 billion connected things will be in use worldwide by end of 2016, which is 30% growth in one year. And they expect nearly 21 billion things by the year 2020, which is growth by more than three times. This consulting firm announced a prediction that, by the end of 2020, some elements of IoT will be applied in more than 50% of major new business processes and systems.

3.2. Integrate digital factory and Smart Factory

In order to make shorter and to improve planning (both product and production), the idea of the Digital Factory came up. When someone mention the Digital Factory term, it means that he implies general digital support of planning following the process chain from product development over process and product planning to production by using virtual working techniques. Based on this definition, it can be made a conclusion that the whole process of developing a product that is new has to be completely simulated prior to realization (this includes also a production equipment that is associated with that product). To sum up, term digital factory encompasses simulation of all activities (research, development and also production) which are conducting physically in the factory (Arndt, 2004, p.27).

The Digital factory is more than pure usage of simulation tools. It has impact on the organization of the factory and all activities in the factory have to be standardized (i.e. impact is on the whole workflow). At every step, data outcome of the workflow should be specified and then saved in a central database (of the whole factory). If it is determined by the process of simulation that the production will meet a given requirements (quality and time schedule), then it can be started with development and production (Arndt, 2006, p.28).

The Digital factory is the model of a real factory, and in the smart factory, this digital factory developed during engineering should be integrated with the real time data and inferred statistics and information of the smart factory. So, an important issue here is integration. Data should be received to the IoT platform of smart factory from IT applications of digital factory, with providing feedback.

3.3. Standardization activities in area of Smart Factory

Many standards development organizations (SDOs) such as the Institute of Electrical and Electronics Engineers (IEEE), the International Electrotechnical Commission (IEC), the International organization for Standardization (ISO), and the International Telecommunication Union (ITU) are working towards developing the Smart Factory standards. Also, some consortiums are working together with SDOs to promote standard technologies for the Smart factories. This standardization process will achieve interoperability, enabling information exchanged and understanding between different components of the Smart Factory.

If we want success of any industrial solution, we must keep cost and deployment effort low and guarantee high availability and durability during their lifetime. All of that is successfully possible only when those solutions are based on vendor independent open standards (Zuehlke, 2010, pp. 130-131).

It can be found in a significant number of sources that some authors suggest that IoT (Muhonen et al., 2015) is the most important technology concerning Smart factories, and it can be said that standards play important role in developing IoT. They allow all players to access IoT equivalently and to use it. The IoT standardization can include plenty of different standards, such as architecture standards, application requirements standards, communication protocol standards, information processing standards, data standards, identifications standards, security standards and public safety standards, and it is the reason of standardization's complexity. It is very important to have common standards in building a successful IoT system. Diverse standards and technical solutions will significantly slow down the development of IoT. The most relevant organizations related to IoT and industrial Internet are: ETSI, ISO, IEC and ITU. Also, there are some number of unofficial alliances and forums that play very important role (GS1/EPC Global, AllSeen Alliance, HART Communication Foundation etc) (Muhonen et al., 2015).

However, reliability and safety of these technologies under industrial environment should be certified in order to persuade users to forget existing control cables by future wireless connections (Zuehlke, 2010, p. 131).

In addition to devices' hardware, software and communication standards, design standards are also needed (Zuehlke, 2010, pp. 130-131). They enable achieving a seamless planning, design and operation environment.

There is no general, worldwide standardized model of the Smart Factory, but it exists for example a reference model that was developed by German Association of Electrical and Electronic Manufacturers. It is named the "Reference Architecture Model for Industry 4.0" (RAMI 4.0), and is considered as a key standard for Industrie 4.0.

RAMI 4.0 is a three-dimensional layer model that contains the most important aspects of Industrie 4.0, and its axis are: Hierarchy levels, Process (value stream process) and Architecture (FMEAE, 2016). The "Hierarchy Levels" axis are hierarchy levels from IEC 62264 series of standards (this series of standards describes enterprise IT and control systems) and IEC 61512 standard (which address batch process control). The "Life Cycle & Value Stream" axis represent the life cycle of facilities and products, based on IEC 62890 for life-cycle management for systems and product used in industrial-process measurement, control and automation. Architecture Axis consists of 6 layers. Those layers are: Asset, Integration, Communication, Information, Functional and Business (Amman Zaheer, 2017).

4. DISCUSSION

Today, the world is changing so fast. The appearance of IoT and many other new technologies has influenced not only the development of mobile communications, but also the industry. And, standards are the fundamental component of the evolution to smart systems. Term "smart", here, have informal meaning, i.e. it is something that has or shows a quick-witted intelligence. There are many examples of smart systems where standards play key role. We can talk about Smart cities, Smart farming, Smart Grids or Smart factories. Regardless of which smart system is considered, the influence of many international and national standardization organizations can be seen, as well as of the number of unofficial alliances and forums. Determining the real impact and the scope of standardization in those smart systems it can raise the awareness about the role of standardization.

The International Electrotechnical Commission pay particular attention to the Factory of the future, and worldwide many local initiatives support that idea. One of them, Industrie 4.0, which is in the focus of this study, is launched by German industrial associations encompassing VDMA, Bitkom and Zvei. As the key elements of these factory are identified (Monostori et al., 2016, pp. 621-641) cyber-physical systems (they are considering to be one of the largest advances in technology) and IoT, which is in accordance with literature. In order to ensure communication and control of cyber-physical systems it is needed to make a

standards based on an international consensus taking into consideration existing standards (national and regional) for industrial automation.

Furthermore, Gartner, Inc. is assured that, by the end of 2020, some elements of IoT will be applied in more than 50% of significant new business processes and systems. If it is achieved even only part of this prediction, it can be understood that without integration standards, as soon as possible, there will be a big variety of different protocols and impossible mission to integrate those systems.

However, the reality has to be considered as well. In this case of the Smart factory concept, that is the digital factory as a model of the real factory. Existing machines and equipment cannot be simply thrown away, forgotten, or a new factory cannot easily be built. That would be a very expensive investment that would not pay off at all. Therefore, the digital factory should be integrated with the real time data and inferred statistics and information of the smart factory. Again, the role of integration standards can be spotted.

At this moment, many formal and informal standardization bodies are working toward developing standards related to smart systems, and more specifically Smart Factories. Their efforts are directed toward information exchange between different components of that factory. Standards play important role also for the development of components for a smart factory. Good example is IoT, where standardization efforts are also present.

Due to the emergence of a large number of different technologies, it was needed somehow to find a way towards their integration. For this purpose, reference architecture models and integration standards are developed. The three-dimensional layer model RAMI 4.0, developed by German Association of Electrical and Electronic Manufacturers, was introduced. Research showed that, in this model, the standards are a key integrative element.

As we can see from smart factory example, there is no necessity to use certain standards. Everything is voluntary. Behind this volunteerism are hidden different motives. Therefore, some need to use those standards exists. By accepting those standards, their users are creating some habits.

All standards are accepted on a voluntary basis, regardless of motivation behind it. After a certain period of time, these standards simply become a habit. In many cases, their acceptance by the authorities also helps in that direction. This study was conducted using methods of analysis and synthesis, in order to review the key aspects of smart standardization and its contribution to the industry. It was concluded that the smart standardization is ubiquitous and it can be seen from the way the Fourth Industrial Revolution pays special attention to it. We should be aware of that there is so much to do in the area of standardization.

5. CONCLUSION

In this study it was shown that standardization is very important element of new technological revolution. During time, conscience about standards has evolved to the level of smart standardization. All standards are accepted on a voluntary basis, regardless of motivation behind it. After a certain period of time, these standards simply become a habit, and that is the state we have today. In many cases they are promoted from the authorities which helps in direction of making them a habit.

Term “smart” is very often in the world of standards. There are many of them related to Smart city, Smart farming, Smart grid or Smart factory. But, the Smart factory is one of the most demanding projects today, because it is capable to collect, distribute and access to manufacturing relevant information anytime and anywhere. It includes horizontal, vertical and engineering integration. Many standards development organizations and some consortiums are promoting standard technologies for Smart factory, but there is no worldwide standardized model of it. Effort were made regarding the IoT standardization, which is the most important technology concerning Smart factories so it is expected that they will allow all players to access IoT equivalently and to use it. This will probably result in making IoT the backbone of the Smart factory.

The results of this study underscored the importance of standardization which is a key component in evolution towards Industrie 4.0. Common standards enable participation of a wide range of stakeholders (for example, companies), regardless of size or location. They help development of systematic, repeatable and efficient systems.

The topic is relevant and this paper can be used by students of the Faculty of organizational sciences as well as by those to whom standardization belongs to the domain of job description. The area of this topic can also be extended in some further papers to other areas of social activity, not only in industry, which would give a real picture of the impact of standardization in the present.

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MODEL FOR APPLICATION OF THE BUSINESS CONTINUITY MANAGEMENT SYSTEM IN HIGHER EDUCATION INSTITUTIONS

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Abstract: *Using of exploratory and descriptive research in work points to the importance and the need of managing the continuity of business in higher education institutions. The aim of the paper is to propose a model of the management system to the continuity of business. Usage of this model will ensure to higher education institutions continuity of provision of education services to all stakeholders. The model is of a general character and can be applied in any higher education institution. Especially, the model is convenient for implementation in the Western Balkan countries in the context of reforms and development of higher education.*

Keywords: *business continuity management system, business continuity plan, ISO 22301, higher education institution, model*

1. INTRODUCTION

In recent years, a significant challenge for higher education institutions (HEI) is providing continuity in the process of using education services to its users, especially for those in transition countries.

The Business Continuity Management System (BCMS) offers a good response, because it represents the management system. The usage of such system would facilitate identifying potential threats and hazards, recognizing external and internal factors which influence risk increasing, defining measures that would reduce the probability of their occurrence, responding in case of their occurrence and continuing with providing services besides preserving the image and reputation of the institution (according to SRPS ISO 22301: 2014; 14).

By analyzing the relevant and accessible literature, the paper highlights the importance and advantages of business continuity management in the HEI. The main aim of the paper is to propose a model for the implementation of the business continuity management system in the HEI that would be enable continuity in the provision of education services by the HEI. The development of the model is based on the PDCA (Plan-Do-Check-Act) cycle, the life cycle of business continuity management and good practice examples of the HEI which were to a certain extent engaged in the continuity of business. The proposed model would create an environment for raising awareness of the importance of continuity in providing education services, as well as for improving the quality of education services.

2. METHODOLOGY

The principal method of research is based on existing theoretical results and examples of good practice in the specified field. The methodology of the research is based on the collection and examination of available literature, its analysis and systematization, with the aim of demonstrating the importance of business continuity management in the higher education institution, as well as the justification and utility of developing new model for applying the management system to the continuity of the provision of education services.

With regard to the type of research, exploratory and descriptive research was used in this paper. During exploratory research, international standards, reference documents and guidelines governing this field have been used in order to perceive BCMS in higher education institutions. Also, the exploratory research includes experiences of universities in the world that approached the implementation of the BCMS to certain extent, as well as publications available through the search of scientific and professional journals and index databases. The following key words were used for searching publications in electronic journals: Business Continuity Management System (BCMS), Business Continuity Plan (BCP), model, higher education institutions and risk. The search included published works in the last 12 years. In the use of the relevant literature, BCMS and BCP publications in higher education institutions have been prioritized, as well as more recent publications describing the risks to the higher education institution.

Currently, a relatively small number of scientific and professional papers on the subject of using the management system in higher education institutions and in general the implementation of the business continuity management system in higher education in the country and the region are available in the literature. One of the additional motives for this research is a particularly small number of researches on the BCMS, the methodological approach and the results of its implementation. The main purpose of this research is an attempt to point to the possibilities and benefits of the using of BCMS in higher education institutions and to propose a general BCMS model applicable to all higher education institutions, especially for those countries that are still implementing reforms in the higher education system..

3. BUSINESS CONTINUITY MANAGEMENT SYSTEM IN HIGHER EDUCATION INSTITUTIONS

3.1. General

The continuity of business represents the ability of HEI to continue providing education services at an acceptable, pre-defined level after the incidence which causes a disorder (adjusted according to SRPS ISO 22301: 2014; 14).

In accordance with the previous said, Business Continuity Management (BCM) in a higher education institution is a holistic management process that identifies potential threats and risks to the institution, as well as their impact on the implementation of the process of providing education services (teaching process), if they are achieved. This way of management provides the basis for reducing the possibility of occurrence of unwanted events, increasing the ability to effective respond to unwanted events, protecting the interests of its key stakeholders and allowing the recurrence of activities to pre-disorder conditions as soon as possible. This is the way of protecting the reputation of the institution and enabling the fulfillment of the activities that create values (according to SRPS ISO 22301: 2014, 14).

Academic continuity points to the commitment of the institution in providing opportunities for the students and teachers to remain in the process of providing education services despite external influences and disorders (SchWeber, 2011, 68).

An early approach to business continuity management was focused on interruptions in information systems of organizations (Elliott, Swartz, & Herbane, 2007, 3), and it can be said that BCM literally derived from the world of information technology (Guide, 2009, 6). However, in recent years, the approach to business continuity management has become much wider. The broader consideration of capabilities of business continuity management is mostly influenced by the adoption of the ISO 22301 standard which defines the requirements for this type of management.

Herbane (2010, 978) BCM links to crisis situations and points to the fact that since 1970 BCM has been evaluated from form of management in crisis situations, as response to technical and operational risks that jeopardize the recovery of organization from the dangers and termination of business. Crisis situations can be defined as organizational functions or processes whose weak implementation can cause damage to stakeholders and further destabilize the reputation of institution (Coombs, 2014, 3).

The general requirements, which refer to the business continuity management of an organization from the point of view of standards SRPS ISO 22301: 2014, include the following areas:

- understanding and determining external and internal factors that affect the ability of organization to achieve the desired results,
- understanding the needs and demands of stakeholders,
- leadership commitment to the BCMS in terms of defining the business continuity policy, defining roles, responsibilities and powers,
- the BCMS planning, in terms of considering risks and opportunities, as well as the measures applied to them,
- providing support, in terms of the necessary resources and their competence, accessibility, as well as the necessary and up-to-date information,
- planning and managing the processes that are necessary to meet the requirements and apply measures related to risks and opportunities,
- establishment, implementation and maintenance of process for analyzing business impact and risk assessment,
- defining a business continuity strategy, from which procedures and business continuity plans are obtained,
- evaluation of performance and improvements (SRPS ISO 22301: 2014, 26-54).

When it comes to terminology, methodology and requirements regarding this system, the authors Lindström, Samuelsson, Hägerfors (2010, 243-255) indicate that private sector employees are basically more aware of BCM concept and its importance than their colleagues in public sector.
Anyway, whether it is a private or public sector, understanding of the business continuity management philosophy should be a strategic concern at the highest level within the organization.

For a higher education institution, it is important to promote business continuity management as one of the key values of the organizational culture, as shown in Figure 1 through the life cycle of business continuity management. This requires the commitment of the leader in the institution and communication with employees about this issue. Beside the leaders, employees need to understand how business continuity is linked to the purpose of the existence of the institution and how they can and should contribute to it in accordance with their roles, responsibilities and authorizations (according to with SRPS ISO 22301: 2014, 30).

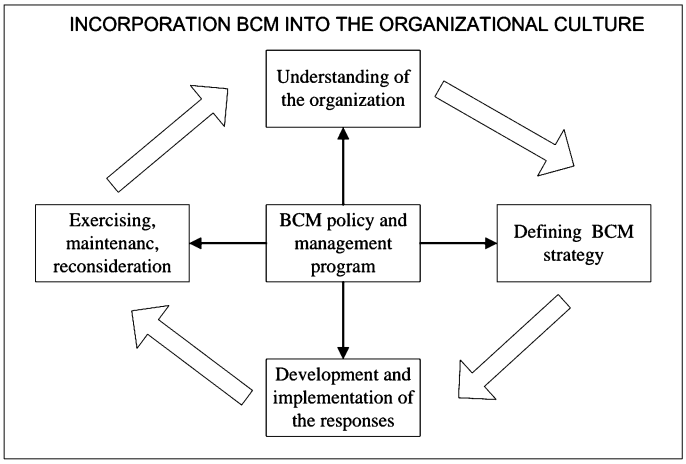

Figure 1:The life cycle of business continuity management (in line with: GPG, 2010, 20; Cornish, 2007, 107)

Business continuity management and recovery after the incident aim to give confidence that the quality of the service will be at the maximum level even during the crisis period and that the departments and institutions will be recovered as soon as possible (Guide, 2009, 2).

When it comes to higher education institutions in our area, the impression is that the theme of risk management in higher education is recently open issue, which is emphasized by the authors Ružić-Dimitrijević and Dakić (2014, 137-152).

Several authors points to the possibilities of applying this system in education but in the educational systems in the world (Asgary, 2016, 49-72; Durmo, 2016,57-74; McGuinness and Marchand, 2014, 291-310). Durmo (2016, 57-74) points to the importance and advantages of the business continuity plan and describes the BCM methodology. In his work Durmo points out that we should not proceed from the fact that the danger cannot happen to us and that the BCM should be seen as a huge competitive advantage. Asgary (2016, 49-72) emphasizes the importance of risk management and business continuity today, to the extent that York University has developed programs and courses in this field. McGuinness and Marchand (2014, 291-310) point to the practice of BCM in institutions in the United Kingdom. They also emphasize the importance of communication in case of incidents.

An analysis of the available university data in the world indicates that universities, although they do not have a certified system of business continuity management, to a certain extent, and in accordance with their needs and possibilities, deal with the business continuity, and most of all, by continuously planning their business. The key components of BCMS's for the higher education institution are the business continuity policy, personnel with defined responsibility, process management related to planning, testing and improvement of business continuity management, as well as internal documents which is a subject of audit and updating and which relate to the assessment risk and impact analysis on business.

3.2. Development of the model of business continuity management system in high education institutions in Serbia

Bearing in mind that the universities in the world have realized the importance of maintaining their business (maintaining the continuity of providing education services) at any time and have worked on a well-defined framework of business continuity management, it is necessary that the higher education institutions accept

this concept and improve their business in this context, especially in the countries of the Western Balkans in the context of development and reform of higher education system.

If we take into consideration higher education institutions in Serbia, the greatest risk for the continuity of providing service by a higher education institution is the process of accreditation, namely re-accreditation. In the process of re-accreditation of higher education institutions, they have to fulfill the standards defined by the Rules on Standards and Process for Accreditation of Higher Education Institutions and Study Programs. Usually, in fulfillment of these requirements, the highest risk of the standard refers to teaching staff and space. First of all, it refers to teaching staff and their competence, in the sense of formal education, and in terms of representative references (published works), teachers' consent, i.e. the willingness of the parent institutions to give or even fulfill the conditions for retirement. Changes in the management structure of the institution also carry the risk if the leaders in the institution do not provide competent successors who are ready to continue with development of the culture of the previous management structure business. The challenge may also be space, in the sense that the institution does not have its own space, than renting it, where there is a change of purpose of space.

A significant threat that could jeopardize the continuity of a higher education institution is reduction of the number of students. This phenomenon can be the result of economic changes on the micro and macro plan (education financing, purchasing power of the population, price growth, state of the economy branches of interest, etc.). However, this phenomenon is not only a problem at the level of one higher education institution, it is a demographic problem at the state level.

An important step in the construction of such a system , especially for developing countries, is the raising of awareness among employees and its incorporation into the organizational culture and the value of the institution.

Building such a system in a higher education institution is a long-term process, which must be well-designed, with well-formulated strategy, designed business continuity plan and with respect to available resources.

In the development of a general model for the application of BCMS in higher education institutions (Figure 2), the basis was the PDCA cycle (Plan-Do-Check-Act) given in SRPS ISO 22301: 2014 standard.

The central place in the model is occupied by the basic processes of PDCA cycles which take place in a higher education institution in order to ensure the business continuity. Each of the elements of this cycle is further expanded by elements related to ensuring the continuity of the provision of education services.

In order for the institution to provide and respond to possible incidents, it is necessary to have a business continuity plan and a clear recovery strategy, which is ensured by business continuity planning. In the planning process, a higher education institution must take into account external and internal issues which are of importance for its ability to provide education services. It must also take into account the needs and expectations of stakeholders. The model also highlights the importance of the relationship between business continuity planning and stakeholders which realize an environment for continuous work in an institution, as well as support for students and other stakeholders in the learning process. It is very important that the top management demonstrates commitment in relation to the BCMS. When determining the BCMS, a higher education institution must necessarily examine the risks and define measures in order to reduce the adverse effects. The higher education institution should have competent human resources to carry out business in the context of ensuring business continuity with developed awareness of the importance of the BCMS (adjusted according to SRPS ISO 22301: 2014, 26-38).

According to Schweber (2011, 71), the key outcome of business continuity management is the plan of resistance, namely elasticity. Plans are not made for any possible situation that can cause interruption of work, already the effects of these interruptions are anticipated. For example. if there is a flood, a fire, a renovation, an expired lease of space, or a danger to chemicals in the laboratory, regardless of which of these events occurred in that institution, a certain period of time it can not continue to provide education services (Guide, 2009, 2). A business continuity plan must at least contain critical services and key activities and in which order they will be realized (i.e. defined priorities) if an emergency situation occurs (Resilience, 2014, 60). Every business continuity plan should be unique to the institution.

In accordance with the Best Practices in Business Continuity Planning in Higher Education (2010, 4-5) and SRPS ISO 22301 (2014, 40-48), the model also shows the BCMS implementation activities in a higher education institution, which refer to an element "Do":

1. *Business Impact Analysis* - This analysis identifies the critical processes of the institution, provides the maximum limits of estimation for delays and defines priorities among business processes for renewal.
2. *Risk assessment* – This assessment identifies specific threats for the institution, assesses the vulnerability of the institution for each threat and assigns a degree of risk to each potential threat.
3. *Risk management* - Analyzes the results of the risk assessment and defines the risks that require specific management, and the result of this phase is the documented widespread plan which defines the procedures necessary for restoring business processes to the original state in the event of an interruption.
4. *Testing, training and updating* - Determining the methodology which the institution uses in order to consistently train employees, test and update the plan and to communicate the plan between employees due to changes.

The plans need to be practiced and tested through an appropriate well-planned scenario in order to ensure that they are consistent with its goals. The reports on acquired experience arise as a result of exercises and testing, which are significant for recommendations and measures for implementation the improvement (SRPS ISO 22301: 2014, 46-48).

In the BCMS implementation process, it is important to determine a team that will be responsible for developing a plan and for managing the continuity of the provision of education services. The emphasis is on analyzing the impact on critical processes and activities, as well as on well-defined communication channels.

In the higher education institutions, critical business processes can be classified into one of three categories:

- Security and safety - all activities that are necessary to maintain a safe and a secure environment,
- Support processes - include activities which enable the financial sustainability of the institution and
- Learning, education and research - include activities and programs which support and realize an academic mission of the institution (Best Practices, 2010, 5).

Identification and protection of critical business processes and resources are needed for maintaining an acceptable level of business, protecting those resources and preparing procedures in order to ensure the survival of the institution at the time of interruption.

The elements related to checking "Check" and which are presented in the model, are: defining the criteria for performance evaluation of BCMS, internal checks, management review and management reporting. The higher education institution must know what monitoring and measurements implements and when implements them. As a result of training and testing of plans, monitoring and measurement and internal verification, changes in business continuity plans are being made, i.e. plans are adapted to new situations. Elements of the "Act" include: corrective measures, improvement and monitoring of system efficiency after improvement. After a certain period of BCMS application, some results of its application and outcomes can be seen, on the basis of which it is necessary to perform BCMS improvements. (according to PDCA and SRPS ISO 22301, 2014, 48-54)

In the development of the model, through the PDCA cycle, the basic activities are considered important for ensuring the continuity of the provision of education services by the higher education institution, as well as their interconnectedness. Evaluation processes can be recognized at the institution level (internal audits and performance appraisal of the BCMS) and at the national level (connection with bodies included in the monitoring and control system of the HEI).

Other significant components of the model are the requirements and expectations of stakeholders and their fulfillment that indicate the relation between the higher education institution and the environment. The environment, in which the higher education institution operates, includes direct beneficiaries (students) and stakeholders, as well as the relationships that the institution achieves with them. The stakeholders are the Government of a specific state, the competent Ministry, bodies involved in the system of monitoring and control of HEI, secondary schools and business entities. The relation that it realizes with stakeholders on the one hand can symbolize social responsibility in terms of ensuring the continuity provision of services of education, which defines the relationship of the institution according to the set requirements of the environment and the level of their fulfillment, but on the other hand, the autonomy of the institution that is reflected in defining of their own goals, policies, strategies and plans, and continuous monitoring of their own results in order to be achieved and constantly improved. The relations with interested parties show that in higher education there is general dependence on the economic, political and social structure. Although the higher education institution has its own autonomy, it is integrated with multiple connections into social and economic affairs with increasing influence that individual stakeholders realize at the institution (the

Government, the competent Ministry, business entities, students, etc.). It is emphasized that the model is dependent from the organizational culture.

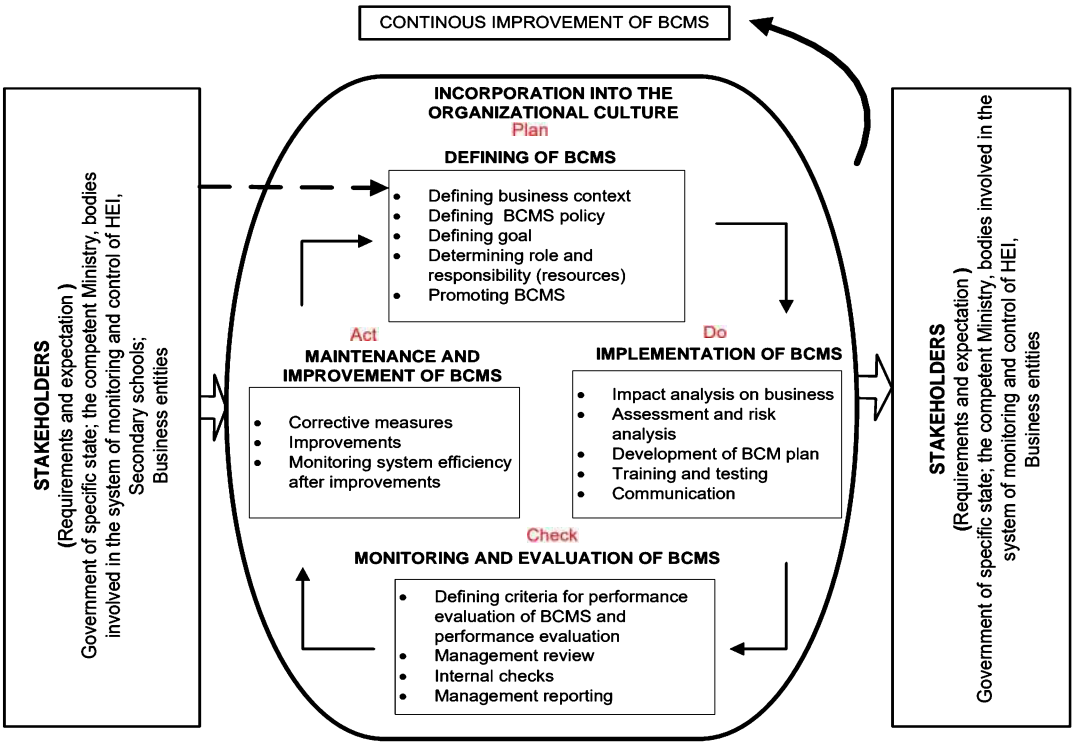

Figure 2: Proposal of BCMS model for higher education institutions in Serbia (harmonized with PDCA cycle and ISO 22301)

Based on the set model, it is possible to obtain a valid picture of the processes which take place in a higher education institution in terms of ensuring the continuity of the provision of education services. In this respect, the proposed model justifies its application by providing a good basis for ensuring the continuity of the education process. The model can be applied in order to:

- facilitating higher education institutions to improve the quality of education services,
- increasing the ability of the institution to absorb, react and recover from disorders,
- ensuring the continuity of the provision of education services,
- encouraging the implementation of BCMS in higher education institutions,
- facilitating the management of the institution by giving recommendations in the planning process, but also by other processes,
- creating an institution's resistance to disorders from the internal and external environment, and inter alia for achieving a competitive advantage over other higher education institutions.

The significance of this model is reflected in its ability to serve as the basis for the development and application of the business continuity management system.

Considering above, it can be seen that the business continuity management is not a set of some specific processes that need to be kept in reserve for some extraordinary circumstances, which can certainly occur at some point. The elasticity of operations at the operational and cultural level may be the best solution in the preparation of the institution for extraordinary activities, with providing additional resources and flexibility that permeates all academic and business activities of the higher education institution (Yanosky, 2007, 157).

BCM presents one type of investment whose benefit and return can hardly be determined as in other strategic investment decisions (Kato and Charoenrat, 2018, 578). The ultimate goal of the BCM is to build the resistance of the institution and ensure the provision of services, despite damage to property and the lack of necessary resources caused by an unwanted event (Guide for SMEs, 2011).

4. CONCLUSION

Research and analysis of relevant literature, which refer to ensuring continuity of business in higher education institutions, have resulted in the development of a model for the implementation of the business continuity management system in conditions of interaction with stakeholders in the environment. The model

has been developed on the basis of the PDCA cycle and systematically provides the basis for understanding the basic activities in terms of ensuring the continuity of the provision of education services.

The PDCA cycle, extended by elements related to ensuring continuity in the process of providing the same service, is a good basis for ensuring the quality of education services and the right solution in the context of reforms and development of higher education system, especially for Serbia and other countries of the Western Balkans.

The proposed model is of a general nature and should help higher education institutions in undertaking a comprehensive approach to ensuring business continuity, enabling them to connect with already established processes, which was the goal in developing the model.

The development of the model has arisen from the need to systematize in a comprehensive manner and show the activities of planning, providing, managing and improving the continuity of the provision of education services. The model defines the business continuity management system in conditions of external relations with stakeholders, from the perspective of a higher education institution. The proposed model gives freedom to higher education institutions in defining their own activities in terms of ensuring continuity of provision of education services, but basically keeps the PDCA cycle as the core of the management of the institution. In realistic implementation of this model, leaders in the institution play an important role in the context of their commitment and the development of awareness among other employees of the significance of such a system.

In theory, this work has resulted in a deeper consideration of the meaning and importance of planning business continuity in higher education institutions and, in general, the importance of application of BCMS in higher education. Considering the insufficient research of this phenomenon, the basic contribution is also reflected in the definition of the general model proposal for the implementation of BCMS in a higher education institution. The developed model can be applied to all types of higher education institutions. Considering the insufficient research of the BCMS problem in higher education institutions, this model can serve as a basis for further research in this field, as well as for reviewing the introduction of certain changes in higher education institutions in our area. In this respect, a new challenge has been posed to the higher education system in Serbia and in other countries undergoing reforms of the higher education system.

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INFLUENCE OF SOME ASPECTS OF DISTANCE LEARNING ON QUALITY OF STUDYING

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Abstract: *The great influence that online learning has on the quality of studying is the importance of observing and analyzing the correlation between the acceptance of online learning among students and their success at college. From the student's point of view, the success of the faculty is considered to be the result of their learning, and in this paper it is expressed through an average grade. The aim of the research is to determine the influence of online learning on the quality of studying. For comparison of these two factors, the questionnaire and the ANOVA test were used, as well as the selection, analysis and synthesis of the collected information in order to obtain the most relevant data. That's exactly the main contribution of this research. Given that there is a small number of papers that explore this issue, this research has a vital importance for the area to which it relates. The analysis carried out concluded that there is an influence of online learning on the quality of studying, but that a large number of students are not yet ready to replace traditional learning with distance learning.*

Keywords*: distance learning, online learning, quality of studying, e-learning,e-learning tools*

1. INTRODUCTION

The traditional context of learning is experiencing a radical change. Teaching and learning are no longer restricted to traditional classrooms. Electronic learning referring to the use of electronic devices for learning, including the delivery of content via electronic media such as Internet, audio or video, satellite broadcast, interactive TV, CD-ROM, and so on has become one of the most significant developments in the information systems industry. With the evolution of wireless networks, it is easy to understand how the mobile devices have gained importance in day-to-day life and in education, too. Today many students want to learn online and in turn get degrees from worldwide colleges and universities, but still cannot go anywhere as they live in isolated areas without proper communication systems. Consequently, many researches encourage learning courses under the e learning system as it saves time and energy of those students staying at any far off distant regions from the universities or colleges they have enrolled. There is also a financial impact. Networks and access to online materials offer an alternative to place-based education which reduces the requirement for expensive buildings, and the costs of delivery of distance learning materials. Although studies and statistics show that between 20 and 30% of those students who begin a distance-learning course do not finish it in the last few years there has been sharp growth in the size of the distance learning market. One of the most important factors relating to e-learning is the element of interaction. Distance students, due to their backgrounds, may also feel more pressure to collaborate and be part of the team (Valentine, 2002).

The need for education has changed because of an increased demand for a highly educated workforce who will be expected to learn continuously. E-learning has become an increasingly important part of higher education. However, the employment of distance education by universities and colleges highlighted issues relevant to the quality and effectiveness of online distance higher education compared to conventional educational patterns. Faculty positive attitude to ICT also does affect the students' perceptions of their distance learning experiences (Valentine, 2002). A lot of evidence has been also provided that the quality and quantity of communication give a raise to the overall student learning perception and satisfaction (Sloan, 2002).

2. LITERATURE REVIEW

The rising use of internet and supporting systems constructed the innovative and easy learning environment for students to acquire more skills and knowledge**.** ICThas transformed the conventional based education system into technology based education system. The classroom environment is moved from teacher centered to student centered form. The radical changes in educational technologies prepared the students to be more responsible in their learning. Viciana et al. describe a computerized system that allows researchers creating, applying and tabulating surveys and paper instruments in an automatized way and consider them

as a useful tool since it permits to input data with higher precision and no need for previous codifications. According to Granados (2015), the use of ICT means breaking with traditional media, boards, pens, etc., and it has given way to a teaching role based on the need for training in and updating one's knowledge of teaching methods based on current requirements.

Recent studies have shown that e-learning implementation is not simply a technological solution, but also a process of many different factors such as social factors (Schepers and Wetzels, 2007; Tarhini et al., 2014b; 2015), and individual factors (Liaw and Huang, 2011), organizational such as facilitating conditions (Sun and Zhang, 2006) in addition to behavioural and cultural factors (Masoumi, 2010).Such major factors play an important role in how an information technology is developed and used (Kim and Moore, 2005). Recent studies have shown that a basic element in traditional classroom learning is communication among the students: the ability to ask questions, to share ideas with others, or to disagree with others is a basic need in the learning process (Picciano, 2002).

Martino (Martino, J., (2007) & Van den Brekel (Van den Brekel, A.J.P., (2007)) found that Virtual environments are best substitutes for those students unable to attend traditional face to face teaching systems. According to A., Jamaluddin, Virtual experiments give great environment for Teaching & Learning (A., Jamaludin et al., (2009)). Fatih Baris and Tosun described the influence of using e-tools in the education process at the high school and concluded the positive influence of this tool on students.More than anything else (34.8% in our research), flexibility is what makes e-learning programs attractive to the learners (Schoech, 2000).In distance-learning courses students can take courses from preferred locations that are convenient for their schedules. This advantage is appealing to most adult learners because it accommodates their work schedules and permits flexibility to manage their family life (Kember, Lai, & Murphy, 1994).Distance students, due to their backgrounds, may also feel more pressure to collaborate and be part of the team (Valentine, 2002).

For beginners, it has been reported that confronting computer technology was more stressful and consumed more time than the actual learning activities at the beginning of a course (Atack, 2003; Atack and Rankin, 2002; Billings et al., 2001; Scollin, 2001). In addition, feeling isolated and missing social contact have been reported in studies of computer-assisted learning. Particularly, the absence of non-verbal cues in solely Web-based learning left students feeling they have been communicating largely with a machine rather than other human beings (Atack and Rankin, 2002; Billings et al., 2001; Andrusyszyn et al., 1999; Bullen, 1998).

The fact that gaps in one's knowledge may be compensated for, and are complemented by virtue of, the knowledge of such person's classmates, constitutes an important advantage of learning in a group (Picciano, 2002). Moreover, people who work together provide social and emotional support to each other (Haythornthwaite, 2001). Different research studies (Lai, 1997; Klemm & Snell, 1996; Jonassen & Kwon, 2001) assert also that subjects that involve discussion, brainstorming, and reflection are best suited to the online format despite the fact that online discussions are significantly different from face-to-face discussions. Courses must be designed so that students could benefit from the interactive potential of online learning (Thorpe, 2002), so instructors require extensive training on how to utilize new technologies and adapt teaching methods to distance learning environment (Valentine, 2002).

Faculty positive attitude to ICT also does affect the students' perceptions of their distance learning experiences (Valentine, 2002). A lot of evidence has been also provided that the quality and quantity of communication give a raise to the overall student learning perception and satisfaction (Sloan, 2002). Gibbs and Simpson (2004) advocate for regular, comprehensive, and detailed feedback as the main interactive component of teaching. They conclude that only immediate and specific feedback provided by instructors enables students to gain control over their learning and monitor their own performance.

Individual background variables found to have an impact on students' acceptance of e-learning are: gender, learning styles, age and organizational factors (i.e. school). Gender seems to be the most influential background factor as it affects the level of computer anxiety (Shuell & Farber 2001), perceived usefulness and ease of use (Shuell & Farber 2001, Ong & Lai 2006). A direct relationship between gender and acceptance is also proposed by Mitra et al. (2000), who concluded that men were more positively predisposed toward computers and tended to use computers more than women. Age influenced students' levels of computer confidence, as younger students were not so anxious in using computers (Jennings & Onwuegbuzie 2001).

The quality of higher education is affected by many requirements and some of them are requirements by (Lazic, 2007):

- Beneficiaries of higher education - stakeholders
- Bologna process, international standards and international organizations (international requirements)

- Requirements of national standards for accreditation,
- Quality management system requirements,
- Requirements of the standard of work and higher education institutions and
- Requirements of technological standards of work or pedagogical subsystem.

3. RESEARCH METHODOLOGY

3.1. Aim of this research

The aim of this research is to see what way of studying is the best for Serbian's students, what students prefer in their learning and what are the biggest problem in distance learning. As well the aim of this study is to examine are the students ready to replace traditional way of learning by distance learning and to see what aspects of quality studying have influence on distance learning.

3.2. Research questions and hypothesis

The first distance learning system was developed in America in the 1960s and has a huge impact on learning in developed countries today. On the other hand, the fact that Serbia is still a developing country, this system began to develop several years earlier. In the beginning, he encountered the great resistance of the supporters of the traditional way of learning, while today, every year, the number of students who are interested in this form of learning grows. Two research questions and three hypotheses can be defined about influence of quality of studying on distance learning in Serbia in this paper:

- ***Research Question 1*** - Most students in Serbia considered that online learning make studying easier.
- ***Research Question 2*** - The largest number of students is not yet ready to replace traditional learning with online learning.
- ***Hypothesis 1*** - The basic criteria of the student's success (average grade) have no impact on using online learning among students.
- ***Hypothesis 2*** - Availability of materials has the greatest influence on the quality of studying.
- ***Hypothesis 3*** - The biggest obstacle (barrier) to online learning is the lack of social interaction.

3.3. Population and sample characteristics

The population of this research are students from Serbian universities. In this paper were used online questionnaire as method for collecting data that will be used in this research. The questionnaire was sent to 150 random Serbian students and only a few of them were not usable. The respondents were male and female students from first year to graduate year of study. Most of them (42%) were 2nd year of study. They cover almost every field of study. Majority of respondents are from technical and engineering fields of study. Priorities was faculties that have developed system of online learning. As well the most respondents were students who spend more than 6 hours on the Internet (58%).

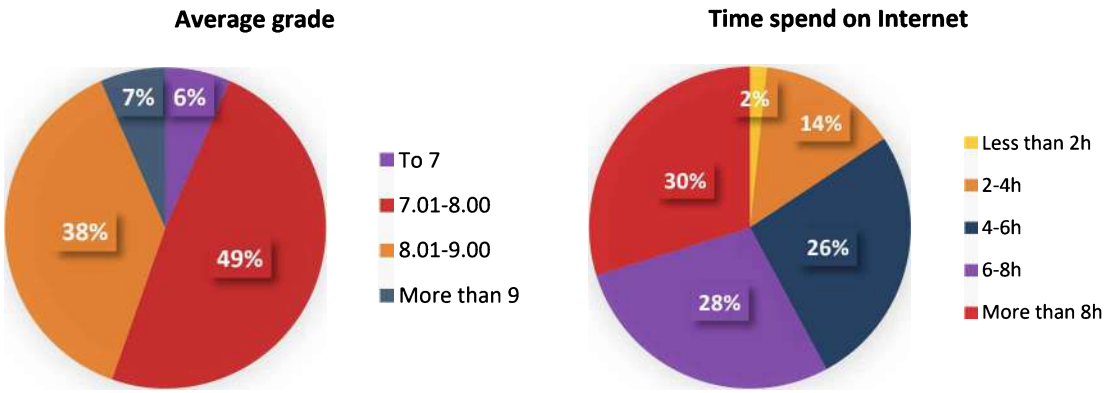

Figure 1: Basic information about average grade and time spend on Internet

3.4. Research instrument

Questionnaire was created and distributed online. It was consisted of three parts. First one was related to basic criteria of the students success about respondents. Those included: time spend on Internet, year of

study and average grade. Second part included questions about students way of learning and different e-tools like are online courses, online tests, online dictionaries and searching literature. Questions in third part were about influence of different aspects of quality on distance learning. This include influence of appearance of the interface, availability of materials, interaction with the professor and flexibility in learning on online learning. They consisted from Likert scale, where one is extremely small influence and five is extremely big influence.

Data Analysis Methods

To examine above mentioned hypothesis, after conducted questionnaire, statistical analysis was performed using SPSS 22. Various tests were used in order to get most precise data.

4. RESULTS

To support the following results, sample characteristics were collected and analyzed. Some of them are more particularly described by giving the answers to some basic questions related to distance learning. One of them is "Do you use any types of electronically supported learning (online learning) during your studies?" The results are represents on picture 2.

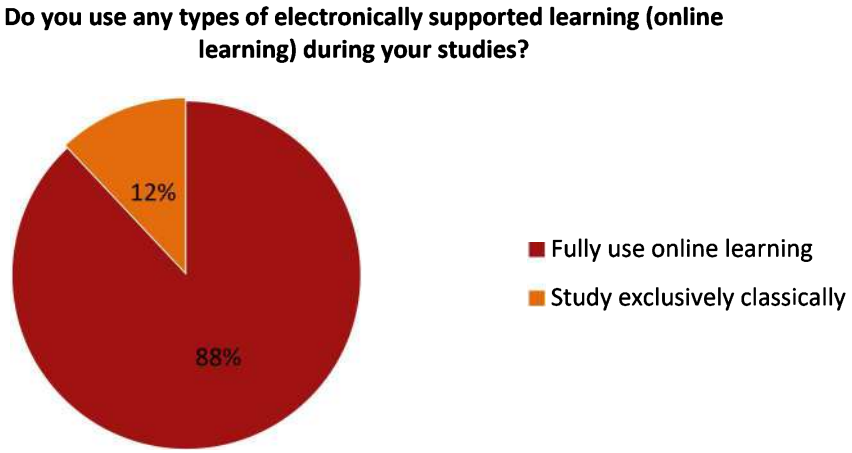

Figure 2: Uses of online learning among students

Now, will be represented the results of two research questions and three hypotheses.

Research question1 **- Most students in Serbia considered that online learning make studying easier.**

Turned out that thatwas right. Using questionnaire it can be proved that most students in Serbia considered that online learning make studying easier. Question consisted from Likert scale, where one is extremely small influence and five is extremely big influence. The results of this research are given on the figure 3.

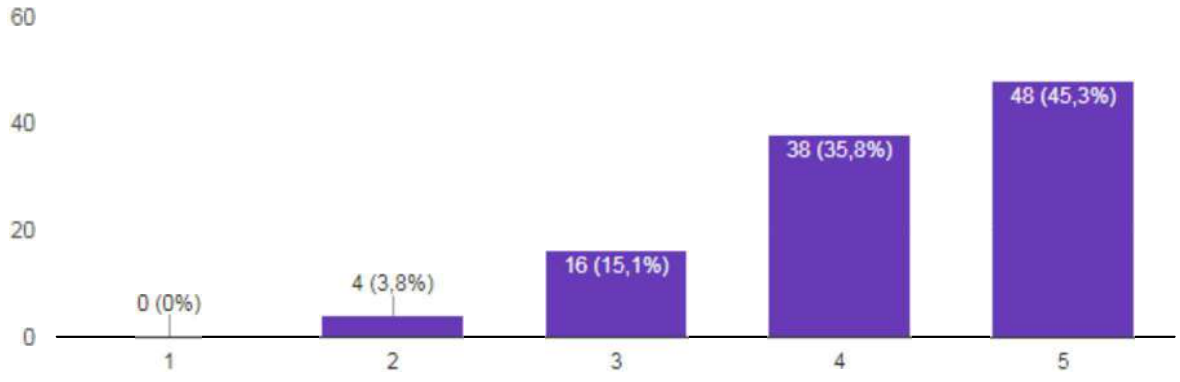

Figure 3: Positive impact of online learning on studying

Research question2 **- The largest number of students is not yet ready to replace traditional learning with online learning.**

Using questionnaire, results show that students are not yet fully prepared to switch from traditional way of learning to online learning. Question consisted from Likert scale, where one is extremely small influence and five is extremely big influence. The results of this research are given on the figure 4.

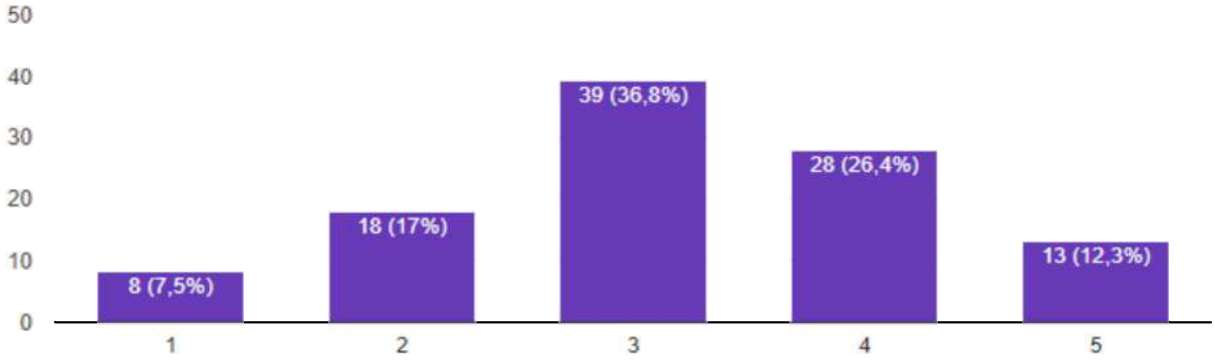

Figure 4: Student willingness to replace the traditional way of learning

Hypothesis 1 **-The basic criteria of the student's success (average grade) have impact on using online learning among students.**

Using ANOVA test it can be concluded that this hypothesis turned out to be right. Significant influence does exist and it is less than 0.05. Average grade truly have impact on using online learning among students. The results of this research are given in the table 1.

Table 1: Average grade and online learning

Influence of average grade on using online learning	**Descriptives**		
	N	**Mean**	**Std. Deviation**
To 7.00	9	2,44	,726
7.00-8.00	59	1,66	,685
8.00-9.00	45	1,69	,596
More than 9	8	1,50	,535
Total	121	1,72	,674

Hypothesis 2 **- Availability of materials has the greatest influence on the quality of studying.**

Using ANOVA test, significant difference was not recognized, considering availability of materials as an aspect of online learning and quality of styding. P value was greater than 0.05.The results of this research are given in the table 2.

Table 2: Literature and quality of studying

Influence of literature on the quality of studying	Descriptives		
	N	Mean	Std. Deviation
Mostly does not influence	7	4,71	1,604
Partly influence	17	4,76	1,786
Mostly influence	8	4,12	2,100
Completely influence	25	4,96	1,620
Total	57	4,75	1,714

Hypothesis 3 **- The biggest obstacle (barrier) to online learning is the lack of social interaction.**

Using ANOVA test it can be concluded that hypothesis was right. Significant influence does exist and it is less than 0.05. The results of this research are given in the table 3.

Table 3: Social interaction and online learning

Influence of social interaction on online learning	Descriptives		
	N	Mean	Std. Deviation
Mostly does not influence	10	1,40	,516
Partly influence	32	1,38	,492
Mostly influence	35	1,57	,502
Completely influence	29	1,72	,455
Total	106	1,54	,501

5. DISCUSSION AND CONCLUSION

Information systems are something that is constantly evolving. With the development of information systems, learning methods are being developed. Thus, it is possible to hear terms such as distance learning, online learning, and so on. Due to the enormous importance of the influence of online learning on the quality of studying, we decided to look more closely at this topic. The aim of this research is to examine whether students are ready to replace traditional way of learning by distance learning and to see which aspects of quality study have a bearing on learning distance. Also the aim of this study is to see which way of studying is best for Serbian students, what students prefer in their learning and what is the biggest problem in distance learning. Based on the research, we found that most students in Serbia considered that online learning makes learning easier and most students use some aspect of online learning, but the largest number of students is still not ready to replace traditional learning with online learning and the reasons for this are mainly lack of social interaction, lack of interaction with professors, etc. It can be concluded that online learning in Serbia is still in the development phase and it is necessary for students to learn more about the benefits of online learning.

Results from first research question proved that most of Serbian students considered that online learning make studying easier. This refers to thought on some e-tools like online courses, online dictionaries,

searching literature and online tests. Fatih Baris and Tosun described the influence of using e-tools in the education process at the high school and concluded the positive influence of this tool on students.

In second research question, it can be concluded that the largest number of students is not yet ready to replace traditional learning with online learning. Only one third of students who participate in survey said that are ready to replace traditional learning with distance learning. This show that student must be more informed about advantages of distance learning.

In first hypothesis, it can be concluded that there is significant difference between average grade that student have and using online learning. That means that students who have higher grades, using online learning more than students who have lower grades. That shows that student who have higher grades are more opened to try something new in learning. This is telling that students with lower gradesaccept things that are easy to use and that require minimum effort and they have no interesting in trying some new ways of learning, like online learning. But some students aren't conscious that online learning can make study a lot of easier.

Results from the second hypothesis were interesting. Some thoughts are that availability of materials has the greatest influence on the quality of studying. But this is not right. It seems that there is no significant difference between availability of materials and quality of studying. That means that availability of materials have the similar influence on quality of studying like others aspect of online learning.

By the third hypothesis is proved that the biggest obstacle to online learning is the lack of social interaction. Picciano (2012) concluded that a basic element in traditional classroom learning is communication among the students: the ability to ask questions, to share ideas with others, or to disagree with others is a basic need in the learning process. Also, Atack and Rankin, Billings, Andrusyszyn and Buleen says that feeling isolated and missing social contact have been reported in studies of computer-assisted learning. Particularly, the absence of non-verbal cues in solely Web-based learning left students feeling they have been communicating largely with a machine rather than other human beings. Research has proven that, indeed, social interaction is something that students most miss in online learning.

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Veerasamy, Ashok Kumar, Impact of ICT on society – Higher education students in South-East Asia

OVERVIEW AND FUTURE OF QUALITY MANAGEMENT CONCEPTS IN ADDITIONAL AIRLINE SERVICES IMPROVEMENT

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Abstract: *In this paper, we discussed the importance of additional services in airlines, their quality and related quality management approaches. Different concepts of providing additional services for both organizations that offer full service and low-cost organizations are presented. We overviewed wide range of services in airline industry, and dedicated special attention to the additional services. The paper also deals with problems related to the definition of quality and quality assesments of these services, followed by the example of RATER model and its use. Key elements of the Gap model are analyzed in order to provide understanding of customers' expectations and perceptions, along with business performances in context of basic quality planning, control, improvement and assurance activities. At the end, new challenges for improvements of additional services in airlines, as well as potential overall advencement of the system perspectives are presented. We concluded that additional airline services will continue to grow along with the trend of adjustment to different groups of customers, thus creating even wider possibilities for the customers. As the new tehnologies will enable growing information, one of the best mechanisms for achieving greater customer satisfaction and successful business is the use of quality management concepts in this field.*

Keywords: *quality management, airlines, additional services, chargable services, non-chargable services, improvement*

1. INTRODUCTION

Althought we are learning from ancient myths about the attempts of flying from men Dedail and Icarus and the traces of ancient Chinese civilization, the history of aviation can be accommodated in the last 100 years. From the time when the Wright brothers in December 1903 performed the first flight with a heavily air-borne, managable drive, the aviation's rapid development began. The first regular airline company was DELAG (Deutsche Luftschiffahrts-Aktiengesellschaft) and it was founded in 1909 with the help of the German government and Cepelin Corporation (Schmitt and Gollnick, 2016). During the First World War, bomber planes were used, and the largest could carry a load of up to 5 tons. In 1919, the first flight was made across the Atlantic, and between 1920 and 1930 there was also progress in the field of civil aviation. The first commercial passenger plane was Douglas DC-3. From this period there are companies that exist today - RDA (Royal Dutch Airlines) founded in 1919 and Qantas (Queensland and Northern Territory Aerial Services) from 1920.

After the Second World War there was a further development of civil aviation thanks to the overflow of resources from the military sector. In 1956, American Airlines transported more passengers than US railways, and in 1957 more passengers crossed the North Atlantic by plane than by boat. Significant events in the development of aviation took place in 1958, by introducing Boeing 707 as the most economical, then Airbus in 1970, and the first plane on solar and electric power in 2010. The largest and most comfortable airplane today is the Airbus 380 with a capacity of 850 up to 1000 passengers.

Over the years, most airline companies were established at the national level and operated in accordance with state interests. However, globalization and new ownership relations and the strengthening of competition lead to permanent changes in the market. The airline's independent operations are more difficult now, so that they associate themselves in partner groups to unite their strengths and resources. Consequently, competitors become strategic business partners, and their cooperation takes place in commercial and operational businesses such as: flight scheduling, marketing, frequent flyer program, and codeshare (bound flights).

Examples in this paper are inspired by the practices of some of the most famous alliances:

- Star Alliance – Lufthansa, SAS, Thai International, United Airlines;
- Oneworld - British Airways, American Airlines and Cathay Pacific;
- Skyteam – Air France, Delta Airlines, KLM, Aeromexico, Aeroflot and Korean Air (Szakal, 2017);

2. AIRLINES AND THEIR SERVICES

Airlines are inherently unique and operate in a unique and different way in comparison with other companies. The basic function and purpose of the existence of airlines is to provide the service of safe and efficient passenger transport from point A to point B. Regarding the basic service, different airlines may include a variety of accompanying and additional services. Additional services complement the quality of the basic service and increase its value. In low cost companies (LCC), the price of the ticket includes only basic passenger transport services, while all other services are considered as additional and charge separately. Full service companies (FSC), in addition to the basic transportation services, include tickets, luggage transportation to a certain weight, flight overnight and other services depending on the selected class. Most of them offer two basic categories - service classes: economic and business.

The economic class includes seats in the central part of the aircraft, luggage within the permitted dimensions, meals and entertainment depending on the length of the flight. Business class passengers can use Premium lounge services, and within the airplane they are sitting in comfortable seats that can stretch and order meal and drinks as desired at any time, and have more options for fun.

On the other hand, many companies offer services to their customers grouped into packages with a distinctive tariff name. For example, the company British Midland International (BMI) classifies several types of packages (economy saver, economy, economy flexible and business) and depending on what service they choose (checking and scheduling, acquiring rights for loyal passengers or some additional benefits) customers gain the right of advantage in checking, collecting and doubling miles or the ability to read newspapers or the use of hot and cold meals and alcoholic drinks (Vinod and Moore, 2008). All other services outside the basic package are considered as additional, so they can be chargeable and non-chargeable, and it is needed to make a special requirement when booking a ticket.

2.1. Chargeable services

Additional services (ancillaries) that are charged separately are optional services that a customer can buy along with the ticket. The airline decides which service will be chargeable and under what conditions. For example, a particular service may be chargeable for one destination, and for the other not, the service may be chargeable to an economy class, and free for business, while frequent flyers may be exempted from paying additional services. Some additional services can be purchased exclusively with the airline tickets, while other services can be purchased as a separate service, with or without booking a flight. The spectrum of chargeable services can be very wide and varies from LCC to FSC. The payment services can be classified into three groups (Marcenko, 2015):

- 'A la carte';
- Commission – based ancillaries (third party services);
- Frequant flyer programme – (services intended for frequent flyers).

The passengers have the opportunity to use such a variaties: food and bevereges during the flight, an advantage in "check–in" and boarding, luggage, seats with extra legroom, fun during the flight, wi – fi, etc. are included in 'a la carte' services. Provision-based services relate to hotel accommodation, car rental and travel insurance, while services intended for frequent flyers allow discounts on airline or other product prices (wrist watches and hotels). Together with basic (transport), additional services round up the entire package offered by one company to the passenger (O'Connell and Warnock, 2013).

2.1.1. The economic significance of chargeable services

Airlines make significant revenues from additional services (Figure 1). Key services with the largest share in the revenue from chargeable services are luggage transportation (25%), a la carte services during the flight

(26%), commission based services (15%) and sales of miles for frequent flyers (12%) .

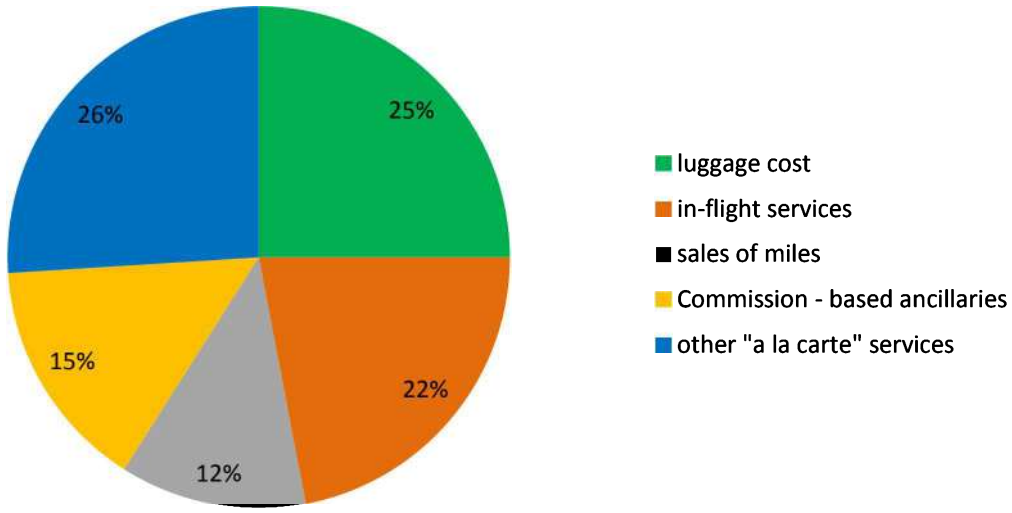

Figure 1: Key components of the revenue from additional services **(Idea Works Company, 2016)**

Revenue from additional services as well as its share in the overall revenue of airlines, grows year after year. Figure 2 shows an increase in the revenue from additional services ranges from $22 billion in 2010 to $65 billion in 2016. At the same time, the increase in revenue is recorded from additional services against the total revenue of 9.2% in relation to 4.6% in 2010 (Amadeus IT group, 2017).

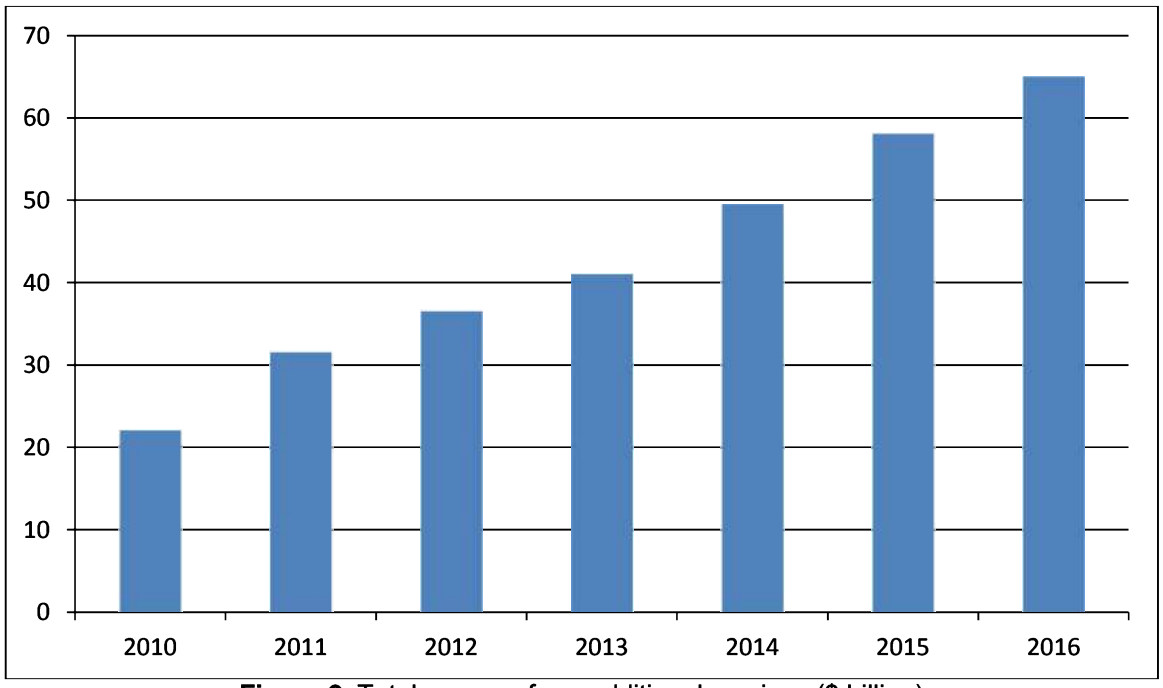

Figure 2: Total revenue from additional services ($ billion)

2.2. Non-chargable services

Companies that provide a complete service, within the price of the ticket, allow passengers and a range of other services that make travel easier, and to get those services, they need to submit a special request. Some of them are: the use of a baby basket, a meal for children or special meals, the use of wheelchairs, transport of bicycles, musical instruments, sports equipment, passengers with reduced mobility, persons with special needs, those who require special medical care, medical carriers, dogs to help blind, deaf and psychiatric patients, the transport of fragile luggage and weapons, etc. Each passenger has the right to use

these services, but it is necessary to make a special request when booking a ticket. The company is obliged, in accordance with its procedures, to consider and assure the execution of the request.

3. QUALITY MANAGEMENT OF ADDITIONAL SERVICES

Quality management is a set of coordinated activities to direct and control an organization in terms of quality (ISO, 2015). All quality management activities are grouped into four processes: planning, control, improvement and quality assurance.

Quality planning is determining the quality objectives by examining the needs and requirements of the customers, translating them into the service specification and planning the necessary resources for the service realization. This phase of quality management includes the design of all processes by providing answers to the questions: who are customers; what are their expectations; how to meet expectations; what resources are needed?

Quality control focuses on meeting the quality requirements and includes the activities of monitoring, controlling and reviewing all activities involved in the service delivery process. It aims to realize planned, i.e., projected quality, permanently, with as few variations as possible. It answers the following questions: whether we are able to fulfill the expectations of the customer; to what extent we fulfill the expectations of the customers; whether we constantly meet the expectations of the customers; whether we are implementing preventive and corrective measures. Quality improvement should enable increased ability to meet quality requirements and involves the implementation of preventive measures for setting up and implementing a new higher quality. Answers to questions: how to improve the quality of service; how to overcome customers' expectations.

Finally, quality assurance aims at assuring that the quality requirements are met. It represents a system of policies, procedures and practices that result in a consistent service in accordance with predefined quality requirements. It is necessary to answer the question: Do we apply policies, practices and procedures?

One of the ways to assure quality is the implementation of international standards. The specific standards, guidences and guidelines developed by the IATA - International Air Transport Association apply to the airline industry. This international airline association was founded more than 70 years ago in order to help companies to cope with their processes and increase customer satisfaction with cost savings and efficiency gains (IATA, 2017). IATA develops standards, instructions and guidelines that enable airlines to safely, efficiently and economically operate according to strictly defined rules. At present, 275 airlines have IATA accreditation. With integrated quality management system and security management system, IATA provides evidence of efficient and effective business in the field of quality and safety for all interested parties.

3.1. Defining the quality of additional services

Quality is the degree to which a set of inherent characteristics of an object fulfils requirement (ISO, 2015). Based on the stated definition of quality, it is clear that the basis for defining the quality of service is to determine the characteristics of the service and the needs of the customers. Most often, this process is not easy due to the specificity of the services in terms of tangibility, durable results, quality consistency and customers' needs. Incomplete service makes it difficult to define service quality characteristics as well as to identify customer needs. The durability of the results is based on the memory and the subjective experience of the received service and can be difficult to measure. The stability of the quality of the service depends to a great extent on the competence, kindness, physical and psychological state and other characteristics of the service provider (Filipović and Đurić, 2009). To evaluate the quality of the service, the most commonly used RATER model is defined by Parasuraman, et. al. and represents an acronym of English words Reliability, Assurance, Tangibles, Empathy, and Responsiveness (Parasuraman, Zeithamel and Berry, 1988). The essence of this model is a questionnaire for the customer regarding his expectations and experience of service in relation to 5 quality dimensions (Electronic commerce group, 2017):

- Reliability - the ability to deliver the promised service in accordance with the specifications specified at a specified time;
- Assurance - having the necessary knowledge and skills to perform the service, the confidentiality and honesty of the service provider, safety (no danger, risk and doubt);
- Tangibles - the existence of physical objects, equipment, printed and video materials;
- Empathy - the effort to get to know the customers and recognize their needs;
- Responsiveness - Readiness to help customers get the service at a given moment, availability.

Below, in Table 1, we present an example of a charge service will be shown – the use of Premium lounge.

Table 1: RATER model for the use of Premium lounge

Quality dimension	Characteristic of the service
Reliability	Consistency and availability of offered content
Assurance	Ability to meet customers requirements
Tangibles	Interior design, modern technology and accessories
Empathy	Understanding customers needs
Responsiveness	Availability of staff for the sale of passes and service personnel

This example shows that the use of Premium lounge, for the quality dimension of the participation of tangible products, the characteristics of quality - the appearance of the interior, modern technology and additional equipment - derived from the question: Are the equipment and technology modern?

Through its quality research, previously, Parasuraman has developed a GAP model (Parasuraman, Zeithaml, Berry, 1985), according to which the quality of the service directly depends on the differences between the customer expectations and the achieved performances. It can be said that the quality of the service can be measured by the size of the gap between the expectations of the customer and his experience of the delivered service, that is, the quality of the service is higher if this difference is lower. The starting point for defining the quality of a service is the customer, his needs and expectations. The task of the marketing function is to research, recognize and understand these expectations, and based on that, specifies the quality of the service. The delivered service must correspond to the specified and promised service. The circle is closed by the customer and his perception of services received in the sense of meeting his expectations.

3.1.1. Understanding expectations and perceptions of the customers

Customers' expectations are not uniform, and often can not be clearly defined. It depends on the demographic, cultural, social and individual characteristics of the customers, so companies constantly make efforts to better understand and assess the needs and expectations of their customers.

Numerous studies analyze the importance of individual services for customers in the field of air transport. One of them is Hong Kong, where 26 airline services are considered (Gilbert and Wong, 2003). Customers evaluated the importance of services with ratings from 1-8, and the results showed that with the highest rating - of the highest importance for the customer - basic services: safety and accuracy in the order of flight. Additional services such as: the ability to use the Internet and mobile phones, car rentals, hotel accommodation and travel insurance are of the least importance for the customer with ratings below 5. The impact of individual services on the loyalty of the customers was also examined and presented with appropriate weighting using AHP method (0.085), leisure time (0.045), and extended service (0.044) (Tsaur, 2002). It is clear that priority customers provide basic airline services, as well as hospitality and cleanliness, while additional services are of minor importance. Nevertheless, the data on the growth of revenues from additional services and their share in total revenue shows that interest in using these services is rising, and that additional services should always be taken in account.

It is known that the price of a service affects the customer's perception of quality, and therefore his expectations. Therefore, the customer's payment ability also affects the expectations and understanding of the quality of customers. If the customer choose a lower ticket price, he decrease his expectations and accepts less benefits and lower quality. On the other hand, customers who are willing to pay extra service expect all service quality dimensions at a high level.

After receiving the service, the customer summarizes the impressions and forms a subjective attitude about the quality of the service. This attitude also depends largely on the accompanying services whose evaluation makes a difference in the perception of the quality and determines the behavior of the customers in the future in relation to the service and the supplier. The positive perception of the service has a positive impact on the evaluation of the service, customer satisfaction and the image of the airline. If the customers' perception of received service is higher than expected, customer satisfaction will be higher, as well as positive image of the airline, customers will remain loyal to the same company and recommend it to others (Park, Robertson and Wu, 2004).

It can be concluded that, in order to achieve customer satisfaction and loyalty, airlines must completely fulfill and even exceed the expectations of the customers.

3.1.2. Business system performance and service quality

One of the definitions of quality was given by Stout, which showed quality as a relationship between performance and expectations. This means that higher performance results in higher quality (Stout, 1985). The performance of the whole system depends on the performance of all of its parts. The gap model indicates the importance of all the organization's functions in the processes of defining, developing, delivering and monitoring of services, from marketing, research and development, through acquisition and quality, to service delivery. In order to minimize the gap, the system performance has to be raised to the highest level. The process of providing the service of the airline is made up of a chain of processes that relate to one another, and the successful realization of each of them depends on the realization of all others. The process success criteria are effectiveness and efficiency, and they depend on the effectiveness and efficiency of the entire business system. Process management involves clear defining of the activities, resources, and the roles and responsibilities of all employees.

The performance of service based business systems is based primarily on employees' work and their direct or indirect contact with the customer, and the competence, motivation and awareness of each individual is crucial for achieving positive business results.

In order to achieve the consistency of the service - that is, the right of every customer to receive a particular service in the same way at any time, from each employee, safely and efficiently, it is necessary to specify the service as accurately as possible and to respect all the rules and procedures for its delivery. In order to avoid improvisation each airline company develops procedures. One of the techniques for graphic overview of processes and relationships between key factors is process mapping (Mijatović, 2015) which is demonstrated through the process of receiving the request for the transport of a bicycle.

The process of receiving a request for the bicycle transport begins with customer request for transporting the bicycle to the booking service. The service receives a request and imports it in the system that checks the inventory for the received request. If it is available on inventory, the specialist confirms the request; however, if it is not available, the booking service receives information and informs the customer about it. Upon receiving the notification, the customer requests for a second flight. If there is an alternative, it resends the bicycle request and repeats the same procedure, and if there is no other flight, the process ends. Upon confirmation of the request, the specialist for this function checks the compatibility of the requirements with respect to the type of aircraft. If the dimensions of the bicycle correspond to the aircraft type specifications, the specialist confirms the request and informs the passenger about it, and if not, rejects the request and transmits the negative message. Thereby, the process of receiving the request for the bicycle transport ends.

4. THE CHALLENGES AND FUTURE OF THE SERVICE QUALITY IMPROVEMENT

The specificity of the airline's basic service related to flight safety is that it must not vary depending on the carrier. However, the economic crisis, fuel price variations, and many market participants have led to increased differences in supply and prices of additional services. The expansion of the LCC for the past 20 years has increased the competition for airlines that provide a complete service, so they often reduce the number and quality of services included in the ticket price, which leads to additional pricing of additional services. With this in mind, the size of the seat gradually decreases, so today the most extensive economy class seats in the four largest airlines are narrower than the smallest seats offered in the nineties of the last century (Wu, 2014).

On the other hand, companies that are monopolists on certain lines reduce the quality of their services (take off in time), while at the same time raising prices and lowering the quality of additional services because they do not have competition (Mazzeo, 2003). In this way, they provide themselves with great revenue because passengers do not have many options to choose air carriers.

One of the problems with additional services is the insufficient information about the possibilities and the right to use the special services of the airline.

It is estimated that the number of passengers on the global level in air transport is growing by 5% annually, and that in 2020 it will reach a figure of 3.8 billion passengers. It is therefore expected that the sale of additional services will grow. In order to meet the customer needs as fully as possible, in the race with the competition, continuous improvement and improvement of the assortment and quality of services is necessary.

Modern trends in improving the quality of additional services of airline companies are moving in two directions. Companies that base their business strategy on a low-cost model are decresasing their services

by offering passengers a minimum of service and expecting that each individual can subsequently purchase a service of his choice. On the contrary, other companies are specifically focused on adaptability to certain categories of customers. In this regard, they develop special programs in which they combine more services into special packages at lower prices (branded tariffs). Connection of optional services that airlines have previously charged separately as a la carte services with common basic services are defined as branded tariffs. The airline benefit is to increase the sales of additional services, but also to target service packages according to customer requirements. Beside the opportunity to fully satisfy customer needs, the customer benefit is ability to get discount of 10% to 12% on the individual additional. Branded tariffs enable the company's brand recognition and customer loyalty (Macnair travel management, 2017).

An example of a successful company is the Emirates Airlines whose motto is "Flexibility" and which has established high standards for all of its services, is the leader in technological innovations, and provides value-added services that are tailor-made and customer-oriented. Customers of the services of this carrier can do the check-in at the airport - at the counter, in the lounge and on the self-checking machine (Dubai airport) or via Internet and SMS. This company is a pioneer in services - fun and communication during the flight (IFEC - In flight entertainment and communication) (Anwar, Hussein, Moosa and Faris, 2012). The first class offers personal rooms with special benefits, which are considered as luxury and significantly increase the price of the tickets, and will only be chosen by more prosperous passengers. Therefore, most airlines will not include them on their regular flights. However, in order to satisfy the needs of majority, it is advisable to expand the range of services so that each passenger can choose between several options. This does not necessarily have to increase the cost of airlines.

Better customer informing includes: arranged and updated websites, transparent chargable and unchargable services, available call centers and provision of complete information by agents. Besides good promotion, it is also necessary to provide feedback from the customers. An unsatisfied passenger will almost certainly appeal to the responsible airline service, while the perception of most passengers will remain unknown to the company. In order to keep track of customer satisfaction, the passengers could fill in a questionnaire during the flight, to show their satisfaction with services. In order to improve and enhance the level of service quality, continuous monitoring and analysis of the results, is needed.

5. CONCLUSIONS

Research incorporates authors' knowledge of quality management and work experience with subject literature. This paper presents additional airlines services (both chargable and non-chargeable), methods for monitoring their quality and quality management functions of these services. The significance of chargable services for airline companies is expressed by the economic indicators of the growth of revenues coming from additional services and their share in total revenue. Considering that there is a steady increase in the number of passengers in the air transport, an increase in the sales of additional services can also be expected. Stronger competition, desire for profit and new markets are encouraging airline companies to be creative and introduce new content at affordable prices. At the same time, the development of information and communication technologies is changing the needs, expectations and demands of the customers, and airlines have to adapt and respond to these challenges.

Bearing in mind that the general trend in service activities is customization, airlines will increasingly abandon the concept of universal service and switch to service-oriented models for different target groups. Expectations and customer satisfaction must be constantly monitored and reviewed, and based on those expectations and reviews, airline companies should define and specify the quality of services. All the functions of the organization and all employees must work effectively and efficiently to meet all the goals of the organization and the quality objectives. In regard to this, continuous review and improvement of system performance is also necessary.

The aim of this paper is to point out the importance of quality management of additional services to increase customer satisfaction, resulting in a better image of the airline, retaining existing ones and acquiring new passengers. The focus of the work was on the theoretical considerations of the function and importance of quality management of additional airline services, especially for the purpose of improving quality, and the ultimate effect of this is the creation of benefits for all stakeholders of the process.

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RISK MANAGEMENT INTEGRATION THROUGH ISO 9001:2015, ISO/IEC 27001:2013 AND ISO 22301:2012 STANDARD REQUIREMENTS

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Abstract: *The main purpose of this paper is to indicate how the organization can deal with risks related to quality, information security and business continuity through the coordination of different risk management methods, and to present the importance of risk management for organizations nowadays. We analyzed the requirements of ISO 9001:2015, ISO/IEC 27001:2013 and ISO 22301:2014 related to risk management. This served to create a base for integrating the requirements of the above-mentioned standards into a simple system that helps organizations to examine and continually treat risks is shown through this paper.*

Keywords*: risk management, quality, information security, standards, integrated management system*

1. INTRODUCTION

The notion of risk, as a situation where the undesired variation from the intended outcome is possible, always exists in our environment, and for the business of today, this situation is inevitable. Risk management is reflected in the systematic prevention of occurrence of harmful events and by undertaking well-directed actions in connection with any business activity, whether financial or non-financial (ISO, 2015 a).

Risk management is an important business activity for companies of all sizes. Implementation of risk control that complies with the requirements of management systems standards is a much easier approach for the organizations. The companies that efficiently manage their risks will much more probably succeed and produce high quality products and services, aligned with its business goals.

Current trends in the field of security and quality management systems are focused on finding solutions that act preventively to losses through efficient and effective tools. Economic crises, migration and globalization have caused constant changes regarding all business dimensions and in that way force management to analyze and manage the risks it recognizes. A risk analysis based on a scientific approach, can be defined as a systematic process with iterations, that implies the assessment and interpretation of accurate information about system analysis and following identified hazards. Implicit results of the analysis, qualitative or quantitative, express the level of risk. The results help us make a decision whether the risk is acceptable or not (Pačaiova, Sinay, Nagyova, 2016).

The fact is that risk management as well as quality management is a 'journey, not a destination', and this road leads to the continual improvement of the business processes, since the creation of the term quality, to the present and in the future (Loosemore, Raftery, 2006). The management system nature is based on Deming's PDCA (Plan-Do-Check-Act) cycle which drives continual development, reviews and improvements of the system. Each review may result in corrective and preventive actions or identification of positions for risk management improvement.

The steps that risk management involves are different authors define through different approaches. For example: setting and defining objectives, forecasting, planning with decision making, obtaining resources, organization, motivation and instruction, realization, coordination, adaptation and learning (Vujošević, 2008); or for example: identification, analysis and risk control (Đapić, Lukić, Kilibarda, 2012).

For the purposes of this paper, the following processes can be singled out for each approach:
- Risk identification,
- Risk analysis and ranking,
- Risk control and
- Risk inspection and monitoring.

2. THE RISK CONCEPT IN STANDARDS FOR QUALITY, INFORMATION SECURITY AND BUSINESS CONTINUITY MANAGEMENT SYSTEMS

2.1. The Risk Concept in the Quality Management Systems

In terms of the ver growing competition on the global market, customer satisfaction is among the critical success factors for the processes related with products and services. The ISO 9000 Standard Series since the first version in 1987 have so far been developed. By collecting numerous examples from business practices, standards are expanded, revised and kept up-to-date. The famous, wise Aristotle's quote: “For the things we have to learn before we can do, we learn by doing”, completely describes the development of standards (Soyle, 1994).

In order for the user to always feel that in "safe hands" while using a particular product or service, it is necessary, in addition to the quality of the output product or service itself, to provide continuous stability and inspection of the company's internal organization. One of the cornerstones of safe and continuously business is an effective risk management that makes the quality constantly ensured.

A new version of the International Standard specifies requirements for an organization to understand its own context and to identify risks as a basis for planning. It represents the use of the new concept of ‘risk-based thinking’ in the planning and implementation of quality management system processes and helps in determining the scope of documented information. One of the key role of the quality management system is to act as a preventive tool (ISO, 2015 b).

2.2. The Risk Concept in the Information Security Management Systems

The fact is that in this so-called. cyberspace happens a lot of undesired events. The important goal of each organization is business safety, which largely depends on the protection of information property, other property and resources. Therefore, the introduction of the information security management system represents the implementation of the necessary actions to achieve a satisfactory level of information security within the organization. The emphasis is on the risk management process that accelerates the selection of preventive and corrective actions and inspections that, if properly implemented, ensure that the system evolves towards a change management system in a safe environment (Kokic, 2016).

The risk in ISO/IEC 27000 is defined as the effect of deviation from the expected and it is indicated by the level of risk that is defined as the relationship between the consequences of the risk and the probability of their occurrence (ISO, 2016). When we talk about the security risks of information, we can notice the three spheres influenced by this management system. These are: information security, information technology security, and corporate (physical) security and protection. The information security refers to all forms of data that an organization has at its disposal. It relies on the classic Confidentiality-Availability-Integrity (CIA) triad for expressing security objectives. The CIA triad was introduced in the Nineties as a multipurpose, standard way to express security requirements regarding information assets (Abdulhadi, Damiani, 2017).

The risk management is according to ISO/IEC 27001:2013 standard presented through clear requirements for risk management and different rules of conduct designed in the form of inspections presented in Annex A of this standard. The inspections in Annex A provide the correct protection and classification of information. This is also achieved through the security of information technologies that includes vulnerability management, incidents, configurations, networks, availability, back-up activities, changes, and everything related to the functional safety of computers and portable devices (ISO, 2013). Corporate (physical) security and protection is a segment that deals with the physical aspects of protection, employee checks, protection against theft, violence, sabotage and any other harmful behavior or situation.

2.3. The Risk Concept in the Business Continuity Management Systems

Business continuity according to ISO 22301:2012 represents the capability of the organization to continue delivery of products or services at acceptable predefined levels following disruptive incident. Business continuity management is defined as holistic management process that identifies potential threats to an organization and the impacts to business operations those threats, if realized, might cause, and which provides a framework for building organizational resilience with the capability of an effective response that safeguards the interests of its key stakeholders, reputation, brand and value-creating activities (ISO, 2012).

Despite the big caution imposed by quality and information security management systems, the hazards still remain present in the organizations. As much as organizations are trying to reduce the risk probability or effects to the acceptable level, those risks continue to exist. If some risk has been identified and especially if

the risk has not been brought to an acceptable level, the probability of occurrence, i.e. the realization of possible undesired outcome, still exists. When a business breaks, organizations are facing with huge financial and reputational losses.

If the interruption of the business is longer, the damage is bigger and more serious. Business continuity management systems emphasizes the need for a well-defined structure of response to incidents. This assures that when incidents occur, there are prepared plans that define the responsibilities and concrete actions that the responsible persons must undertake in order, to return the system to the normal state of functioning. Depending on which interested parties, incidents have an impact, appropriate communication schemes are also defined in times of crisis, for example with the public or state authorities (Tangen, 2012).

3. MANAGEMENT SYSTEMS STANDARDS' REQUIREMENTS RELATED TO RISK MANAGEMENT

Standards can generally be viewed as the 'best practices' of management in some business areas, resulting from the experience of dissimiliar companies with different environments and conditions, as well as detailed analyzes and requirements imposed on the market. Standards are designed to represent a set of requirements or guidance that organizations need to conform to or follow, in order to achieve the appropriate level of regulation of their business functions, such as quality management, information security, environmental protection, compliance, anti-bribery etc.

The latest versions of the management systems standards are accordance with the Annex SL High Level Structure and recommendations. According to this document, the standards must contain the scope, normative references, terms and definitions, and requirements relating to:

- Context of the organization,
- Leadership,
- Planning,
- Support,
- Operation,
- Performance evaluation and
- Improvement.

Through most of these groups it requires standards, which is especially noticeable in ISO 9001:2015, those who are related to risks are intertwined, which will be presented in this chapter of work.

3.1. Requirements Related to Risk in the Quality Management Systems Standard

In the ISO 9001:2015 standard, requirements related to risks and opportunities are interwined across all clauses of the standard to a greater or lesser extent. Below are the locations in the standard that mention the risks:

Table 1: Requirements related to risk in the ISO 9001:2015

Clause	Title	Description
0.3.3	Introduction	▪ Describes the concept of risk-based thinking.
4	Context of the organization	▪ The official request for actions concerning risks and opportunities is directly addressed to this point.
5	Leadership	▪ It is required to promote the concept of risk-based thinking throughout the organization by the top management. ▪ It is required to determine the risks that affect the conformity of the product/service by the top management
6	Planning	▪ The organization is required to consider issues relating to the context and interested parties, and in accordance with that, determine the risks and opportunities to deal with, as well as to apply and evaluate the effectiveness of risk-related actions.
7	Support	▪ The organization is required to identify and provide the necessary resources, taking into account the inherent risks and limitations.
8	Operation	▪ It is required to apply actions to prevent human fault.
9	Performance evaluation	▪ It explicitly requires the establishment of actions relating to risks and opportunities.
10	Improvement	▪ It is required that the organization, if necessary, again review and update the risks and opportunities it identifies.

Requirements 4 and 6 represent the most important risk-related requirements. In Clause 6 – *Planning* specify that the organization must plan risk-related actions, however, there are no requirements relating to formal risk management methods or a documented risk management process. The organization is responsible for the implementation of its *risk-based thinking* and for the actions that it undertakes to deal with risk, including whether it keeps or does not keep documented information as evidence of its risk assessment.

The Clause 4 entitled '*Context of the organization'* is another novel concept in the new version of the standard for quality management systems. We note that before the requirements are complied with, at the very beginning of the reading of the requirements of the standard, there is a need to identify the organizational environment, but also all internal issues. Also, at the outset, it is necessary to identify all the interested parties that have an impact on the organization, in order to meet their requirements faster and faster. To apply this requirement, there are multiple methods, the choice of which, depends on the type and size of the organization.

In the light of fullfiling requirements about Context of the organization must identify internal and external issues that may affect the effectiveness of the quality management system. This means that these issues are subsequently used for the purposes of defining actions that address risks and opportunities.

3.2. Requirements Related to Risk in the Information Security Management Systems Standard

Standard ISO/IEC 27001:2013 is developed as a set of requirements, which are very similar to those for quality management systems due to the compliance of the Annex SL. Many clauses have the same title as the ISO 9001:2015 standards' clauses, but they refer to the consideration of these topics in terms of information security. Also, besides the requirements (clause and subclauses), there is a Annex A with a large number of inspections related to information security. Below is a summary of the ISO/IEC 27001:2013 related risks (ISO, 2013):

Table 2: Requirements related to risk in the ISO/IEC 27001:2013

Clause	Title	Description
4	Context of the organization	▪ Determining internal and external issues relevant to the information security management system refer to ISO 31000:2009 for risk management systems; ▪ The organization is required to identify interested parties relevant to the information security management system.
6	Planning	▪ It is required that the organization defines and applies the risk assessment process for information security; ▪ It is required that the organization defines and applies the risk-based process for information security based on the results of risk assessment.
8	Operation	▪ It is required that the organization defines and applies the risk-based process for information security based on the results of risk assessment.
	Annex A	▪ Inspections and goals related to documented information, information technology and physical security.

Clause 4 - *Context of the organization* is very similar to that of ISO 9001:2015, while clauses 6 - *Planning* and 8 - *Operation* are the remaining clauses that mention risks, by requiring a clear process of assessing and handling risks that are not explicitly exist in ISO 9001:2015.

Assessed and analyzed risks should be compared with those inspections and their objectives from Annex A and link them with the impact on the relevant information property that the organization owns. If the identified risk coincides with one of the inspections or can jeopardize the realization of any of the stated objectives, the actions to mitigate this risk must include all those standards specified in this inspection. In other words, the action will include at least the one that requires the appropriate inspection in Annex A.

3.3. Requirements Related to Risk in the Business Continuity Management Systems Standard

Although ISO 22301 also has the structure prescribed by the Annex SL and a large number of the same requirements as the previous two analyzed standards, it is important to note the requirements related to risks that this system will emphasize in an integrated management system. The most specific requirements that complement the risk management projection in relation to ISO 9001 and ISO/IEC 27001 are contained in the

Clause 8 - *Operation*. These requirements, as well as other generic requirements in which the aspects of business continuity are stated, are explained in the following table (ISO, 2012):

Table 3: Requirements related to risk in the ISO 22301:2014

Clause	Title	Description
4	Context of the organization	The organization is required to identify interested parties relevant to the business continuity management system.
5	Leadership	Management must demonstrate its commitment by participating in: – defining the criteria for accepting risks; – testing of Business Continuity Plans;
8	Operation	This clause of the standard explains in detail that it is necessary: – implement an impact analysis on business; – implement risk assessment and ranking; – define a business continuity strategy based on the results of the impact analysis of threats to business, as well as to provide all necessary resources for the implementation of this strategy, and then implement actions that reduce the probability of termination of business, shorten the interruption period or limit the termination of business; – establish procedures and Business Continuity Plans that respond to potential incidents and business disruptions; – implement regular testing of Business Continuity Plans.

It is particularly interesting to point out that the inspection A.17 *The aspects of information security* in business continuity management in Annex A of ISO/IEC 27001:2013 is very familiar with this standard because it requires information security continuity to be embedded in the organization's business continuity management systems. This inspection further requires: planning the continuity of information security, implementing the continuity of information security through appropriate processes and documented information, and conducting verifications, reviewing and assessment the continuity of information security (ISO, 2013).

4. RISK MANAGEMENT INTEGRATION

How to start the implementation of the management systems and how to integrate multiple management systems at once? The answer to the question is an *integrated management system*. The preceding chapters of this paper have analyzed the requirements of the standards for quality management systems, information security and business continuity. Although all these standards are the same in structure, we paid attention to the places with emphasis on risk management i.e. which requirements related to risks are specific to ISO 9001, ISO/IEC 27001 and ISO 22301.

Integration of the management systems implies the upgrade of one management system with another, precisely those aspects that are unique to that management system. The essence of this paper is the integration of risk management in standardized management systems, and in this chapter, based on the analyzed requirements of three standards for management systems, will be presented the way in which risk management can be applied in the organization of any type, so that it meets the requirements of the three International standards.

The following are the aspects that need to be addressed in the implementation of risk management, in accordance with the requirements of ISO 9001:2015 for quality management systems, ISO/IEC 27001:2013 for information security management systems and ISO 22301:2012 for business continuity management systems:

Table 4: The main aspects of risk management for integration of standardized managements systems

ISO 9001:2015	ISO/IEC 27001:2015	ISO 22301:2012
Context of the organization	Context of the organization	Context of the organization
Risk-based thinking	CIA triad	Implementation of Business Impact Analysis
Risk consideration related to interested parties and stakeholders	Evaluation of probability and consequences of risks	Implementation of business continuity strategy
Risk consideration related to processes	Application of risk treatment plans and inspections from Annex A	Implementation of Business Continuity Plans

We can see that the basis for integration is to determine the context of the organization, in particular, its internal and external environment and interested parties in relation to quality, information security and business continuity. If we look at risk management separately from the implementation of the overall management system, it can be said that establishing the context of an organization is the starting point of the risk identification step.

It can be noted that when the requirements of the ISO 9001:2015 standard are fulfilled, the risks remain only upgraded by looking through information security and business continuity, by evaluating their likelihood of occurrence, consequences and impact on business, defining the way of risk treatment, and determining special treatment of risks that jeopardize the continuity of business and determine the manner in which it is handled if the risks are realized. In the continuation of this chapter, analyzes are proposed that can support this way of integrating risk management.

4.1. Implementation of Integrated Risk Management

Risk identification is the initial and at the same time the most difficult phase of risk management. As an initial method of identification, a *brainstorming* method can be used to identify the risks, associated with the quality, effectiveness, and efficiency of the implementation of the process, together with the owners and executors of the process. In the identification step, it is important to generate as many ideas as possible regarding potential unforeseen situations, whether they have already occurred or are likely to occur, by looking at the results of the SWOT and PEST analysis, but also by using benchmarking. Sometimes it is difficult to identify risks related to information security and business continuity without a person who has expertise in those fields, and in that situation as a help we can use, a risk assessment matrix created and filled out by an expert for information security. For identifing risks related to business continuity, consultations with the physical-technical protection manager, corporate security specialists or employees in charge of evacuation and fire protection are needed in order to define general business continuity risks.

The step of risk analysis and ranking usually consists of assigning a qualitative description or quantified value to the identified risks. The risk analysis is the fundamental of the FMEA method. This method represents structured approach to risks and thus helps system designers understand the outcomes and priorities even before the formal completion of an analysis risk (Jenab, 2015). FMEA analysis is often used to detect possible causes of a technical and technological nature, but has recently been recognized as suitable for the analysis of the cancellation of various types of systems related to the providing of services. If there is any system like the quality management system, FMEA analysis can be applied. In the risk analysis step, it is most important to clearly identify the scope and significance of risk assessments in order to obtain as precise results as possible. In this step, it is also possible to join the Business Impact Analysis by looking at its results and deciding what needs to be done as an activity to combat these risks.

Risk control should answer the following questions: How can positive effects be strengthened? How to reduce or prevent unwanted effects on the desired result? The management of the organization should determine how to deal with the analyzed risk, i.e. which risks will be accepted and for which they will define and implement certain actions for their suppression. For risks related to the security of information, according to the requirements of the standards, it is necessary to develop Risk Treatment Plans, and for the risks that cause a business stoppage, it is necessary to develop and regularly test the Business Continuity Plans.

Risk inspection and monitoring should respond to the question of how the organization evaluates the effectiveness of the actions undertaken in the risk control phase and how the organization can achieve continuous improvement in risk treatment. It is precisely this step that relates to the identification of new and revaluation old risks in order to assess the effect of the conducted action and, if necessary, define additional or correct the already established actions. The following is an overview of a possible combination of tools and methods by which integrated risk management can be applied:

Table 5: Useful tools and methods for the implementation of integrated risk management

	Quality management system	**Information security management system**	**Business continuity management system**
Risk identification	SWOT, PEST(EL), Brainstorming, Benchmark	SWOT, PEST(EL), Brainstorming, Benchmark,	SWOT, PEST(EL), Brainstorming, Benchmark,
Risk analysis and ranking	FMEA worksheet (analysis)	FMEA worksheet (analysis)	FMEA worksheet (analysis) Business impact analysis
Risk control	FMEA worksheet (actions)	FMEA worksheet (actions) Risk Treatment Plans	Business Continuity Plans

Risk inspection and monitoring	Monitoring the implementation of the actions from the FMEA worksheet (actions); restarting the risk identification process	Monitoring the implementation of the actions from the FMEA worksheet (actions) and implementation of the Risk Treatment Plans and their correction; restarting the risk identification process	Monitoring the implementation of Business Continuity Plans; restarting the risk identification process

4.2. Obstacles for Implementation of Risk Management

Until we achieve the benefits of risk management integration, many problems can arise during its implementation. When we talk about the information security management system, there are many aggravating occasions for its effective implementation. It often happens that there is a lack of expertise and competencies, necessary to deal with information security at all hierarchical levels of the organization, while imposing constant changes in the form of restructuring, merging organizations, various acquisitions and alliances. Each of these changes has a major impact on the security of information (Asheden, 2008).

In order for organizations to understand the importance of dealing with risks at all, it is necessary to create an appropriate internal culture, that is often very difficult to achieve. It develops in line with the behavior of employees and their awareness of risks, in the same way that organizational culture develops in accordance with the behavior of employees in the organization. It is based on the interaction of employees with information property and the safe behavior they implement in the context of organizational culture. For the purposes of this paper, a culture of risk is defined as habits, assumptions, principles, values and knowledge that employees and stakeholders have in interaction with the organizational system and procedures at any time. From interaction arise acceptable or unacceptable behavior (e.g. incidents). The culture of risk and information security comes in time (Da Veiga, Eloff, 2009).

Of course, for many organizations there is a problem of lack of time for systematic risk management, resulting in misinterpretation of risk management at different hierarchical and organizational levels.

4.3. Benefits of the Implementation of Risk Management Integration

Implementation of a quality management system requires the organizations to plan their steps carefully with consideration of all factors that can disturb efficient business processes and thus reduce the quality of final products and services. Implementation of the information security management system improves the quality of the information system and information security in general, and raises awareness of safety among employees, customers, suppliers, etc. It also contributes to a better integration of information technology with business (Pelnekar, 2011).

The business continuity management system assures that organizations are always ready for a quick response and return to operational conditions if incidents that have interrupted business happen. Planning and testing of Business Continuity Plans are the activities that employees learn to react in emergencies, and therefore, they more easily handle crisis situations.

If an organization wants to benefit more from the management system, it should understand that their implementation is influenced by the business strategy, the size and structure of the organization, the environment and changes in the environment as well as the risks that arise from the organization's internal and external environment (Kaziliunas, 2012). Thus, the risk management integration related to quality, information security and business continuity gradually becomes part of every business segment.

The principle of risk-based thinking becomes part of everyday activities, different projects, organizational changes and control over any type of resource. This means that employees become aware of the risk of the listed business segments in relation to quality, information security and business continuity. In this way, activities and resources are protected, while barriers that can deter organization from reaching set goals are considered.

5. CONCLUSION

We can conclude that risks have become one of the key roles of business quality. After considering the notion of risk management from different sides, risk management steps are presented, which are very close to the fundamental management steps and the famous Deming PDCA cycle.
Meeting the requirements for quality management systems standards creates the fundamental for upgrading the system to the aspects of information security management. By analyzing the requirements of the

standards for Information security management systems it can be concluded that they can easily be complemented by requirements for Business continuity management systems. This provides an indication of how the risk management required by these three standards can be integrated into an effective and efficient system by selecting appropriate tools and methods for its implementation. The FMEA method is proving to be very efficient and effective when used with other tools such as SWOT, PEST, brainstorming, benchmarking, Risk Treatment Plans for Information security and Business Continuity Plans.

The initial point of the quality management system, information security and business continuity (as well as other management systems) is *the context of the organization*, which examines everything on which the business of an organization is based and what it surrounds. With a higher level of integration of the quality management system, information security and business continuity, a modern framework for safe and secure business is being created.

Organizational culture based on awareness of the importance of security and safety, will reduce the risks to quality, information, bad behavior and harmful interaction with information property and inadequate handling in emergencies. It is necessary to present the first effects of such a system in the right way to the employees. Once employees understand that risk management is not a burden, but simply helping to raise their daily work to a higher level, then it is possible to talk about the effective implementation of risk management.

By cyclical repetition and continuous improvement of actions and methods, we have proved that risk management is a 'journey, not a destination'. Risk management is to be 'built-in' in every business process, and it teaches employees to think ahead, which speaks of its necessity for business. By integrating the requirements of standards for quality management systems, information security and business continuity, a holistic system is provided that is capable of predicting and responding to an organization of any kind on the risks that can occur inside or in its surroundings.

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THE SOFTWARE IMPLEMENTATION OF THE PROTECTION MEASURES OF INFORMATION IN THE BANKING INFORMATION SYSTEM

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Abstract: *The ISO 27001 standard is a significant standard for organizations dealing with services in areas that are related to Information Technology and the need to preserve confidentiality of information. Implementation of the system of protection and security of information provides conviction to the clients and business partners of the organization to be accountable according to the information. Examples of organizations that pay tremendous attention to data security, and in which the ISO 27001 standard is applied, are banks and other financial organizations. This paper deals with the software implemented measures for ensuring data security and the original privacy protection measures for users of the bank's information system.*

Key words*: ISO Standard 27001, Information security management system (ISMS), Security Information, User privacy protection,The Banking Information System*

1. INTRODUCTION

Information security is becoming increasingly important in modern society. Modern state and business entities are increasingly dependent on information and communication infrastructure that allows the flow of large amounts of information between entities, thus providing information and information systems to numerous attacks and abuses. The concept of security of information includes the following types of protection measures:

- Technical protection measures - use passwords, encryption, access rights, network security, and more;
- Administrative protection measures - include security policies, bylaws, procedures harmonized with laws;
- Physical protection measures - include video surveillance, room protection, physical access control;
- Organizational measures - include the division of duties and responsibilities for security, and for human resource management, and others.

All these protection measures include the ISO 27001 standard. When talking about this standard, information is primarily meant as they represent the core business of the largest number of companies in the present day. Information can be created and used in various forms: written on paper, in electronic form, sent by class mail or by electronic means, mentioned in the conversation, and the like. Information protection is necessary because there are threats to information assets from various sources. These sources of threat may be internal, external or incidental, and increasingly threats arise from the abuse of new powerful technologies. Exactly the ISO 27001 standard offers the ability of the organization to effectively and efficiently manage risks due to the likelihood that a threat will exploit existing information system problems and do damage.

Organizations that provide their services using information technology are undoubtedly interested in the ISO 27001 standard. Banks, insurance companies and other financial institutions are the real example of organizations whose business activities have IT support. In addition to physical, organizational and administrative measures that imply the ISO 27001 standard, it is obvious that, due to financial information in the banking information system, banks will be most interested in the application of measures to protect this information that the software should provide.

In this paper, attention will be given to software implemented measures to achieve the security of financial information, as well as to protect the privacy of the users of the information system of the bank.

2. ISO STANDARD 27001 AND SECURITY INFORMATION

In the era of current information technologies, information is not only easily accessible but also very "vulnerable". This particularly applies to information of a confidential nature. Today, when almost complete business, from production organizations to banks, is done through specialized information systems, information security becomes very important. In accordance with the security of information, a whole series of ISO 27000 standards are developed that closely define requirements, methods, controls and processes

processes and activities related to the security of information within the organization. In addition, ISO 27001 is one of the most important standards in this series because it defines the requirements for the Information Security Management System. As such, it is applied in all organizations that want to provide their information systems and information for which their security is guaranteed.

Benefits and advantages that the organization can achieve by implementing the ISO 27001 Information Security Management System are:

- evidence of compliance with the requirements of ISO 27001;
- compliance with the best practice of risk management, in accordance with ISO 31000 and ISO 27005;
- Compliance with laws;
- establishing a framework for systemic protection of information resources from malware software, computer abuse, cybercrime and other negative impacts;
- improving credibility among staff, clients and partner organizations;
- the financial benefit of returns through investment in information security;
- Improving the sales of services by raising the level of customer confidence;
- practical decisions relating to security techniques and development solutions;
- the existence of responsibility for the security of information in the organization by all and at all levels;
- better market opportunities by introducing a safer environment for customer data and the knowledge that the organization is exposed to competent assessment.

The official name of the ISO 27001 standard is ISO / IEC 27001: 2013, and in Serbia the official name is SRPS ISO / IEC 27001: 2014. The standard is part of the 27000 series. ISO 27001 is an international standard that relates to the protection and security of information. The Standard provides a comprehensive framework through which an organization identifies, analyzes and addresses security risks of information and ensures compliance with security arrangements in order to keep pace with changes in security threats, vulnerabilities and business impacts. ISO 27001 provides the framework that is necessary to create a secure system. The ISO 27001 compliant system will provide a systematic approach to identify and combat the full range of potential risks to which the organization's information is exposed. It defines four main areas of the information protection system with its requirements:

- Information Security Management System (ISMS)
- Responsibility of the management
- Rating of the management
- Improving the ISMS.

ISO 27001 is a specification of the information management system (ISMS). ISMS is a framework of policies and procedures that includes all legal, physical and technical controls involved in the organization's risk management processes. According to his documentation, ISO 27001 was developed to "provide a model for the establishment, implementation, operation, monitoring, review, maintenance and improvement of information security management systems". ISO 27001 uses a top-down, risk-based approach and is neutral in technology. The specification defines a six-part planning process:

1. Defining a security policy
2. Defining тхе ISMS scope
3. Conducting a risk assessment
4. Management of identified risks
5. Selecting the control objectives to be implemented
6. Preparing a statement of applicability.

The specification includes: documentation details, management responsibility, internal audit, continuous improvement, and corrective and preventive action. Standard requires co-operation between all parts of the organization. The ISO 27001 standard is comprehensive because it treats information security from three aspects:

- informatics - analyzing and defining the performance of IT equipment, access rights, encryption, passwords, protocols, policies from the point of view of risks to data and information security;
- administrative - defining clear instructions, policies and procedures for generating information, their distribution, storage (storage);
- physical - physical access control, employee records, video surveillance, workstation protection.

The Standard treats information as asset and provides basic guidelines for its preservation, safe management and use. Like most other standards, it is compatible with ISO 9001 but specifies additional requirements for identifying information security risks and establishing mechanisms to eliminate or reduce them to an acceptable level. Implementation of the system of protection and security of information provides conviction to clients and business partners to act responsibly according to information and to use them and distribute them professionally and safely.

ISO 27001 is also compatible with ISO 22301: 2012, in Serbia officially SRPS ISO 22301: 2014 - Social Security - Business Continuity Management Systems - Requirements, which refers to the identification of potential threats per system and which through the established business continuity management system aims to protect the company from potential threats, reduce the likelihood of termination of business, prepare for adequate response if it comes and provide appropriate recovery plans. The incidents covered may range from the sudden break of the IT system to natural disasters and terrorist attacks.

3. UTILIZATION OF STANDARD ISO 27001 IN THE BANKING INFORMATION SYSTEM

The ISO 27001 standard applies in various areas where there are different processes in the organization that are related to security management control such as: security policy, security of organization, control and classification of resources, staff security, security of material goods and the environment, operational management and communication, access control, development and maintenance of various systems and business continuity management. ISO 27001 can be implemented in any organization, profit or non-profit, private or state, small or large. It was written by the world's best experts in the area of information security and prescribes a methodology for the application of information security management in an organization. The organization receives a certificate or certificate that the organization has implemented information security in accordance with ISO 27001.

The ISO 27001 standard is important for organizations that rely on information technology in their business. In these organizations, the basic goals of introducing standards are:

- continuous availability of IT equipment and communications
- protection of information from unauthorized access
- protection of data from loss
- protection against leakage of information
- to ensure business continuity and provision of services in the event of an unforeseen event.

Information protection through the ISO 27001 standard will enable organizations: establishing correct account settings, controlling access to information, controlling network services, securing personal data protection, and securing media protection with transit data.
Implementation and application of ISO 27001 standards allow for better cooperation with similar organizations around the world operating under this model. This standard of organization demonstrates to its users and other stakeholders that they work with business processes based on the principle of security and that business policy is focused on continuous improvement in the information management system and the services related to its services. The benefits of the organization are reflected in the following:

- competition advantage
- reducing the risk of damage and loss of information, and therefore costs
- compliance with applicable legal regulations
- greater confidence of clients, employees, associates, institutions and all stakeholders due to the knowledge that their data is safe
- the existence of responsibility for the security of information by all and at all levels of the organization.

Implementation of the system of protection and security of information provides conviction to clients and business partners to act responsibly according to information and to use them and distribute them professionally and safely. For all these reasons, the ISO 27001 standard is applicable in banks and other financial institutions.

Due to the specific financial nature of the majority of the data in the information system, huge attention is paid to the security of data in both data transmission and access to data and their modification. Priority information security measures in the bank relate to security measures such as encryption of information, regulation of data access rights, network security and others, but at the same time implies the implementation of administrative, physical and organizational measures. The Assembly of the Republic of Serbia, by harmonizing Serbia's legislation with the legislation of the European Union, adopted a set of laws related to information security:

1. The Law on Personal Data Protection
2. The Law on Secrecy of Data
3. The Law on the Keeping of Business Secrets.

In accordance with the Law on Secrecy of Data, the Government of the Republic of Serbia adopted a Decree on special measures for the protection of classified information in information and telecommunications systems. Article 10 of this Regulation explicitly states that in order to maintain the security of the system during its use, the public authority or legal entity shall implement the implementation of new technical and

program resources in the system in accordance with the relevant technical standards SRPS ISO / IEC 27001. Therefore, information protection is in accordance with the ISO 27001 standard, and the basic and most reliable way of implementing information security measures in the bank is just programmatic.

4. THE SOFTWARE MEASURES TO PROTECT INFORMATION IN THE BANK INFORMATION SYSTEM

Software solutions for data protection measures follow the modern accelerated development of information technology. The most up-to-date solution for the platform model of the Bank's information system is Hadoop in Cloud, Hadoop as a cloud service.

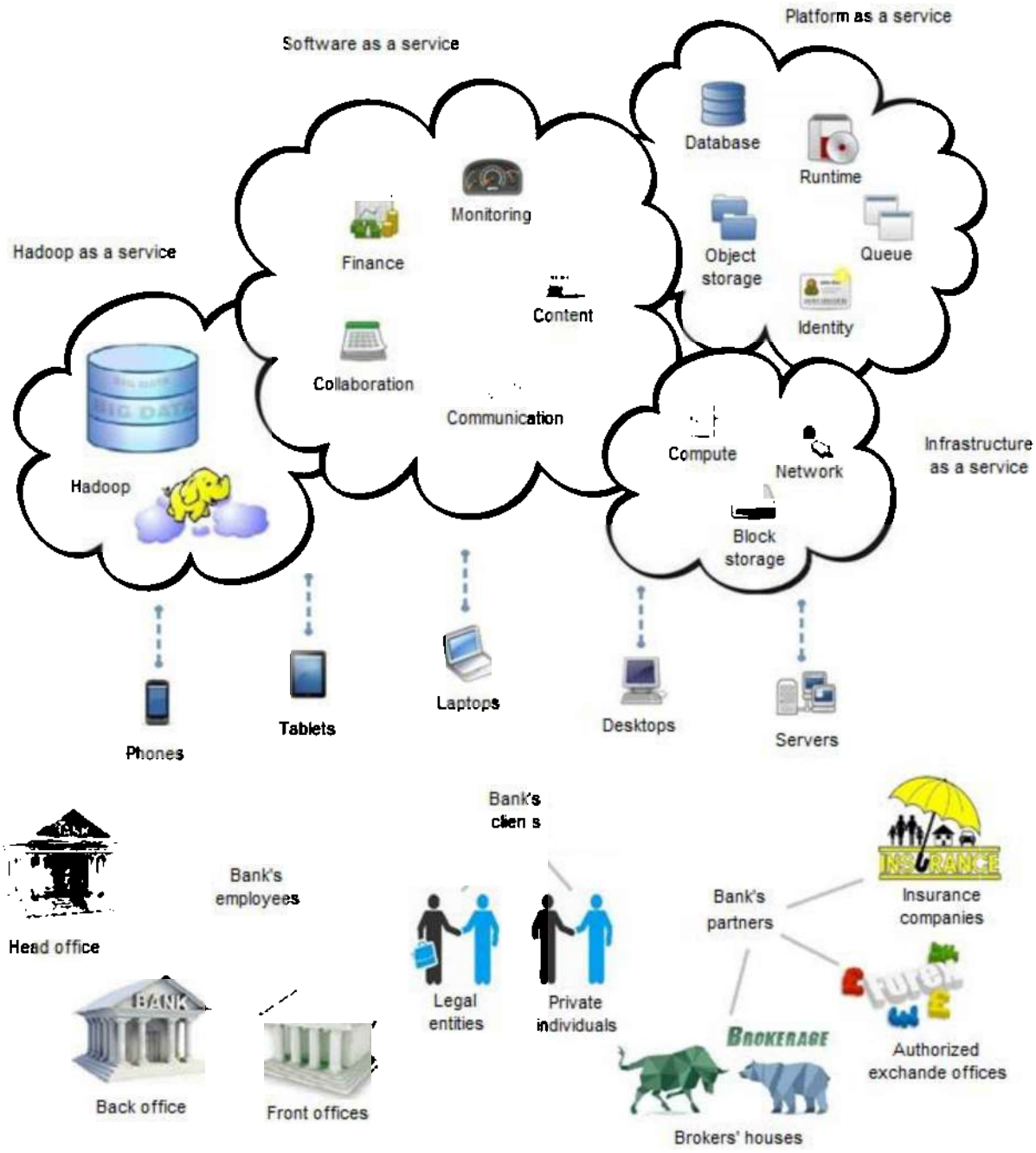

Figure 1: Hadoop in cloud as a solution for an IT banking platform

Hadoop Cloud technology ensures the placement of large amounts of crews in cloud computing clusters as well as rapidly distributed processing of these data, with software and infrastructure and platforms in the remote cloud of the provider, i.e. vendora. With the appropriate infrastructure in the cloud, users come to

access the information system in a modern way using smartphones, tablets, laptops and other modern devices. The customers in the bank are: bank clients (legal entities and private individuals), bank partners (insurance companies, brokers, authorized exchangers and others) and bank employees - at front offices, back office and bank management (head office) A cloud cloud with services as an IT platform for the bank's information system is given in Figure 1.

If the Hadoop in the cloud is selected as the IT platform solution in the bank, it is necessary to consider also which cloud model to decide - for a public, private or hybrid model. Choosing a cloud model also means ensuring data security and user privacy. The decision on the choice of cloud models is made by a commission comprised of representatives of the following organizational parts of the bank:

- Executive Board
- Information Systems Division
- Department of Security
- Department of Legal Affairs
- Financial Division.

Bearing in mind the financial nature of data in the banking information system and even that most important data should be stored privately in the bank, and also having in mind that due to the need of users of some application can be publicly available to the clients of the bank, it is undoubtedly that the hybrid model clouda a solution for choosing a cloud model. The hybrid model will integrate the internal part of the private cloud of the bank in which the important bank data is located, and the external part of the public cloud in which certain client applications will be specified. The merging of these two parts is shown in Figure 2.

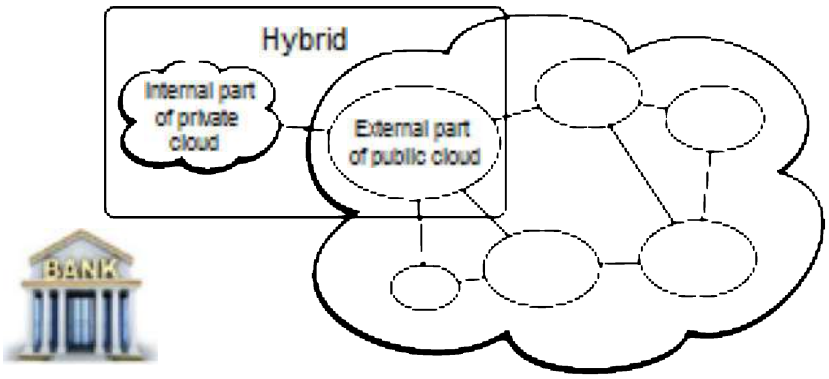

Figure 2: Hybrid cloud as a choice of cloud models for the banking information system

The business data model in the bank implies the following data groups:

1. Clients
2. Organizational structure and employees
3. Market data
4. Segmentation and rating of clients
5. Loans
6. Accounts
7. Collaterals
8. Derivatives and Repo
9. Limits
10. General Accounting and Profits & Losses
11. Cache flow
12. National and international payments
13. Security
14. Financial information
15. Regulatory reports.

These data are allocated to the internal part of the private cloud and to the external part of the public cloud, and the allocation is under the responsibility of the Finance Department. Obviously, for example, data from all bank strategies will be secure in private cloud, for example. data on the bank's product sales campaigns for customers will be secure in the public cloud. Data groups are deployed in the confidentiality classes defined by the Department of Security. Based on the confidentiality class, it is known which data is stored in a public cloud, and which is in a private cloud. The confidentiality classes are: (1) Public data, (2) Internal data, (3) Confidential data and (4) Strictly confidential information. Preservation of data security and user

privacy is regulated by program implementation of measures for achieving data security and privacy protection of users.

4.1. Data security

Data security is achieved by program implementation of data encryption when data is transmitted, when the data is made by the data transmitted from the bank to the cloud and from the cloud to the user, both in reverse and in data restraint, at the following levels: the application level, the level of the Hadoop Cluster, and the file level, i.e. level Hadoop Distibuted File System (HDFS).

Data encryption uses different algorithms from simple to cryptographic algorithms such as:
- Symmetric algorithms
- Asymmetric algorithms
- Cryptographic functions for compression - hash functions
- Digital envelope, digital signature, digital stamp and digital certificate.

4.2. User privacy protection

Users' privacy to access cloud applications would be provided by introducing programmatic measures such as, for example:
- authentication of bank clients when using applications via the Internet;
- assigning passcode to the bank partners (brokers, authorized exchangers, authorized appraisers from insurance companies and others) for authentication during Internet access to the information system;
- Authentification of employees both at the level of the operating system and at the level of each application from the information system.

5. THE INFORMATION SECURITY IN THE BANKING INFORMATION SYSTEM

Information security should also be provided when storing data while transferring a transfer between the bank and the cloud, and vice versa. Significance depends on the following information properties that are also requests for information:
1. confidentiality
2. integrity
3. availability
4. authenticity
5. intolerance
6. authorization.

There are three general categories of cryptographic algorithms that are used today in database systems - symmetric algorithms, asymmetric algorithms, and hashing algorithms, and a more specific category of hybrid algorithms: Digital envelope, digital signature, digital stamp and digital certificate. Symmetric algorithms use the same key both for encryption and decryption of data. Equivalent names for symmetric algorithms are: conventional, secret key, classical, and private key algorithms. The most well-known symmetric cryptographic algorithms are Data Encryption Standard (DES) and Advanced Encryption Standard (AES). Unlike secret keys with one shared key, asymmetric algorithms use two keys. One of the keys is public and other secrets. These algorithms are also called public key algorithms, and their operating principle is as follows: based on the secret key assigned by the recipient, a public key is generated. Known as cryptographic asymmetric algorithms are: RSA, ElGamal, i Diffie-Hellmann.

Cryptographic functions for compression - hash functions are categorized into cryptographic algorithms without a key. Hash function denotes a function that compresses an array of data of arbitrary length into a fixed-length data set. Hush functions are used to protect the integrity of the data and work on the following principle - when the new data is received, it is hacked and then compared to the original hash value. The hash function is used as an accessory, for example, when saving passwords in the database. The famous hash algorithms are, from the older ones - SHA-1 and MD5 algorithms, and the newer ones - SHA-224, SHA-256, SHA-384, and SHA-512. Given which data is encrypted and at what level encryption is performed, there are different types of encryption that are applicable in the protection of the database system, and accordingly the following division:
- encryption for data protection during transmission
- encryption for data protection during hibernation:
- encryption at application level
- encryption at the database level
- encrypting the file.

Data encryption during transmission protects data on the way from bank to cloud and from cloud to user, and vice versa. Data transfer is done via the Internet or via wireless networks. Encrypting data during transmission is necessary to prevent the content of the message after the interception of traffic is detected. This encryption type is most used in data protection since it does not bind to applications and requires minimal development efforts. There are different security protocols for this type of encryption, such as: SSL (eng. Secure Sockets Layer), TLS (eng. Transport Layer Security) and IPSEC (eng. Secure Internet Protocol).

Encrypting data that is idle is the encryption of information in warehouses, i.e. clusters of computers. In this case, there are three most commonly accepted encryption methods: at the application level, at the database level, and at the file level. An example of the most basic protection of information by software at the application level is data masking. Banking ISs usually mask the amounts, bank identification numbers of the bank's clients, their card numbers and others. In Figure 3, a screen display is displayed on which the client card numbers are masked. The procedure for masking the card numbers is software solved by placing six '*' characters from the seventh position in card number data. In Figure 4, there is a screen display of the application where the amount for the premium client is masked. The masking of the amount is software implemented by setting the black color for the color field property for the amount.

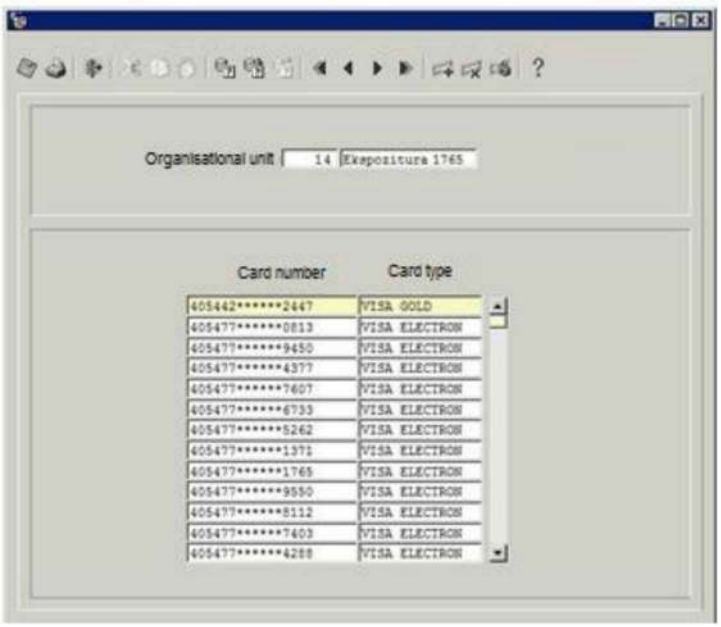

Figure 3: Standard masking the data Card number in banking information system

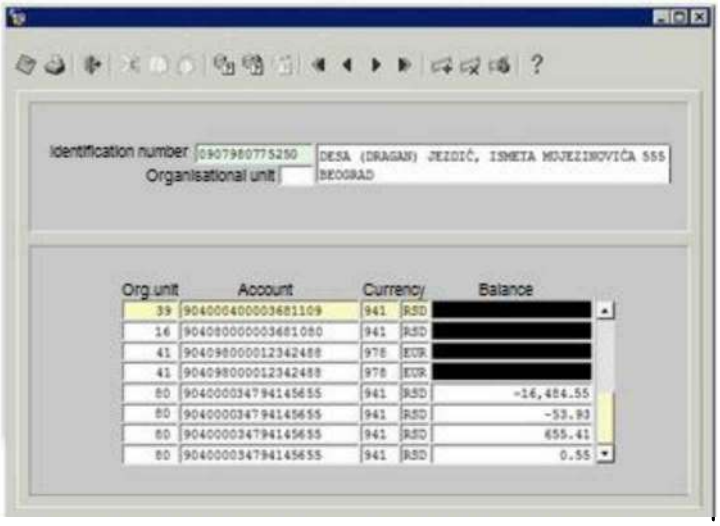

Figure 4: Standard masking the data Balance in banking information system

6. PROTECTION OF USERS' PRIVACY IN THE BANKING INFORMATION SYSTEM

The users of the bank's information system are bank clients, bank partners and employees of the bank. The policy of access control to the system over the Internet, in terms of user recognition, is realized through software implemented user authentication. Each user is embedded in a unique client record. When tricked, the user gets a unique combination of two data code and password, which he can later change in the system. User authentication is accomplished by a program test whether the combination of these two data, which the user has entered, is the same as an existing combination in the system. If it is, it is considered that the authentication is successful and the user is identified by withdrawing his name from the client's records, otherwise authentication is considered unsuccessful. Further work of users in the information system is done in accordance with the set of privileges it has to perform banking activities.

Interesting is the additional authentication of the bank's partner when they access information in the bank by telephone by interviewing a bank employee. In this case, for reasons of safety, measures are taken to record a telephone conversation and program the user's recognition by the employee. This situation occurs in the bank every morning on a business day, when authorized exchangers and partner companies who perform dealer business and who use the money from the bank's vault for these jobs, contact the employees in the bank, ie the dealers in the bank, and ask for a sales course and a purchase the rate that the bank has internally adopted for the current day.

The original software-implemented authentication of authorized external dealers consists of generating a password, i.e. passcode for each external dealer and checking the pascode at the beginning of a telephone conversation between an external dealer and a bank dealer. Passcode is a unique alphanumeric data of a certain length and consists of large letters of the alphabet and digits, excluding the letter 'O' and the digit '0' in order to avoid possible confusion when writing these two signs. The bank automatically generates a bank account for each external dealer and sends it to him at the address he applied to the bank. An external dealer can be a partner company or a currency exchange office. Each company gets its own unique passcode. The exchange office has one or more exchange offices located at different addresses. In agreement with the exchange, it is decided whether the same exchange rate will be assigned to all exchange offices of that exchange office, or a different board will be generated for each exchange point. In a telephone conversation initiated by an external dealer, the bank dealer pays an ex-dealer for his passcode. When an external dealer announces a passcode, a bank dealer in the system on the basis of that passcode recognizes which external dealer is working and tells him the information stored for him. In Figure 5, a screen display for generating a passcode for an external dealer firm is given. In Figure 6, a screen display for generating a passcode for an authorized exchange office is given, in the case where different passcodes are generated for all of its exchange sub offices. On the screen display there is a radio group that defines whether the exchange sub offices will have the same passcode or different passcodes. In Figure 7, a screen display is used to identify an external dealer, whether it is a dealer firm or an authorized exchange.

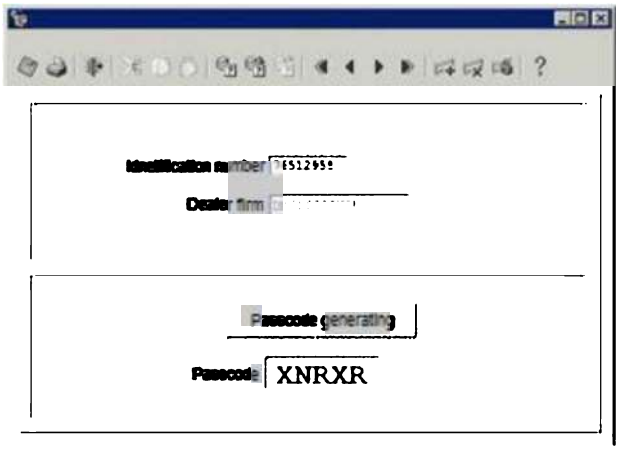

Figure 5: The passcode generating for externel dealer firm

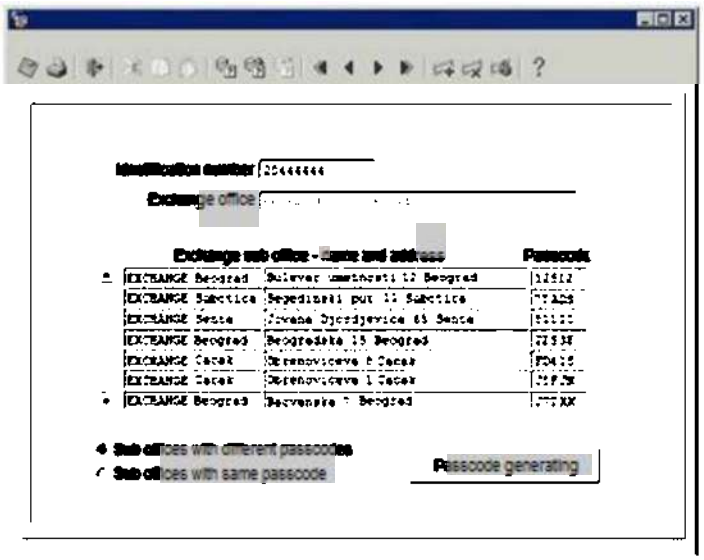

Figure 6: The passcode generating for exchange sub offices of exchange office

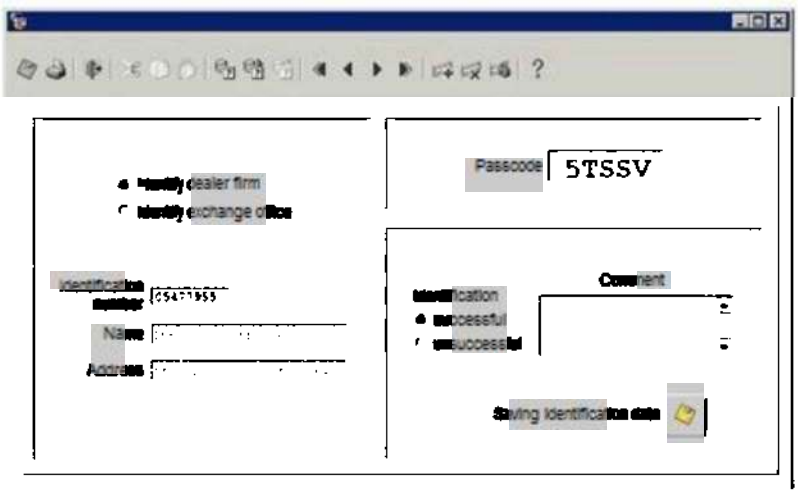

Figure 7: Identification a dealer firm or an external authorized exchange office

7. CONCLUSION

Efficient data protection is required both for storage on computer systems, as well as for transmission by communication paths. The problem that has arisen either by disrupting information security by unauthorized access to information can cause catastrophic consequences in organizational systems such as, for example, banking, judiciary, military, medical and other systems.

The ISO 27001 standard provides organizations with a framework for securing information security. All types of measures that comply with the ISO 27001 standard, and in particular program measures, can be applied in banks. By selecting the appropriate encryption method and program implementation of the encryption algorithm, the basic measure of protecting "sleeping" data and data transmitted by communication channels is realized. Each cryptographic algorithm has its own advantages and disadvantages. Symmetric algorithms are best suited to solve the required confidentiality because they are faster and look for smaller keys. Symmetric algorithms solve all requirements except intangibility.

Asymmetric algorithms are best suited for solving integrity and authenticity requirements, and they also solve non-compliance requirements. When it comes to confidentiality requirements, asymmetric algorithms are only used to exchange a symmetric key that encrypts the message and ensures its confidentiality. Hashing algorithms are used in integrity protection, and the best way to solve is authorization requests. Some

systems use a combination of these algorithms and thus exploit their stronger sides. Such cryptographic systems are called hybrid systems. Examples of algorithms of these systems are: digital envelope, digital signature, digital stamp and digital certificate.

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BENCHMARKING AS THE QUALITY MANAGEMENT TOOL FOR THE EXCELLENCE ASSESSMENT OF MEDICINES REGULATORY AUTHORITIES IN EUROPE

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Abstract: *Nowadays, majority of European Union (EU) member states use international benchmarking as a quality management tool for guiding medicines regulatory policy priorities. Unfortunately, there is limited research on how medicines regulatory authorities use this tool for continual improvement. The concept of Benchmarking of the European Medicines Agencies (BEMA) aims at harmonizing regulatory performance and procedures in each Member State's medicines regulatory authority. Therefore, the paper strives to explore how medicines regulatory authorities in EU perceive the significance of the BEMA methodology itself, thus highlighting its positive and negative aspects. Although some limitations of the BEMA have been identified, the key findins indicate that all the medicines regulatory authorities involved in the BEMA process are confident that the BEMA methodology can be a useful tool for continuous improvement. It should be noted that only the authorities within the EU member states could be the part of BEMA exercise, although it could be potentially used in candidate countries in preparing for the EU membership.*

Keywords*: quality management, quality assessment, benchmarking, medicines regulatory authorities, EU*

1. INTRODUCTION

Quality improvement in medicines regulatory authorities has required a series of changes that have had a significant impact on medical practice. These changes have led to the creation of such an organizational culture, based on appropriate social and moral principles, in which the medical world, supported by many other disciplines, is trying to find the optimal way to take care of each individual patient (Tosic et al. 2017). In the European Union, a well-established regulatory system ensures that the human and veterinary medicinal products available for patient use are acceptable in every way and this means encompassing various activities that aim to ensure the safety, efficacy and quality of medicines as well as the appropriateness and accuracy of product information (Pejovic et al., 2014). The majority of researchers agree, on a wider scale, that regulatory work in medicines regulatory authorities should be performed with accountability and transparency (Ibid.). The regulatory performance of the medicines regulatory authorities should be regularly and systematically monitored in order to identify problems in the process and to determine if all the implemented activities are in line with the strategic goals of these authorities. Various methodologies can be used to assess the performance of medicines regulatory authorities, such as self-assessment, supervisory authority assessment as well as a review by another medicines regulatory authority dealing with the same activities – peer review. These approaches can all complement each other in assessing the performance of medicines regulatory authorities, but can also help them identify number of areas for continual improvement.

Various tools and/or models like Total Quality Management (TQM), European Foundation for Quality Management, Balanced Score Cards (BSC) and terms like "Best Practices" and "World Class Manufacturing" have prevailed in discussions about quality management in different years. In order to improve operations they first had to be measured and a new target had to be set. For this, a tool called benchmarking was created (Putkiranta, 2012). The benchmarking, defined as the comparison using a set of specific indicators, was, until recently, the domain of market specialists. This changed, however, with the publication by the World Health Organisation (WHO) of its report *Health Systems: Improving Performance* (2000) which thrusted international health system comparisons to the forefront of high-level political discussions, highlighting the potential role and pitfalls of such comparisons (Wait and Nolte, 2005). Since then, many countries have used international benchmarking as a basis for guiding medicines regulatory policy priorities.

The concept of Benchmarking of the European Medicines Agencies (BEMA) was first discussed at the Heads of Medicines Agencies (HMA) meeting in Rome in November 2003. It builds on an earlier initiative (such as the Pan European Regulatory Forum (PERF)) whose main role was to help candidate countries for EU membership to fully prepare and adjust their regulatory systems to EU requirements (Pejovic, 2012). The initiative for this methodology was given by the HMA which established a steering group that had exclusive jurisdiction to coordinate the implementation of the BEMA methodology and analyze the results (HMA, 2006). A steering group was established in January 2004 to develop proposals for the exercise, including a series of

key performance indicators as well as methodology of how to identify and share the best practices (HMA, 2012). To the best of the authors' knowledge, there is no paper that deals with such subjects generally. According to the Heads of Medicines Agencies (2018), the aim of the BEMA methodology is ''to contribute to the development of a world-class regulatory system for medicinal products based on a network of authorities operating to best practice standards''. The main purpose of BEMA is to gather the information on best regulatory practice thus enabling identification of areas for continual improvement within authorities. It is also significant to point out that BEMA is not designed for direct comparison of, or ranking of, medicines authorities. Medicines authorities are encouraged to develop suitable best practices in order to enable an improved operation of the network of medicines authorities. The entire process of anonymization has been agreed so that none of the information held in the centralized database is attributable to any authority. Therefore, HMA (2016) claims that the most valuable part of the BEMA is that it is a form of self-assessment enhanced by consultancy carried out by authorities that are also fulfilling national responsibilities under EU legislation.

In this paper, after the introduction, the review begins with the brief description of the BEMA methodology and the BEMA questionnaire. The next section of the review is dedicated to the research methodology. The results follow. Additionally, the paper presents key findings thus presenting all areas of strengths and weaknesses, as well as all the positive and negative aspects of the BEMA. These findings provide an indication of the status of the medicines regulatory authorities with respect to their willingness for continuous improvement within BEMA in any area where improvement might be made. Finally, the review offers some conclusion remarks.

2. BENCHMARKING OF THE EUROPEAN MEDICINES AGENCIES (BEMA)

During time, the benchmarking has evolved into a well-established methodology for comparing individual management systems and it is not just an inspection or an audit designed to identify non-compliance. It is a business practice which stimulates process improvement by determining best practices across organizations through performance measurement and understanding those factors which enabled the higher performance of the organizations (Watson, 1994). Actually, the essence of benchmarking lies in the fact that it is “the process of identifying the highest standards of excellence” (Milosevic et al., 2013). In the following chapter, we will discuss the implementation of this popular methodology within medicines regulatory authorities in EU.

2.1 BEMA Methodology

In order to identify the best practice and improve their system, medicines regulatory authorities apply BEMA methodology. The BEMA is a quality management tool for continuous regulatory and public service performance improvement. It is based on comparing and finding best practices, sharing positive experiences, ad hoc consultations from colleagues coming from a similar work environment and/or working on similar jobs (Pejovic et al. 2014). Therefore, the BEMA methodology does not serve for the competition or self-promotion of medicines authorities but solely for the purpose of assisting the internal improvement of the whole process. This is the basic concept of the BEMA methodology, but in its background is the tendency of the HMA to monitor the work of all the medicines regulatory authorities in the EU by standardizing their work and raising their performance to the highest possible level (Ibid.). The BEMA methodology includes both self-assessment and peer-review assessment and is broadly based on ISO 9004 guidelines. ''Self-assessment against a performance excellence model by organizations within a multi-organizational network can provide an effective basis for cooperative learning and benchmarking'' (Saunders and Mann, 2005). On the other hand, according to ISO 17000:2004, peer-assessment is “assessment of a body against specified requirements by representatives of other bodies in, or candidates for, an agreement group”. The peer review assessment is important as it allows each medicines regulatory authority to be visited by teams of specially trained assessors for an independent assessment against the performance indicators. The usage of ISO standards in the BEMA methodology ensures mutual understanding between different parties in the process in order to develop a world-class pharmaceutical regulatory system based on the mutual cooperation of best practice standards. Using the ISO 9004, a reference questionnaire was defined, which initially included only the areas of pharmacovigilance and documentation assessment activities which were later added to parts related to the general organization and the connection with the inspection bodies. From September 2012 to October 2014, the total of 47 benchmarking visits to medicines regulatory authorities or ministries responsible for the field of medicines were made, of which 17 agencies regulate both human and veterinary medicines, 14 regulate human medicines only and 14 regulate veterinary medicines only (HMA, 2016). Forty two assessors from 18 countries and 24 authorities participated in these visits, with three assessors from different authorities in each team (Ibid.). First three BEMA cycles showed some weaknesses, which were reflected in the inadequate training of BEMA assessors, unequal evaluation criteria etc. Therefore, the steering group within the European Medicines Agency (EMA), "the key central body for European regulatory decision-making activities'' (Pejovic et al. 2011). has launched an action to define a new version of this questionnaire, which has been significantly improved as well as a series of very serious BEMA assessors

trainings (twice a year), removing deficiencies observed in previous visits. Therefore, this enhanced version is often referred to as the BEMA IV methodology and, according to this version, medicines regulatory authorities are currently being evaluated. The key findings of these visits were entered into an anonymized database which is not designed for direct comparison of, or ranking of, medical regulatory authorities, but will be used for analysis and as a useful source of good practices for the benefit of the network of authorities, continuous improvement within the BEMA methodology or at any stage when the network of authorities is considering improvements. The description of each BEMA cycle from January 2004 to September 2018 is presented in the Table 1.

Table 1: BEMA Assessments (Heads of Medicines Agencies, 2018)

BEMA I	BEMA II
Began in January 2004 with the establishment of the steering group and the development of the KPIs, questionnaire and methodology. Visits to agencies took place between June 2005 and May 2006 and successfully established the methodology as a tool for benchmarking of the network of agencies in the EU/EEA.	Development of the second cycle was based on formal feedback gathered from agencies and assessors at the end of the first cycle and the experiences of the steering group and logistics team, in order to make amendments, including the KPIs for the revised questionnaire. Visits took place between June 2008 and July 2011.
BEMA III	**BEMA IV**
The HMA Strategy 2011-2015 was used to direct an extensive review of the KPIs resulting in a more streamlined and focused questionnaire. Formal feedback gathered from agencies and assessors at the end of the second cycle, and the experiences of the steering group and logistics team, were used to make amendments to programme. The BEMA III began in September 2012 with 47 agencies to be visited by October 2014.	It was established following a positive outcome of the previous BEMA cycles, allowing its development into a tool for the improvement of quality management system and consistency of best practices across the EU network of medicines agencies. Revision of the KPIs and updates in line with the EU Medicines Agencies Network Strategy to 2020 resulted in development of comprehensive, yet focused questionnaire. BEMA IV began in June 2016 with 47 agencies to be visited by October 2018.

2.2. BEMA Questionnaire

In order to achieve quality and excellence, every organization should review its performance in relation to the specified criteria, determine the current levels of maturity and determine its strengths and weaknesses (Horvat, 2018). Criteria given for a higher level of maturity can help the organization understand the issues to consider and help it determine the necessary improvements to achieve a higher level of maturity (ISO 9004:2009). Hence, the new rating system was introduced based on the concept of Capability Maturity Model (Table 2) in which a rating scale (5 levels) is complemented by a statement of maturity for each rating level, specific for each indicator (HMA, 2016). According to the rating system presented below, each question from the questionnaire is evaluated and the final assessment for the given question is obtained by the consensus of all team members. If the team decides so, it is possible to make estimates that correspond to the half of one score (0.5). Based on the experience, it has been decided not to give a final rating to an authority, but to evaluate each individual segment defined by the questionnaire. The BEMA evaluation ends with an exchange of experiences between the two sides and with the comparison of the obtained grades during BEMA visit with the grades achieved after the self-assessment phase. If there is a significant deviation in the rating, this is an exceptional opportunity to discuss it with team members. Also, ‘‘the best in class’’ grade is never given, because it would mean that further improvement of the process is not necessary, which in practice is never the case. Contrary to the implementation of the BEMA I, the tendency of the evaluators, during the visits to the authorities is often focused on interviews and on concrete evidence, rather than on the presentation of the results contained in the self-assessment questionnaire itself (Ibid.).

Table 2: Capability Maturity Model: The Rating System Applied in the BEMA Procedure

Maturity	Performance Level	Note
1	There is no formal approach	No systematic approach, no matching results, poor or unpredictable results
2	Reactive approach	Approach based on problem solving or the implementation of certain corrections, a minimum number of data is available
3	A stable, formal system approach	Systematic approach based on processes, the initial phase in stematic improvement; there are data on compliance with set goals and the existence of an improvement trend
4	Continuous improvement is emphasized	The improvement process, good results and a constant improvement trend are used
5	Performance "best-in-class"	The improvement process is fully integrated; benchmarking results matching "best-in-class" performance are displayed

3. METHODOLOGY

The questionnaire (Table 3) was created in order to examine how the medicines regulatory authorities perceive the significance of the BEMA methodology itself. A group of academic experts examined the questionnaire for content validity and clarity. These researchers suggested a number of minor changes to clarify technical vocabulary in questions with a Likert-scale scoring system, and these changes were incorporated into the survey instrument. This survey was conducted during BEMA IV. It should be noted that only the authorities of the EU member states could have an actual experience as this methodology is not applied at candidate or non member states countries. Because purposive sampling was chosen for this study, a comprehensive study of available national medicines regulatory authorities' (NMRA) contacts has been conducted to recognize NMRA general managers and those responsible for quality management. The questionnaire was sent by an e-mail to 39 medicines regulatory authorities in EU, responsible both for human and veterinary medicines. The target correspondents were quality managers and they had the opportunity to evaluate certain aspects of the BEMA methodology by using ranking from 1 (most useful) to 7 (least useful). The focus was on ranking the appropriateness of BEMA for the application in medicines regulatory authorities performance constant improvement, but also to indicate all the weaknesses of this methodology, which the respondents have noticed.

Table 3: The Questionnaire on BEMA Methodology

BENCHMARKING OF EUROPEAN MEDICINES AGENCIES (BEMA)	
Are you familiar with the BEMA methodology?	
a) yes	b) no
Has your agency been included in BEMA process?	
a) yes	b) no
In case your previous answer was "yes", do you consider BEMA methodology a useful tool for continual improvement of agency's performance?	
a) yes	b) no

Please rank the following aspects of BEMA methodology in terms of their benefit to agency's performance improvement (based on your personal opinion). Please use the following ranking system, staring from 1 (the most beneficial) to 7 (the least beneficial)	
a)	agency's self-assessment
b)	cooperation with colleagues from other European agencies
c)	internal comprehensive preparation and work prior to BEMA visit
d)	team work and team spirit
e)	it is an opportunity to get a comprehensive picture of agency's regulatory performance, as whole
f)	it is an opportunity to evaluate the level of implemented quality management system
g)	it gives a possibility for continual improvement

What are the negative aspects of BEMA methodology? (you can mark more than one answer)	
a)	BEMA questionnaire in some sections is unclear
b)	not enough time for preparation for BEMA visit
c)	BEMA assessment and evaluation/ranking procedure was unclear for us
d)	team work was missing during preparation phase
e)	agency's top management didn't implement all the recommendations for improvement after BEMA visit
f)	the importance of BEMA methodology wasn't understood among agency's staff
g)	KPI and SPI evaluation system is not described well
h)	BEMA team members were not qualified enough for the procedure
i)	other:

Do you support further organization of BEMA visits?	
a) yes	b) no
Explain your answer:	

4. RESULTS

Finally, a total of 17 replies were received, which makes 43.59% of the total number of questionnaires sent. Respondent regulatory authorities have within their jurisdiction human, veterinary medicines, medical devices, but also a number of specific areas, such as cosmetics, tattoo products, precursors, price fixing and medication consumption monitoring, etc. Regarding the size of the authorities that responded to the questionnaire, the highest number is those with more than 200 employees, which indicates good potential for adequate performance of all regulatory functions when human resources are in question. The majority of medicines regulatory authorities have a well-established and certified qualty management system, while in a few authorities the quality management system is not formalized, or is being implemented.

By analyzing the responses, all medicines regulatory authorities involved in the BEMA process believe that the BEMA methodology is a useful tool for continuous improvement of performance and they support its further organization by the HMA. Furthermore, it was possible for respondents to evaluate certain positive aspects of the BEMA methodology, as well as to indicate those negative. Seven positive aspects of the mentioned methodology were evaluated, where it was necessary to rank on the scale of 1 (the most useful aspect) to 7 (least useful aspect). Figure 1 shows a summary of this assessment, ie. the mean value of the assessments given by the respondents for each aspect of the BEMA.

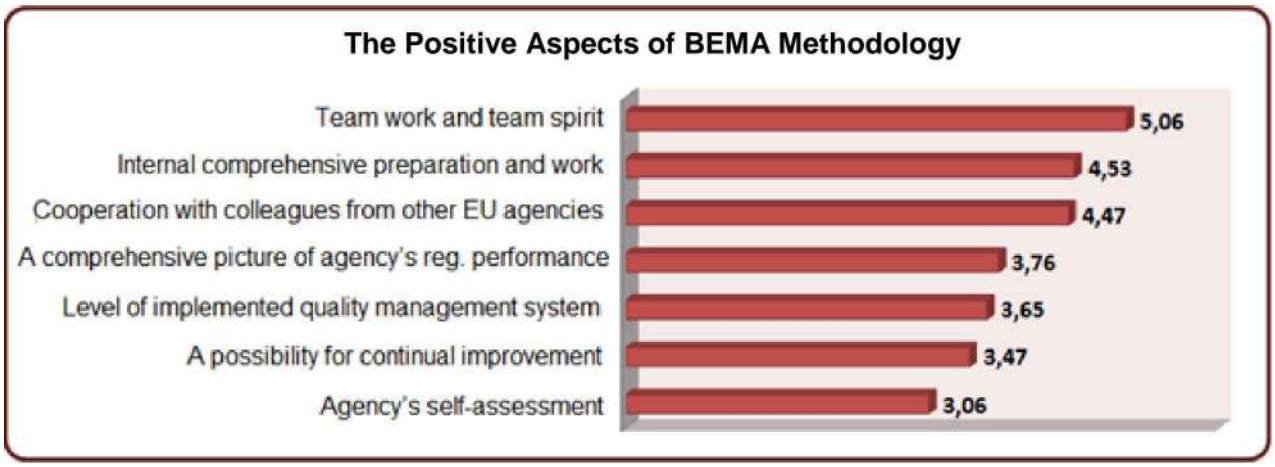

Figure 1: Mean Values of the Assessments of the Positive Aspects of the BEMA

The results have shown that the respondents, as the most important and beneficial aspects of the BEMA methodology, highlighted the need to carry out self-assessment in the preparatory phase (grade 3.06), giving it the possibility for continuous improvement (grade 3.47), as well as the ability to assess level of the implemented quality management system (grade 3.65). Relatively high rating (3.76) respondents gave an aspect "it is an opportunity to get a comprehensive picture of agency's regulatory performance, as whole''. On the other hand, low ratings indicate the aspect of cooperation with colleagues from other European agencies (grade 4.47), who are actually members of the BEMA assessment team, which is also indicated by the individual comments of the respondents that there is not enough education for the members of the BEMA team, or that their criteria for assessing the regulatory functions of the medicines regulatory authorities are uneven. However, the results in this part of the questionnaire also point to the fact that there are obvious problems with the internal organization and preparation for the BEMA methodology (grade 4.53), which must be comprehensive, long-lasting and involve multidisciplinary teams, because the aspect of teamwork is marked the lowest ratings (5.06). It can be concluded that, with the development of the regulatory performance level, the importance and role of the BEMA methodology are changed, so that it is not viewed only as an additional obligation, but also as a possibility for continuous improvement of performance as well as a quality management tool that medicines regulatory authorities should introduce into their everyday work.

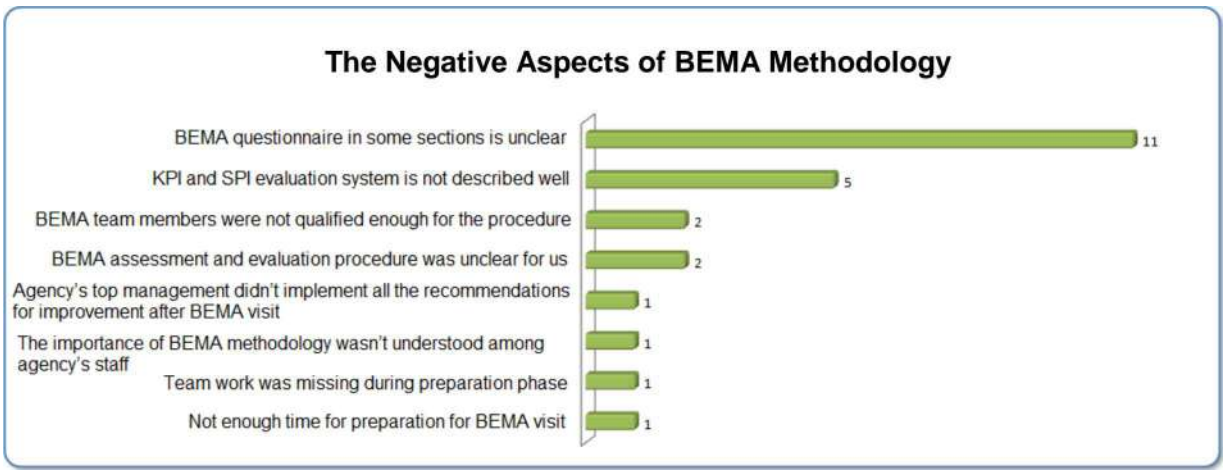

Figure 2: Mean Values of the Assessments of the Negative Aspects of the BEMA

Regarding the negative aspects of the BEMA methodology (Figure 2), the dominant number of responses concerned the fact that the BEMA questionnaire, which is the basis for the implementation of the BEMA methodology, is, in some areas, unclear. This is actually an essential problem for the implementation of the entire procedure, because, according to the questionnaire, self-evaluation of the medicines regulatory authorities is carried out at the preparatory stage followed by the actual assessment by the BEMA team. If there is a fundamental lack of understanding of the questionnaire, this can lead to poor results of assessing and representing the regulatory performance of a given authority worse than it actually is. The second prominent problem, which is directly related to the questionnaire, is the system of evaluating key and specific performance indicators, which causes a suspicion in the investigated medicines regulatory authority, and a doubt about the correctness of the assessment.

5. CONCLUSION

The BEMA methodology is an excellent way of sharing best practices in the work of regulatory authorities across Europe, helping the medicines regulatory authorities with less developed capabilities to find the most appropriate way to organize their regulatory functions. The primary goal of organizing and implementing this methodology within EU is to create such a quality regulatory environment in which any regulatory body will be able to accept and recognize the work of other authorities. This will significantly save resources and ultimately create preconditions for creating a single market for medicines in Europe, thus creating the unique capacity of all medicines authorities to implement adequate health protection. All surveyed medicines regulatory authorities support the further organization of the BEMA because they consider it to be a unique opportunity to compare regulatory functions between them. General conclusion indicates that medicines regulatory authorities in Europe accept BEMA methodology as a quality management tool for improving regulatory functions, but do not perceive its' all aspects. Some limitations of the BEMA have been identified, which directly influence the acceptance of the BEMA questionnaire in the regular processes of measuring and improving the performance, which is its main goal. As it is already emphasized, there are no similar data available in the scientific literature on examining the role of the medicines regulatory authorities in quality infrastructure, their consideration of the significance of the quality management system, as well as data on the possible application of the benchmarking methodology for the continual improvement of regulatory functions. The role of medicines regulatory authorities in public health system in every country is undeniable, as they are responsible for assuring quality, safe and efficacious medicines and medical devices. Therefore, the measure of their quality performance impacts the general population, in terms of medicines access and availability. The significance of the conducted survey is that it provides the basis for further research of the new ways for the quality management system improvement within the medicines regulatory authorities in Europe. Such research would be unique, having in mind the fact that there are no similar published results.

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QUALITY OF LIFE AND DIGITAL TRANSFORMATION IN HEALTHCARE

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Abstract: *Paper explores the perception of the quality of life and its relations with the overall health of the population and the healthcare system. New technological improvements have led to a transformation in business, hence the healthcare system as well. Paper presents the main trends in the field of healthcare digitalization process and illuminates the problems which can occur, such as safety of privileged patient information, use of different applications, managing and storage of patient data etc. As well as selecting benefits of digitalization process and it impacts on quality of life.*

Keywords*: quality of life, quality in healthcare, digital transformation, healthcare industry*

1. INTRODUCTION

The quality of life is not simple to define, for it involves several aspects of individual satisfaction in different spheres of life, as well as the psycho-physical condition of a person. However, this term is used more and more today and it is considered that the way citizens grade the quality of life will replace the accepted GDP analytics. It should also be noted that the well-being of citizens is most commonly related to the term of quality of life. And so, to begin, we will consider the definitions of the quality of life, health status, as well as health-related quality of life.

The quality of life can be also defined as an overall well-being comprising objective descriptors and subjective evaluations of physical, social, material and emotional well-being along with the level of personal development and purposeful activity weighted by a personal set of values (Felce and Perry, 1993). It can also be formulated in terms of one's context (standard of living), absence of well-being (depression), or in a collective manner (Pollard and Lee, 2003). As written in the report "Wellbeing and policy", countries worldwide are becoming attracted to these appealing ideas but are worried about how they can be implemented in real life. The authors of the report are of the opinion that such ideas could encourage the governments and individuals to make 'better' decisions that would contribute to enhancing the overall wellbeing.

Chancellor Merkel pointed to the relevance of the notion of wellbeing by stressing the following: Industrialized countries do not only have the GDP and growth issues. Even hard-nosed central bankers, like Ben Bernanke, have argued: "The ultimate purpose of economics, of course, is to understand and promote the enhancement of well-being." Very few academics would argue that a country should invest efforts into maximizing the GDP (O'Donnell et al., 2014).

Besides that, the digitalization of the process leads to completely new relations in doing business. And when we discuss the healthcare system, the data relating to the well-being of citizens has become more valuable on the grey market than credit card information. This paper deals with the perception of the quality of life and its relationship with the health status of the individual, as well as the way in which the digitalization of the healthcare industry affects the quality of life; but also, how one measures quality within the healthcare system.

2. QUALITY OF LIFE, HEALTH-RELATED QUALITY OF LIFE AND HEALTH STATUS-WHAT IS THE DIFFERENCE?

World Health Organization (WHO) provide a highly influential definition of health, they defines health as "a state of complete physical, mental and social well-being, and not merely the absence of disease and infirmity" (WHO, 2014). WHO definition include some key aspects like social well-being and the emphasis on more than the absence of disease. That is important because not everyone agrees on the inclusion of social well-being in the definition of health (Torrance,1987). For example, some authors define health as "an individual's level of function" (Patrick et al.,1982), where "optimum function" is judged in comparison to "society's standards of physical and mental well-being".

Defining QoL, Quality of life has proven challenging (Brazier et al., 2014), (Moons, 2006) and many approaches to defining quality of life exist (Ferrans, 1990). There are approaches based on subjective well-being, expectations and human needs (Bowling, 2005).

A related literature on well-being distinguishes between approaches based on objective lists, preference satisfaction, hedonism, flourishing, and life satisfaction (Peasgood et al, 2014). Other examples of definitions of Quality of life are: "an individual's" perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns" (Kuyken and Group, 1995) , "a conscious cognitive judgment of satisfaction with one's life" (Rejeski and Mihalko, 2001).

Defining HRQoL, Health-related quality of life has also been problematic (Bowling et al.,1995) and in the literature we can identified a few definitions of HRQoL. For example, HRQoL can be defined as "how well a person functions in their life and his or her perceived wellbeing in physical, mental, and social domains of health" (Hays, 2008), other definition relates HRQoL directly to QoL: "quality of life is an all inclusive concept incorporating all factors that impact upon an individual's life. Health-related quality of life includes only those factors that are part of an individual's health" (Torrance, 1987). According to Torrance non-health aspects of QoL, like economic and political circumstances, are not included in HRQoL.

3. QUALITY IN HEALTHCARE

Numerous reasons testify why it is important to improve quality of healthcare, including enhancing the accountability of health practitioners and managers, resource efficiency, minimizing and identifying medical errors while maximizing the use of effective care and improving outcomes, and aligning care to what patients want in addition to what they need (Subhash, 2003).

When it comes to quality assessment, there is only but a handful of frameworks used for analytic purposes. These frameworks have guided the measure development initiatives in both the private and public sectors, and the most influential among them was implemented by the Institute of Medicine (IOM). The framework itself examines six criteria throughout the healthcare system (Institute of Medicine, 2001): Safety; Effectiveness; Patient-centeredness; Timeliness; Efficiency; Equitability.

The measures used currently give priority to some of these criteria more than to others. For example, the present majority of measures is focused on safety and effectiveness, whereas only a small portion gives importance to timeliness and patient-centeredness. And even fewer measures assess the importance of efficiency and equitability (Institute of Medicine, 2005).

Frameworks like the ones implemented by IOM domains also prove to be a good learning curve for helping others understand the true meaning and importance of quality measures. And research has proven that by having a framework with which you can grasp the relevance of quality measures, you in fact are capable of valuing a wider range of quality indicators. So, if you were to offer a detailed explanation about the importance of safety, efficiency and patient-centeredness, consumers would have no trouble grasping the relevance of all three criteria. Better yet, when you take those three IOM domains and present them in user-friendly versions of the measures they represent, consumer are able to comprehend the importance of those measures more clearly and from a personal healthcare perspective (Hibbard and Pawlson 2004).

It is important to mention that the rising cost of health care have led to situation that healthcare industry has become especially oriented on improving outcomes and patient satisfaction (Sarkissian, 2017). We can compare it with definition of quality system "a set of interrelated or interacting elements which is using a variety of resources to achieve objectives related to quality" which are focused on fulfilling and overcoming user's requirements (Filipović and Đurić, 2010). According to the National Association for Healthcare Quality (NAHQ) we can found a set of main functions which are recognized to advance the profession and ensure that health care quality leaders are sufficiently prepared: Patient Safety; Regulatory and Accreditation; Quality Review and Accountability; Performance and Process Improvement; Health Data Analytics; Population Health and Care Transitions (Curdy et al., 2017).
Setting quality as top priority of organization it can result in achievement changes in goals, guidelines, attitudes, and activities.

4. DIGITALIZATION AND DIGITAL TRANSFORMATION IH HEALTHCARE

When it comes to the comprehension of the influences and alterations on the business side of things, as it is written in I-scoop text, it's important that we research digitization, digitalization and digital transformation right form the beginning.

When it comes to aspect of digitization, there are two closely-related meanings that we can consider crucial:

Digitization presents the transformation of analog/physical things (paperwork, photographs, sounds etc.) and creation of their digital counterparts (bits and bytes). Digitized information is not limited to a specific set of materials, in the final instance, it is grounded in the configurations of materials. Relying on that fact we can see how digitization mediates between the material and the immaterial (Manoff, 2006) which makes digitization a united process (Hayles, 2003).

Digitized information is the only one that can be represented on any set of transistors, "all forms of data such as alphanumeric text, graphics, still and moving pictures, and sounds" can be digitized (Verhulst, 2002). "All signals are chopped into little pieces" (Van Dijk, 2005) and encoded as strings of 1s and 0s, and that is the fundamental process. It is also important that this process can be applied to almost every information, occurs through specific technical mechanisms and requires specific technical infrastructures that modify the original signal itself.

On the other hand, digitalization serves to: Create revenue; Improve business; Replace/transform business processes (instead of digitizing them); Create the foundation for digital business processes; The structure of this endeavor uses digital information as the core, whereas digital technologies and data (digitized and natively digital) are used as the building material.

If digitalization is also about changing business operations, business models and even revenue streams and new business opportunities, then what is the difference between digital transformation and digitalization?

It all comes down to the range and scope of it all. In comparison to digitalization, digital transformation is a much broader concept of upgrading to digital business. The foundation you build with a digital transformation strategy is much bigger because it requires more elements to help it function. Digital transformation originally served a very simplistic purpose of converting paper into digital information – since that time, it has significantly evolved.

Nextgov reports that: "Around three-quarters of the $80 billion the federal government spends on information technology each year is used just to keep legacy systems running." Even though technology is considered a crucial element in terms of digital transformation, this goes to demonstrate that rather than invest into new tech, it is often more about ridding ourselves of outdated process and legacy technology (Moore, 2015). According to a study done by Triger Text (and using research conducted by HIMSS Analytics): "Despite widespread use of smartphones and other mobile devices among healthcare providers, 90% of hospitals still use pagers and overpay by 45% to maintain legacy paging services." (Landi, 2016).

And these types of examples are present in all industries, where the prevalence of legacy technology stand in the way of a revolutionary digital transformation strategy that can only contribute to a business (Mark Samuels, 2015).

4.1. Digital Transformation In Healthcare Industry

Smart care, care anywhere, empowered care and intelligent healthcare enterprise – these are the four digital themes that will prove to be essential to the digital transformation of healthcare in the future.

1) Smart Care will use precision medicine, robotics and medical printing to improve patient outcomes and lower healthcare costs.
2) Care Anywhere will make household healthcare a reality, with the help of advances in connected homes and virtual care.
3) Empowered Care will give citizens more control in managing their well-being and healthcare through the development of "living services".
4) Intelligent Health Enterprises makes possible for healthcare workers and their enterprises the option of monitoring patient health more effectively in real time, with the help of data-driven solutions.

Value-based healthcare is quickly becoming reality with the advancement of the digital aspect. With new technological advancements, the gap between the physical and digital world is becoming much smaller. As a result, hospitals and other healthcare facilities are now available to consumers with a simple click, scroll or tap. You now have combined smart sensors, devices and highly connected software that can lead patients to exactly what they need – low-cost healthcare outcomes with top-quality experience and convenience (World Economic Forum, 2016).

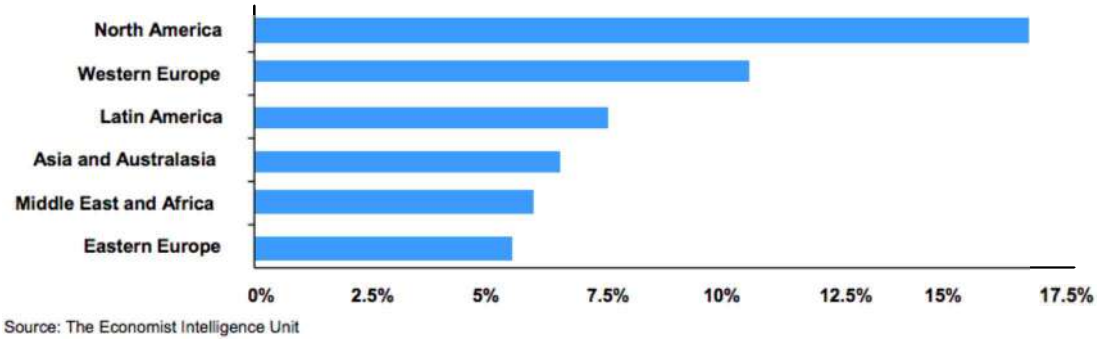

Figure1. Digital Transformation of Industries Healthcare Industry, (World Economic Forum, 2016)

Nearly 18% ($3.2 trillion) of the total GDP of the Unites States was accounted to national health expenditures in 2015. Additional research found that as much as $300 billion can be saved in the healthcare sector with the help of the digital revolution. This alone should paint a picture of how influential the introduction of new technologies could be when it comes to the healthcare market. In fact, CISCO research goes to define several more influential ways this can happen:

Telemedicine
Back in 2015, a majority of doctors and physicians were surveyed to answer whether telemedicine is a better way of managing chronic diseases or not. More than 80% of those surveyed answered that it was a more efficient method than a traditional visit to the office (AHA, 2015). The fact is that with telemedicine, both doctors and patients gain more freedom and accessibility. For one, patients would no longer be limited in terms of geographical location and distance from their physicians. This means that even patients in the most remote of areas would be eligible to receive the highest level of care afforded to those living downtown. And all it would take is a good Internet connection and a smartphone. This in itself ends up saving patients both time and money. Instead of wasting hours waiting and travelling for a simple check-up or prescriptions, they could receive it within minutes on a conference call.

Mobility and Cloud Access
It's estimated that over 65% of interactions with healthcare facilities will occur via mobile devices by the end of this year. In fact, the number of physicians using smartphones and medical apps already exceeds 80%, most of which access drug information on the mobile devices daily. You can wave farewell to the days of extensive paperwork and file rooms, given that all medical facilities and insurance companies are now storing patient records on the cloud, giving you 24/7 access to your test results, bloodwork etc.

Wearables and IoT
With the constant progress of technology come many perks, even in medicinal terms. ECGs, DIY blood screening, thermometers and other types of tests can now be conducted in the comfort of your home with mobile devices the size of car keys. With the introduction of automation, patients are even able to keep track of their weight, pulse, oxygen levels etc. all of which they can then post online for their physician to inspect. And as a result, people are able to prevent and avoid risks of heart disease and other chronic illnesses, which can ultimately save their lives (PWC, 2018).

Artificial Intelligence and Big Data
Big data holds the true power of the digital world, and the same goes for healthcare. Most people consider big data as a great feedback and review tool. However, it holds a much greater potential for identifying health-related risk factors and preventing them with pre-emptive treatment. Even more exciting: with the rise of the Internet of (Medical) Things (IoMT), mobile and wearable devices are increasingly connected, working together to create a cohesive medical report accessible anywhere by your healthcare provider. And this type of data goes beyond the individual patient – it holds the key of studying entire cultures and countries to help predict mass healthcare trends (Newman, 2017).

Empowered Consumers
Everything we mentioned up until now has led to the creation of a completely new and game-changing trend in the world of healthcare – empowered patients. We as patients are finally in a position where we get to dictate it all. No more long waits and unplanned overcharges associated with healthcare – we now have equal access to all forms of healthcare, which leads to higher overall satisfaction rates (Sherman, 2015).

4.2. Quality in e-Health

It looks really clear that e-health includes more than just technological development. The Internet created new opportunities and challenges to the traditional health care information technology industry, the use of a new term to address these issues seemed appropriate. According to Eysenbach, e-health can be defined as an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology (Eysenbach, 2001).

In terms of medicine, ICT (Information and Communication Technologies) development can lead to better quality of healthcare. A typical example here would be the application of high-tech sensors (i.e. pulse, body temperature, ECG, etc.), able to provide real-time data via wired or wireless communications technologies, interactive interface etc. This improvement actually presents "e-Health" – which is the primary engine for assisting patients. It does this by combining the use of electronic communication and information technology with the use of digital data transmitted, stored and retrieved electronically, both locally and at distance.

You are now capable to constantly monitor and record the condition of patients with chronic diseases, which you can then log within a larger database. The data that is gathered from these sensory devices is usually analyzed, monitored and managed by medical professionals. And the main advantage of such applications is that they trump time and space. They can capture any atypical symptoms or bodily activity at any time and in any place, so you are no longer limited geographically. Which means that patients can be monitored at their natural environment (Varshney, 2007).

The only re-occurring issue here is the complexity when it comes to managing this type of data. There are times when medical specialists are confronted with inaccurate, incomplete or overwhelming amounts of input. This, in term, leads to questions concerning the quality, security and privacy of the data in this domain. The fact remains that the quality of the data gathered in the healthcare domain always was and should be the priority. Otherwise, we risk achieving a negative effect of the applications used to collect all the information necessary. And if we choose to ignore the data collected, it also impacts the decision-making process.

In the last couple of years, technological improvements have been opening new possibilities in healthcare and the practice of medicine. But those possibilities also carry inherit risks and leave decision-makers with numerous unanswered questions regarding: quality, security, privacy, ethics and risk management and other important matters. Some surveys and approaches have showed the importance of data quality for end-users, in particular, in healthcare domain (Shaw et al. 2009). Many quality criteria have been proposed without a general consensus; in fact, each domain has its specific vision of data quality as well as the solutions to solve the quality problems (Wang and Strong, 1996). Data quality is often considered as "fitness-for-use". It is based on the specific use of data and the requirements to be satisfied. To tackle this issue, based on existing quality modeling approaches (Wang and Strong, 1996), (Naumann and Rolker 2000), (AHIMA, 1998), we can analyze the e-health monitoring systems according to appropriate quality criteria. Such strategy aims to manage data quality at every point, which should lead to the minimization of potentially poor data quality from spreading.

4.2.1 Impacting data quality

To correctly identify data quality issues, we have firstly to identify the source of the quality problems, analyze its impact and, where possible, propose a solution. Some difficulties are related to technology (i.e. equipment, QoS (Quality of Service), to human intervention (input errors, misunderstanding…), or to process of data transformation (i.e. optimal analysis and processing). According to Gutiérrez and Riveill (2011) there are three main levels of data management and processing over the system defined as: Data collection (sensor data collection, pre-processing and transfer), Data processing (data processing, storage and delivery) and Data discovery (data access, enhancement and discovery).

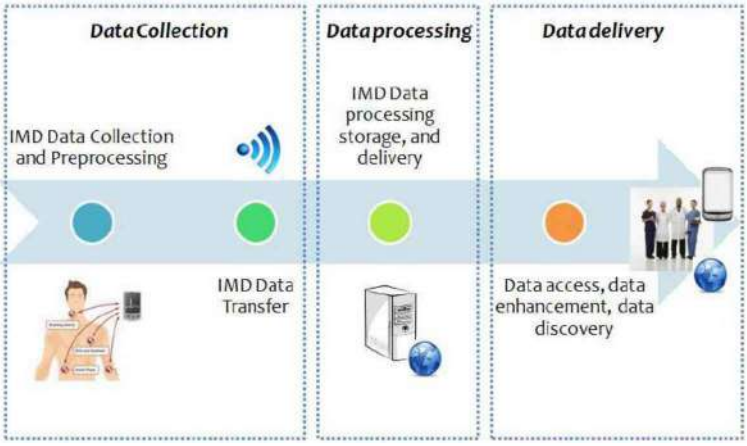

Figure2. Data quality analysis for e-health monitoring applications, (2010).

5. INFORMATION SECURITY MANAGEMENT (ISM)

Just like any other knowledge intensive and information-based enterprise, the healthcare industry depends on the IT sector to analyze, acquire, manage and disseminate all information and expertise related to healthcare (William and Herbert, 2009). IT solutions are used to: Develop the decision-making process; Promote information exchange; Aid in self-care and professional support; Improve the effectiveness of healthcare facilities; Make electronic records of patient information (Economic Commission for Africa, 1999).

Information that relates directly to the health of a patients in defined as personal health information. This type of information includes everything – from a person's health condition and use of health services to any potential disability or other relevant information (Office of the privacy commissioner, 2001). The way to gain access to such information is through health information systems (HIS). As an integral part of any healthcare system, HIS lays the foundation for processing, analysis and reporting of healthcare information. In additions to this, it also supports the development of the top healthcare indicators needed to monitor and evaluate the overall performance of a particular healthcare system (Matshidze and Hanmer, 2007). In comparison with paper-based data collection, and on the negative side of things, HIS-based collection and data storage can cause certain complications in terms of information protection measures and security (Quynh, 2005).

Information security management (ISM) has a primary goal to ensure business continuity while it reduces the business damage. It can do so with prevention and/or minimization of any security incident impact (Krause and Tipton, 2003). The goal of ISM is to establish, implement, operate, monitor, analyze, revise, maintain and boost information security.

The ISO/IEC 27001 (ISO 27001, 2005) is an internationally recognized standard that provides a specification for ISM systems. One of the standards that supports the implementation of ISO/IEC 27001 is the ISO/IEC 27002 - Code of practice for ISM (ISO 27002, 2005). This standard provides implementation guidance in support of the security controls specified in its clauses and is cross-referenced for this purpose in the ISO/IEC 27001 (ISO 27001, 2005). In 2008, a new standard was published for ISM in healthcare. The ISO/IEC 27799 international standard provides guidance on how best to protect the confidentiality, integrity and availability of their information with the implementation of ISO/IEC 27002 standard (ISO 27799, 2008).

6. CONCLUSION

Since the introduction of electronic medical devices (EMRs) back in 2009, the healthcare industry has undergone a major transformation. Providers, payers, and other medical organizations have undertaken the long-term project of securing every patient medical record electronically in order to comply with government regulations. The rewards for current players and new entrants are likely to be quite substantial for creating transformational digital services as scale, considering that the overall amount of finances spent on healthcare annually amounts to $7.5 trillion. Digitization is still defined as complex and challenging, mostly due to the effect it has on every piece of data, relationship and business interaction. Just consider this – healthcare providers are now able to use apps to track patients and assets, and thus support the experience of the consumer with wayfinding, mapping and scheduling. The potential that such a system carries is endless in terms of: Handling big data; Mass records analysis and comprehension; Creating a top-quality

healthcare system. With all this in play, the old data gathered from centers and CRM systems can now be combined with the data collected from digital sources (mobile networks, social media, medical apps, equipment sensors etc.).

As it mentioned, HRQoL means "how well a person functions in their life and his or her perceived wellbeing in physical, mental, and social domains of health", not surprising the fact that governments invest such a big money in improvement of healthcare system in order to achieve better conditions for their citizens aligned with new technologies. As is told at the beginning of the paper, new measure for GDP will be a QoL score, witch is directly connected to healthcare system.

Regarding to that fact healthcare records are among the most hacked data in the world. It is estimated that medical information is worth 10 to 20 times more on the black market than credit card data because of its potential for fraud, identity theft, and abuse (Humer and Finkle, 2014). With the development of technology comes the growth of potential threats and risks as well. So, as the Internet of Things grows, the security of medical devices is beginning to be questioned more and more.

In Nederland's National Institute for Public Health and the Environment report it is also mentioned that nowadays digitalization in health care is equal to common good. Health data are measured, stored and exchanged in bits and bytes. Digitalizing health data can bring benefits as well as challenges for patient safety. Accordingly it is important that health care providers are aware of the risks related to hackers, viruses, and the safe transfer of data.

A set of different benefits might be achieved by digitalizing health data, and some of the are dedicated to next goals: Improving public health by electronic health data which can be used by health care professionals. This can be done by by combining databases with medical information or using electronic medical data to identify intervention or surveillance strategies. (Lin and Schneeweiss 2016). Securing the privacy of the individual patient is the main challenge in using electronic health care data to improve public health. Empowering the patients in direct online insight and use of digitalized health data. Direct access of health care services improves patient self-management and safety, but will also affect the workload of health care professionals. In these way communication technologies change the interaction between patient and health care professional (Mold and Lusignan 2015); Cost reduction can be achieved through implementation of the medical data in electronic health records. (Shen et al. 2015).

As mentioned above, when we discussed the healthcare system, all the digital transformations that are occurring today have a goal to satisfy the demands of the users. By meeting those demands, the level of the quality of life also grows. However, this also brings new issues related to the quality of services, security measures etc. Digital transformations definitely introduce a new era to our way of life and conducting business, and this is what we set out to demonstrate with this paper, as well as to predict new movements and trends. Those who manage to get behind these trends first and meet user demands the most will also gain the largest advantage. The next step in the continuation of this research can be the analysis of the healthcare system in the Republic of Serbia, as well as grading the quality of life of its citizens.

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PUBLIC ADMINISTRATION QUALITY DETERMINED BY CUSTOMER-RELATED CAF MODEL

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Abstract: *CAF model, developed to support the introduction of the idea and the principles of total quality management (TQM) in the public sector, has today become an important tool for measuring quality improvement in public administration. On the other hand, any quality improvement should be directed according to customer satisfaction. Thus, the CAF model is used in this study to evaluate and compare public administration quality including customer-related results, as part of the CAF model. Furthermore, CAF results are compared with the municipalities' quality system maturity level assured by ISO 9001 certificate. The results show significant correlation between CAF scores and maturity level as well as between citizens/customers results and overall CAF scores.*

Keywords*: service quality, public administration, customer satisfaction, municipality, CAF model*

1. INTRODUCTION

The public administration function is a crucial element of any country, and has many times been a starting point for economic growth and social justice. The need for improvement of performance and results in the area of public services has never been more important (Vakalopoulou et al., 2012). In accordance with the quality management movement, customer focus has become a key issue, with the satisfaction of customer needs and expectations being a major concern (Flynn, 1997; Nwankwo, 1995). According to Schainker (2013), to achieve exceptional service, an organisation must first listen to its customers. In line with this, Hill (et al., 1999) recommend that in order to identify things that are important to customers and to measure the degree by which they are satisfied, it is useful to make an internal assessment.

The Common Assessment Framework (CAF) method is used for public administration in order to define the level of fulfilment of criteria which have an influence on quality, so the CAF has become an important tool regarding quality improvement in public administration (Luczak & Wolniak, 2013). It was developed in 2000, under the authority of the Directors General of Public Administration of the EU member states in order to support the introduction of the idea and the principles of total quality management (TQM) in the public sector across the EU and beyond. The model was revised in 2006 and after that in 2013. It already has more than 2010 registered users (organisations that have implemented the CAF) spread in 38 countries, while it has been translated into 20 languages (Staes et al., 2010). Among the non-EU states working with the CAF are candidate members and neighbouring countries like Bosnia-Herzegovina, Croatia, Macedonia, Russia, Serbia, and many others (Patrick & Nick, 2010). The CAF may be applied in all types of public organisations regardless of the number of employees (Staes & Thijs, 2005). It has been designed for use in all parts of the public sector, and is applicable to public organisations at a national/federal, regional and local level (Thijs & Staes, 2006). Rickards (2013) showed the distribution of CAF users by sector in 2010, highlighting that local governments were the most represented.

The basic structure of the Common Assessment Framework has been derived from the European Excellence Model, although in a slightly modified way. The CAF thus handles a set of 9 evaluation criteria (figure 1): five criteria are used to assess the performance of the enablers, meaning what the organisation does in order to achieve excellent results, and then four criteria are directly used to assess the results that an organisation achieves.

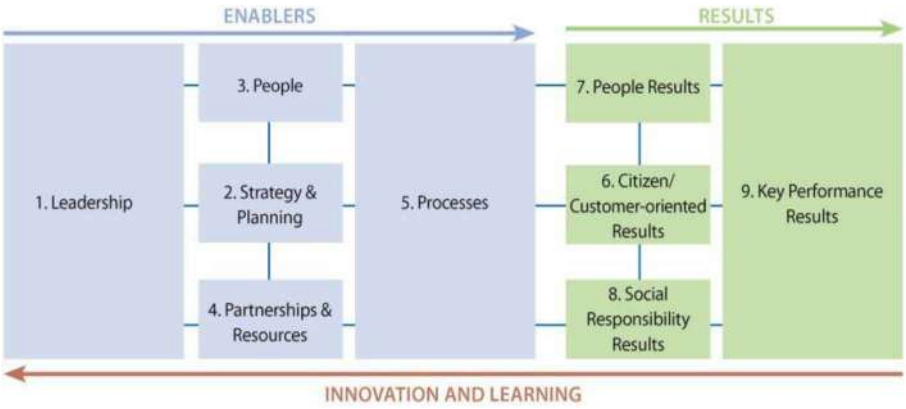

Figure 1: CAF model structure (Vakalopoulou, 2012)

The CAF has been developed by making use of the "European Excellence Model" promoted by the European Foundation of Quality Management (EFQM), various national quality management tools derived from the Excellence Model and the Speyer Quality Award Scheme widely used in German-speaking European countries. One of the aims of the CAF is therefore to serve as a bridge between different quality management instruments and quality management cultures in Europe. It is not in competition with these instruments, but tries to complement them and to bring together their most important elements. The CAF is designed to be an easy-to-use tool for quality management in the public sector. It aspires to bridge the different quality models and to serve as a useful 'starter model' before moving on to more sophisticated quality management models (Van Dooren & Van de Walle, 2004). It is a simple, cost free and easy to use self-assessment tool (Vakalopoulou et al., 2012).

The most important reason to use the CAF is to identify a number of strong and weak points, which will then serve as a basis to set up targeted improvement actions (Dearing et al., 2006). On the other hand, many authors (Kelly & Swindell, 2002; Higgins, 2005; Wood et al., 2007;) use the CAF performance for comparing with the customers' satisfaction. Taking this into account, as well as that any quality improvement should be directed according to customer satisfaction, the CAF model for three municipalities is examined in this paper, aiming at analysing the quality of three observed municipalities.

2. THE FRAMEWORK OF THE RESEARCH

For the requirements of the research, the CAF Scoring and assessment panels (2006) were used. An instrument for data collection was prepared for the purpose of scoring according to the CAF model.

2.1. Objective of the research

The basic objective of the research in this study is to determine and compare the results obtained using the CAF model related to citizens/customers in three municipalities. This would be a way to gain additional trust in the results obtained using the CAF model which refer to users of local self-governments. Moreover, the results obtained using the CAF model in this research can be compared with similar research for additional confirmation of their results.

2.2. Research questions

Based on the literature review, the following research questions are set out:

- A higher average score for each of the citizens/customers results for the local government obtained using the CAF model corresponds with a higher average overall CAF score;
- Municipalities with ISO 9001 certificate ang higher maturity level gain higher CAF score comparing to the municipality without the certificate and low maturity level.

2.3. Research instruments

The first instrument was prepared according to the CAF fine-tuned scoring (2006 version) which served for data collection in order to determine individual scores for each component of the model relating to the work of local governments. The model was used according to the proposed structure of the criteria (Figure 1). The sixth criteria, "Customer results", was considered in detail in order to be able to compare the results with overall CAF scores. The following items were considered:

1. Results of citizen/customer satisfaction measurements (item 6.1 from the CAF model) – examples:

- Results regarding the overall image of the organisation (e.g. friendliness and fairness of treatment; flexibility and ability to address individual solutions);
- Results regarding involvement and participation;
- Results regarding accessibility (e.g. opening and waiting times, one-stop-shops);
- Results relating to products and services (e.g. quality, reliability, compliance with quality standards,
- Processing time, quality of advice given to the customers/citizens).

2. Indicators of citizen/customer-oriented measurements (item 6.2 from the CAF model) – examples:
   - Indicators regarding the overall image of the organisation:
     - Number and processing time of complaints (e.g. resolution of conflict in cases of interest);
     - Extent of public trust towards the organisation and its services or products;
     - Waiting time;
     - Handling/processing time of services delivery;
     - Extent of employee training in relation to the effective handling of citizen/customer relationships (e.g. professionalism and friendly communication with, and treatment of, citizens/customers);
     - Indicators of complying with diversity and gender aspects;
   - Indicators regarding involvement:
     - Extent of involvement of stakeholders in the design and the delivery of services and products and/or the design of decision-making processes;
     - Suggestions received and recorded;
     - Implementation and extent of use of new and innovative ways of dealing with citizens/customers;
   - Indicators regarding accessibility;
   - Indicators regarding products and services:
     - Adherence to published service standards (e.g. citizens' charters);
     - Number of files returned with errors and/or cases requiring repeated processing/compensation;
     - Extent of efforts to improve availability, accuracy and transparency of information.

From the previous division it is noticeable that, in general, both items of this criterion (6.1 and 6.2) may be observed using the same 4 elements:

- Overall image of the organisation;
- Involvement and participation;
- Accessibility;
- Products and services.

During the scoring of the three municipalities according to the CAF model, the same team of appraisers used the following scale of scores:

- 0-10 points: No results are measured and / or no information is available.
- 11-30 points: Results are measured and show negative trends and / or results do not meet relevant targets.
- 31-50 points: Results show flat trends and / or some relevant targets are met.
- 51-70 points: Results show improving trends and / or most of the relevant targets are met.
- 71-90 points: Results show substantial progress and / or all the relevant targets are met.
- 91-100 points: Excellent and sustained results are achieved. All the relevant targets are met. Positive comparisons with the relevant organisations for all the key results are made.

2.4. Population and sample characteristics

Since this research is related to the views of citizens regarding the quality of the municipality services, it was necessary to place it in an appropriate situation in the municipality. This situation had to satisfy certain conditions, such as: a) offering a whole range of municipality services, so that all citizens were exposed to at least one of the services, b) being a unique institution for offering the services available to all citizens, in order to avoid confusion between different authorities, c) homogeneous delivery of the services in order to have similar levels of service available to all respondents, d) being a somewhat dense, urban type of population, in order to exclude distance from being an obstacle to the service experience, and e) interest of the municipality authorities. All the above stated conditions were met by three municipalities in Northeastern Bosnia and Herzegovina, with an estimated total population of 47,000 inhabitants.

For the purpose of researching the scores acquired using the instrument according to the CAF model, visits by the appraisal team were organized to each of the local areas during 2011 according to the given plan of assessment. The data were collected working with a selected team which included managers from particular

organisational units of the local governments. The work was organised through workshops and focus groups several times during the course of the project.

3. RESULTS

In order to facilitate the display of the data, abbreviated marks were assigned to the municipalities:

- A – for the municipality A (Municipality with no ISO 9001 certificate and low matyrity level);
- B – for the municipality B (Municipality with ISO 9001 certificate and medium matyrity level);
- C – for the municipality C (Municipality with ISO 9001 certificate and high matyrity level).

Table 1 shows the results of scoring for the three municipalities according to the CAF model, where the average values of the scores are shown according to each criterion related to this model. The scores show the rank of the municipalities A-B-C, where the municipality A has the highest total score, as well as the highest scores for each individual criterion.

Table 1: Scores for the three municipalities according to all the items of the CAF model

	max	**A**	**B**	**C**	**Relative**	**A**	**B**	**C**
1. Leadership	400	45	66.25	147.5	100	11.25	16.56	36.87
2. Strategy	400	33.75	47.5	85	100	8.43	11.87	21.25
3. People	300	37.5	38.75	55	100	9.37	9.68	13.75
4. Partnership	600	135	138.75	151.25	100	33.75	34.68	37.81
5. Processes	300	43.75	53.75	123.75	100	10.93	13.43	30.93
6. Citizen results	200	20.75	28.75	34.375	100	5.18	7.18	8.593
7. People results	200	20	20	32.5	100	5	5	8.12
8. Society results	200	45	47.5	47.5	100	11.25	11.87	11.87
9. Key performance	200	70	72.5	77.5	100	17.5	18.12	19.37
TOTAL	2800				900	112.68	128.43	188.59

From the results shown, the same rank of the municipalities is observed for each of the items, and in total:

- Municipality A is the municipality with the lowest score (total of 112.68) and is therefore categorized as the worst municipality compared with the other two municipalities observed;
- Municipality B is the municipality with the middle score (total of 128.43) and is therefore categorized as the middle compared with the other two municipalities observed;
- Municipality C is the municipality with the highest score (total of 188.59) and is therefore categorized as the best municipality compared with the other two municipalities observed.

Table 2 has separate scores for the “Customer-related” item, which consists of two parts:

- Results of citizen/customer satisfaction measurements (item 6.1 from the CAF model);
- Indicators of citizen/customer-oriented measurements (item 6.2 from the CAF model).

Table 2: Scores for the three municipalities according to the items 6.1 and 6.2. of the CAF model

			A	**B**	**C**			**A**	**B**	**C**
Citizen R	6.1.	**Trends**	26.75	26.75	27.75	6.2.	**Trends**	3	4	5.75
		Targets	6.5	19	27.5		**Targets**	5.25	7.75	7.75
			33.25	45.75	55.25			8.25	11.75	13.5
		TOTAL	16.63	22.88	27.63			4.125	5.875	6.75
Max 200	A	20.75								
	B	28.75								
	C	34.375								

Scores for the above mentioned 4 elements (Overall image of the organisation; Involvement and participation; Accessibility; Products and services) as the common elements of the two items (6.1 and 6.2) of “Customer-related” criteria can be found in Table 3.

Table 3. Scores for the three municipalities according to the common elements of the items 6.1. and 6.2. of the CAF model

6.1.		A	B	C	A	B	C
a. Overall image	Trends	31	31	31	Polling of the citizens performed through surveys on satisfaction from 2010. Not performed for 2011. Slight positive trends are stated in both surveys.	Polling performed for 2010 and 2011. Partial progress is present.	Polling performed for 2010 and 2011. Partial progress is present.
	Targets	11	31	40	There are no goals for 2010. In 2010 there is also a considerable portion of negative scores and answers. 26/40 of dissatisfied and very dissatisfied. There are no scores for 2011.	There are goals for 2010. Slightly greater portion of positive answers in comparison to S. Goals defined for 2011.	There are goals for 2010. Slightly greater portion of positive answers in comparison to B. Goals defined for 2011.
b. Involvement	Trends	10	10	10	According to the presented strategies and programs, certain matters concerning inclusion of citizens in decision making processes in local governments are present. There is no data on the de ree of their realization.	The same as in case A.	The same as in case A.
	Targets	5	5	5	There are no objective indicators. Except estimations that are not results of systematic monitoring.	There are no objective indicators. Except estimations that are not results of systematic monitoring.	There are no objective indicators. Except estimations that are not results of systematic monitoring.
c. Access	Trends	35	35	35	Service Center opened	Service Center opened	Service Center opened
	Targets	5	5	5	There are no indicators	There are no indicators	There are no indicators
d. Services quality	Trends	31	31	35	Scoring performed for 2010.	Scoring performed for 2010 and 2011.	Scoring performed for 2010 and 2011.
	Targets	5	35	60	There is no data for 2011.	There is data for 2010 and 2011 with partially realized goals.	There is data for 2010 and 2011 with mostly realized goals.
Total	Trends	107	107	111			
	Targets	26	76	110			
Average	Trends	26.7	26.7	27.7			
	Targets	6.5	19	27.5			
6.2.		**A**	**B**	**C**	**A**	**B**	**C**
a. Overall image	Trends	6	6	10	There is data on complaints. Determination of their exact number is very demanding. There is no data on speed of their resolution. There are no other indicators.	There is data on complaints. Determination of their exact number is very demanding. There is no data on speed of their resolution. There are no other indicators.	There is partial data about other indicators as well, but it is not reliable.
	Targets	0	0	0	There is no system for defining and monitoriny.		
b. Involvement	Trends	3	3	3	Unreliable data is partially present.		
	Targets	0	0	0	There is no system for defining and monitoriny.		
c. Access	Trends	0	0	0	There is no data		
	Targets	0	0	0			
d. Services Q	Trends	3	7	10	Not very reliable and difficult to determine data on incompatibilities.	It is possible to determine the number of noncompliance. There is no data on monitoring and analysis.	It is possible to determine the number of non-compliant cases. There is certain data on monitoring and analysis.
	Targets	21	31	31	Recertification is not performed for 2011.	Recertification is performed as a goal for 2011.	Recertification is performed as a goal for 2011.
Total	Trends	12	16	23			
	Targets	21	31	31			
Average	Trends	3	4	5.7			
	Targets	5.2	7.7	7.7			

4. CONCLUSION

The CAF model is increasingly being used in different ways, one of which is to identify space for improvement, particularly in the public sector. However, this is an easier method in relation to other self-assessment management tools (such as EFQM Business Excellence Model, the ISO 9000 or 14000 series, Balanced Scorecard approaches, Six Sigma, etc.), which enables all organisations, regardless of their size, to perform self-evaluation. Therefore, the goal of this study was to evaluate and compare public administration quality including customer-related results.

Comparing the results obtained by the analyses in this study performed on both the total average values and individual elements of the noted models, it may be concluded that the ranking of municipalities regarding Citizens/Customers results is proportional to the overall CAF scores. Such results confirms the first research question set in this study. Therefore, the CAF model may be considered a sufficiently reliable method for obtaining data on real user satisfaction. In other words, based on this conclusion it is expected that as the customer-related CAF scores increase/decrease for a municipality it may be expected for the real degree of its user satisfaction to be higher/lower. This conclusion may be significant for the municipalities which have conducted or which regularly conduct self-assessment, but which are not able to examine their user satisfaction in a certain period in a direct way.

The analysis also showed that the CAF scores of three observed municipalities differ according to the maturity level. Results also confirms that the municipality with the high maturity level gains the best CAF score, while the municipality with no ISO 9001 certificate and the low maturity level gains least CAF score.

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TRANSFORMATION OF FINANCIAL SERVICES **479**

Vesna Bogojević Arsić, Milica Latinović
ALTERNATIVE ONLINE FINANCE: CROWDFUNDING AND ICO **480**

Tijana Obradović, Milica Latinović, Veljko Dmitrović
HE WHO DARES WINS: NEUROFINANCE APPROACH TO FINANCIAL DECISION-MAKING **485**

Milos Milosavljević, Nemanja Milanović, Nevenka Žarkić Joksimović
PLATFORM BANKING: EMPIRICAL EVIDENCE ON CUSTOMER EXPECTATIONS AND ACCEPTANCE **490**

Milenko Radonić
PAYMENT PROCESSING IN WEB BASED ENVIRONMENTS: THE BENCHMARK OF THE WORLD'S LEADING PAYMENT PROCESSORS **496**

Davor Vašiček, Josip Čičak, Ana Marija Sikirić
ACCOUNTING FOR EXPECTED CREDIT LOSSES – CROATIAN CASE **505**

Nela Milošević, Slađana Barjaktarović Rakočević, Miloš Savić
SME FINANCIAL OPPORTUNITIES **510**

ALTERNATIVE ONLINE FINANCE: CROWDFUNDING AND ICO

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Abstract: *Blockchain is the main driver of the world's decentralization and initial coin offerings is the main driver of the investment decentralization. Initial coin offering represents a new model of financing start-up projects. Investors invest in projects and receive digital coins/tokens for their investments. After the initial coin offering investors can trade those coins/tokens on the cryptoexchanges. Therefore, technology development is creating a new class of securities through the initial coin offering. However, legislation connected to the initial coin offering is still loose and no real uniform framework exists, which enables that some offerings can be of very poor quality. Crowdfunding reward-based platform introduced its first initial coin offering, and we investigate whether critical success factors are the same for the real and blockchain project. We find that there are similarities.*

Keywords*: Initial coin offering, crowdfunding, blockchain, token, case study*

1. INTRODUCTION

Fourth industrial revolution brought many changes into the world we know. Technology and Internet became the essential in conducting almost any type of business. Financial service industry is undergoing profound changes as well. Currency is not just a currency, Internet and technology introduced cryptocurrencies. ValueWeb affects banking: retail, commercial, transaction, and private. Also, technology affects investment banking, asset and wealth management. Stock exchanges move to block exchanges (Tapscot & Tapscot, 2016). Initial public offering of stocks are getting competition of initial coin offerings, which are starting to be much discussed topic in the cryptocurrency community. Trading strategies, trading analytics and alternative finance are the main FinTech categories in the investment and capital markets settings (Skinner, 2016).

Crowdfunding is an alternative financing source of new ventures and an informational mechanism. Investors' allocations can provide information regarding how they value the project, and entrepreneurs use this information to decide on product release. In this way, they test and validate their innovative ideas on the Internet. Music is one of the main categories in the terms of the number of crowdfunded projects (da Cruz, IN PRESS). Platforms are used to finance cleantech or alternative energy projects (Cumming et al., 2017). Crowdfunding could even help raise funds for the Academic libraries (Bushong et al. 2018). This type of an alternative financing also has its place in the global healthcare. Different types of health projects can use crowdfunding platforms to raise capital, and they introduce certain economic benefits and risks (Renwick and Mossialos, 2017).

Now, established crowdfunding platforms are incorporating new kind of ventures, they are moving to the territory of coins offering. Coins represent the first generation of cryptocurrency assets. Tokens are the second generation of digital assets, which cover broader purpose of use then coins (Hale, 2018). Through the sale of the tokens entrepreneurs can obtain financing for the initial development of the digital platform (Catalini & Guns, 2018).

The rest of the paper is structured as follows, in the section 2 phenomenon of crowdfunding is defined and different models are presented. In the section 3, blockchain technology and initial coin offering (ICO) were introduced along with a case study of a first ICO on one of the reward-based platforms. Section 4 gives concluding remarks and directions for further research.

2. CROWDFUNDING

Crowdfunding is a process of funding a project or a business by a large group of people, or a crowd, where open call is performed essentially through web-based intermediary platform. Crowdfunding is a generic term which combines crowdinvesting and a crowdfinancing. Fundraisers, entrepreneurs and others seek funds through certain platform, and investors invest in these projects assuming risk and expecting payoff. Value of the platform stems from the number of existing and potential users, essentially from the ability to attract new users which represents network effect (Forbes & Schaefer, 2017; Tomczak & Brem, 2013). Therefore,

crowdfunding represents online alternative finance practice of financing an innovation idea, through electronic platform which involves a large number of people (Davies & Giovannetti, IN PRESS).

There are four models of crowdfunding: reward-based, equity-based, lending-based, and donation based. Reward-based crowdfunding model assumes that backers or funders provide finance to individuals, projects or companies in exchange for non-monetary products or rewards (Zhang et al., 2016). This type of crowdfunding is supported by platforms like Kickstarter and Indiegogo (Forbes and Schaefer, 2017). A backer or investor receives an award based on the size of the donation, and reward can take the form that entrepreneur chooses, like a product itself or some type of an artwork. Furthermore, platform itself can be of a different format. “All or nothing” is a platform that requires that a funding goal must be reached, in order for entrepreneur to obtain funds. “Keep it all” is a type of a platform that allows entrepreneurs to keep all the funds raised, irrespective of whether goal is reached or not (Davies & Giovannetti, IN PRESS).

Equity-based crowdfunding assumes that individuals or institutional funders purchase equity issued by a company (Zhang et al., 2016). Platforms that back equity-based crowdfunding are for example, Seedrs and Crowdcube (Forbes & Schaefer, 2017). Lending-based crowdfunding can take a form of peer-to-peer consumer lending and peer-to-peer business lending, where individual or institutional funders provide a loan to a consumer or a business borrower. The Funding Circle represent an example of a lending-based platform (Forbes and Schaefer, 2017; Zhang et al., 2016). Donation-based crowdfunding is a model of crowdfunding where donors provide funding to individuals, projects, or companies based on philanthropic motivations with no expectations of monetary or material return; where donations could be placed through Just Giving, for example (Forbes & Schaefer, 2017; Zhang et al., 2016).

When engaging into crowdfunding, the key is to know which crowdfunding practices can lead to a successful fundraising. Therefore, it is essential to determine characteristics of the crowdfunding practices and to exploit them. We can distinguish between individual crowdfunding practices and practices on standardized platforms. In the case of individual crowdfunding, it is found that crowdfunding helps entrepreneurs to attract attention of the crowd or potential customers on their venture. Such practices are proven to be especially important for artists. Furthermore, non-profit entrepreneurs proved to be more successful in the crowdfunding and reached their capital targets. If entrepreneurs are less focused on profits, investors believe they are more committed to deliver greater benefits to the community (Belleflamme et al, 2013). Significant motivation for investors’ participation in the crowdfunding platform campaign and their willingness to pay are product oriented, which stem from the investors’ desire to make-the-product-happen (Zvilichovsky et al., 2018). In order for crowdfunding to be successful, Forbes and Schaefer (2017) propose several guidelines in the domain of product development. Platforms are very different, not just according to the alternative finance model they implement, but some of them favour smaller projects and other support a big scale projects. Moreover, platforms could be oriented to the certain industry. Critical for success is to adequately determine funding goal and to compile the list of rewards, although backers are usually motivated to buy a product as a reward. Also, campaign should have a video, which should give all the relevant information in the first 30 seconds, since it is found that investors lose interest for the video afterwards. Petitjean (2017) find that backers react positively when reward-based campaign is connected to a video. The first week of a campaign is critical for the success of the project, as well as, the past success rate of the projects category. Crowd values comments and reviews regarding the project, since anticipation of the participation is important for project success (Petitjean, 2017). Success of an equity crowdfunding is dependent on the stage of the production process, where developed products are more likely to get financed then ideas. Also, ventures with large corporate clients have more chance to succeed in equity crowdfunding campaigns. Furthermore, entrepreneurial teams that consist of more members are more prone to success, and returning entrepreneurs’ that previously were funded by angel investors have greater success rate (Mamonov & Malaga, 2018).

3. INITIAL COIN OFFERING

3.1. Cryptocurrencies and blockchain technology

Cryptocurrencies represent a mixture of a computer science, cryptography and economics. Therefore, they are digital tokens that consist of peer-to-peer network, consensus mechanism and a public key infrastructure (Hileman & Rauchs, 2017). Cryptocurrency is a digital/virtual currency (Hale, 2018). Specific to cryptocurrencies is that, that there is a diversified infrastructure which supports them and no central authority oversees this network. Rules governing this type of the cryptocurrencies system are enforced with all nodes or network participants. Transactions are written in a shared ledger called blockchain. Transactions can be verified by each node since everyone has a copy of shared ledger. Cryptocurrencies use cryptography and blockchain for security (Hileman & Rauchs, 2017; Hale, 2018). Blockchain technologies enable digital assets

to be moved, and they have capability to prove that sender of an asset does no longer possess it. Blockchain technology is connected to the cryptography, where the owner of the private key can dispose of an asset by moving it, where movement is performed by changing the key pair (CMS, 2018). Therefore, it can be said that cryptocurrencies are primitive tokens. They represent an atomic element from which open public blockchain network is created. In contrast to primitive tokens, secondary tokens are created on top of a blockchain network and are representation of some property rights (real world asset or a blockchain product/service) (Sehra et al., 2017).

New tokens can be created through deployment and scaling of a new blockchain network or through issuance of tokens on the top of the existing blockchain network, which is not an easy process. Introduction of Ethereum opened the way for creation of smart contracts. Smart contracts represent applications that run atop of the decentralized network. In this way tokens can be created and distributed to users, and made tradable afterwards. Process of creating tokens and distributing to the users in return for cryptocurrency is an ICO process. ICO can be seen as a new distribution channel for assets. One should separate the primitive tokens which are cryptocurrencies like Bitcoin and Ethar, and secondary tokens (Sehra et al., 2017).

3.2. Properties of the Initial coin offerings

Initial coin offering represents a mechanism for financing a project by the means of selling future cryptocurrency or tokens for current and liquid cryptocurrencies, such as Bitcoin (Hale, 2018). Therefore, with ICO, companies are trying to attract investors to finance the implementation of their projects and in exchange investors receive cryptocurrencies or tokens, depending on a project. Coins or tokens can be traded on exchanges after the ICO, for the price that is higher than in the process of initial coin offering.

We can compare real and digital world in the sense of the issuance process, and differentiate between initial public and initial coin offering. Initial public offering (IPO) is a way that an existing, established, successful and large-scale company can raise capital by selling shares to the public (Hale, 2018; Norman, 2017). IPO represent a very long and an expensive process, where company needs to satisfy number of the requirements of the exchange. Only limited number of shares enter the market. Initial coin offering is similar in this respect to an IPO, since only limited number of coins/tokens enter the market (Norman, 2017). Companies that launch ICOs are start-ups', they only have an idea and they do not have minimum viable product (MVP). ICO can go through several phases: pre-sale or pre-ICO, crowd sale, and post-ICO (Hale, 2018; Norman, 2017). Pre-sale can be private and public, and one ICO can have both phases of pre-sale. Pre-sale is a token sale event that goes before ICO campaign or crowdsale, and it is run by blockchain enterprises. Both, fundraising target and price in pre-ICO are lower than in ICO, where tokens could be sold for a 10-50% discount in this phase. Speculators usually buy tokens in pre-sale phase and resell it on the exchange afterwards. Crowdsale assume mass sale of tokens. After ICO, some post-ICO activities can be organized such as fulfilment of commitments or even additional token sale (Hale, 2018). Main challenge with an ICO and issued tokens is that there is substantial difference between the qualities of individual offerings. It is still not defined what the boundaries for tokens issuance are and how regulators around the world see the issuance process (Sehra et al., 2017).

During the launch of the ICO, tokens are issued by adding transactions to the blockchain with description, number and unique ID. After the ICO, tokens are placed and can be traded on the crypto exchanges. Price of the token is formed according to the laws of supply and demand, and in many cases it follows a certain trend (Hale, 2018). Tokens market price rise up sharply after they are placed on the exchange and that is usually followed with a large drop in price. Such price movement is connected to the characteristics of investors that participate in digital market. Investors in ICO are usually small and non-professional, and they could be motivated by ideology. Moreover, other group of investors in the ICO are motivated to pursue speculation. Investors that participate in ICO's could be risk takers, and they can speculate that they will earn high returns in a short period of time. As soon as they make a return, they withdraw from the market, which is a viable strategy connected to the ICO since there is no lock-up period (Norman, 2017). Speculators sell their tokens when they are placed at the exchange, which introduces sharp drop in price and capitalization, and could stimulate the remaining token owners to sell them. Therefore, investors with ideological or intangible motivation are crucial for the ICO (Hale, 2018).

There are different types of the initial coin offerings. ICO could be in a form of payment tokens (currency tokens), utility tokens, and asset tokens. Payment or currency tokens are used as a means of payment for acquiring goods or services. Utility tokens provide access to an application or service. Asset tokens represent an assets in the economic sense much like equities, debt, and derivatives are different asset classes. Also, tokens which enable physical asset to be traded on the Blockchain are considered asset tokens (CMS, 2018). Investors in tokens can earn dividends or capital gain. Dividends in a digital world are based on smart contracts (Hale, 2018).

3.3. Case of the reward-based crowdfunding platform ICO

ICO's are loosely regulated worldwide and the quality of offerings can vary significantly. Even Security and Exchange Commission (SEC) see this area as the wild west of financial services. Value is created in a regulatory arbitrage (Sehra et al., 2017). That is why we turn our focus to the well-established crowdfunding reward-based platform, Indiegogo since they are making an effort due to their experience to select quality cryptocurrency investments. We are going to investigate whether successful crowdfunding practices related to funding a project are implemented when initial coin offering is launched. This is going to be tested on the first such an offering on Indiegogo.

We have collected information regarding the Fan-controlled Football League ICO from the Indiegogo web-site and relevant legal documents. The Fan-controlled Football League (FCFL) represents a professional football league that let fans control the course of a match, who trains a team and who will play the game. Fans can engage into the league by using Fan Access Network (FAN) tokens, which are smart tokens based on the Ethereum blockchain. This initial coin offering is over, and the project is funded.

Previous research find evidence that non-profit entrepreneurs are more successful and that investors are product oriented (Belleflamme et al, 2013; Zvilichovsky et al., 2018). Since this reward-based ICO provided fans with access to decisions making in professional sports, we can see that investors were very product oriented and supported this campaign since it is funded. This product makes fans more in control of football. Funding goal is reached, which means that it was adequately defined which is in accordance with finding of Forbes and Schaefer (2017). Existence of an informational video is seen as critical success factor, and especially in a reward-based crowdfunding platform. Backers lose interest in watching a video after 30 seconds, and that is why it is important that all vital information are disclosed in that time span (Forbes and Schaefer, 2017; Petitjean, 2017). FCFL creators did not put all relevant information in the 30 seconds of their video. In that time period accent was more on a video then on the information. Perhaps, sport itself is motivation enough for the backers to buy tokens. Petitjean (2017) find that crowd values reviews, but no comments were provided on a website, and social networks were not part of this analysis. Total number of team members that created FCFL is 15, which is a large team and this project wasn't completed by an individual and was successful in fundraising. Therefore, we can say that this finding is in accordance with Mamonov & Malaga (2018).

4. CONCLUSION

ICO's are much discussed topic recently and many market participants are against them, since there is no firm regulatory framework and the quality of many offerings are of very poor quality. However, blockchain start-ups have raised more than $7B since 2017 (Catalini & Guns, 2018). Many of them oppose to the ICO but many investors are keen to invest, which is evident from the amounts raised in just one year. Maybe with such results we could expect that blockchain crowdfunding would have an impact on the stock markets. Although, backers in a crowdfunding are small investors and stock markets attract investors of various sizes and sophistication, we could assume that number of small investors could decrease connected to the stock exchanges.

ICO's influence traditional, product/service crowdfunding industry in a way that we can see introduction of blockchain projects and their corresponding initial coin offerings on one reward-based platform. Practices that proved to be successful in product crowdfunding industry are mostly implemented in the case of the blockchain project. Those practices proved to be fruitful and in the case of the blockchain project.

Limitation of this study is that it looks only at one ICO on a reward-based platform. However, this ICO is a first of its kind on this platform and no comparison to other projects was possible. Further research should follow future ICO's and check for the consistency of the results and to test whether there are peculiarities connected to the ICO on a reward-based platform.

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HE WHO DARES WINS: NEUROFINANCE APPROACH TO FINANCIAL DECISION-MAKING

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Abstract: *It is not a secret that some underlying assumptions of traditional financial theories appear to be wrong. One of the most obvious is that investors are rational and that they make sound investment decisions. Emotions seem to be the missing part, and the impact of affect behavior on decision-making process should not be neglected. The question is what is happening in investor's brain and how do they really make their decisions. Neuroscience can give the answers, by studying the human mind, and explaining how and why a particular behavior occurs.*

Keywords*: neurofinance, the human brain, investment decision, risk, emotions*

1. INTRODUCTION

The traditional model of decision-making process assumes that humans are rational. Therefore, it provides with the set of explicit assumptions and axioms that would ensure rational decision. However, traditional finance theories fail to answer the questions like why do investors trade, how successful they are, how do they make decisions, why are they not behaving rationally, and why they do not play according to utility theory? The rational aspect of decision making is evident and understood, but the emotional element was neglected.

A few decades ago, scientists were intrigued with what is happening in the humans' brain shortly before, while and after making a financial decision. Why do some investors become reach, while others fail? There must be something more than just following financial theories and making the calculation. However, it is also more than just bravery, self-confidence, or understanding of risk and returns. What makes successful trader, why is he so special? There are countless examples of financially very educated people, even Nobel prize winner, people who are deeply familiar with every financial theory, who still failed on the reality of financial markets. Why? Neurofinance can give the answers. The problem was obviously inside them, not outside on the market. It was all in their brain. The answer lies in about 60.000 miles of brain's neural wires (Turcan & Dedu, 2010). Humans are irrational.

2. TRADITIONAL VIEW OF INVESTMENT DECISIONS

The standard economic theory claims that humans behave rationally, and therefore, they will make decisions in alignment to maximize their utility. Rational behavior means that people choose the best solutions based on logic and currently available options (Sadeghnia, Hooshmand, & Habib, 2013). Markowitz's portfolio theory states that rational investors choose their portfolio based on expected reward and variance, optimizing it through diversification. Portfolios that lie on efficient frontier are rational, and individual risk aversion would determine individual portfolio. One of the basic assumptions he made in his mean-variance theory was that people are risk aversive, and that decision they make would be rational as a result of the overall cognitive assessment of different investment options (Markowitz, 1952).

Risk and return certainly play a central role. However, do investors use risk and return on the investment decision? The answer is no (Sadeghnia, Hooshmand, & Habib, 2013). Much of unexplained is classified under "market anomalies," but these anomalies force researchers to see what will happen to their theories if we clear it from its assumptions (Shariff, Al-Khasawne, & ElSharif, 2012). For example, Fama (1993) introduces three-factor asset pricing model, and much empirical research was conducted over it. Whenever researchers have shown that the model did not work, it was classified as market anomaly: when small companies made higher returns due to higher risk adaptability, this was named "small firms effect" (Banz, 1981); abnormal return in January was called January effect (Thaler, 1987); and abnormal return in December were explained with Christmas decoration and named December effect (Rozeff, 1985). The existence of these anomalies shows the necessity for the further development of these theories.

3. THE ROLE OF EMOTIONS

Early researchers of decisions in uncertainty conditions considered investors to be rational and did not consider their emotions. Financial theories did not include the role of emotions in the financial decision-making process. Still, the practice has shown that it is not enough just to be smart nor highly educated. There are too many extraordinary scientists, genius minds of economics and finance who did not make a fortune on their theories put into practice, and oppositely, there are people who did not go to college, but no meter made billions on financial markets (Turcan & Dedu, 2010). Many organizations do not achieve the set goals in the execution of their projects and many of them seem to fail to achieve business goals, even though they were managed in accordance with the most contemporary project management systems and tools (Petrović, Mihić, & Obradović, 2014).

Decision-making process involves emotional assessment along with cognitive one, in fact, emotions color cognitive assessments, and cognitive risk assessment is often different than their emotional reaction to the same risk (Tseng, 2006). This can be easily observed from research that has shown that people in the negative shape of mind make a more pessimistic judgment, they overanalyze and overjudge, and vice versa, people in the positive mood, express enthusiasm and self-confidence tend to make more optimistic decisions and take a risk (Lucey & Dowling, 2005). Zajonc assumed in early 1980. The year that in financial decisions emotion play the much more important role than people were ready to acknowledge (Zajonc, 1980). When making a decision, investors encounter set of emotions, like fear, concern, satisfaction or pleasure regarding their return on investment (Jinda & Bahl, 2016). Emotions influent cognition, so decisions are not rational, in traditional financial theory way. It becomes clear that emotions must be understood to appreciate their obvious and deep influence on the decision-making process.

Despite the knowledge about standard financial theories and principles, people want to avoid possible future regret, which is powerful cognitively developed emotion, and end up with decision different from rational ones (Coricelli, Dolan, & Sirigu, 2007).

Emotions are specially awakened in the risk circumstances, more precisely, emotions influent decisions depending on how the risky, uncertain and intangible decision is. The more complex decision is, the more emotions influent it (Lucey & Dowling, 2005). Emotions play an important role in taking or avoiding risk; people love to believe that they use common logic when choosing an investment. The truth is that emotional decision making is a default option for our brain (Montier, 2007), and most of the business cycle is determined by the volatility of satisfaction in people's brains, as Keynes concluded (Kolev, Njegovanović, & Ćosić, 2015).

Comprehending the emotions and their influence on decision process in finance requires researchers to go into the human brain and observe its functioning with a goal to understand how investor's brain works.

4. AWAKENING OF NEUROFINANCE

Decisioning in a real world worked in an opposite way than traditional financial theory suggested, real people, do not behave rationally and do not make rational decisions. The practice confuted theory since investors do not choose their portfolio solely on risk and return basis, and their decisions do not always maximize their utility. (Simon, 1957) (Kahneman & Tversky, Judgment under uncertainty: heuristics and biases, 1974) (1979) So, why real investor's behavior differs from rational one?

Questioning existing theories about financial decision-making made quite a confusion among researchers, and standard, widely accepted theories started to lose over the new theories that were dealing with behavior in finance. The new field, called behavioral finance, examines finance from a broader perspective. It combines finance with sociology and psychology and tries to explain how emotions influence financial decisions. (Turcan & Dedu, 2010) Behavioral finance has its roots in cognitive psychology, and according to it, emotion represents the result of the cognitive assessment of stimulus or event (Merkle, 2008). The issue is that people have cognitive limitations which lead to cognitive disorders and cause biases in behavior (Pompian, 2006). Behavioral finance tries to explain causes for exceptions in financial literature and investigates how investors make organized and mental errors in their judgments (Sadeghnia, Hooshmand, & Habib, 2013).

Even though theories in behavioral finance were beneficial for decision science, with enormous impact on the illuminating decision-making process, their research scale was limited since they explain the behavior of investors that can be seen on the outside. They could not explain how and why this behavior occurs. Furthermore, behavioral finance could not quantify emotions or look inside the source of these emotions and resulting behavior. (Shalini, 2012)

The next step in understanding the financial decision was to examine the human brain, to comprehend how and why it affects investor's irrationality. This led to a new field called neuroeconomics, and it subfield neurofinance. Standard financial theories explain and deal with the investors should behave, behavioral finance study how real investors truly behave, and neurofinance investigates how and why this investors' behavior occurs (Jinda & Bahl, 2016) (Edwards, 2004) (Zaleskiewicz, 2006). The closer difference between behavioral finance and neurofinance is in that behavioral finance explores how people react and interact in financial decision making, while neurofinance explores how and why these reactions and interactions occur based on human brain and hormonal activity (Tseng, 2006). The human brain becomes central intention of recent research of financial decisions. Neurofinance is a science that combines psychology, finance, and neuroscience to analyses the role of the human brain in investment choice (Peter & Hilke, 2005).

Neurofinance explains why human behavior differs from the principles of traditional finance; it explores human behavior, affective states, and psychological biases by keeping track of brain activity right before, during and fight after making a decision. It deals with neural basis of emotions and how these neurons influent financial decision-making (Jinda & Bahl, 2016). In that way, it can be determined which mental factors influent financial choice (Greenfinch, 2008). A neuroscientist is mapping human brain to find out how wear and greed color financial markets (Turcan & Dedu, 2010).

It is important to note that neurofinance is not contradictory to theories of rational choice, it widens the horizon by observing variables that were not considered in traditional theories. (Camerer, 2008) Neurofinance should be seen as a bridge between brain and financial decisions which enables a better understanding of financial decisions made by humans (Sadeghnia, Hooshmand, & Habib, 2013).

Development of modern technologies for brain scanning recently made a path for a deeper understanding of brain physiology, enabled simultaneous stimulation of a different part of the brain and made a foundation for experimental research in this hypersensitive area (Kolev, Njegovanović, & Ćosić, 2015). Kuhnen and Knutson (2005) performed the very first study on neurofinance by using human brain, using event-related fMRI. Their study has shown that emotions had an important role in the decision-making process and gained a set of brain images proved that emotions caused by anticipating gain or loss could have different neural signatures.

5. CONTRIBUTION AND SIGNIFICANCE OF NEUROFINANCE

Neurofinance, as a young science, tries to understand internal processes in investor's brain that lead to thinking which manifest in external (re)action, since behavior arises from thoughts laying behind them (Shalini, 2012).

The basic premise of neurofinance is the existence of differentiated brain regions that independently or in interaction with each other involved in making financial decisions (Kolev, Njegovanović, & Ćosić, 2015). The question is whether activation of certain part of the brain can predict subsequence behavior (Knutson & Bossaerts, Neural antecedents of financial decisions, 2007). Recognition of brain regions involved in making investment choice proved that emotive aspect interacts with rational ones since human decisions are the product of two decisions systems (Shalini, 2012). First one is emotional, more primitive, effective, intuitive and quick. It resolves that more complex decisions are providing approximate solutions and helps in narrowing set of possible choices. The other one is rational, more calculative, biological and slower. It can solve only well-defined problems, makes well-thought decisions, but function in a much slower way. (Olsen, 2007)

In order to detect activation of certain brain regions, and track brain function during decision making process, neurofinance use the latest technology such as functional Magnetic Resonance Imaging (fMRI), Magnetic Resonance Imaging (MRI), Electroencephalography (EEG), Positron Emission Tomography (PET), Computed Tomography (CT), Steady State Typography (SST), Magnetoencephalography (MEG), Transcranial Magnetic Simulation (TMS), eye tracking or blood pressure (Jinda & Bahl, 2016) (Turcan & Dedu, 2010).

The capability of investors to perform the optimal behavior in decision making probably depends on the functions of a set of brain structures, including the prefrontal cortex, which is responsible for complex cognitive decisioning, memory, analysis and making conclusions. Neurofinance researches shown that whenever investors make a cognitive mistake, it is due to insufficient and incomplete information gathered in the prefrontal cortex (Jinda & Bahl, 2016). Neuroscience found that these two systems constantly interact, even fight each other, and influent decisioning. It is shown that emotional part often wins in this interaction, stressing out how strong our subconscious instincts are (Morse, 2006).

The brain reacts to the aspiration for gaining reward and avoiding loss, and both behaviors can be activated or deactivated autonomously (Peterson, Neuroeconomics and neurofinance, 2010).
Risk seeking and risk aversive choices can be activated from two different neural circuits, including nucleus accumbens (NAcc) and the anterior insula. Activation in Nacc and insula respectively can lead to a change in investor's risk preferences. Risk assessment means that person choose between potential gains and losses. When people expect to gain money, the Nacc ventral stratum is activated, and when someone expects a feeling of pain, anger, disgust or fear, anterior insula is activated. The research has shown that risky choices and mistakes because of risk-seeking were succeeding activation of Nacc, and less risky decisions and mistakes because f risk-aversive behavior was due to activation of anterior insula. (Kuhnen & Knutson, 2005) Another research in neurofinance found that Nacc activation spontaneously increases just before taking financial risk (Knutson, Wimmer, Kuhnen, & Winkielman, 2008) (Turcan & Dedu, 2010).

Nacc releases two neurotransmitters (Peterson, 2007) (2007). The first one is dopamine or pleasure chemical. Brain reward system, activated by profit expectations, communicate through dopamine neurotransmitter and gen that regulates them influent investor's judgment about gaining reward and avoiding risk (Kuhnen & Chiao, 2009). Dopamine has a great impact on reward expectations and increases risk-taking behavior (Sadeghnia, Hooshmand, & Habib, 2013). The other one is serotonin, responsible for the feeling of anxiety and depression. When unfulfilled expectations like investment lose occurs, the level of serotonin lowers, and it leads to investor's loss of enthusiasm. To avoid further losses because of risk-aversion, investors with a low level of serotonin make bad investment choices, sell investment too early and increase their loses (Jinda & Bahl, 2016). In decision process, one more brain activation is happening, in the amygdala, brain's center of fear. Fear can be an emotional expression of uncertainty in financial assessment (Hsu, Bhatt, Adolphs, Tranel D, & Camerer, 2005). This is a system for loss avoidance. Both gaining reward and avoiding loss systems lay in a limbic system, an emotional region of forebrain and they guide investors behavior through subtle emotional influence on judgment, thinking and acting (Peterson, 2007).

Neurofinance attempted to understand increased deeply and decreased activation of these brain systems, to change biases in behavior that led to huge money losses (Sadeghnia, Hooshmand, & Habib, 2013). Next step might be to explore modifications of different generations thinking process, since their business behavior significantly changed, especially obvious in Millennials comparing to generation of Baby Boomers (Obradović, Mitrović, & Pavićević, 2017).

6. CONCLUSION

Financial researchers recently realized the necessity to understand better how emotions influent decision-making process and what can be done about it. In an attempt to deal with investor's choice under risk and uncertainty, a new scientific field arises. Neurofinance, as a completely new business concept, became top topic around the world, the new trend in economic thinking (Kolev, Njegovanović, & Ćosić, 2015). Neurofinance provides the possibility for a deeper understanding of emotions and their influence on decision making; it explains how and why investor's specific behavior occurs (Cohen, 2005). Furthermore, neurofinance can tell us how to drive investor's behavior closer to optimal, by learning how to overcome subconscious emotional reactions.

Neurofinance, with its diagnostic tools, enables much profound analysis of human brain in the light of financial decisions, enables further explanation of investor's behavior and their emotional biases. It is a very young scientific field. The future will show its limits, and how far they reach. The unthinkable of impact on all areas of business is to be expected yet.

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PLATFORM BANKING: EMPIRICAL EVIDENCE ON CUSTOMER EXPECTATIONS AND ACCEPTANCE

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Abstract: *The platform business model operates as a many-to-many business model with the infrastructure controlled by a particular entity. Various industries have so far seen the radical changes due to the emergence of this phenomenon. However, the full platform strategies have not been actualized in banking by now. The infantile platform concept, such as branchless banking are the outmost reaches of banking platforms. Our aim is to explore the costumers' expectations regarding the platform and branchless banking. For this purpose, we collected primary data using the questionnaire as a research tool. The results indicate that costumers find platform businesses to have the first mover advantage. Also, the study finds that perceived risks and attributes of banking-as-a-platform are strong predictors of the future use.*

Keywords*: platform banking, fintech, customer expectations, retail banking*

1. INTRODUCTION

Developments in technology have changed the way in customers and suppliers interact (Teece, 2010). In a traditional or linear model, companies create values such as products or services and then sell them to customers downstream the supply chain. The platform business model operates as a many-to-many business model with the infrastructure controlled by a particular entity. This concept attracts more and more scholarly attention (Kornberger, Pflueger & Mouritsen, 2017).

As such, it is a potential panacea for the improvements in the efficiency and decrease in costs. Accordingly, the popularity of platforms has grown exponentially in last decade. Some platforms even dominate the industries in which they operate. As seen by Manville (2016) 'The networks and markets forming around—and orchestrated by-- Google, Airbnb, Uber, and other virtual exchange enterprises are the maws into which traditional companies are now disappearing.'

The banking sector has already been challenged with disruptions in service providing. For instance, the emergence of payment card transactions created a two-sided network with strong network externalities (Rochet & Tirole, 2002). This disruption was only incremental by nature, because the consumer's bank – the issuer – and the merchant's bank – the acquirer – only have to obey simple rules such as 'honor-of-all-card' or 'no-surcharge' rule. The essence of banking remains untouched. Nonetheless, platform banking may completely change the role of the bank in the supply chain. Instead of actively controlling depositing and crediting activities, the bank (if even a bank) only maintains the platform, and the service is provided by many to many. This might seem as a clairvoyant-type of prediction, but it is even became a cliché at fintech conferences to see at least one success story in what is now known as Banking-as-a-Platform (BaaP) model (Brear & Bouvier, 2015)

Even though the platform models could potentially change the landscape of banking, only a paucity of research has tackled consumers beliefs, expectations and acceptance toward this phenomenon (Karjaluoto, Mattila & Pento, 2002). To the best of our knowledge, this is the first study examining consumer's perspectives related to the emergence of platform banking.

Our aim is to explore the consumer's attitudes and expectations regarding the platform banking. Particular aim is to determine which companies have the "first mover" advantage. An additional aim of the study is to explore the main risks and drivers of the future platform banking use as seen by customers.

We proceed as follows. To start off, we review the literature related to economy of sharing, platform banking as a business model and the main risks associated with the consumers' use of platforms. Second, we elaborate on the methodology used in the study – the questionnaire as a research tool, sampling procedure, data collection and processing. Third, we explain the results of the study. Finally, we place our findings in the context with previous work in this area, leaving the space for concluding remarks.

2. RELATED WORKS

In this section, we depict the platform as a business model. Afterward, we delineate the use of platform business models in the banking industry with a particular emphasis on disruptive competitors in the banking sector and the main risks associated to the implementation of this model in the banking.

2.1. Sharing economy and platforms as business models

In popular and academic literature there is no unanimous consent on the concept and term of sharing economy. However, a common element in various definitions is sharing of underutilized assets in ways that improve efficiency, sustainability and community. Sharing economy became an umbrella term for spectrum of non-ownership forms of consumption activities (Habibi, et al., 2017). Hawlitschek, et al. (2018) proposed seven criteria to distinguish sharing economy among the ocean of related terms, such as collaborative economy, on-demand economy, peer economy or gig economy: (1) increasing utilization rates, (2) peer-to-peer principle, (3) existence of reimbursement, (4) no transfer of ownership, (5) resource tangibility, (6) leveraging of information systems, and (7) temporariness.

Bucher et al. (2016) describe this new culture of making people's belongings accessible through online networks with one simple sentence: "What's mine is yours, for a nominal fee". Depending on who owns the asset and who sets the conditions of sharing, there are three distinct models that prevails in sharing economy: decentralized platforms (i.e. Airbnb), centralized platforms (i.e. Zipcar), and hybrid platforms (i.e. Uber). According to Vaughan and Daverio (2016), these platforms generated revenues of nearly E4bn in Europe in 2015. This research also predicts that global revenues of sharing economy could hit the value of $335bn by 2025.

Due to complex nature of sharing economy, some authors even suggest avoiding academic debates about finding common single definition. Acquier, et al. (2017) state that instead of narrow definition, the efforts should be made to find organizational framework for mapping its perspectives. Their research proposes three foundation pillars of sharing economy:

1. "Access economy – sharing underutilized assets (material resources or skills) to optimize their use"
2. "Platform economy – intermediation of decentralized exchanges among peers through digital platforms"
3. "Community-based economy – coordinating through non-contractual, non-hierarchical or non-monetized forms of interactions".

Fintech has fully enabled the implementation of sharing economy. In general, Vives (2017) states that 'new digital technologies automate a wide range of financial activities and may provide new and more cost-effective products in parts of the financial sector, ranging from lending to asset management, and from portfolio advice to the payment system.' An important game-changer in the banking industry are technologies that enable Banking-as-a-Platform models.

A platform can be described as a business that facilitates direct interaction between two or more distinct types of customers. Platform business models generate value by connecting and organizing transactions and create strong network effects (Acquier, et al., 2017). These effects help in structuring the innovation process and accelerate the adoption and use of platforms (Gawer & Cusumano, 2015). Within the sharing economy, it is possible to distinguish four types of platforms: (1) accommodation sharing platforms; (2) car and ride sharing platforms; (3) peer-to-peer employment markets; and (4) peer-to-peer platforms for sharing and circulating resources (Martin, 2017).

2.2. Business case for platform banking

Banking-as-a-Platform model is still a working concept without solid definition in theory. Other than tech-based studies, most of the scholarly effort has so far been put to, the use for unbanked population (Dermish et al., 2011) or the general social impact (Fernandez, et al., 2017).

Mas (2009) states that 'a branchless banking platform is made up of three key elements: (1) The retail network, composed of the collection of retail outlets where transactions are originated (2) The payment network, which aggregates the transactions from the collection of retail outlets and routes them to the appropriate issuer (3) The account platform, which manages the service logic by authorizing individual transactions and maintaining the value of accounts.' Further on, Porteous (2006) illustrates the difference between bank-based and non-bank-based models. These categories depend on the nature of the scheme provider. On one side, bank-based models are push strategies provided by the existing banks. On the other

side, non-bank-based models are pull banking schemes of telecommunication or other companies with the expertize in technology.

Following the all aforementioned, we set one research question and two hypotheses:
RQ1. Whom do customers trust more in setting the banking platform – banks or platform businesses?
H1. Perceived risks negatively affect the adoption of platform banking
H2. Perceived benefits positively affect the adoption of platform banking

3. METHODOLOGY

3.1. Research instrument, measures and variables

We used questionnaire as a research instrument to collect the primary data. It was distributed in a paper-and-pencil form. This technique was used in order to assure that sophisticated examinees are the only sampled ones. Prior to providing a questionnaire to them, they were pre-tested for the awareness of the Banking-as-a-Platform model.

The questionnaire had five sections. After the demographic section, we asked the examinees if they would prefer platform to be operated by banks or platform business, such as Google, Airbnb, Uber etc. The third section examined a perception of the main risks associated to the use of platform banking. This section was developed following Yousafzai, Pallister, & Foxall (2003) and Mha (2015). We developed the fourth section on the main drivers for the use of platform banking inspired by Martins, Oliveira & Popovic (2014) and Vankatesh et al. (2003). Finally, the last section examined the overall readiness of the examinees to use platform banking services in the future.

3.2. Sampling procedure and data collection

The sample used in the study was random. The examinees were interviewed by trained assistants (four year students from the Faculty of Organizational Sciences mentored by the authors). The examinees were asked first about their knowledge of banking services and the concept of Banking-as-a-Platform model. Out of the population of 423 examinees, 146 (slightly more than a third) of them fulfilled the criteria on the awareness of the concept. The gender was slightly misbalanced in terms of gender structure as 56.8% of examinees were male.

3.3. Data processing

The data was entered in the Statistical Package for Social Sciences (SPSS). Quantitative data was analyzed with descriptive statistics: percentages, means and standard deviations. Interdependence of determinants (independent variables) and contract management efficiency (dependent variable) was determined by correlation (Pearson moments two tailed correlation coefficient analysis) and multiple regression.

4. RESULTS

4.1. RQ1 – Who has the advantage in creating banking platforms?

The results for RQ are displayed in Table 1. Interestingly, less than one fifth of examinees would join platform banking if it would have been developed by a bank. Contrary to that, nearly 90% of examinees would use the services if they were provided by platforms such as Airbnb, Amazon or Google.

Table 1: Costumers' opinion

	If banks would create banking platforms, would you use the services		**If platform businesses would create banking platforms, would you use the services**	
Valid	3	2.1	0	0
Yes	26	17.8	131	89.7
No	117	80.1	15	10.3
Total	146	100	146	100

4.2 Hypotheses H1-H2

Before testing the hypotheses, we conducted pre-analysis including descriptive statistics (mean, standard deviations, and internal reliability tests) and correlation analysis.

Table 2: Descriptive statistics and correlation matrix

	Mean	StD	CA	1	2
Risks	2,44	,83	.89		
Drivers	3,49	,99	.90	-,01	
Overall use	3,55	,95		**-,29**	**,55**

bold – significant at .01

Since we found both correlations to be significant, the next step was to examine the influence and intensity of variables seen as independent to the overall use of platform banking (dependent variable) in the model. The results of the regression analysis indicated that the research model predicted 63% (R2=.63) of the variance which is displayed in Table 3.

Table 3: Regression analysis for the potential use of platform banking

Variable	Coefficient	SE	t-statistic	Prob
Constant	2.49	.29	8.53	.00
Risks	.33	.07	-4.41	.00
Drivers	.53	.06	8.48	.00
R square	.63	F		46.05
Adj R square	.39	Sig		.00
SE of regression	.75	Dependent variable: Potential use of PB		

5. DISCUSSION AND CONCLUSION

5.1. Key findings, implications and contributions

Our study had two basic aims. The first one was to explore a perceived 'strategic' advantage in platform banking. As seen by costumers, platform businesses have far better position in establishing the full scale capacity for platform banking. Banks are, obviously, not perceived by customers as key innovators in the future and they will need to proactively manage the disruptive forces of the emerging financial technologies (Reddi, 2016; Kumar, 2017). This seems to be in line with the studies focused on the inability of incumbent firms to identify new markets in the face of disruptive technologies (Vecchiato, 2017).

The second aim was to explore the effects of perceived risks and main motivators on the future use of platform banking services. The results of our study provided support for the research model and hypotheses tested. Examinees were aware of the potential risks. The most important risks was related to the cybercrime and potential loss of private data (see Appendix 1). Additional aim was to examine the driving forces for the use of platform banking. The most important force is the facilitating conditions and the availability of resources for platform banking (see Appendix 2).

Our study has twofold implications. As for the implications for researchers, this study is the first to examine the potentials of platform banking. Future studies should concentrate on the development of this business model in banking and capture on evolutionary characteristics of this phenomenon. From the practical point of view, this study is particularly interesting for platform businesses and banks. The first ones could harvest the perception of the 'first movers'. It could, however, be speculated that they could experience barriers related to regulatory environment (e.g. Makaya & Nhundu, 2016). The second ones should develop key competencies related to fintech development and position themselves as the 'domain' leaders.

5.2. Conclusions

Platform businesses are gaining importance nowadays. The wealthiest incumbent firms are platform businesses. Still, banks are still out the platform ecosystem. Nonetheless, not only digital, but traditional banks consider modular banking (in Banking-as-a-Platform or Banking-as-a-Service model) will be the future of banking. This study puts an additional light to this forecast. We demonstrate that customers envisage platform banking to be an important and widely used concept. Moreover, they see current platform businesses to be possible leaders in the field of offering banking services through their or new platforms.

The most important pillars of future platform banking are risk mitigation related (especially to the security of data) and driving forces – particularly the ones related to the sufficient resources of banking service users.

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APPENDIX 1 FREQUENCIES FOR THE PERCEIVED RISKS OF PLATFORM BANKING USE

	Mean	Std. Deviation
I believe that it is risky to create an account for PB	2,2808	,95948
I do not believe in security of PB	2,5068	,99825
I could use my financial resources if I use PB	2,2055	,93157
I could face operating errors with PB	2,2466	,97246
I could lose control over personal financial data	2,6712	1,19256
I could be a vicitim of cyber crime	2,7260	1,14783

APPENDIX 2 FREQUENCIES FOR THE MAIN DRIVERS OF PLATFORM BANKING USE

	Mean	Std. Deviation
I have resources for PB use	4,1438	1,27571
I have a knowledge for PB use	4,0959	1,27754
PB would be easy	3,5342	1,21578
PB would be widespread	2,8973	1,42262
PB would be simple to use	3,4452	1,03744
PB would be secure to use	3,1986	1,09305

PAYMENT PROCESSING IN WEB BASED ENVIRONMENTS: THE BENCHMARK OF THE WORLD'S LEADING PAYMENT PROCESSORS

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Abstract: *With the development of ecommerce industry and payment processors such as PayPal, the concept of electronic payment models and payment processing has become crucial for the success of web-based businesses. There are several ways to collect the funds, from using e-cash to using e-wallets. E-wallets have the huge potential, while credit cards as payment alternative are still one of the mostly used payment methods during electronic purchases and payments. What are the trends of using e-payment methods, what should the businesses pay attention to when choosing a payment processor and what are the top payment processors worldwide are the questions that are answered in this paper. By reviewing the offer of payment processors, the author has analyzed the key factors which could affect the costs, efficiency, conversion rate and the profitability of any web business which uses e-payments as a way of collecting funds. By reviewing the current literature and based on the empirical experience, the author has chosen the top 8 payment processors and gave their opinion – which of the payment processors could have the biggest impact on the web businesses.*

Key words: *payment processing, benchmark of payment processors, payment methods, web companies, credit cards*

1. INTRODUCTIONTOONLINE PAYMENT PROCESSING AND PAYMENT METHODS

E-commerce and internet have brought the third industrial revolution and all of its benefits. The internet traffic has increased at a significant rate from the beginning of third industrial revolution until now. Conventional payment methods rates are reducing in favor of e-payment methods. With the e-payment trends, overall spending for the goods and services bought via Internet have been increasing constantly over the years (Lowry, Wells, Moody & Humphreys, 2006). United States as the most developed e-payments market have reported 1.18 trillion US dollars in online spending in 2016. In Europe, this number has reached 281.5$ billion. With more than 311 million consumers who are actively paying through e-payment channels, this number will keep growing (Statista, January 2018). With the market globalization and stronger e-commerce industry, companies operate in a tough economic environment which require a strong focus on cost optimization, timescales and resources optimization in order to boost efficiency. Also, in order to increase competitiveness, companies tend to adapt to new business models, to react quickly and to raise efficiency (Scheer & Brab, 2010).

Nowadays, the vast majority of businesses use e-banking systems for payments. That trend continues for B2B [1]segment. However, during the 90's, e-commerce industry has created a need for the fast and efficient payments in B2C [2] segment, as well as in PtP (peer-to-peer) segment (Jeffrey, 2002). Peer-to-peer payments enable one side (not registered as a business) to transfer the money easily to the other side. But, before that, wire transfers and cash as the traditional payment methods have been replaced with credit card payments, which became a dominant payment method. On the other hand, new payment methods became available due a significant growth of e-payments. Although internet banking has reached its peak, considering the security and the quality of the service, money transmitting systems search for a full replacement of money orders through wire transactions and paper checks (Joseph, 2002).

The concept of online payment processing is defined as the process of connecting the buyer and the seller through an online platform by exchanging the data (Lowry et al, 2006). On the other hand, online payment systems are defined as an online monetary system which connect all stakeholders in the process of online payment such as sellers, buyers, banks and other financial institutions.

The first online PtP payments worked as an online auction e-Bay and Amazon. Zhang and Haizheng have shown that there are several factors which could affect the choice of a payment method in an online auction. The payment method customer will choose, depends on product attributes and seller's characteristics as

[1] B2B – Business-to-Business segment
[2] B2C – Business-to-Consumer segment

well. If the surrounding is more secured, the use of credit cards will increase, otherwise cash-equivalents will dominate as a payment method (Zhang & Haizheng, 2006).

One of the main reasons for introducing this paper is to show the benchmark of types of online payments and types of payment processors which could help the tech companies to increase the overall business performance, especially those in the early development stage– startup companies. In order to understand the importance and purpose of online payment processors, it is crucial to have an overview of the e-payment industry and companies which operate within this industry.

Based on a sample of more than a million websites (n=1.066.419), PayPal is the global leader in an online payment industry with more than 72% of market share. The top 10 payment processors based on the market share according to the **Datanyze**[3] are the following:

Table 1: Top 10 Payment Processors by market share (n=1.066.419 domains)
Source: Datanyze, 2018

No.	Payment Processors	Domains	Market Share
1	PayPal	778,385	72.99%
2	Stripe	113,132	10.61%
3	Square	20,644	1.94%
4	Authorize.net	18,811	1.76%
5	Amazon Pay	17,716	1.66%
6	Klarna	16,623	1.56%
7	CCBill	11,923	1.12%
8	Braintree	11,735	1.10%
9	Google Checkout	10,654	1%
10	WorldPay	5,125	0.48%

There are several payment methods which are crucial to mention as e-payments methods. According to Hsieh (2001), payment methods could be divided into:

- Electronic credit card payments - e-credit,
- Electronic cash payments - e-cash and
- Electronic check payments – e-check (Hsieh, 2001).

In Table 2, there is an explanation to the difference between these three types of payment methods, considering the advantages and disadvantages of each of them (Peffers & Ma, 2003).

Table 2: Overview of e-payment methods and their characteristics
Source: Peffers, K. and Ma, W. (2003), An Agenda for Research About the Value of Payment Systems for Transactions in Electronic Commerce

Payment method	Advantages	Weaknesses
e-credit card payments	This payment method solves the anonymity issues by supporting users in processing the transactions without showing their personal information. It can also be used in an offline mode.	It is hard to implement a sustainable system of anonymity with data that are hard to trace. That data security is necessary in order to prevent the fraud and allow disputes of the transaction (Hou X.& Tan C., 2005)
e-cash payments	E-cash payments are based on cryptography in order to provide and sustain the security of transactions.	Overlooked due to the popularity of e-credit. It can take longer for transactions to settle. The speed of settlement and disbursement also depends on the processor.
e-check payments	This method is widely used and trusted and could be used both, online and offline. It leverages the existing credit accounts.	These transactions can't provide anonymity and have security issues due to fraudulent activities.

[4]Datanyze is a platform for collecting information on the usage of payment processors.

Many companies search for the increase of purchases by accepting additional forms of payments and by increasing the number of credit cards by which a customer can pay. However, there are certain risks businesses have to face. Some of those risks could be reduced by using e-payments. During the period from 1994 to 2001, the usage of the traditional payment methods, such as cash and checks have reduced by 10% and 3% retrospectively. The usage of credit/debit cards have been increased over the years. As well as the total amount of spending (Rysman, 2007)[4]. The alternative payment methods such as e-cash and usage of e-wallets will also face a growth in the upcoming years. Therefore, the risk of not being able to collect the funds is one of the biggest issues web companies could have. The benefits of using e-payments could be related to decreased costs, improved cash flow efficiency, increased protection of information and protection of payment provider.

2. PAYMENT GATEWAYS AS PROCESSORS AND PAYMENT PROCESSING TYPES

Payment gateways or online payments processors are defined as the companies which are authorized to process credit card transactions between buyers and sellers. In order to buy or sell via online channels, the customer needs to submit the information on his/hers credit card to an online business (2Checkout, 2014). Payment gateway is also defined as the processor for collecting the funds through credit card or e-cash payments. There are several types of processors based on payment methods mentioned in Table 2. The first one is a conventional credit card payment processor. It is connected to several objects such as the merchant's website and shopping cart, merchant's bank and cardholder's bank. The overall concept of this type of processing could be seen in the Figure 1.

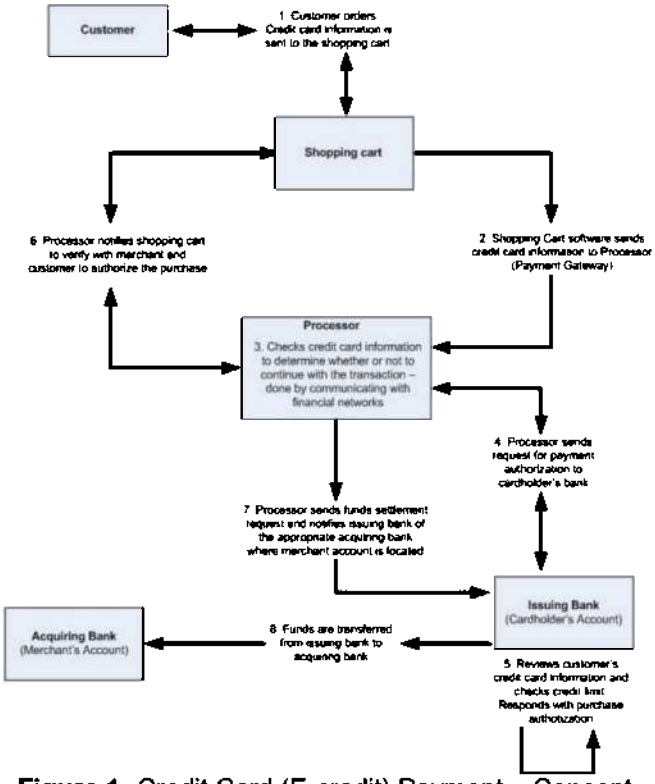

Figure 1: Credit Card (E-credit) Payment – Concept
Source: Lowry, P. B., Wells, T., Moody, G., & Humphreys, S. (2006). Online Payment Gateways Used To Facilitate E-Commerce Transactions and Improve Risk Management

Merchant's bank accounts established at bank in order to collect the funds from credit card holder. Internet merchants, such as web companies, usually do not keep the funds as a business checking or business savings but use them as daily or weekly transfers to another bank account. The whole process starts with the customer orders a certain good or service through the shopping cart. The payment gateway coordinates the communication between entities by handling the information collected from them through several phases from authorization and submitted for settlement phase to the final settlement and disbursement of the funds to the merchant's bank account. In the first phase – authorization phase, the credit card information of the client/customer is being sent from the merchant's website to the payment gateway (processor) by the shopping card with verification of the credit card information. As soon as the information gets verified, the

[4]The study done by Mark Rysman (2007) has taken in consideration the usage of payment methods in non-online environment.

request is being sent to the cardholder's bank for the card to be charged (Lowry et al., 2006).When the information from the credit card is being processed and validated, if it's valid and there are enough funds on the customer's bank account, the credit card company sends an approval to the payment processor. Later on, the payment processor communicates with the merchant's website and shopping cart and confirms the authorization of the purchase/reservation. After the authorization is done, the payment processor initiates a funds transfer. This phase is known as the "submitted for settlement" phase in which the processor allows the transfer of the funds from the customer's bank (credit card) to the merchant's bank account.

With the PtP, it is necessary for both, customer and merchant to have an opened account with the PtP provider. All the payments are processed and handled through PtP provider. There is no need for other financial institutions to be an intermediate between two parties. However, in comparison to the credit card payments, the use of PtP services is limited, so not everyone could subscribe. The main condition to process the transactions using PtP is that both sides have the accounts opened at the same PtP provider. Figure 2 is illustrating the flow of the system. The communication (both-sides) goes through a PtP platform, first by initiating a purchase, through creating invoices and money requests to the final stage - the transfer of the funds.

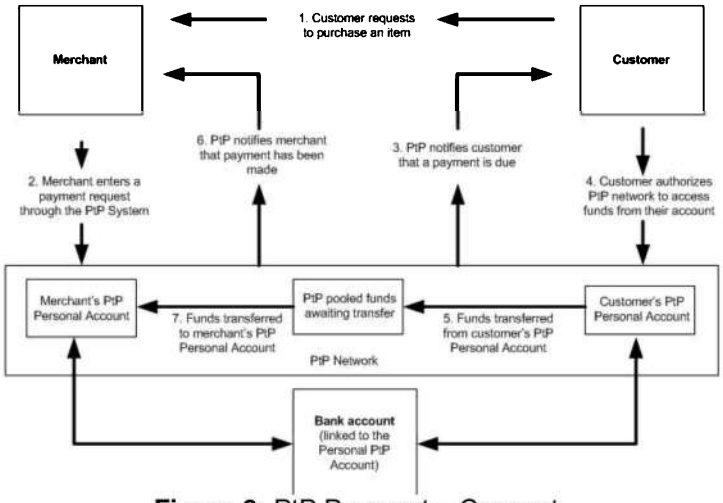

Figure 2: PtP Payment – Concept

Source: Lowry, P. B., Wells, T., Moody, G., & Humphreys, S. (2006). Online Payment Gateways Used To Facilitate E-Commerce Transactions and Improve Risk Management

The PtP system's simplicity makes it suitable for low-volume sellers or for sell through auctions. There are no monthly fees for maintaining the account, although there are fees paid on each transaction which (in the case of PayPal - 2.9% of the transaction value + 0.3$ per transaction).Considering all the facts, PtP accounts have several benefits:

- Automatically invoicing;
- Accepting payments directly from the website through API;
- Both ways transactions (selling and buying) with the members of the same PtP network;
- Payment without credit cards, using e-cash.

The comparison between these two types of processing could be seen in the Table 3. The main difference between concepts shows both – benefits and disadvantages of each type of processing.

Table 3: The comparison between e-credit and PtP concepts of processing

	E-credit processing	**PtP processing**
Duration of the payment settlement	0-5 days	instantly
Duration of the payment disbursement	2-6 working days	0-1 working days[5]
Type of disbursement	Automatic	Manual (on demand)
Communication	Communication with the third-party intermediaries (banks and credit card companies); Only one side is required to have the merchant account opened in order to process payments	The direct communication between two sides without intermediaries; Both sides need to have an opened PtP account
Verification	Multi step verification	One step verification after the account is being made

[5]The data are based on a empirical research;

It would be devastating for any business and its growth, if the credit/debit cards are excluded as a payment method, since they are still the mostly used method of payment. Without processing credit cards, the potential growth that a business may expect from this type of plan is limited to the number of similar users that would be potential customers. Many PtP providers offer an upgrade, called a premium, or business account. Both PtP and Credit Card payment processors operate using a similar fee model. They collect the fees as a percentage of the value of processed transactions and add a fixed fee price per transaction. The model of paying cost per transaction could be seen in the Equation bellow.

$$\boldsymbol{FC = \sum_{i=1}^{n}(TVi\ x\ ß + \ \theta i)} \quad (1)$$

$$\boldsymbol{TTV = TV\ x\ n + FC} \quad (2)$$

FC – Total costs of the transaction fees
TV – Transaction value
TTV – Total value of the transaction
i – number of transactions
i = 1,….,n

TV – the value of transaction
ß – relative fee per transaction [%]
θ – fixed fee per transaction

In the case of the refund, the payment processor returns the amount with the relative fee, but keeps the fixed fee amount.

$$\boldsymbol{TRV = TTV + (FC - \theta)} \quad (3)$$

TRV – Total refund value

Most of the payment processors offer ß as 2.9% and θ as 0.3$. The more transactions the company has, the bigger chances are that the company could negotiate lower fees. Some of the processors have highlighted this option on their websites. For example, the payment processor - *2Checkout* has put a target of 50.000$ in monthly transactions in order to lower the fees for the merchant.

3. THE TRENDS OF E-PAYMENTS

In order to make a benchmark of payment processors, the author has focused on the e-payment trends. For making a decision which processor of portfolio of processors to use, it is important to understand the consumer market and the trends of processing. Based on various researches and analyses, debit and credit cards are still dominant as a payment method. According to the research of the Total System Services Inc (2016), people still tend to trust more on paying through credit cards (42%), than on PayPal (26%) and Debit Cards (12%)(Total System Services Inc., 2016).

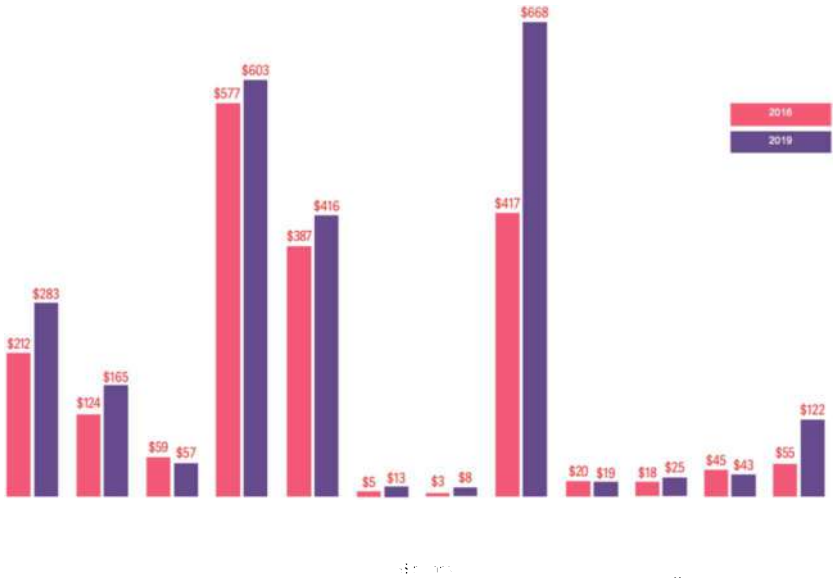

Figure 2: Payment Method Forecast for 2019th
Source (WorldPay, Global Report, 2015)

The trend of online payment through payment processors is increasing. With 577$ billion, credit cards are on the first place based on the volume of processed transactions and total processed amount. It is expected to have a growth of 4.5% until 2019th and to participate with 24.4% of all payment methods and by 2020th to reach 711$ billion in processed transactions with 20.2% participation in payment methods. In the Figure 3, there are the data which represent the structure of payment methods used in 2015 and the predictions for 2019. It is expected that credit and debit card payments will decrease in the upcoming years in the favor of alternative ways of payment which are recording a growing trend of usage. Considering the credit cards, Visa is the most dominant credit card with more than 50% of participations, with the following MasterCard, Amex and Discovery retrospectively.

Based on the forecasts, the credit card usage will drop to the second position from 2019, due to strong expectations of e-wallet growth. The digital wallet or e-wallet is a form of online payment platform based on using virtual money. With the development of trade market for cryptocurrencies and blockchain technology it became one of the most important payment methods. Digital wallets could be defined as a software application which enable the secure transfer of money without the need to enter all the credentials (Gulati, Nadeau, & Rajgopal, 2015). Credit Card with the biggest participation in total credit card transactions is Visa, which goes from 14% in China to 64% in Netherlands and India, 65% in Poland and 61% in Russia. Master Card is the second biggest credit card provider. Third and fourth are American Express and Discovery. United States as the most developed market has recorded 53% of Visa transactions, 24% of MasterCard and 15% of American Express transactions, considering the total volume of processed transactions by using different credit card types.

The biggest growth of alternative payment methods is expected in the North America, Asia Pacific countries, while in Europe this trend will have a negligible growth in comparison to North America and Asia Pacific. Considering the Global Market, it is expected that the credit cards participation in e-payments will drop from 29.9% in 2014, to 24.9% in 2019. The similar estimation goes for debit cards – from 20.1% in 2014 to 17.2% in 2019. On the other hand, e-wallets should record a growth – from 21.7% in 2014 to 27.6% in 2019. In North America, the credit cards usage will drop, but it will remain the number one payment method, while in Europe and Asia, e-wallets will be the primary payment method (WorldPay, Global Report, 2015). However, it was shown that people tend to trust more to credit card payments while purchasing online - 42% in comparison to PayPal payments - 26% (Total System Services Inc., 2016). There is no doubt that the credit card usage will keep having a strong impact on e-payments. Therefore, it is important to analyse both payment methods – the ones that support e-cash and e-credit payments.

4. THE BENCHMARK OF PAYMENT PROCESSORS

Not all payment processors have the ability to process the transactions in each country or to connect to the merchant's website. Therefore, the author took into consideration several factors as a key determinant for choosing the payment processors. The first one is the availability on the market where the website is being established. Since most of the web businesses offer their products or services to at least several markets, it is crucial to have the exchange office implemented by the processor which allows to process the transfer in currencies different than the domestic currency. All types of costs are important for the company, so are the processing and maintenance costs and chargeback fees. People tend to trust more if the purchase is done directly through the website and if it has an additional security certificates shown on the check-out page (Schlosser, White, & Lloyd, 2006). By having an option to pay directly from the merchant's website, the company could turn more visitors into buyers. This is also one of the factors which was analyzed. Every modern web business tends to increase its conversion rate. Conversion rates could be increased by applying the payments directly from the website where the merchant offers its product or services. By using the API payment, processors offer as an extension for developers. Based on the analysis of several payment processors (PayPal, Authorize.Net, 2Checkout, Stripe, Braintree, WePay, Dwolla, Paymill, Square), the author has made an overview of their offer in the Table 4. The selection of the processors was made based on the number of countries the service is available on the first place. The market share was not crucial when making a selection.

The collected data is related to location where payment processors are providing their service, use of the exchange office for payments in the foreign currencies, monthly maintenance costs, transaction fees, chargeback fees and the information could it be implemented on the merchant site through the API or is it *off site* oriented. PayPal has recently adopted the use of credit cards for payments as well, which made it a hybrid version of payments – PtP and E-credit. However, it doesn't offer the possibility of *on-site* payments. Therefore, many businesses consider using multiple processors as a best practice. Considering the trend of payment methods, the author has selected only the processors which operate through the PtP and e-credit methods, since they are the most dominant ones.

Table 4: Payment processors benchmark

Payment processor (Market Share)	Location availability and support	Use of the exchange office	Monthly maintenance costs	Transaction fees (ß + θ^6)	Chargeback fees	Onsite/Offsite payment (PtP/E-credit)
PayPal (73%)	193 countries	Yes	0$	2.9% + 0.3$ per transaction	/	Offsite (PtP)
Authorize.Net (1.76%)	US, Canada, UK and some European countries	In process	45$ setup + 25$ a month	2.9% + 0.3$ per transaction	/	Onsite & Offsite (E-credit)
2CheckOut (0.16%)	Over 200 countries	In process	0$	Varies according to the location: 2.4% (EU)/ 2.9%(US)/3.9 % (non-EU) + 0.3$ per transaction (Volume discount for processing more than 50.000$ a month)	25$	Onsite & Offsite (E-credit)
Stripe (10.61%)	US, Canada, UK, Belgium, France, Ireland, Netherlands	Yes (1% conv.fee)	0$	2.9% + 0.3$ per transaction	15$	Onsite (E-credit)
Braintree (1.10%)	US, Canada, Australia, Hong Kong and part of Asia, Europe	Yes	0$	2.9% + 0.3$ per transaction (Amex 3.2$ + 0.3$ per transaction)	15$	Onsite (E-credit)
Wepay (0.04%)	US	No	0$	2.9% + 0.3$ per transaction	/	Onsite (E-credit)
Dwolla (0.02%)	US	No	25$ (basic)/250$ (premium)/15 00$ (custom) per month	0.25$ per transactions (for transactions less than 10$ - free)	/	Offsite (E-credit)
Paymill (0.06%)	39 countries (mostly in Europe)	No	0$	2.95% + 0.28 eur per transaction	/	Onsite
Square (1.94%)	US, Canada, Australia, Japan, UK	Yes	0$	2.9% + 0.3$ per transaction	/	On site + Application (E-credit)

[6] Cost per transaction/merchant account fees

PayPal as the world's leading payment platform has over 137 million active accounts which makes it an absolute leader. With presence in 193 markets, it is possible to use it for payment in more than 26 currencies. It is easy to transfer the funds and easy to request payments. PayPal has many advantages, such as its recognition as a payment processor, pricing policy, enormous customer base, multiple account option, ability to accept and send international payments as well as no monthly maintenance cost. Many authors see PayPal as the best alternative for processing e-payments (Niranjanamurthy M, 2014). However, not all countries have fully adopted PayPal in their economies. In the Republic of Serbia, online payment processors such as PayPal and others were being banned and restricted for opening as an option until the late 2016. One of the reasons is that PayPal and other well-known payment processors didn't have the license for processing payments in some countries and were not interested in smaller markets (Narodna banka Srbije, 2016). However, there were other possible payment processors beside PayPal.

Web companies which offer the services worldwide should have an option for collecting the funds in as much countries as possible. Therefore, processors such as PayPal, 2Checkout, Authorize. Net, Braintree and Stripe are the most important. If the company considers that as a priority, then Paymill, Dwolla and We pay would be excluded from further analysis.

Authorize.Net is one of the most popular processors. On the other hand, the exchange office is something which is necessary to have in order to transfer different currencies. It also has a monthly maintenance fees as well as the setup fees. It doesn't have any special benefit in comparison to the other processors. If the company seeks only for the lowest costs, Dwolla could be the best payment alternative, but only on the US market. Square has a unique benefit through a hardware extension and an application for e-payments which could process the payment online and on the spot of sale. However, it excludes Europe and most of the Asian countries. Stripe is a huge payment processor, which takes 1% of each payment paid in a different currency, besides the transaction fees. Therefore, PayPal, 2CheckOut and Braintree are recommendations by the author.

Based on the empirical experience from the processing of one online reservations company, the best way to be able to collect the funds is to have a portfolio of both PtP and E-credit processor. There is one leading PtP processor - PayPal, which is highly recommended to be implemented. The fact that PayPal has acquired Braintree, could help choose between 2CheckOut and Braintree. Since it's easier to open the merchant account on Braintree if the PayPal account is previously opened, the combination of PayPal and Braintree could make a good payment infrastructure for each web business. If a company combines both types of processing, the disadvantages of each type mentioned in Table 3 could be reduced. By having a PtP processor, the overall liquidity of a company could get improved, and with E-credit processor the possibility of global mass payments through using credit cards would be available. In Serbia, there are several startup companies which operate like this, such as FishingBooker, CarGo, ActiveCollab and others.

4. CONCLUSION

By further growing ecommerce industry, the electronic payments and payments processors will grow as well. By 2020, it is expected that ecommerce will reach the value of more than 2.4$ trillion. As a support for this kind of trade, payment processors will need to follow the trends in e-payments.

Even though e-wallets represent a huge potential and the future of e-payments, e-credit as a payment method is currently the mostly used method of payment. People still tend to use credit cards for their online purchases. Visa is the most used type of credit card with the following MasterCard, Amex and Discovery at the last place. The fundamental problem of this paper is how to choose the best payment alternative for web business which collect the funds by using a certain platform (payment processor). Through the analysis of concept of payment processing, payment methods and e-payment trends, the author highlighted the important features of processing which could be a guideline for choosing the proper processor for business.By benchmarking the top payment processors and advising on which to use, the author tends to help businesses through stimulating key results, such as payment efficiency, cost reduction, conversion rate and overall profitability.

As today's businesses need to adopt online payment systems and technologies, they need to understand the benefits of e-payments methods, type of payment processors and potential problems for not implementing the proper payment processor. Besides having an opportunity to lower the transaction costs, companies could use existing payment processors systems to manage the cash flow.

It is the opinion of the author that it's valuable for businesses to have a diversified portfolio of implemented payment processors on their websites. PayPal is one of the most important processors for PtP processing. By comparing the available locations for providing services and support, transaction and maintenance costs,

the specifics of the processors and benefits and disadvantages of each type of e-payment and payment processor, the author suggests using a combination of PayPal and Braintree as a best combination and a great payment infrastructure.

All in all, the author calls out for a research of the current use of e-wallets and its benefits, since it starts showing a huge potential for global e-payments, with cryptocurrencies as their type of payment. By combining credit card and e-wallets, companies could get a wider perspective of a potential for their businesses.

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ACCOUNTING FOR EXPECTED CREDIT LOSSES – CROATIAN CASE

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Abstract: *This paper discusses the results of application accounting for expected credit losses IFRS[1] 9 model. Accounting for expected credit losses (AECL) should provide to users of financial statements useful information about an entity's expected credit losses on its financial assets and commitments to extend credit. This field of accounting is substantial in banking business and it is inevitable to research AECL through its effect on banking business regulation. Although AECL was covered by accounting standards, last financial crisis has shown weak spots of the regulation. Delayed recognition of credit losses on loans (and other financial instruments) was identified as a main weakness in existing accounting for expected credit losses model. This is why accounting in this area has changed. Due to recognition of credit losses would decrease financial result and value of assets, banks have found solution through claims management companies so there is visible correlation of claims management business results growth and IFRS 9 introduction in Croatia.*

Keywords: *Accounting, IFRS 9, expected credit losses, banking business*

1. INTRODUCTION

Issue of accounting for expected credit losses was subject of huge debate among accounting standard setters. Also researchers have made great efforts to create a model which will improve the quality of accounting standards and the quality of accounts produced in accordance with these standards. Last financial crisis has shown weak spots of the accounting standards for expected credit losses. Delayed recognition of credit losses on loans (and other financial instruments) was identified as a main weakness in existing accounting for expected credit losses model.

As demonstrated during the financial crisis, the financial condition of a bank is highly sensitive to rapid increases in credit risk. Therefore, appropriately determining how, when and in what amount to recognize the effects of increases in credit risk should be a priority for all stakeholders in the banking industry, including bank directors and management, supervisors, investors and other users of bank's financial statements (Basel Committee on Banking Supervision, 2015).

The significant role of accounting in this financial crisis is to minimize the pro-cyclical impact of accounting on bank capital regulation in order to achieve financial stability (Song, 2012). Marton and Runesson (2016) pointed out three main reasons why accounting for credit losses must be studied in context of IFRS and the incurred loss model and its effect on banking business. First, accounting for credit losses in banks is characterized by high measurement uncertainty of loan loss provisions, which reflects the estimation of credit losses and constitute an innately high-judgment item. Thus, it is possible to write accounting standards that allow high judgment in this area. Second, loan losses play a central role when evaluating risks and stability of banks; as such, credit losses have substantial economic significance. Third, there exists a favorable research setting in that the change from local GAAP[2] to IFRS happens at different points in time in the EU, enabling a difference-in-differences (DID) test.

The incurred loss model in IAS[3] 39 resulted in credit losses being recognized only when a credit loss event occurs, which is corrected with IFRS 9.

In July 2014 the IASB added to IFRS 9 the impairment requirements related to the accounting for expected credit losses on an entity's financial assets and commitments to extend credit (IFRS 9, 2014). Previously in March 2013, IASB published Snapshot: Financial Instruments-Expected Credit Losses where they described a three-stage approach model for expected credit losses accounting. That model is the current model required by IFRS 9 for expected credit losses accounting.

[1] International Financial Reporting Standard
[2] Generally Accepted Accounting Principles
[3] International Accounting Standard

US GAAP and IFRS do not have a converged standard for credit losses accounting. At the beginning of the project for credit losses accounting, the FASB and IASB worked jointly. Due to the lack of support for a three-stage approach in the US, the FASB developed a single measurement model, while the IASB decided to continue with the three-stage model. FASB also decided it would not continue to pursue a classification and measurement model similar to the IASB. As a consequence, IFRS 9 is not a converged standard.

2. EXPECTED CREDIT LOSSES MODEL – IFRS 9

Expected credit losses model should be applied to:

- investments in debt instruments measured at amortized cost,
- investments in debt instrument measured at fair value through other comprehensive income,
- all loan commitments not measured at fair value through profit and loss,
- financial guarantee contracts to which IFRS 9 is applied and that are not accounted for at fair value through profit or loss, and
- lease receivables that are within the scope of IAS 17; leases, and trade receivables or contract assets within the scope of IFRS 15; revenue with contracts with customers.

Expected credit losses are expected to be recognized before financial assets become delinquent, as a forward-looking information, and when credit risk has increased since initial recognition, and when contractual payment is more than 30 days past due.

Expected credit losses model required by IFRS 9 is defined with a three-stage model for impairment based on changes in credit quality since initial recognition. The model is shown in Picture 1 below:

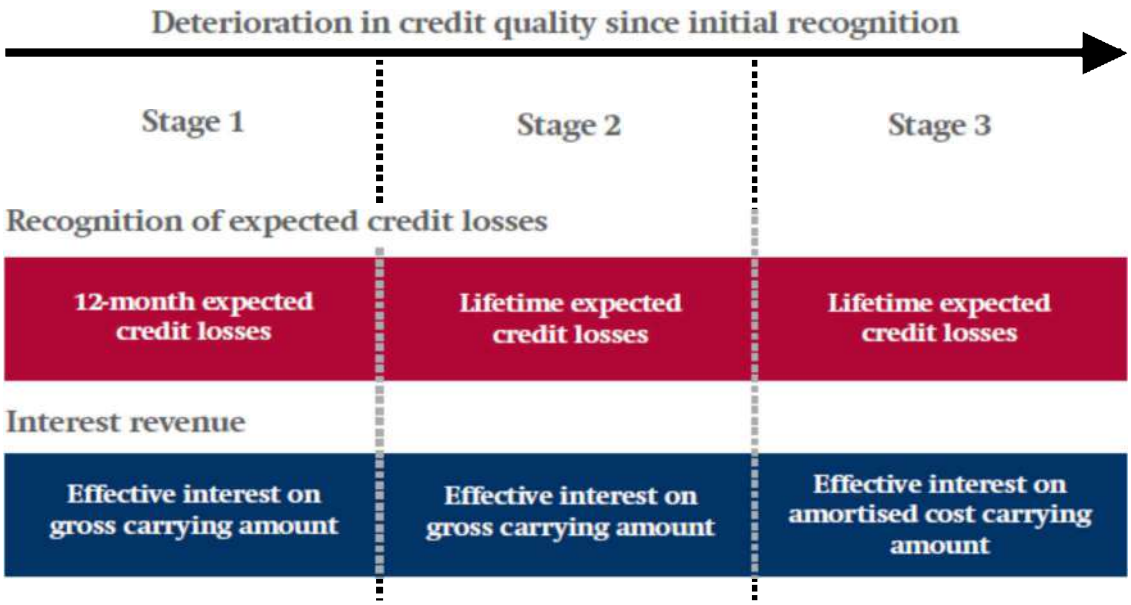

Figure 1: Expected credit losses model – IFRS 9; Source: IASB, 2013, Snapshot: Financial Instruments: Expected Credit Losses

The model is based on expected credit losses in the period of twelve months, in which recognition of expected credit losses through IFRS 9 is divided into three stages. Stage 1 recognizes expected credit losses when a financial instrument is originated or purchased. Immediately, twelve month expected credit losses are recognized in profit and loss and an allowance for expected credit losses (loss allowance) or provision is established. Stage 2 considers instruments with increased credit risk from initial recognition. At stage 2, full lifetime expected credit losses are recognized. Stage 3 is a situation when credit losses are incurred or the asset is credit-impaired. Interest revenue is then calculated based on the net amortized cost carrying amount.

At initial recognition, a financial debt instrument is supposed to be in stage 1 (except for purchased or originated credit-impaired financial assets). At each reporting date, the entity holding such an instrument will

have to assess whether credit risk has increased significantly since initial recognition and if there is any objective evidence of impairment in order to maintain it at stage 1 or downgrade it at stage 2 or 3 (Salhi and Thérond, 2014).

IFRS 9 ECL model requires that more than 90 days past due must be shown as loss in profit or loss account, which is why it was big issue for entities who had bad receivables in their balance sheets.

3. PRESENTATION OF IMPAIRMENT EXPENSE

According to IFRS 9 (2014) impairment expense can be presented in statement of profit or loss, or in other comprehensive income. If the impairment is the result of changes in market interest rates, reducing the market value of financial instruments, the effect of value loss should be presented through other comprehensive income. However, if increased credit risk is caused by subjective risk, the risk of bad assessment, the effect of expected credit losses is to be presented through profit or loss. The following example shows the investment in a financial instrument, where expected credit losses are caused by the change in fair value of financial instruments as well as by subjective risk. In that case, the total expected credit losses are allocated in the statement of profit or loss and fair value of other comprehensive income (FVOCI).

Example 1 – Presentation of impairment expense

An entity purchases a debt instrument with a fair value of CU 40,000 and measures the debt instrument at fair value through other comprehensive income. The instrument has an interest rate of 3% over the contractual term of 5 years, and has a 5% effective interest rate. At initial recognition, the entity determines that the asset is not a purchased or originated credit-impaired asset.

Table 1: Recording

		Debit	Credit
Purchase of a financial instrument	Financial asset - FVOCI	40,000	
	Cash		40,000

On the reporting date, the fair value of the debt instrument has decreased to CU 38,000 as a result of changes in market interest rates. The entity determines that there has not been a significant increase in credit risk since initial recognition and that expected credit losses should be measured at an amount equal to 12-month expected credit losses, which amounts to CU 600.

Table 2: Recording

	Expected credit losses	Debit	Credit
Increase in credit loss during the period	Impairment expense (P&L)	600	
	Other comprehensive income	1,400	
	Financial asset - FVOCI		2,000

The cumulative loss in other comprehensive income at the reporting date was CU 1,400. That amount consists of the total fair value change of CU 2,000 (that is, CU 40,000 – CU 38,000) offset by the change in the accumulated impairment amount representing 12-month expected credit losses that was recognized (CU 600).

4. CLAIMS MANAGEMENT GROWTH IN CROATIA

Although, for example in UK under Ministry of Justice exists claims management regulation office and publishes annual report on data about industry, in Croatia does not exist data about industry at one place. Hypothesis is that new AECL model has led to growth of companies in claims industry. Data on financial performance of companies in the industry of claims management indicate correlation of claims management companies' performance and IFRS 9 introduction. Recognition of credit losses would decrease financial result and value of assets, so for that reason banks have found solution through claims management companies. Biggest claims management companies, which are operating on Croatian market are funded by banks and owned by banks. From case of chosen companies, it is clear that after publication of IFRS 9 AECL banks have start solving problem of credit losses through claims management companies. On January 1 2018 when started application of IFRS 9 recognition of credit losses would lead to decrease of financial result so banks have solved that problem by transferring ECL to, sometimes their subsidiaries, and rearranging contract details about payment date.

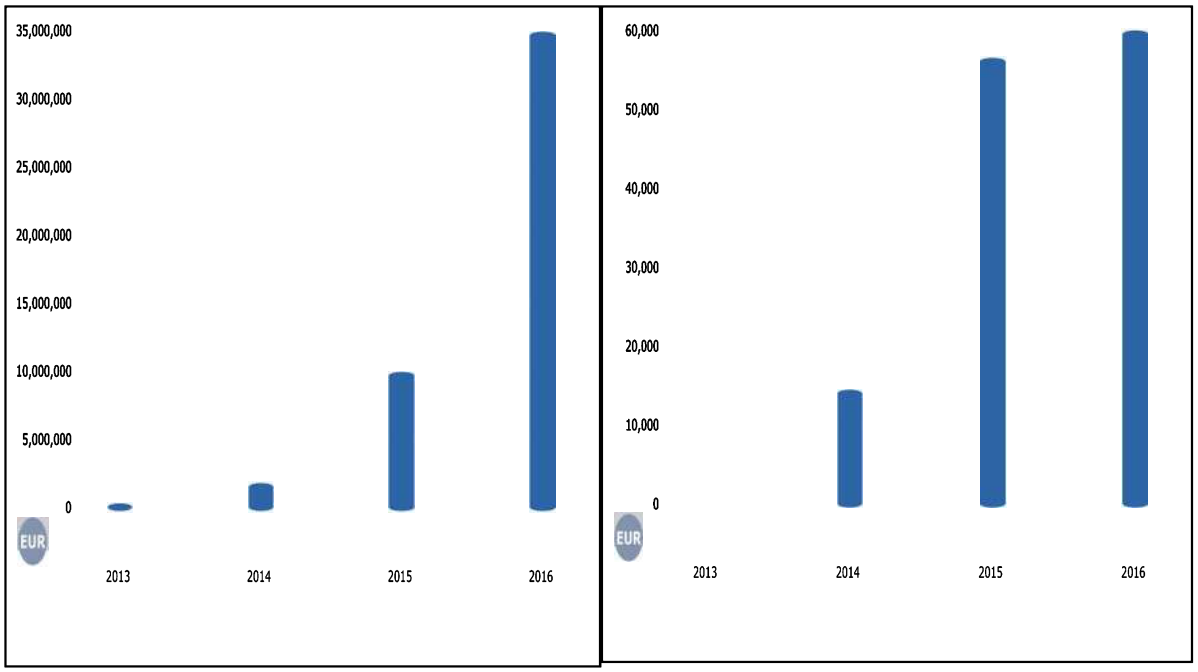

Figure 2 and 3: Turnover of two chosen Croatian claims management companies after IFRS 9 introduction; Source https://amadeus.bvdinfo.com

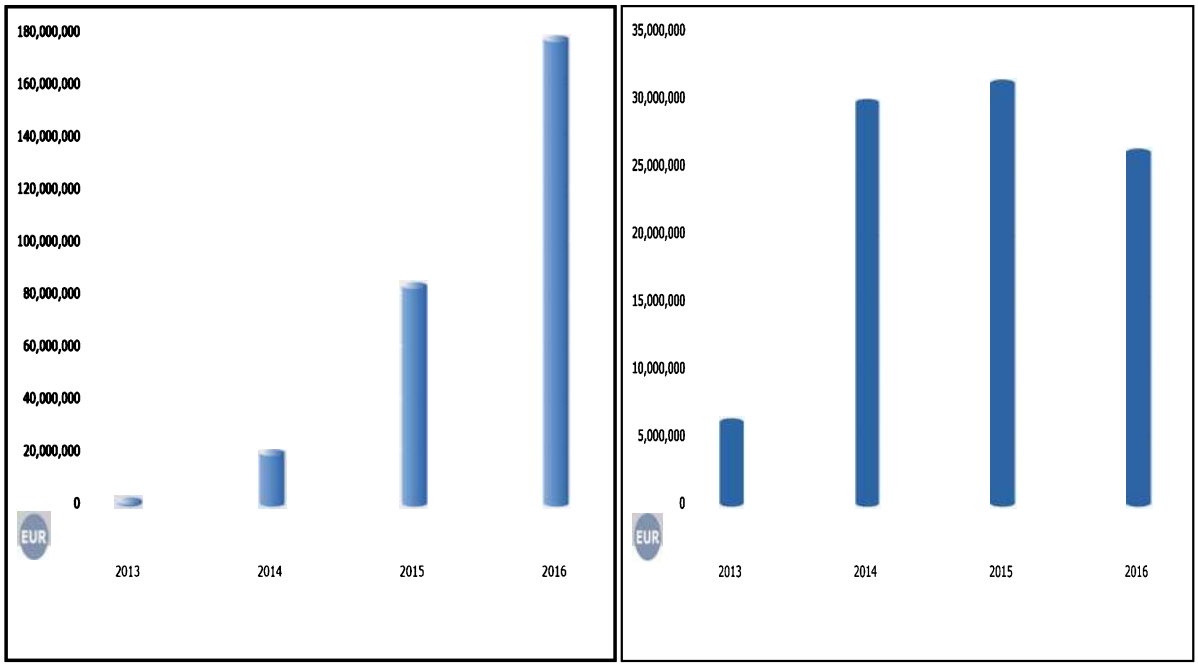

Figure 4 and 5: Total assets of two chosen Croatian claims management companies after IFRS 9 introduction; Source https://amadeus.bvdinfo.com

Shown data about total turnover and total assets are data from two Croatian claims management companies related to banks. One of the companies is owned by bank and the other one is related to bank and solves financial claims, in most cases related with real estate business. From shown figures it is clear that in those two cases exponential growth started in 2014. The implementation of the standard model of AECL was a burning issue in the concrete terms in Croatia. In Croatia, late payments of credit receivables are very frequent due to general insolvency of business entities, although generally speaking, most of the claims are still paid within the limits that do not deviate significantly from the environment. The literal application of the IFRS 9 and Basel Guidelines in described conditions on January 1 2018 would lead to serious problems presented result. That is why banks in Croatia have transferred their ECL to the claims management companies. Hypothesis of this paper was that there is correlation between IFRS 9 introduction and claims

management companies' growth. Although Croatia is small market with less than thirty banks operating, information about their real ECL is hard to get. At the same time in Croatia there is no claims management regulation office which usually publishes annual report about the industry. Also claims management companies are not under the same NACE classification number so researcher must take case study to confirm the hypothesis. Case study of two banks related claims management companies confirmed that there is correlation between IFRS 9 introduction and increase of claims management sector in Croatia. From turnover and total assets data it is clear that growth of those two financial statement elements was significant, especially in 2014 and 2015, first two years of IFRS 9.

5. CONCLUSION

This paper analyzed and presented the accounting treatment of expected credit losses. Credit losses have become issue since the start of the financial crisis in 2008, leading many financial institutions and companies with a significant share in financial investments to the edge of existence. In such situations, timely prediction and accounting for expected credit losses are crucial. IASB and Basel Committee on Banking Supervision identified it as a priority problem to be solved through accounting procedures, although belatedly.

Standard accounting model for predictions of credit losses during the period records, along with anticipated credit losses recorded at the beginning of the period, additional credit losses estimated on a basis of the dynamics of collection of financial assets receivable. Every delay in collection of receivables is recognized in accounting as an increase in ECL. In this way, a portion of realized profit is reserved for possible expected losses, which, if not effectuated, return to profit.

The implementation of the standard model of accounting for expected credit losses was a burning issue in the concrete terms in Croatia. The model is based on deterioration in credit quality due to the time lag from the due date, which in given conditions calls for recording of credit losses. However, in Croatia, late payments of credit receivables are very frequent due to general insolvency of business entities, although generally speaking, most of the claims are still paid within the limits that do not deviate significantly from the environment. Thus, the literal application of the provisions of IFRS 9 and Basel Guidelines in described conditions on January 1 2018 would lead to serious problems presented result. That is why banks in Croatia have transferred their ECL to claims management companies. Hypothesis of this paper was that there is correlation between IFRS 9 introduction and claims management companies' growth. Although Croatia is small market with less than thirty banks operating, information about their real ECL is hard to find. At the same time in Croatia there is no claims management regulation office which publishes annual report about industry, and claims management companies sometimes have different classification in NACE, so researcher must take case study to confirm the hypothesis. Case study of two bank related claims management companies confirmed that there is correlation between IFRS 9 introduction and increase of claims management sector in Croatia. From turnover and total assets data it is of clear that growth of those two financial statement elements in two Croatian claims management companies has been significant.

Without predictions and recording of credit losses, the presented financial result, being the subject of allocation, can be seriously overestimated and sometimes a condition for an organization's survival, even though it can generate excessive reserves of financial results. But regulation in one field of business must be covered with regulation in related field. Otherwise, there is possibility to delay problems, which sometimes can result with serious issues.

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SME FINANCIAL OPPORTUNITIES

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Abstract: *SME sector and its financing mechanisms have received significant attention in the last several decades. In today's business environment which is characterized by tremendous competitiveness and globalization of business, the discrepancy between the development of SMEs and availability and affordability of financial resources becomes a critical success factor. Despite comprehensive literature reviews on similar topics, studies focused on SMEs financing opportunities in Serbia are still at the initial phase. This paper aims to provide an overview of upsides and downsides of currently used SMEs' financing methods, to illustrate alternative financial sources such as venture capital, private equity and crowdfunding and to make recommendations in order to improve SME financing practices in Serbia.*

Keywords*: SMEs financing, access to finance, alternative financing sources, venture capital, crowdfunding*

1. INTRODUCTION

Over the last decade, Serbian government has made a significant progress in promoting the importance of small businesses and even announced 2016 as the year of entrepreneurship in Serbia (CCIS, 2016). Nevertheless, poor access to finance remains one of the biggest problems that affect the majority of SMEs in Serbia, especially in the sense of country's economic recovery and development. Compared to the regional EU counterparts, Serbia is ranked below them, and has to deal with some of the highest costs of finance (Schwab, 2016). The discrepancy between the development of SMEs and availability and affordability of financial resources for them is a very attractive topic.

SMEs have a vital role for economic and social development in Serbia. Their flexibility and responsiveness to changes give added value in the process of economic transformation. What is more, SMEs give support to the development of society by not only employing people, but also, concentrating on improvement of their abilities and skills. SMEs should be considered as an unavoidable part for creating a sustainable, competitive and well-developed economy.

Many bank business models are oriented to traditional corporate lending and are unadjusted to the special needs, risks, and profitability requirements of SMEs. Their funding structure, lack of risk management tools, and legal requirements force banks to redirect market and credit risks to enterprises through toughening their lending terms. The general lack of market knowledge about the SME sector and financial illiteracy makes it difficult for lenders to identify good financing opportunities. Traditional financing resources such as small business loans, overdrafts and personal credit cards represented a commonly used way of financing SME sector in Serbia (Rupeika-Apoga, 2014). Banks have been more aversive to provide loans even for companies that they already have had experience with. But also, new SMEs face numerous difficulties accessing alternative funding. Having in mind higher interest rates, shortened maturities and increased request for collateral, it seems logical that harmful situation in banking sector has affected real economy in Serbia. Therefore, we need to rethink traditional ways of financing SME sector. The rapid growth of alternative ways of financing opens a new door for significant amount of capital. Alternative finance is very broad term which covers several financial models, but in this paper we will be focused on venture capital, private equity funds and crowdfunding.

The small and medium-sized enterprises' operating environment is facing tremendous changes, especially considering globalization and economic integration. More serious competition has affected SMEs by new financing challenges and strong expectations from regulatory environment that will support development and improvement of SME sector. This paper aims to illustrate different financial sources for SMEs and make recommendations in order to improve SME financing practices around the country. Despite comprehensive literature reviews on similar topics, this kind of research is very rare in Serbia and has a potential to be very useful for different types of stakeholders, such as SMEs, banks, regulatory and financial institutions, international financial institutions, as well as companies which provide alternative ways of financing.

The first part of this paper relates to the definition of key features of SME segment, and the literature review. The financial challenges which SMEs face are described further on, as well as the need of traditional and alternative financing mechanisms. A special emphasis is placed on financial constraints in emerging economies such as Serbian economy and findings of research are presented in this part. Moreover, conclusions from a public discussion which was organized within USAID Business Enabling Project are presented as well. Finally, the paper provides a brief description of the economic importance of small and medium-sized enterprises and recommendations for practitioners and academics.

2. LITERATURE REVIEW

Angilella and Mazzù (2015) point out that innovative SMEs face more obstacles regarding financing, because of insufficient and unreliable financial data. Ryan et al. (2014) examine bank market power and SME credit constraints in an international, highly developed economy setting. They find that the effect of bank market power on financing constraints increases in financial systems that are more banks dependent. Keasey et al. (2015) examine the relationship between leverage and the willingness of listed family firms to share control. The results show that owners with a greater equity capital prefer to raise finance via debt rather than dilute their position via equity, and that young family firm's face a trade-off between their control risk aversion and the need for external financing.

After the 2008 financial crisis there has been an increasing focus on access to financing SMEs especially for small innovative firms. Credit conditions have been rationalized and analyses have shown that commercial banking financing is one of the most expensive ways of gathering financial assets. Lee et al. (2015) find that innovative firms are more likely to be turned down for finance than other firms, as well as that this situation worsened significantly during the crisis. They emphasize two issues in the financial system caused by the financial crisis. The first is a structural problem which restricts access to finance for innovative firms, and the second is a cyclical problem which has had a relatively more significant impact on non-innovative firms. Eniola et al. (2015) offer methods that could help entrepreneurs on alternative financing and discuss its positive impact on small and medium enterprises performance. Moving away from traditional ways of financing and pointing out the high information asymmetry and uncertainty, Davila et al. (2003) argue that venture capital has an important role in the first phase of a start-up. Moreover, in favour of the alternative ways of financing, Blow et al. (2015) find out that private equity owned firms are much better organized and therefore more successful relative to those that use traditional financial resources. Mollick (2014) points out that success of the project depends on its quality and suggests that practitioners and researchers should invest more effort towards an analytical understanding of crowdfunding.

Simmons-Süer (2016) raises very interesting question: Does financing matter after all? The author focuses on the role of the cost of capital and the importance of the type of financing. His findings challenge the concept that the type of financing is irrelevant to the investment process. Additionally, El Kalak et al. (2015) developed models for SMEs in order to forecast the bankruptcy probabilities and point out that there are differences between micro, small, and medium enterprises considering financial constraints. Moreover, the authors suggest that these categories need to be considered separately when modelling their credit risk and therefore financing opportunities. Boscoianu et al. (2015) propose new tools based on innovative mix of private management and governmental support on a new type of financial public-private partnership. Moreover, Rupeika-Apoga (2014) discusses the fact that it is vitally important to understand the financing needs of SMEs and entrepreneurs in order to overcome the main obstacles to finance availability and accessibility. Mason et al. (2015) focus on the constructs of entrepreneurial orientation and their ability to improve performance through innovative attitude, risk taking behaviour, aggressiveness, autonomy and competitive energy. Moreover, Prohorovsa and Beizitereb (2015) analyse the amounts and the structure of micro-enterprises financing with regards to the three main sources – bank loans, leasing and factoring.

The lack of non-bank financial institutions, capital markets and inter-firm financing mechanism is a crucial reason for the current situation in Serbian SME sector. Banks are not able to overcome all important financial gaps and are very limited in providing different financing options as business of their SME clients is growing. Some of the limitations affecting access to alternative ways of financing in Serbia are (USAID, 2012): no regulatory framework for non-bank lenders; under-developed leasing; under-developed debt capital markets; under-developed markets for inter-firm financing; underdeveloped Asset Appraisal Services. Having all previously said in mind, there is a need for alternative ways of financing in Serbia. According to the discussion presented, the study sets out following research questions:
RQ1. Access to finance is one of the main challenges for SMEs in Serbia.
RQ2. Alternative financing sources are becoming more important for SMEs in Serbia.

2.1. Key features of SME's

Small and medium-sized enterprises and entrepreneurs are the most efficient segment of the economy in almost all countries of the world. Individually, these enterprises make the largest contribution to the increase in employment, gross added value and turnover, and are, therefore, considered to be the backbone of growth and development of a national economy.

SMEs sector comprises over 99% of business entities in EU. For the EU economy growth, SMEs have produced 85% of new jobs in the last five years. Totally, SMEs in EU generate two-third of entire private sector employment in the EU economy (http://ec.europa.eu/growth/smes/). Similar is for the US economy since SMEs in this country also representing 99% of all businesses. This sector provides work for over 50% of employment in US private sector and creates two-thirds of net new private sector jobs in recent decades (https://ustr.gov/issue-areas/small-business). SMEs in US generate more than 50% US non-farm GDP, represent 98% of all U.S. exporters and 34% of US export revenue. From the data for 2013 (last known official data) SMEs in Serbia represent 99,8% of total business entities in Serbia. It also generates jobs for two-third of employment in Serbia and generates around 50% of GDP and 43% of non-financial export (Ministry of Economy, National Agency for Regional Development, 2014).

The role of SMEs is particularly important in emerging countries which are faced with problems of high unemployment, low level of economic activity, insufficient competition and lack of investment, and where large inefficient state-owned enterprises are still present. As a reliable source of employment, small and medium-sized enterprises have an important social role in absorbing surplus labour generated in the processes of transition and ownership transformation of state-owned and socially-owned enterprises.

Basic characteristics of small and medium-sized enterprises and entrepreneurs, primarily referring to their size, flexibility, propensity for innovative and risky ventures, and greater opportunity for specialization, enable them to adapt much easier to continuous changes in consumer demand and business conditions in the global market. In this way relative to large business systems, SMEs encourage the strengthening of competition, which results in the improvement of the quality of products and services and lower prices, innovations and development of new technologies, and the growth of the national economy in general. Additionally, successful SME management can be defined as flexible and well prepared to analyse the environment and to evaluate important information in order to crate a successful strategy for the enterprise (Vrchota & Rehor, 2016).

Survival, growth and development of small and medium-sized enterprises are primarily determined by funding opportunities from favorable sources. Limited access to the sources of finance, both on the money market and the capital market, especially in terms of prices and conditions of use, is perhaps the most important feature and the biggest problem of these companies. In an effort to provide the necessary funding from the most favorable sources, companies face, throughout their existence, the following dilemmas: should the investments and business development be financed from own resources or borrowed; how much capital should be obtained from loans; should the capital be provided by banks and other financial institutions, on the securities market, or by attracting formal or informal investors; and what is the desired capital structure. Depending on the objectives of growth and development, stage in the life cycle, financial status, nature of business activity and investment structure, the stability of cash flows, the relationship to risk management and the availability of certain resources, companies decide to obtain capital from one or a combination of funding sources, while aiming for the optimal capital structure. The number of available sources of financing SMEs is small and they meet their needs for capital much harder than large business systems (Milosevic et al, 2014).

4. RESEARCH METHOD

The study employed a mixed-method approach, having in mind that it incorporates both quantitative and qualitative data on financing SMEs (Lor, 2012). This method uses advantages of both qualitative and quantitative analysis, and creates a synergy (Lieberman, 2005). The study explored the contextual background of the SME financing and the role of banks and other financing sources available to SMEs in Serbia.

Accurate secondary data were used for addressing the research questions proposed above. The sources of data were carefully chosen using only high quality datasets, such as the OECD Scoreboard: Financing SMEs and Entrepreneurs 2015. Also, in this paper authors have used Survey on the access to finance of small and medium-sized enterprises in the euro area, conducted by European Central Bank in 2014 and European investment fund working paper - European Small Business Finance Outlook for December 2015. Additionally, results of the public dialogue performed by the WM Equity Partners with the support of USAID

Business Enabling Project in 2017 is used too. Moreover, we provide the explanation for any potential weakness of the data used in the study.

5. RESULTS

As indicated in RQ1 and issues of access to finance of Serbian SMEs, the study is focused on three broad issues. Firstly, the study analyses the readiness of banks to provide loans to SMEs. Secondly, the focal point is on the share of short-term SME loans as a proportion of total loans. Finally, the study sets up a scene for trends in SME loan rejection rates.

In 2013 some countries showed a reversal of the growth of SME loans. In particular, Columbia, Hungary, Ireland, New Zealand and Serbia all experienced negative loan growth in 2013, in contrast with 2011 (in the case of Serbia and Ireland) and 2012 (in the case of Columbia, New Zealand and Hungary). On the other hand, Estonia, Japan and United States experienced an increase in outstanding SME loans after years of decline (OECD, 2015b). Table 1 examines the consistency of growth patterns over time, by comparing the growth of outstanding SME loans between 2012 and 2013 with the growth trend recorded over the 2007-2012. It illustrates that in Serbia, the SME loan market in 2013 had not yet recovered from the financial crisis. SME loan growth turned negative in 2009, 2012 and 2013.

Table 1: Growth of SME business loans, 2007-2013

Country	2008	2009	2010	2011	2012	2013
Serbia	39.7	-0.7	5.9	2.8	-10	- 8.1

Source: OECD, 2015b

One would expect from banks to restrict long-term landing more than short-term lending under severe economic situations, but SMEs rely more on long-term landing in Serbia (see Table 2) which can be an interesting topic for further research.

Table 2: The share of short-term SME loans as a proportion of all SME loans

Country	2007	2008	2009	2010	2011	2012	2013
Serbia	34.9	31.6	34.	34.1	30.2	27.2	29.7

Source: OECD, 2015b

It is important to keep in mind that large firms are generally less dependent on bank finance than SMEs. This fact leads to the conclusion that SMEs usually have limited financing sources available which makes them dependant on the changing conditions in credit market. The perception of the riskiness of SME lending has changed over time, resulting in relatively higher average interest rates charged to SMEs. Between 2007 and 2013 the interest rate spread between large firms and SMEs widened significantly in most countries, with Serbia being one of the countries that is exception (OECD, 2015b). For the year 2013, for most of the countries from OECD research average interest rate declined for the SME sector. Other fees associated with SME landing and commissions, are usually not available and privately held by the banking sector. In the United Kingdom only 30% of all loans were collateralized in 2013, while in Serbia data suggest that collateral requirements were higher than 30% (USAID, 2012). This means that a higher percentage of SMEs had to provide collateral in order to access bank finance in previous years which is relative to negative economic changes. Data on collateral and rejection rates are usually unavailable for most countries, but the OECD (2015b) research has shown that loan applications illustrates that the most reasons for rejection are: 1) the terms and conditions of the loans on offer are seen as unacceptable 2) the average creditworthiness of loan applications have deteriorated or 3) banks are rationing credit. Next table represents trends in SME loan rejection rates from 2007 to 2013 in Serbia.

Table 3: Trends in SME loan rejection rates: 2007-13

Country	2007	2008	2009	2010	2011	2012	2013
Serbia	18.7	17.2	28.4	27.1	15.8	31.5	31.8

Source: OECD, 2015b

Lee at al. (2015) show that innovative firms find it harder to access finance especially after financial crisis. Moreover, Zeneli and Zaho (2014) suggest that information asymmetry between banks and enterprises are the main reason for the SMEs' gaining funds so hard. Moreover, they pointed out that the banks do not know the operating conditions and credit situation of SMEs. Onyiriuba (2015) educates bankers on how to identify, exploit, and optimize lending prospects and possibilities in the SME sector. It is very important to do good quality credit analysis having in mind SME business goals and banking liquidity issues. Within emerging countries such as Serbia, which, generally speaking, do not have an opportunity to raise money from

alternative sources or do not have access to equity financing markets, banking industry is the only way of financing. On the high side, 42% of SMEs in Greece, 23% in Ireland, 19% in Italy and 18% in Spain and Portugal mentioned access to finance as the most pressing problem, compared with around 6% of SMEs in Germany and 9% in Austria and Finland on the low side (ECB, 2014). At the euro area level, on balance, 4% of SMEs reported an increase in their demand for bank loans and 7% reported an increased need for bank overdrafts. The situation was similar for trade credit. Fixed investment and inventory and working capital remained the two most important factors affecting SMEs' need for external financing (ECB, 2014).

In order to analyse SME financing, ECB have done the research on the access to finance of enterprises. The results have shown the most important problems faced by SMEs over the first half of 2015, were for the Euro Area and the four largest economies. For the Eurozone, 10.8 percent of SMEs reported access to finance as their most important problem. Moreover, ECB have illustrated the relative importance of different funding sources used by Euro Area SMEs. On the other hand, bank products (loans and overdraft) remained the most popular financing products for SMEs (ECB, 2014).

In a EIF Working Paper, Moritz et al. (2015) have done an analysis of the use of various financing instruments by SMEs. The authors have done cluster analysis including 12,726 SMEs in 28 European countries and come to the conclusion that there are six distinct SME financing types: mixed-financed SMEs, state-subsidised SMEs, debt-financed SMEs, flexible-debt-financed SMEs, trade-financed SMEs and internally-financed SMEs. A holistic perspective taking into account the interrelationships between different financing instruments and their determinants can be a very interesting topic, especially because there is a lack of studies that have discussed and investigated this problem. Although the general economic outlook might have improved after the 2008 financial crisis, market situation in Europe is still fragile and unstable. Looking forward, Serbian SME sector will be faced with numerous problems especially with those linked to access to finance, but if this becomes one of the priorities, future investment climate will improve. As for the RQ2, and a potential increase of the importance of alternative financing sources in Serbia, it should be noted that the access to financing for SME sector should be improved and supported by financial reforms and development of alternative financing resources. When a company thinks about gathering money through external resources, one of the first decisions is to take bank loans. Financing by issuing bonds and shares is characteristic for developed countries more than for those struggling with unsecured market conditions. The tendency for companies to borrow from capital markets instead of banks is a common situation in the US although in Europe the most important external resources are bank loans and other banking products and services. From the supply side, SMEs in euro zone indicated a further improvement in banks' willingness to provide a loan in the period from October 2013 to March 2014 (-11% compared with -17% in the previous survey period). Broadly unchanged from the previous survey period, 25% of euro area SMEs applied for a bank loan, while 47% did not apply because of sufficient internal funds (ECB, 2014). As for the Serbia, main financing sources are business earnings and personal savings, mostly used for working capital financing (81%). According to the research, the most common source of external funding are bank loans (35%), overdrafts (8%) and finds and family borrowings (7%) (Ministry of Economy, National Agency for Regional Development, 2014).

Survey on the access to finance of small and medium-sized enterprises in the euro area which has been conducted by European Central Bank in April 2014, has shown that the financial situation for large euro area firms remains more favorable than for SMEs. Availability of financial funds depends on the company's development level. That is the most important reason for SMEs to focus attention to alternative resources such as venture capital funds and business angels. SMEs should try to find more competitive funding sources than bank loans. Looking ahead this is rather new, but necessary direction for Serbia in order to become innovative driven economy one day.

5.1. Alternative financial opportunities

Turning to the factors affecting the availability of external financing, in ECB survey (2014) respondents indicated that the general economic outlook continues to have a negative effect, but less so than previously (-12% compared with -24% in the previous survey round). Although access to finance is one of the most urgent problems in SMEs in most European countries, the situation significantly differs based on a country's development level and overall business environment. SMEs in Serbia are mostly using bank loans and overdrafts according to very risky and volatile market conditions, but the importance of alternative financing sources are growing, especially for innovative SMEs with very high growth potential. Although official data (Ministry of Economy, National Agency for Regional Development, 2014) imply that the Serbian economy is composed of over 97,000 small and medium-sized companies, these companies still have a significant need of external financing sources. For start up companies financing sources from the banking sector are particularly unapproachable.

In order to encourage public attention to diversified financing opportunities, adapted to each business stage development of domestic companies, WM Equity Partners, on the 14th September 2017, with the support of USAID Business Enabling Project, organized a public discussion related to that issue with the title "Public-private dialogue on equity-based financing for SME's in Serbia". Public discussion was very successful and brought together over 96 participants, of which 31% were representatives of small and medium-sized companies in Serbia, concerned in collecting new information and knowledge on this subject. Other participants included state institution representatives, regional equity funds managers, domestic and foreign financial institutions representatives. Participants were asked to evaluate current availability of alternative funding sources for SMEs in Serbia. The average score was 2.76 for being 1 – low and 5 – high. Second interesting question regards their opinion if SMEs in Serbia are sufficiently familiar with alternative sources of funding. The answers show that professionals in SME industry in Serbia with the vast majority of 92% think that SMEs are not familiar with the alternative source of finance.
Along with the previous question stands the fact that just 30% of participants had experience with Venture Capital and Private Equity funds so far in Serbia. Still, conclusions for the future of alternative source of funding in Serbia state increasing engagement of professional equity investors, with the clear current focus on IT industry and usage of IT solutions in other industries, is evident in the Serbian market.

The dialogue clearly indicated that professional equity investors bring much more than financial support to company, professionalization of management, improvement of organizational structure, improvement of financial management system, support to development of existing and new markets are just some of the added values of professional equity investors that go beyond pure financial support. This conclusion clearly indicate that it is newer about competitiveness between different financing sources (loan vs equity), but the right mix of financing sources available. At the beginning of cooperation with a professional equity investor, it is crucial to clearly define all responsibilities and activities, as well as a planned Exit strategy indicating that transparency and good corporate governance represent the basis of successful cooperation. Cooperation between management and owners, clearly defined product or service, stable cash flow in the later stages of development are the key requirements for professional equity investors. Acknowledged challenges in cooperation with professional equity investors are primarily related to more formal way of doing business. Management control can bring growth of certain costs and decline of profitability in the short-term, but in medium-term it contributes to growth and stability of business operations. Growth of venture capital industry in the region has been recognized through the cooperation between regional countries governments and international financial institutions.

Furthermore, Serbian Government recognizes the importance of innovation and entrepreneurship for the growth of domestic economy. The Government is actively working on establishing a more favorable climate for development of the local SME sector, with particular emphasis on improving the education process and the creation of favorable environment with less administrative burdens for companies. It could be concluded that there is always space for progress on the state level, but required improvements are also needed at the business level. Companies should invest in the process of innovation, promote professionalism in their operations, which will consequently create basis for a new generation of entrepreneurs.

Venture capital is financial capital provided to early-stage, high potential and high risk companies and it is usually focused on innovative fields of business (Rupeika-Apoga, 2014). Venture capital is a subset of private equity and can be provided by a group of venture capitalists or by an individual business angel. Private equity is a relatively new industry in much of the world but it will play an important part in the future. IT is the most relevant industry for venture capital, although European market shows a significantly higher preference for biotech. According to OECD research (2015a), venture capital represents a very small percentage of GDP, (less than 0.05%) for most of the countries, except for Israel and the US where the venture capital industry is more mature and represented respectively 0.38% and 0.28% of GDP in 2014. Venture capital investments in the United States represents more than 80% of the OECD total in 2014. The crisis rigorously distressed the venture capital industry, more later-stage financing than seed and start-up stage financing. Venture capital investments were higher in 2014 than in 2007 in just a few countries: Hungary, Korea, US, Russia and South Africa (OECD, 2015a).

Most European countries faced a sharp decline in venture capital after the financial crisis. This decline was uniform over venture capital for seed and early growth investments, later stage capital investments and growth capital investments (OECD, 2015b). Serbian equity market has started to develop before the financial crisis and it seems very encouraging. However, measures intended to support alternative ways of financing were not successful because of the unstimulating regulatory changes. Although there were chances for public and private co-investment in venture capital programmes it is not enough in comparison to other sources such as bank lending. Also, it should be kept in mind that venture capital is limited to mature markets and according to general opinion euro zone is one of them. Trends in venture capital are hard to analyse and interpret especially for SMEs and start-ups.

Referring to corporate venture capital (CVC), in Europe, Germany was the most active market in 2014 with investments of around EUR 2 billion (OECD, 2015a). Second most active market was the UK with corporate investments of around EUR 847 million. The activity in the European markets is significantly lower than in markets like the US (around EUR 23.4 billion) – driven in particular by Google and Intel – or China (around EUR 8.9 billion – driven by China based internet companies like Alibaba, Tencent or Baidu (who are also active beyond their home country and in particular in the US).

According to Serbian Government Strategy for SME one of the pillars of the Strategy is enhancement of access to financing sources. Within this pillar important dimensions are: development of new models for SME financing and improving capabilities of SME and entrepreneurs for different funding sources. When analysing new models of financing, strategy focuses on venture capital, private equity and business angels are seen as important sources for future SME funding in Serbia (Government of Serbia, 2015).

Up to now, there are just a few private equity funds that are active in Serbia. Also, in Serbia exists business angel's network that promotes entrepreneurship and investing culture. Nevertheless, this market is still on its early stage considering the growth potential for start-ups and entrepreneurship in Serbia. Having in mind that 2016 was promoted as the year of entrepreneurship, one could expect better support and potential for this industry in Serbia. One the other hand, bank-oriented economy is still limited factor for any other source of financing, since around 92% (National banks of Serbia, 2015; SEC, 2015) of all financial assets in Serbia hold banks.

Finally, for Serbia, interesting source of finance could be crowdfunding. Crowdfunding is a relatively new finance technique that uses the internet to match investors and borrowers for projects of common interest (OECD, 2015b). It could be a way to bypass the venture capital and business angels. Although it may impact future development of SME market, it needs good infrastructure in order to use all the benefits of crowdfunding. To be exact, crowdfunding depends on well-functioning bank instruments such as bank accounts, credit cards, online payment system, tax issues etc. The main advantage of using this type of financing is that it covers the finance gap that SMEs face. Consequently, crowdfunding presents some risk, but generally its market is in an upward phase and expects to rise in terms of finance potential. Non-financial benefits should be analyzed as well as financial, especially having in mind that idea owners are able to control business, validate R&D outputs, estimate the potential product demand and share knowledge, expertise and experience through founders' network. So far, there are just a couple of examples of using this technique for start-up financing in Serbia. But, for sure, the use of alternative ways of financing, such as crowdfunding, will be discovered and promoted in the future.

4. CONCLUSION

Survival, growth and development of small and medium-sized enterprises are primarily determined by funding opportunities from favourable sources. This study discusses the importance of different financing opportunities of SMEs. Moreover, it focuses on SMEs' access to finance and availability of alternative financing, as one of the major obstacles to doing business in Serbia. Results show that RQ1 (Access to finance is one of the main challenges for SMEs in Serbia) and RQ2 (Alternative financing sources are becoming more important for SMEs in Serbia) are fully supported. Many bank business models are oriented to traditional corporate lending and are unadjusted to the special needs, risks, and profitability requirements of SMEs. On the other hand, access to alternative financing is one of the main challenges for SME sector, both in Serbia and in well developed countries. Alternative financing for SME is a relatively new field of research, but it is, undoubtedly, very important for competitive and innovative economies.

Despite comprehensive literature reviews on similar topics, studies focused on limited financing options are still at the infantile phase. The study offers quality basis of information for different types of stakeholders, such as SMEs, banks, regulatory and financial institutions, academics, as well as companies which provide alternative ways of financing. The study incorporates both quantitative and qualitative data on financing SMEs. The analysis in this study has some limitations due to the fact that results are limited by the secondary data and the method, used in OECD Scoreboard and European investment fund working paper. However, the limitation of the analysis provides interesting research directions to further investigate alternative ways of financing in the context of improving overall performances of SME sector. Finally, the results can support policy makers in adapting access to finance options to the specific characteristics and needs of SMEs.

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DIGITAL TRENDS IN MARKETING AND COMMUNICATION 520

Slavica Cicvarić Kostić, Arsenije Ivanović, Milan Okanović
INFLUENCER MARKETING IN A SOCIAL MEDIA CONTEXT 521

Željko Dudić
ANALYSIS OF THE GLOBAL ELECTRONIC RETAIL MARKET 527

Slađana Đurić
CASE STUDY: AIRBNB SOCIAL MEDIA CAMPAIGN 533

Radmila Janičić
CHALLENGE OF HOLISTIC MARKETING IN ARTISTIC PROJECTS 542

Tijana Jugović, Milena Šćekić, Nino Ćorlić
INTEGRATION OF PERFORMANCE INDICATORS FOR DIGITAL AND TRADITIONAL ADVERTISING 547

Milica Kostić-Stanković, Valentina Vukmirović, Tatjana Cvetkovski
TENDENCIES OF CONTEMPORARY MARKETING COMMUNICATION IN DIGITAL ENVIRONMENT 553

Ana Langović, Milica Kostić-Stanković, Dejana Nikolić
SPECIFICS OF DIGITAL ASPECTS IN CREATIVE INDUSTRIES 562

Milica Matić, Gordana Jakić
CHANGING THE MARKETING TERMINOLOGY IN DIGITAL AGE 569

Marija Mićović, Branka Novčić Korać
BUILDING DIGITAL BRAND AWARENESS FOR KFC SERBIA 575

Sara Milošević, Branka Novčić Korać
CASE STUDY: DIGITAL STORYTELLING IN BRAND MANAGEMENT OF MOXY HOTELS 584

Miroslav Mitrović
INFLUENCE OF COMPUTING MODEL ON PUBLIC OPINION-DYMATICA, DIGITAL COMPUTING SYSTEM FOR MANAGEMENT OF PUBLIC OPINION 592

Dejana Nikolić, Slobodan Vasilić, Azra Tibo
INTEGRATION OF ONLINE AND OFFLINE COMMUNICATION ACTIVITIES IN EVENT MANAGEMENT 598

Milan Okanović, Tijana Smiljić, Slavica Cicvarić Kostić
THE ANALYSIS OF CONTENT USED IN POLITICAL CAMPAIGNS:DOES CONTEXT MATTER? 603

Selena Radović, Tamara Vlastelica
THE SYNERGY OF SALES PROMOTION AND ONLINE ADVERTISING IN AFFECTING FMCG CONSUMER BEHAVIOUR 609

Milica Slijepčević, Ivana Radojević
CURRENT TRENDS IN DIGITAL MARKETING COMMUNICATION 618

Milica Stevanović, Milica Tešić, Marija Jović
DIGITAL MARKETING STRATEGY FOR HEALTHY FOOD INDUSTRY 624

Miloš Subotić, Teodora Lolić, Darko Stefanović
MULTIPLE SWARMS ARTIFICIAL BEE COLONY ALGORITHM APLIED ON RETAIL SHELF SPACE ALOCATION PROBLEM 631

Jelena Veinović Stevanović
NEUROMARKETING IN ADVERTISING TODAY 638

Tamara Vlastelica, Tamara Veselinović
SEARCH ENGINE OPTIMIZATION STRATEGY IN PERSONAL ONLINE REPUTATION MANAGEMENT 641

Valentina Vukmirović, Zoran Tomić, Velimir Štavljanin
TENDENCIES IN DIGITAL MARKETING COMMUNICATION WITH SPECIAL OVERVIEW OF GENERATION Y MEMBERS IMPACT 648

INFLUENCER MARKETING IN A SOCIAL MEDIA CONTEXT*

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Abstract: *The expansion of the use of social networks has led to changes in the communication of brands and companies with consumers. Currently, the leading trend in marketing, according to the magazine Forbes, is influencer marketing. The paper examines this new trend in a social media context. The purpose of the paper is to explain the concept of influencer marketing in a social media context by finding its "roots" in a marketing concept known as word of mouth and by setting the same concept in the digital era and in a world connected by social media. Lastly, the paper presents the classification of influencers into different types to help campaign creators in monitoring, analyzing, and choosing the most appropriate influencers for a specific campaign and brand.*

Keywords*: influencer marketing, word of mouth, social media, eWOM*

1. INTRODUCTION

The expansion of social media has reached an even higher level according to the latest results in the Global Digital Report 2018 made by "We are social", a global marketing agency, and "Hootsuite", a well-known social media management platform. Data from this research show that the number of social media users worldwide has passed 3.1 billion. Social media has changed the way companies and consumers communicate. Companies began addressing consumers' issues with social media by hitting clicks, sending links and being responsive and interactive. This especially refers to Generations Y and Z (Obradovic et al., 2017), as 85% of them learn about new products on social media and 59% of them are more likely than older generations to connect with brands on social media (researched by Hootsuite and Pew Research Center).

Motivated by the rise of innovative approaches and strategies in marketing on social media and by statistics from different surveys, this paper examines the new trend of influencer marketing in a social media context. Data from an influencer marketing survey conducted by Collective Bias, an influencer marketing company, which included 14,000 respondents in the United States, reveal that 70% of millennial consumers are influenced by the recommendations of their peers in buying decisions. In the next few years, influencers will become a vital staple in marketing in a social media context and in the service of businesses around the world. Some of the most popular and successful companies, such as Microsoft, Starbucks, Rolex, Virgin America, etc., have started implementing influencer marketing in social media campaigns (Solis&Webber, 2012).

The rise of using influencers in marketing campaigns on social media motivated us to examine this trend by explaining the relationships between some well-known marketing concepts and relatively new but increasingly important phenomena, such as influencer marketing. As the paper deals with a subject that is not yet sufficiently represented in academic work, the authors seek to explain the roots and basic elements of this concept, especially in the context of social media.

The purpose of this paper is to explain the concept of influencer marketing in a social media context by finding its "roots" in a marketing concept known as word of mouth (WOM) and by setting the same concept in today's world and digital era where everything is connected by social media.

2. WORD OF MOUTH AS A PRIMORDIAL CONCEPT

2.1. Word of mouth

Word of mouth marketing is mostly defined as the process of sharing information from one person to another through face to face contact, telephone, social media, etc. The term "word of mouth" was coined by Whyte (1954) and on the basis of observations he claimed "People who talk about products and services together

* This paper has been financially supported by the University of Rijeka for project ZP UNIRI 9/17

also show alike purchase behavior and have similar product preferences". Arndt (1967) was one of the earliest researchers of the influence of WOM on consumer behavior. He characterized WOM as oral, person-to-person communication between a receiver and a communicator whom the receiver perceives as non-commercial, regarding a brand, product or service. He also concluded that senders of WOM messages may be motivated by "the desire for enhanced status, ego-defense, or dissonance reduction" and that messages flow through shared-interest groups, friendships, or family members in a multistage interpretation process.

Brown and Reingen (1987) claim that word of mouth plays one of the most important roles in consumer behavior by shaping consumers' values, attitudes, preferences and behaviors. Nowadays, this notion is widely accepted. Additionally, consumers are more likely to trust in informal communication when they make a purchase decision than in advertising campaigns (Bansal and Voyer, 2000). A similar conclusion was reached by Silverman (1997), who argued that word of mouth has been proven to be an effective method of obtaining useful information for purchase decisions.

Word of mouth has been acknowledged as an enormous influence on people's knowledge, feelings and actions (Hennig-Thurau et al., 2004). The main cause for presenting this concept as very important in communication with potential consumers is the rising occurrence of lack of trust in advertising. For this reason, customers prefer to find out information from other sources. The findings of the research by Buttle and Frencis (1998) support the previous claim that consumer behavior is more submissive to and influenced by word of mouth than by other marketer-controlled sources.

As markets change, marketing theories, concepts and strategies must also change to accommodate them. So, WOM theory and practice has developed in parallel with the development of technology and the emergence of new approaches in marketing (Kozinets et al., 2010). With the expansion of the Internet and the advent of the digital and social media era (the emergence of posted-views, discussion forums, personal mails, chatrooms, instant messaging, blogging, use of social media, etc.), the WOM concept has evolved into eWOM, which is more pervasive and more important in purchase decision-making (Chang et al., 2010).

2.2. Social media and eWOM

The phenomenon and growth of the Internet gave consumers a new empire in which they could communicate and thus influence each other (Negroponte and Maes, 1996). The Internet has become an important source of information for consumers. We can find a great deal of content on the Internet for "entertainment and providing reviews on products and services" (Minazzi, 2015). As a sustainable marketing channel, the Internet has allowed "the democratization of knowledge giving companies, public or private; brands, small or big; and people local or celebrity, an equal footing to share information" (Booth and Matic, 2011). This led to the conceptualization of electronic word of mouth (eWOM).

Henning-Thurau et al. (2004) define electronic word of mouth as a communication process where one individual may influence others on the Internet. Furthermore, the authors explain that eWOM refers to a "positive or negative statement made by potential, actual, or former consumers about a product or company, which is made available to others via the Internet" (Hennig-Thurau et al., 2004). eWOM is a particular form of communication that has emerged especially with the advent and great evolution of social media. "Thanks to the shifting landscape of information and communication technologies, users have begun to electronically exchange opinions and information about products and services" (Tabbane and Debabi, 2015).

Social media and eWOM have radically changed the relationship between consumers and companies. Also, social media platforms allow eWOM to be seen by consumers around the world (Hennig-Thurau et al., 2004). These platforms give the chance to their users to collaborate and share opinions and experiences as well as sharing different perspectives. Social media provides a sharing platform with its tools, such as social networks, forums, e-mails, and blogs. The shared views, experiences and opinions of online users are actually an electronic type of word of mouth (Cheung&Thadani, 2012).

eWOM information shared in social media can be presented in several different ways. Users can intentionally post information about products and services made by some brand. Furthermore, users can show and display their preferences to their network, such as becoming fans of brands, they can be interactive with brand posts through engagement they provide by liking, commenting and sharing. Also, users can post a brand content without any advertising purpose (Erkan and Evans, 2016).

3. SOCIAL MEDIA INFLUENCERS

Katz and Lazarsfeld (1955) refer to "influentials" as "consumers who influence the purchase decision of other consumers", and Watts and Dodds (2007) use this term for "highly-connected people". Goldenberg et al. (2009) claim that influential people are believed to have three important traits: (1) they are convincing (may even be charismatic), (2) they know a lot (i.e. are experts), and (3) they have a large number of social ties (i.e. they know many people).

Nowadays, digital influence is becoming one of the hottest trends in social media. With an effective digital influence strategy, "businesses will spark beneficial word of mouth, create brand lift, and ultimately influence the actions of other consumers much more authentically than does traditional marketing" (Solis&Webber, 2012). These authors define digital influence as the ability to cause effect, change behavior, and drive measurable outcomes online.

Influencers, as they are often labeled, form strong unions with like-minded individuals within social networks and fortify those connections with value and meaningful interaction. These influencers are individuals who may possess the capacity to influence based on a variety of factors, such as a substantial or concentrated following in social networks, notable stature, or authority within a community, and the size or loyalty of an audience. Because competition in eWOM marketing has become fierce and social networks are now the most important marketing channel for communication with consumers, identifying influencers is vital to increasing the efficiency of social network-based marketing (Liu et al., 2015).

Social media influencers represent a new type of independent third party endorsers who shape audience attitudes through blogs, tweets, and the use of other social media (Gorry and Westbrook, 2009). They can be also defined as a new type of "independent actors who are able to shape audience attitudes through the use of social media channels in competition and coexistence with professional media" (del Fresno García, Dely and Segado Sánchez-Cabezudo, 2016).

Influencers are usually novel information contributors who have the ability to affect the behavior and attitudes of others (Liu et al., 2015). Due to the persuasive power of social media influencers, technologies have been developed to identify and track the influencers relevant to a brand or organization. Most of these efforts rely on factors such as the number of daily hits on a blog, number of times a post is shared, or number of followers (Freberg et al., 2011).

Uzunoğlu and Kip (2014) explain that when companies and brands started considering the Internet as a strategic communication tool and channel, they also recognized the power of influential users of this platform. The authors conclude that digital influencers have an impact on the members of particular groups, all gathered around similar values and interests.

Kempe, Kleinbert and Tardos (2003) suggest that the main question should be how to select initial influencers who will take part in a social media campaign. To do that, managers need to have "an intelligent system that supports them in finding the optimal group of influential customers". The selection of a group of individuals who are most likely to generate the largest cascade of influence through eWOM is also known as the influence maximization problem. Roelens, Baecke and Benoit (2016) add that there are several developed approaches to resolving the influence maximization problem. They also warn that these algorithms typically are "not based on data that represent influence flow as it is not straightforward to gather such data set".

A framework for influence is built upon three pillars to clarify the role they play in assessing the capacity to cause change or effect. These pillars are reach, resonance and relevance (Solis&Webber, 2012):

- **Reach** is "a measure of popularity, affinity, and potential impact".
- **Relevance** is "the glue of the interest graph and the communities of focus. Individuals aligned through subject matter create a series of linked relationships that send information along communities of focus".
- **Resonance** is "the measurement of the duration, rate, and level of interactivity around content, a topic, or conversations. High resonance ensures that more people will see each post or update".

According to the same authors, in the world of social media, practitioners are transforming the way to communicate with their target audiences. With the immense growth of bloggers and their increasing power as influencers for media and consumers alike, analyzing and evaluating the most influential will be a vital part of any social media campaign.

Through social networks, blogs and videos, consumers are entrenched in the dissemination of information.

Long gone are the days when the media would communicate a brand's message to consumers. Consumers are now the individuals broadcasting personal or second-hand stories to their social networks and the world – they are a brand's storytellers – the new brand ambassadors (Booth and Matic, 2011).

3.1. Typology of social media influencers

The classification of influencers into different types can help campaign creators in monitoring, analyzing, and choosing influencers most appropriate to a specific campaign and brand. There are different ways to make a typology of influencers. In his article in *CRM* magazine, Sam Del Rowe (2018) suggests that influencers can be categorized by the number of followers in their networks. Accordingly, there are two main types of influencers: mega-influencers and micro-influencers. Mega-influencers have a big community and a huge number of followers, numbered in hundreds of millions, while micro-influencers are "everyday people" who promote a specific brand on social media. Also, influencers may be segmented by the industry in which they are promoting products and services (fashion, beauty & cosmetics, gaming, food, electronics, etc.).

In most cases, influencers are segmented by two types of classification: the 4Cs or the 3Rs. According to the online marketing company SEO.com, the 4Cs represent a combination of context, consistency, connection and content that should relate to the selection criteria for influencers. The second classification, the 3Rs, is based on reach, relevance and resonance, which are explained above (Solaris and Webber, 2012).

On the other hand, Traackr, a leading influencer management platform, suggests ten types of influencers. Their typology is based on three pillars that clarify the influencer role: reach, resonance and relevance. Table 1 shows the characteristics of all types of influencers based on the 3Rs typology.

Table 1: Types of online influencers by Traackr

Type of influencer	Reach	Resonance	Relevance
The celebrity	High	Medium	Low
The authority	Medium to High	Medium to High	Medium to High
The connector	Medium to High	High	Low
The personal brand	Medium to High	Medium	Medium
The analyst	Medium to Low	Medium to Low	Medium to High
The activist	Medium to Low	Medium to High	High
The expert	Low	Medium to Low	High
The insider	Medium to Low	Low	High
The agitator	Medium to High	High	Medium to Low
The journalist	High	Medium to Low	Medium to Low

Solis and Webber (2012) emphasize that the choice of influencers in a campaign needs to be aligned with campaign objectives. For example, if raising brand awareness is the desired outcome, then the campaign should engage individuals who are popular or have earned image and reputation, while if the desired result is to establish thought leadership, the campaign should engage individuals who possess authority or trustworthiness.

4. CONCLUSION

The expansion of the use of social networks has led to changes in the ways in which brands and companies communicate with consumers. According to the magazine *Forbes*, the leading trend in marketing is influencer marketing. Furthermore, research shows that a great number of millennial consumers are influenced by the recommendations of their peers in buying decisions, and projections are that in the next few years, influencers will become a vital staple in marketing in a social media context. This motivated us to examine this trend. We started with the primordial concept of word of mouth, which we then set in today's world and digital era connected by social media, thus introducing and explaining the concept of electronic word of mouth. Afterwards, we explored digital influence as well as social media influencers, in terms of the role they play in assessing the capacity to cause change or effect. With the immense growth and increasing power of influencers, analyzing and evaluating the most influential people will be a vital part of any social media campaign. To help campaign creators monitor, analyze, and choose the most appropriate influencers for a specific campaign and brand, the paper presented a classification of different types of influencers and emphasized that the choice of influencers in a campaign needs to be aligned with campaign objectives.

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ANALYSIS OF THE GLOBAL ELECTRONIC RETAIL MARKET

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Abstract: *This paper describes the phenomenon of the growing electronic retail market. It explains its main characteristics and gives an overview of the level of maturity by regions and also describes main players on the market. The goal of this paper is to get a better understanding of e-retail market by showing its main trends. Retail market as it was ten years ago will never be the same. This transformation period, termed by some as apocalyptic with serious changes, left behind the old way of doing business and brought new rules and new formats. Technology has a significant influence on the e-retail market, and some already implemented innovations are described in this paper. In addition to the leading e-retail companies, the trend is emerging of physical stores called brick-and-click. We can expect that electronic retail market and traditional retail market will converge in the future. Future growth in sales in the retail market will be driven by the growthin sales in the e-retail. The observation data are collectedon the basis of secondary resources.*

Keywords: E-retailing, E-tail, B2C, Internet, electronic retail market, Amazon, Alibaba

1. INTRODUCTION

In the past twenty years, retail has experienced great changes that have been influenced by technological progress. Beside the traditional retailing, e-retailing also emerged. This new type of retailing uses electronic market. At its very beginning this market was separated from brick-and-mortar retailing. After some time electronic retail market evolved and got connected with the traditional market. A new term was introduced, brick-and-click. It is difficult to make a clear division between traditional and electronic market. In this paper e-retailis defined and main aspects of electronic market explained. The biggest concern is that the traditional brick-and-mortar store will disappear. Trends in e-retailing are explained, and countries that are global leaders in online retail are listed. There is also a brief overview of companies which are genuine innovators and have a leading market position. Finally, the research findings are presented.

2. ELECTRONIC MARKET

2.1. Definition

As the electronic market grew, so did the number of definitions explaining e-retail. Luce (2013) in her report explains e-tail as: “commerce done via computer or smartphone. ”The following definition is given by Kashyap and Maurya (2013): “the electronic retailing (e-Tailing) is the perception or approach to sell retail products & services using digital/electronic media, in particular, the internet. E-retailing is synonymous with business to consumer (B2C) transaction model of e-commerce. Electronic retailing or e-tailing can include business-to-consumer and business-to-business sales. E-tailers are not dependent solely on the Internet; some brick-and-mortar businesses also operate through websites to reach customers. Online retailing in general is referred to as e-tailing. Revenue in E-tailing can be calculated from the sale of goods and services, through contribution to website content, or by advertisement. ”A similar definition is presented by Laudon and Traver (2014):”Retailing conducted over the Internet is called electronic retailing (e-tailing), and those who conduct retail business online are called e-tailers. E-tailing can be conducted through catalogs with fixed prices as well as via auctions. E-tailing also makes it easier for a manufacturer (e.g., Dell.com) to sell directly to the customer, cutting out the intermediary. The concept of retailing and e-tailing sales of goods and/or services to individual customers – that is, B2C EC.”

I can be said that it is common for all the definitions that they say e-retailing is a trade conducted over the Internet. It is not unified because it is constantly developing and changing, so there exist many definitions.

2.2. Status of the global electronic retail market

We can measure the level of development of the electronic retail market with the number of possibilities to realize the online store. A good indicator of this is the number of websites. Today exist more than 1 billion websites. There were 29 million in 2001. In 1993 there were only 130 websites (Chen, 2017). The same author also says that “retail sales through e-commerce jumped from $4.4bn in the last quarter of 1999, to

$105.7bn in the first quarter of 2017." Growth rate of e-commerce sales in the past thirty years is always above 10%, and that is a reason why e-retailing is gaining in importance. It is clear that there is a correlation between the number of websites and sales through e-commerce.

When online shopping started, sales of computer hardware accounted for 30% of electronic sales and it was the main product category for online trade. That was in 2000, but fifteen years later computer hardware is not in the top five categories of e-retail. Consumers accepted that many product categories could be sold via Internet. Today, e-retailers are trying to get a share in all product categories sold by traditional retailers.

There is competition in all products groups. On the other side, brick-and-mortar retailers are also important players on the electronic market. "We can see that eight of the top 10 e-commerce companies own traditional brick-and-mortar stores. The online-and-offline ("bricks and clicks") business model would help traditional retailers to get the market share of e-commerce (Chen, 2017).

Electronic market is very specific, it is at the same time both local and global market. While rules of the game differ from country to country, on the one hand rules are the same from a global point of view. There is a need for law harmonization, addressing security issues, protection of customers, customs barriers, data protection (Končar, 2008).Every day, e-retailers find new ways to reach their customers.

A prerequisite for e-retailing is readiness of a market. If a country does not have conditions for electronic market, e-tailor cannot access this country. UNCTAD in the course of its regular activities developed a B2C e-commerce index. UNCTAD in its report B2C E-COMMERCE INDEX 2017 (2017) calculated a country B2C E-commerce index with four components: share of individuals using the Internet, share of individuals with an account (15+ old), secure Internet servers per 1 million people, and postal reliability score. In 2017, the highest ranking is Luxembourg with an index value of 96.5 in 2016. It is same ranking as in the previous year, but with 0.5 index point less. Switzerland is ranked second, with a very close index value of 96.43. But it is an improvement compared to 2015 and ranking 8th. Norway is ranked 3rd, as it was in 2015. The rest of list is as follows: The Netherlands, Republic of Korea, United Kingdom, Sweden, Japan, Germany, and New Zealand.

From our region, Slovenia is ranked 25th, ahead of the USA, Croatia is 32nd, Hungary is 36th . Serbia is ranked 41st with an index value of 73. Our share of individuals using Internet and secure Internet servers per 1 million people are the main reason why we do not hold a higher position. Serbia was ranked 39th in 2015, and our index value was higher by three points. Countries ranked below us are Romania (45$^{th)}$, Bosnia and Herzegovina, (52nd), Montenegro (69th).The full list contains 144 countries.

According to the Global E-commerce Report 2017 (2017), the share of population using the internet in Europe is 80.5%, 74.6%in North America,63.3% in South America,46.6% in Asia Pacific and 67.1% in Middle East & Africa. Without an internet access there is no e-retailing, so this indicator is good to show the level of electronic market.

The report Global Powers of Retailing 2018 "finds that global grocery sales through e-commerce channels jumped 30 percent in the past year. Countries leading the growth charge were China (+52%), South Korea (+41%), the UK (+8%), France (+7%), and Japan and the US (both +5%). China is the world's dominant e-commerce-and mobile-market" (Deloitte, 2018).China, the largest e-commerce market in the world, is setting the benchmark for global retailing. E-commerce is expected to account for 18% of China's $5 trillion retail market, compared with 8% in the US, according to the National Bureau of Statistics of China. The country represents 47% of digital retail sales worldwide, driven by its 731 million Internet users (Weinswig, 2017).

According to Eurostat report, the volume of retail trade in euro area had an increase of 1.8% in February 2018 compared with February 2017. The main reason is increase in trade volume of non-food products. "The highest increases in the total retail trade volume were registered in Malta (+11.7%), Poland (+7.9%) and Ireland (+7.1%), while decreases were observed in Slovenia (-1.6%) and Austria(-1.2%)"(Eurostat 2018).

The report Tomorrow's World Retail, (2017) shows the electronic "UK market being the most mature in Europe, whilst Southern Europe and Central Eastern Europe remain relatively immature in terms of online penetration. In 2016, over 80% of UK individuals had ordered goods online compared to less than a third of the Italian population. On another measure, Spain's e-commerce sales account for 2.1% of total GDP vs. the UK's E-GDP at 7.2%." The decision on Brexit resulted in sterling depreciation and UK based e-retailers becoming cheaper abroad leading to the increase in online sales. Consumers in Southern Europe are not at the same level of maturity. They still want to touch the product they want to buy.

3. E-RETAILERS

Global E-commerce Report (2017) gives a list of the top highest market value internet companies. Their market value in billions of USD in May 2017 was as follows: Apple 801, Google/Alphabet 680, Amazon 476, Facebook 441, Tencent 335, Alibaba 314, Priceline.com 92, Netflix 70, Uber 70, Baidu 66. It can be seen that two biggest e-tailors on the top 10 list are Amazon and Alibaba. These two companies are leaders in innovations and in e-retailing.

Amazon and Alibaba are main players on the electronic market. Amazon is the leader in the West, and Alibaba is the leader in the East. Amazon has 244 million active users, and at same time Alibaba has 500 million active users across its websites and apps. Amazon increased the number of employees from 32,000 five years ago, to 110,000.It offers 400 million products and operates websites in 15 countries. Amazon started with the Kindle books and moved quickly to electronic products. Now, Amazon is entering the grocery sector with the purchase of Whole Foods and is exploring growth possibilities on the apparel market. Alibaba started as a pure e-commerce player when it launched the online shopping website Taobao in the early 2000s. It became world's biggest retail platform, and also entered the financial sector through the digital payment business Alipay and digital wealth management companies like Yu'e Bao. Alibaba also entered the entertainment industry.

Alibaba is in a unique position to understand the consumer more thoroughly than anyone else. Sophisticated 'big data' analytics has allowed Alibaba merchants to make use of visitors' shopping history, not only to recommend products but also customize storefronts that are catered to various types of shoppers (Tomorrow's World retail, 16. November 2017).French grocer Auchan and Chinese e-commerce technology platform Alibaba are bringing together their respective offline and online expertise to explore new retail opportunities in China's food sector, leveraging the physical presence of Sun Art Retail Group, in which Auchan is a leading shareholder (Deloitte, 2018).

According to the report Global Powers of Retailing 2018 (Deloitte, 2018) the world's largest retailer Wal-Mart has made it clear that e-commerce is one of the company's strategic pillars. They removed from the name of the company the word "store", just to send a message that it is not limited to brick and mortar stores. Wal-Mart and JD.com formed a strategic alliance in June 2016, positioning themselves as the world's No. 1 retailer in China.

When we take a look on top ten retailers in 2001 and in 2016 we can see that just four companies are on both lists. Those companies are Wal-Mart, Kroger, Home Depot and Carrefour. Only Wal-Mart kept the leading position, the other three companies lost the positions they took in 2001. On the 2016 list real e-tailer Amazon is ranked 6th. It can be expected that more e-tailers will be on the list in 20 years, and some retailers will switch to e-tailers. The complete2016 list is as follows: Wal-Mart, Costco, Kroger, Schwarz Group, Walgreens Boots Alliance, Amazon, Home Depot, Aldi Group, Carrefour and CVS Health (Global Powers of Retailing 2018,Deloitte 2018). It is very interesting that no company has in its sales structure more than 70% share in e-commerce sales. It is also interesting that seven of the top ten retailing companies are from the USA, two are Germany-based companies and one is from France (Kalish, McGarrigle, 2018).

The report Global Powers of Retailing 2017 (Deloitte, 2017) finds that with the rapid rise of click-and-collect services, more retailers, including those selling primarily food, have established an online presence. Also, online growth has slowed down compared with a period 20 years ago, and a greater share of retail sales continues to shift to digital channels. This research included top 250 global retailers, and e-commerce is the primary driver of (their?) revenue growth.

Majority of the top 50 e-retailers are based either in the United States (26 companies) or Europe (19 companies). The other five are emerging-market companies (four from China and one from Brazil). Although some of the largest and fastest-growing e-commerce companies are based in Asia.Two of the top three fastest-growing retailers in 2016 are China-based e-commerce retailers, Vipshop and JD.com" (Deloitte, 2018). In total, just 12 of the 50 top e-retailers are non-store or web-only retailers.

The rapid shift to e-commerce is quite literally transforming the retail landscape. With online growth outpacing overall growth in retail sales, retailers are rationalizing their physical footprint and intensifying their e-commerce presence. Given the negative impact of e-commerce on store productivity, many have concluded that their existing store base is simply too big. This is resulting in a rash of store closures, a move to smaller-footprint and more flexible store formats, and new roles of brick-and-mortars.

Consolidation and fragmentation are trends in a changing retail environment. "Macy's, Sears, Kmart, J.C. Penney, Kohl's and even Walmart have been closing stores. American Apparel, Aeropostale, BCBG, Chicos,

Finish Line, Men's Wearhouse and The Children's Place are restructuring with fewer stores. Many more, such as The Limited, Pac Sun, Sports Authority and Wet Seal have said goodbye to their customers" (Creating a Unified, Personalized Shopping Experience with Live Data, April 2017). Although some brick-and-mortar stores slumped this past holiday season, and mall-based retailers like Macy's, Sears, and Kmart are closing more than the usual number of stores, that doesn't mean that shopping centers themselves are doomed (Retail News February 2017).Up to 25% of U.S. shopping malls may close in the next five years (Retail News June, July, August 2017). There is a fear that traditional retail will disappear, but the research shows that it is just a transition period which will transform both traditional retail companies and new e-retail companies.

4. CHARACTERISTICS OF ELECTROINC MARKETS AND TECHNOLOGY INFLUENCE

Electronic market is closely connected with technology development. We can say that without technology solutions e-retail would not be possible. Technology has a great influence on market improvements, and all innovations can find any role in online shopping. Development of retail and e-retail are connected with technology innovations. It is interesting how customers access online shops. First, they were using desktops and notebooks, then they were replaced with tablets, and the past ten years are the era of smartphones. According to the report Tomorrow's Word Retail (2017) from October 2016, the use of phones and tablets is higher than the use of desktops and notebooks. Japan and the UK are leaders in online shopping via mobile devices. Personal computer era in Africa did not exist, they started with mobile markets, so they have enormous business opportunities for m-commerce.

As stated inthe Global E-commerce Report 2017 (2017)the main reason forshopping online instead in stores is the possibility of 24/7 shopping for 58% consumers. The second most frequent reason is a possibility of price comparison (54%). The third most frequent reason is better prices for online shoping (46%). Other reasons are: time saving, convenience of not going to shops, greater variety of items, free shipping offer, everything in one place, posibility to find rare items, avoiding crowds, unavailability of items in own country and avoiding checkout lines.

Mobile purchasing has a growing importance and the main reason for its use is convenience and saving time and it is the same in all regions in world. Other reasons are: better prices, purchase of items that cannot be found in stores, getting goods immediately, entertainment, safer than cash buying and so on.

E-commerce is very effective for customer feedback. The most popular website and social media platform in 2017 for feedback was definitely Facebook. In Europe, WhatsApp and Instagram follow Facebook. In North America, Instagram is the second most popular and it is followed by Twitter. The Asia Pacific region prefers WeChat and Instagram. In the Middle East and Africa WhatsApp is ranked second, and Instagram third. South America, after Facebook prefers WhatsApp, while Instagram and Twitter together are ranked third.

Consumers want a personalized experience and retailers are focused on improving their personalized services. While 40% of retailers indicate they are focused on personalization as a top digital priority, many are not currently offering the personalized services consumers expect (BRP special report, 2016).Personalization is not just a trend – it is a critical way for retailers to differentiate themselves from companies like Amazon and survive.

According to Weinswig (2017), 3D scanning and printing will give a comparative advantage to retailers who deliver customized products. It is important for fashion retailers, with scanning of customers they will be able to offer unique products using 3D printers. Another trend in retail is the speed to market and social media marketing. With the mobile market, speed is a very important factor. In the past period, the focus in the supply chain was on the cost of lead time, but now speed is more important. There will be a great improvement in visual search, which will enable a possibility of finding some products where the name and description are missing.

Walmart is developing a facial recognition technology to detect frustrated or unhappy shoppers. The technology uses video cameras at store checkout lines that monitor customers' facial expressions and movements to try to identify varying levels of dissatisfaction (RETAIL NEWS June, July, August 2017).

Technology has enabled the emergence of omnichannels that give a new retail approach by combining multiple retail channels into one. According to a research done by Hooijdonk (2017) US shoppers like to use omnichannel shopping for consumer electronics (70%), toys (66%), apparel (58%), home appliances (57%). At the end of the list are: cleaning products (14%), OTC medications (15%) and food and beverages (15%). Retailers are focusing on innovative areas when they prepare omnichannel strategy. For instance, according to the same research (Hooijdonk 2017) "while in Germany85% of retailers consider physical stores as the

most important trade channel, in Nordic countries, retailers are using mobile channels to sell their products." Retailers are aware of all benefits from omnichannel strategy, but some of them still find it very challenging to implement these features.

5. CONCLUSION

E-retail is a commercial activity over the Internet which involves businesses and consumers, B2C. Brick-and-mortar stores are changing to brick-and-click and establish connection between traditional retail and e-retail. It is evident that majority of main players on the electronic retail markets are not involved in online sales only. They are making a combination of traditional physical stores and online stores.

Electronic retail market is permanently booming, and the growth rate is changing year by year, but has never been below 10%. However, in total retail sales e-retail accounts for 10%.In next five years we can expect that this share will grow by 1% per year. But it cannot be expected that the traditional retail format will disappear within a short period. There is an obvious trend of closing physical stores. However, there is also a trend of changing their format due to an impact of e-retail. Electronic retail market is specific because it is at same time local and global. Internet is the main prerequisite for online retail. And we can see that e-retail is more accepted in a region in which the structure of internet users is dominant. Europe and America are leaders in the number of top global e-retail companies.

It is interesting that Luxemburg and Switzerland have a leading position according to the E-commerce index 2017, which takes into consideration four factors important for online retail. Serbia is ranked 42ndout of 144 countries included in the research.

China records the highest growth in electronic retail and this country is also a leader in innovation. Two companies are global leaders and trendsetters, Amazon and Alibaba. These two companies have a great impact on the development of global electronic retail. Alibaba is a China based company with 500 million users. With this number of users they combine the big data analytics and artificial intelligence (AI) to customize customer experience on both sides: in physical store and in online store.

Wal-Mart, as the biggest retail company for a few decades, also entered the electronic retail market. One of the pillars of their strategy is digitalization. It can be concluded that traditional retailers will become digital and that e-retailers will not have only online sales.

Technology has a great influence on e-retail and it directly creates characteristics of electronic markets. All innovations can be very easily tested and implemented in real time. High level of online sales using tablets and smartphones enables using e-retail anytime and anywhere. Mobile technology enables shorter time between the buying decision and realization. Time reduction is experienced in many segments, including payment, delivery, and customer feedback. Using 3D scanners and printers, robots, AI, Internet of Things (IoT), Big Data, high level of personalization and of other innovations has a significant role in the development of electronic retail market. E-retail will have one new role, e-retail will have to create a new emotion for customers.

Retail will continue to grow, e-retail, combined with geographic expansion, will be the primary drivers of the growth in retail.

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CASE STUDY: AIRBNB SOCIAL MEDIA CAMPAIGN

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***Abstract**: This paper represents the summary of basics related to marketing promotion and its communicational aspects. Communication is the key to establish successful long-term relationship between the company and its potential customers. Marketing strategy and online marketing, as a part of overall marketing strategy, is the central topic of this paper. New technologies and the usage of different tactics and tools are the essence of online marketing. In order to create effective online campaign marketers conduct market research to segment the audience properly. Different social media platforms, social networks and mobile phones are inevitable media for launching successful promotional campaigns. To promote brand, company or a product, marketers usually launch the campaign over various social media and platforms. The Case study is the result of gathered data by studying Airbnb successful campaigns launched through different social media.*

***Keywords:** promotion, campaign, customer, social media, digital marketing, brand*

1. INTRODUCTION

Marketing strategy includes selection and analysis of targeted audience and creating and conducting adequate marketing mix (product, price, placement, promotion)to satisfy that audience. It represents planning and coordination of all available marketing resources in attaining the objectives of the company. Good strategy should define market, determine and engage all organizational strengths, fulfil the needs of the market in a superior manner than the competition. Marketing plan is based on the strategy of one particular company and is a written statement of necessary marketing activities. Once marketers decide which market to target, marketing plan is made containing clear set of actions to penetrate the market with a particular brand or product (service). Marketing mix has been defined as “the set of controllable, tactical marketing tools” (Kotler, Wong, Sounders, Armstrong, 2007) that the company uses to pursue its marketing objectives in the targeted market. The 4Ps (product, price, place, promotion) concept is a framework for marketing management decisions and was extended by marketers, especially for services, to 7Ps, and 8Ps (people, process, physical evidence, performance) and, sometimes, politics. As an extension to basic 4Ps concept, a more customer driven model was defined as 4C (consumer with his needs and wishes, cost to the customer, convenience and communication). Promotion refers to communication between the company and its customers, and thus is elastic and dynamic. Communication refers to the process of transmitting the message or a concept to a wider audience.

2. PROMOTION AND COMMUNICATION

Communication is the key to establish fertile long-term relationship between the company and its customers. New technologies created new markets and new opportunities for marketers. Technology lifecycle significantly reduces, trends are changing very fast and marketers need to follow those changes seriously in order to break the barrier between them and their customers, establish and maintain consistent brand image and to differentiate their own brand against similar brands and product in very crowded global market. The essence of marketing nowadays is to predict and recognize the needs and wishes of customers, to shift the communication from public toward private, satisfy the customers and convert them into leads and brand evangelists. Marketers link all communications in targeting customers and coordinate all messages they send to their customers over a variety of disposable media. Internet and contemporary network communications define the phenomena of the crowd through the existence and norms of online and cyber community behavior. These virtual flash mobs connect and behave over common interests and are defined by specific language of the computer and mobile communications (to like, to dislike, to share, haters, trolls, bots, LOL, hashtags, emoticons, Facebook-friendly, Insta-friendly, mobile-friendly etc.). Designing communication requires defining the content of the message that needs to be communicated to the customer

message strategy), to whom the message should be send to (creative strategy), who sends the message (the sender) and through which channels is the most effective message to be transmitted (media).

2.1. Communication

Successful communication implies following steps, of which each needs to be undertaken accurately to result in a fertile long-term relationship with customers:

- Identifying the audience
- Defining communication objectives
- Communication channels design
- Selection of communication channels
- Setting the promotional budget
- Mix of communications selection
- Measuring the results of communication
- Conducting the integrated marketing communications

Communication objectives are usually: creating awareness and knowledge about the company or brand/product/service, positioning the company, projection and affirmation of brand image, shaping attitudes, stimulation off need and desire and improving sales. Positioning is the process of defining an image of the company or developing its brand. Branding is the essence of the promotion and the key to positioning a product/service. The American Marketing Association defines brand as "a name, term, design, symbol or any other feature that identifies one seller's good or service as distinct from those of other sellers" (Kotler,Keller, 2006). Branding is about creating mental projections about the particular brand and developing emotional images inside customer's mind, in order to differentiate product from similar product and to affirm the strength of the brand. Before marketers design and choose communication channels it is a priority to choose and define the audience. Marketers conduct the market research to segment the audience. The most common research methods used are: previous sales analysis, buying patterns history, questionnaires, focus groups, interviews, different online statistics etc. Marketers ought to know their targeted audience, and therefore they use as many segmentation criteria as possible: location, age, gender, education, employment, hobbies and interests, priorities, buying habits, cultural characteristics in global business etc. Communication channels are selected after deep analysis of the company's marketing strategy and orientation, financial aspects, corporative culture, defined objectives of communication activities, specification of segmented audience, approximated presence in media, period of planned campaign and necessary budget for planned campaign.

2.2. Communication mix

After the budget for promotion is set the marketers select the most suitable among the elements of communication mix: mass media, sales promotions, public relations, personal selling and direct marketing. Mass media uses outdoor ads, business directories, magazines and newspapers, television, movies, radio or infomercials. Sales promotions includes coupons, discounts different loyalty incentives. Public relations conduct media instructions, PR events, media releases, causes and charity, customer appreciation events and other. Personal selling includes activities of sales force, showrooms, exhibitions, trade shows, point-of-sale, end-cap etc. Direct marketing targets segmented market with direct mail, catalogues, bulk mailers, e-mail, telemarketing and digital marketing.
Digital marketing is the imperative of contemporary marketing campaigns and it implies the activities via company website, social media, blogging, mobile phone promotions, YouTube, search engine optimization (SEO) etc.

2.3. Online campaign media

Digital marketing campaign is the set of actions within the marketing communications strategy that move the company toward meeting the objectives determined in overall marketing strategy. Overall digital campaign must consider each media, method and approach to ensure they all work in harmony to give the single message to a proper audience. Due to the growing impact, usage and distribution of online media, promotional tactics are classified according to media used in online campaign: paid, earned and owned

media. Owned media are all web properties that the company can control, such as: website, blogs, social media accounts, case studies, educational contents, e-books, whitepapers etc. Owned media are driven by content marketing strategy. Earned media are all content and conversations about the brand or product created by customers, public or press and published elsewhere than company-owned media (valuable content, press mentions, shared links, positive reviews, reposts, retweets, recommendations etc.). Earned media are more trusted and credible, and therefore very valuable in online marketing. Paid media are very effective to direct traffic to own media, create more exposure and generate more earned media (social media paid advertising, pay per click and display ads Google AdWords, sponsorships, advertising on third party sites etc.). Paid or bought media are media where there is investment to pay for visitors, reach or conversions through search, display, ad networks or affiliate marketing (Dave Chaffey, 2012). Different studies show that the best campaigns combined traditional and digital media.

There are numerous software and applications to measure effects of different campaign media. For owned media it is essential to follow numbers of followers, "seen", likes, comments, shares, subscribers, retweets, top stories, top hashtags and etc.

Google analytics, Google AdWords, Bing, Facebook, Pinterest, Twitter, Linkedin, Instagram analytics, Brandwach analytics, all can provide some metrics for measuring campaign media. Conversion rate (number of conversions divided by total number of visitors, e.g.: number of those visitors who made a purchase or a call to company on a company page divided by a total number of visitors) is also very useful metric for marketers. There are numerous analytic tools that can assist marketers to conduct market research in order to assess the competition and to determine segment of the market and niche for promotion, but also to measure the effects of campaigns ran through various digital media.

3. ONLINE CAMPAIGN

Online campaign is usually ran in several online media and platforms at the same time. People use different media, depending on their age, occupation and interest, and it is important for marketers to combine different media and platforms to reach particular segment of the audience.

According to Smart Insights statistics (Dave Chaffey, 2018), and their results match other statistics online, the world population is 7.593 billion in 2018. There are 4.021 billion Internet users, which makes 53% out of total population number, and that is 7% more that in January 2017. Out of total population, 3.196 (42%) use social media, 13% more than in January 2017. Mobile users are 5.135 billion (68% of total population number, and 4% growth since January 2017), social media users accessing via mobile are 2.958 (39% out of total world population) and active mobile Internet users are 3.722billion (49% out of total population). With total number of 2.17 billion users, (15% growth since 2017) Facebook is still the most important social media to use for marketing. YouTube with 1.500.billion users, WhatsApp 1.300 billion users, Instagram 800 million users and (annual growth of 11%), Tumblr 795 million and Twitter with 330 million users (Statista, The Statistics Portal, 2018) worldwide are platforms with a huge potential to be used for brand promotion.

More than 4 billion people spend approximately 6 hours per day using computers. These are very serious statistics to consider when planning online campaign.

3.1. Web site

Most customers nowadays undertake online query before making decision to by some product, and therefore it is important to create a website that will be easy for potential customer to use.In order to attract visitors to explore website and to encourage repeated visits, web designers need to consider following rules (Kotler,2007):

- Context: layout and design
- Content: text, pictures, sound and video
- Community: enable communication with visitors and among visitors
- Customization: adjust the page to different users and their needs and enable personalization
- Communication: models of communication between the site and users
- Connections: connection to other pages and platforms
- Commerce: enables purchasing transactions
- Constant change

Website must be attractive to customers and updated with relevant and useful information. The content needs to be easily shared or downloaded, must contain links to other pages on various media and platforms,

outlined product and services that can be easily explored, contests, loyalty programs (67% of buyers spend more money with loyalty programs), coupons etc. Oversized content that take long time to open or download can result in potential buyers to leave the site. Some statistics (HubSpot, 2018) show that 47% of customers expect a webpage to load in 2 seconds or less,64% of smartphone users expect pages to load in less than 4 second, 79% of customers who report dissatisfaction with website performance are less likely to buy from that same site again, 1 second delay in page load time means 11% of page loss viewers and 7% reductions in conversions. Consumers do not want to be interrupted while searching the web and according to some data 85% of people do not watch interrupting commercials, 11% of global Internet users use adblock on the web and those numbers grow. Broken links, 404 pages and poor landing pages can all make customer to abandon the site. Landing page or a Call-to-action is the page where the potential buyers "land" once they click on a Google AdWords or other site or link.

3.2. Search engine optimization-SEO

SEO is important for online success since it refers to the process of optimizing online content (web site or webpage etc.) in a web search engine's unpaid results (organic, earned or natural results). Content highly ranked on the search result page attracts more visitors. SEO requires technical and creative efforts to improve ranking and visibility of online content. Search engine provide user who clicks on a certain keyword with the selection of most trusted, functional and informative sites. Marketers must consider both, on-page and off-page optimization. On-page optimization refers to creating high quality content, fast-loading sites, proper keywords, easy to follow navigation, pages that are easily read and indexed by search engines and proper heading and image titles. Off-page optimization refers to creating links from other relevant websites or social media platforms. It is important to create links from reliable and trustworthy websites with content related to the topic. Search engine marketing (e.g. Google AdWords and Microsoft Bing Ads) is related to pay-per-click or cost-to-click advertising, where advertiser pays a publisher when the ad is clicked on. Websites and some social media platforms display advertisements when advertiser's keyword list matches a keyword query (sponsored ads).

3.3. Blogging

Blogs contain high-quality, valuable, educational and interesting content created for the blog followers. Blogs are very useful for brand promotion, communication with potential customers, growing brand's community and establishing trust and authority. Blogs and social media have produced many instant celebrities and influencers. Many bloggers have large community of followers who highly appreciate content they publish and share and due to that fact they became brand ambassadors. Companies cooperate with bloggers and other influencers, such as athletes, actors, musicians, photographers, journalists and reality TV stars in brand promotion since potential customers tend to relate with them which leads to increase in product sales.

3.4. Social media

Social media is Internet space where likeminded users connect to communicate to each other. Appearance of social media platforms has changed the way people socialize, interact and do business. If conducted properly social media campaigns are very effective and there are numerous examples for that. Social media have massive audience and marketers can connect to their customers in a very direct and personalized manner by creating useful, interesting content to promote their company/brand/product. Social media campaigns are more than broadcasting promotional message. These platforms are used as very powerful conversion tools. Marketers use social media and platforms, such as Facebook, Twitter, Instagram, YouTube, Pinterest and others, to post advertisements, stories, videos, helpful and relevant posts, calls for participation in different contests, coupon codes, links to exclusive offer pages, limited time deals, experts and satisfied customers testimonials, links to company blogs, to generate more leads and to convert them into buying customers. The key to success is to add a warm approach to a business and to show customers that company appreciates them. Free recourses like e-books, free webinars, how-to-videos, behind-the-scene videos or helpful guides (that are send via e-mail after leaving data that can be used for creating very useful data base for company) are very interesting for customers. Social media users look for entertainment and therefore interesting videos are very useful tool to create long-lasting relationship with the customers and to build brand trust. Marketers need to follow and to take part in conversations related to brand and

product that are ongoing on social platforms since these are the word-of-mouth of the Internet. The way marketers handle complaints and negative comments are very important for brand image, since almost 45% of online users read reviews and feedbacks prior to making purchasing decision.

4. CASE STUDY: Airbnb ONLINE CAMPAIGN

Airbnb is a peer-to-peer travel marketplace and network that allows people to book, rent or to list accommodations around the world in more than 34 000 cities and 191 countries. Peer-to-peer is a decentralized communication model or distributed application architecture in which peers are equally privileged and either party can initiate a communication. In traditional client-server model, client makes a service request and the server fulfils the request. In peer-to-peer model peers are both consumers and suppliers of the resources.

Based in San Francisco, USA, Airbnb is an online service, which does not own real estate and does not organize tours, but acts as a broker that connects people who want to lease or rent short-term logging. With the notion that "anything is bookable" the experiences that this company provides to its customers, besides regular accommodations are apartments in the centre of cities, nights in castles, tree houses, airplane accommodations, floating houses, private islands of Fiji, train carriages, private rooms, boats, manors, igloos etc.On each booking the company charges guests 6-12% and hosts 3-5% service fee. For hosts offering special experience (e.g. excursions) Airbnb charges 20% of total charge. Hosts and guests must sign-in and attach their verified ID, profile picture, other documents or accommodation certificates (if required), e-mail, phone number, verified address and etc. The hosts list their accommodation with all details, location, price and picture taken by themselves or by professional photographer provided by Airbnb. Hosts and guests are both encouraged by Airbnb to write reviews about accommodations.

The company was founded by Brian Chesky and Joe Gebbia in 2008. in San Francisco. With no money to pay their own rent, they decided to rent three air mattresses which they placed in their own living room and turned it into bed and breakfast. They made a computer booking application and their first guests were two men and one woman who attended Industrial design conference in the city and had problems to book a place to stay. That first night they earned 80$. With Nathan Blecharczyk they founded AirBed &Breakfast and launched the website Airbedandbreakfast.com. In order to finance their site and company they created special edition of breakfast cereals "Obama O's, Hope in every bowl" and "Cap'n McCain's, a Maverick in every bite" with Barack Obama and John McCain (president candidates) as the inspiration. In two months time they gathered more than 30 000$, by selling 800 boxes for 40$ each.

In 2009, they renamed the company to Airbnb and expanded the website contents from just bed and breakfast to various types of accommodations. In April the company received 600 000$ seed money from Sequoia Capital, and until today the company raised 3.95 billion dollars of very important investments in ten rounds. In February 2011, they announced the first millionth night booked, in January 2012 its 5 millionth night booked, in June 2012 10 millionth night booked and today they have 4 million listings worldwide and 80 million of guests enlisted. In 2011 Airbnb set a sum of 50 000$, that was increased to 1 million $in 2012, as a host guarantee to cover property damage and thefts. In May 2011 they opened the first international office in Hamburg, and after that in London, Paris, Milan, Barcelona, Copenhagen etc. In June 2012 Airbnb launched a wish list that enabled users to make their online list with lodgings they would like to visit and share it with other users.

After Hurricane Sandy Airbnb partnered with New York Mayor and launched "Open homes. Open your heart and home to someone in need" campaign to offer free housing for displaced persons by building a microsite for victims to register and connect with property owners willing to rent for free. The Airbnb set a goal to provide short-term free lodging for 100 000 people in need (refugees, disaster survivors and relief workers), and to donate 4 million dollars to International Rescue Committee to support needs of displaced persons globally. They invited members of their community to share their homes and to help displaced persons to not just find a place to stay, but to feel connected, respected and a part of community. "Open homes" program also provides free or low cost accommodations to individuals and families in time of need, medical patients travelling for treatment, students with low income when traveling to universities, people working for charity or other good causes.

Hotel industry claimed that the hotels have been forced to lower their prices due to Airbnb. In 2016 the US Federal Trade Commission began investigating how Airbnb effected housing costs and by now many states

in US and worldwide discussed this matter. Many laws and regulations have been implemented imposing restrictions to Airbnb and their hosts. Until today Airbnb continued to grow rapidly and made many partnerships and acquisitions. The value of the company is estimated to 30 billion dollars.

4.1. Airbnb content marketing and online campaign

Airbnb encourages people all over the world to rent accommodations from local hosts and to embrace experience of living like locals. Their "Don't go there, Live there" social media campaign, launched in 2016 via social media encourage travellers to experience places they travel to like locals and to explore attractions that local people visit. The campaign advised people not to go to different places (Paris, New York, Los Angeles, Tokyo etc.) but to live there and do things they normally do. The campaign earned 11 million views on Facebook, 56 000 likes and 5 200 comments. On YouTube channel "Don't go there" video earned over 13 million views.

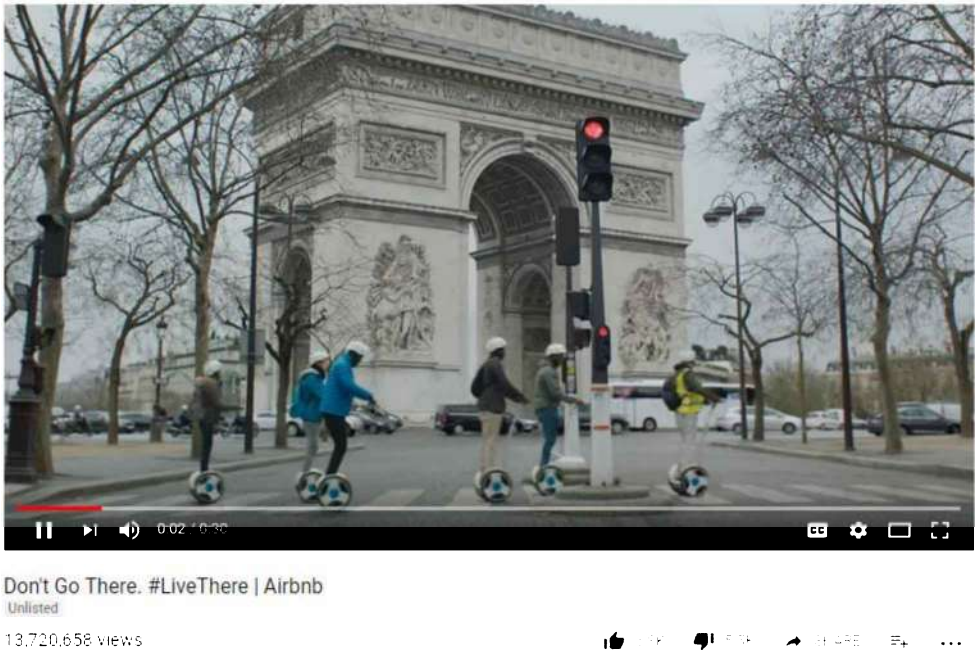

Figure 1. "Don't go there. Live there." campaign

"Airbnb Neighbourhoods" is digital content marketing product, a travel guide that informs travellers about where local people go in the neighbourhoods they visit, by photos, maps, tags, essays and information about public transportation, dining, nightlife, what to see and visit. "Airbnb Concerts" is content for music fans to find local musical events to visit. Airbnb encourages storytelling approach in content marketing by having "Airbnb stories" where guests and hosts post their images, videos and stories sharing their experiences. Local photographers and Airbnb stuff produce story movies that provide in-depth experience of different places.
In 2018. Airbnb launched "Airbnb Plus" with a listing of more than 2000 homes in 13 countries with high ratings of 4,8+ and consistently strong reviews. These accommodations satisfy Airbnb 100-points checklist of requirements. Airbnb CEO and Head of Community Brian Chesky (Brian Checky, 2018) tweeted: "We finally think we have a home for everyone".

Airbnb partnered with many non profit organizations in promoting good will and common goals. Many profs of that can be found on Airbnb official website **www.airbnb.com** and their blog **https://blog.atairbnb.com.**
Airbnb encourages their community members to take part in different contests. In 2015 Airbnb created a Halloween contest and partnered with the city of Paris to provide a contest winner unforgettable experience of spending the night in the largest cemetery in the world and to sleep with the skeletons of 6 million people in the Parisian catacombs. In 2016 Halloween season, the contest winner got a flight to Romania and had a chance to sleep in red velvet coffins in Dracula's castle with no phone, TV or any other connection to the outside world. The winner got a dinner and was left alone during the night to freely explore the castle. The contest that was organized in partnership with KLM, Royal Dutch Airlines, brought the winner the opportunity to stay in a luxury Airplane apartment.

When a bookstore Waterstone customer tweeted the company to inform them that he has been, by accident, locked in their London store for two hours, Airbnb used the opportunity to connect to Waterstone and within 24h the partnership with Waterstone provided Airbnb community members the opportunity the book the night in their store. Airbnb organized the competition and the prise for a winner was to spend the night in the very same store where Twitter user was locked in. IKEA also joined Airbnb in offering people to have such experience in their stores. What happened to be very unpleasant experience for one customer turned out to be a trigger to launch a very successful campaign "Night At" for Airbnb whose marketers used a viral trend to make a campaign out of it. Airbnb organized many similar contests (e.g. floating house on the river Thames) and launched some very successful campaigns ("Airbnb-Belong anywhere", "#OneLessStranger", "Never a stranger", "Live there with your family", "#LiveInTheMovies" etc.) that brought Airbnb huge success.

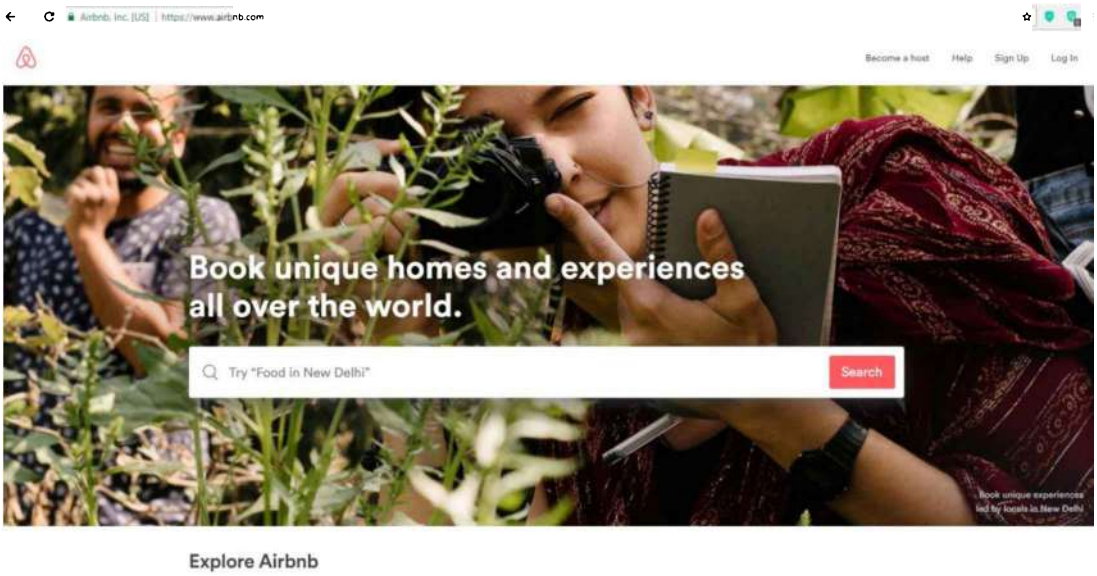

Figure 2: Airbnb website

Airbnb developed a Facebook and Instagram campaign for mobile phone users, that used carousel and canvas ads for these platforms. Sound-off auto-play videos provided users with unique experiences.
The campaign was very successful in targeting people of age 18-54 interested to travel to UK, Australia, Germany, France etc.

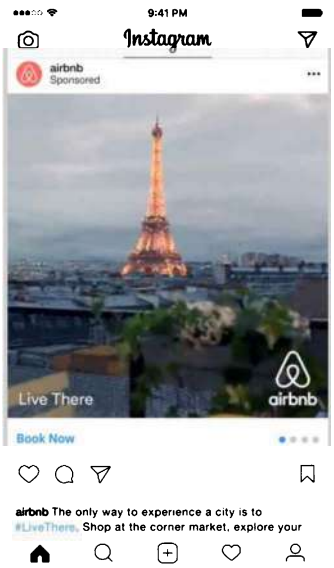

Figure 3: Instagram ad for mobile phone

In 2017 Super Bowl, Airbnb promoted its “We Accept” campaign that caused many talks and controversy. By promoting message of diversity and acceptance in their video Airbnb stated their attitude related to President Trump’s order to temporary close America’s border for refugees from seven Muslim countries. Airbnb had one more reason for launching this campaign. It was Airbnb’s way to show the public their opinion and attitude about some accusations that Airbnb hosts discriminate some guests.

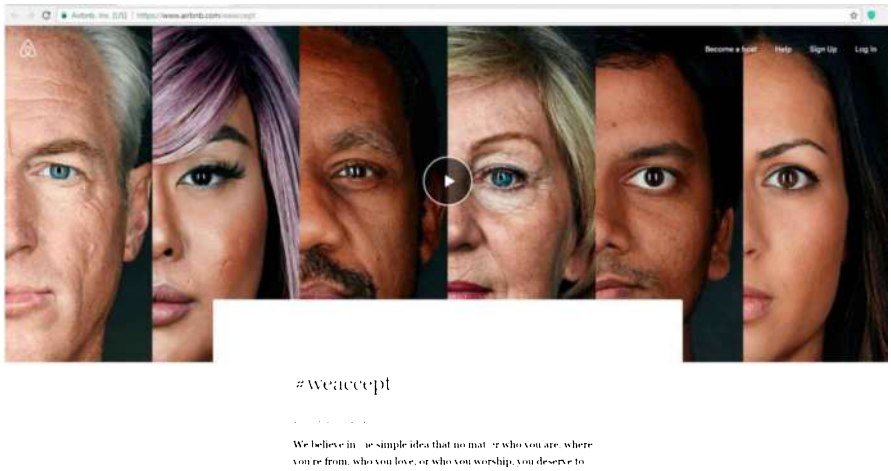

Figure 4: “We accept” campaign

The 30 second line-up featured different faces and promotion message: “We believe no matter who you are, where you’re from, who you love, or who you worship, we all belong. The world is more beautiful the more you accept” (Airbnb website, 2017).

5. CONCLUSION

Airbnb appeal adventure, nostalgia and cultural heritage in their campaigns to encourage people to travel and connect. They include their hosts and guests in a process of storytelling, content creating and brand image establishing and that approach made this company grow so fast. Inspiring digital campaigns launched over various platforms and media using modern marketing techniques and tools made them one of the leaders in modern tourism business.

Online promotion and digital marketing take primacy over TV and printed media advertising. Growing competition and dramatic business conditions changes force companies to fight for every potential buyer by using new and more effective methods and tactics. It is the imperative for companies to make their customers satisfied and even delighted, since customers are more educated and informed today and expect desired products to be available by acceptable price in a short period of time. Marketing as the economic, social, business and scientific process takes part in almost every aspect of human life nowadays. Customers do not want their daily activities to be interrupted by marketing and therefore creating interesting and attractive promotional campaigns became very challenging for modern marketers.
Due to the habits of new generations of people who use technology in almost every aspect of life, digital marketing will enhance and develop faster in time that is coming.

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CHALLENGE OF HOLISTIC MARKETING IN ARTISTIC PROJECTS

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Abstract: Challenge of holistic marketing approach and strategies in artistic projects is based on inclusion of internal marketing, integrated marketing, relationship marketing and social responsible marketing. Challenge of holistic marketing approach in artistic projects is, also based, on inclusion of classical and modern media, as well as in opportunities to get close artistic projects to target audiences, in modern ways. Marketing in arts is specific field of marketing and require sophisticated approach, what is real challenge. Researching needs and wants of target audiences of artistic projects is point for success and good way to present artistic ideas and messages. Goals of artistic projects are to motivate public for thinking and to inspire them for social changes. Art is support for social changes, that's why marketing strategies in artistic projects are challenge in holistic marketing approach. In modern environment, strategies of branding change shape and become adaptive for modern, social media. Today, public has opportunities to get inform about artistic projects, as well, to create their own artistic projects. Very often artistic projects are support by new media communications platforms. Strategies of relationship marketing are good way to communicate with public. Social media give these communication easy ways. Strategies of emotional branding of artistic projects present special challenge for holistic marketing approach. Modern museums, like *Louvre*, *Tate Modern*, use social media communication with target audiences, especially for new exhibitions in field of paintings, photography's and sculptures. Artistic projects have innovative approach. Creating innovative strategies to lead artistic projects represent challenge for marketing managers in arts.

***Keywords*:** Holistic marketing, marketing strategies, artistic projects, strategies of branding, strategies of relationship marketing, strategies of innovation, social media.

1. INTRODUCTION

Artistic projects are very important in past decades. Artistic projects have to be organized, through exhibitions, performances, literature evening, educational programs and social responsible programs. Artist usually fined support for their artistic projects in some institutions of culture and art. Planning of artistic projects is holistic process which includes organizational and marketing skills, as well as, continuing communications with public audiences.

Artistic project has specific period of duration, social responsible goals and modern communications instruments in order to improve communications with target audiences. The process of planning artistic projects can be percept as products. There are so many theoretical approaches in holistic marketing process of planning artistic projects. It is important to implement strategies of relationship marketing, strategies of internal marketing, strategies of integrated marketing, all based on social responsible approach. In process of holistic marketing planning of artistic projects, strategies of branding are crucial.

Holistic marketing approach has challenge in improving planning process of artistic projects. All parts of holistic marketing approaches are important, internal marketing, integrated marketing, relationship marketing and social responsible marketing. Internal marketing strategies improve organizational structures of artistic projects and communications with team workers. Strategies of integrated marketing improve consistent of artistic project's storytelling. Social responsible approach is base for every artistic project. The key message of artistic project is social changes and movement. Strategies of relationship marketing make platforms for clear and direct communications with target audiences of artistic projects. In all these ways holistic marketing approach is base platform for realization of artistic projects. The elements of holistic marketing approach are present on Figure 1. (Kotler, 2017)

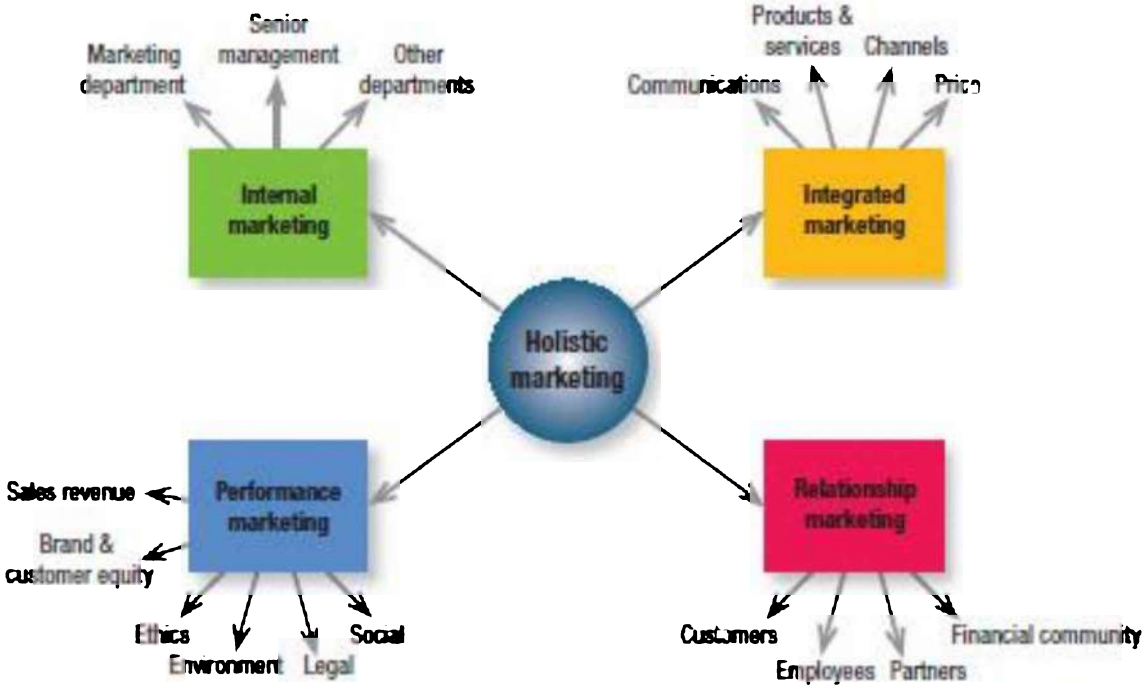

Figure 1: Elements of holistic marketing approach

Implementation of holistic marketing approach in artistic projects is challenging, because target audiences are sophisticated, process of planning and organizing artistic projects is requesting, as well as, social responsibility is strong.

Strategies of relationship marketing and modern media give opportunities for direct communication with target audiences. It is important to make good connections with audiences of artistic projects, as well as, trust, based on truth and openness of artists. The key strategies in artistic projects are strategies of innovations, strategies of adaptation, strategies of relationship marketing, social responsible strategies and strategies of communications with target audiences.

Many artistic projects include audience in organization and performance of artistic projects, using volunteer work, focus group discussion, social media discussion and in the way of interactive communications with management of artistic projects. Mostly, artistic projects have social responsible impact on social problems, through history. Artistic projects have impact on social movement, as well as, improve social awareness about social problems. History facts prove that arts develop awareness about future movement. Arts and educations are the base for development of modern society.

In that way holistic marketing approach present base for improve artistic projects. Modern society needs interactive communications through modern media. Artistic projects send messages to audiences and, also, listen needs and wants of target audiences. Specific opportunities of social media are that artistic projects can impact on awareness and attitude of public audiences.

2. MARKETING IN ARTISTIC PROJECTS

Modern term of arts theoretical is describe in second part of 18. and first part of 19. century. Modern theoretical approach established intelectual society, againts previous aristocrates approach. In previous approach arts were symbol od status. New approach gives arts opportunities to be challenge of human's souls. In the first period art included literature, music and painting. New era include art as holistic project that impact on human's souls and thoughts. Nowadays art are not revolutionar, as it was in past. Today arts stimulate human's atitude, souls and thoughts by mesaages and storytelling. (Books of modern culture, 2012)

Artistic projects are independant and present atittude of artist, whose present their views of world. (Kolber, 2010)

Holistic marketing approach has integrated marketing communication with target audiences, which present opportunities for research needs and wants of public, as well as, social movements. It is very important that integrated marketing communications have consistent storytelling with target audiences. Artistic projects send social impulses to public and call people to think about social problems, ways, social attitude, educations, young people, future, modern civilizations, life, life stories, history, sociology. In that way artistic projects drive people to react, to have atittude, to communicate with other people and to create better world. Artistic projects are creative and drive public to think and feel. (Pelsmacker, 2007)

The creative idea motivate public, as well as, creative idea is original approach, base on imagination. Creative idea has to be clear, simple and inspire. (Reid, 2008)

Strategies of public relations are very important in process of planning of artistic projects. These strategies improve communications and connections between artistic projects and target audiences. (Pelsmacker, 2007)

Strategies of public relations develop and imrpove communications between cultural institutions and their target audiences. Social responsible approach gives platform for artistic projects, as well as, purpose and message to target audiences. Strategies of relationship marketing have specific impact in leading of artistic projects. They give opportunities of interactive communications with public, through traditional ways of communication and modern, social media. Two way communications give opportunities for listening of wants and needs of public, that shows ways for furture development. (Kotler, 2008)

Media communications are part of artistic projects. Media culture is also culture of high technology. This nee technology gives opportunities for better communications and gives to artistic projects global dimension. (Kelner, 2004)

In this paper is present modern example of artistic projects.

3. INCLUSION OF HOLISTIC MARKETING APPROACH AND ARTISTIC PROJECTS

Good example of holistic marketing implementation on artistic projects is museum Louvre, whose is one of the most important museums in the world. Museum Louvre is in Paris, near river Siena. Museum has 35.000 presentations from prehistory period to 20 Century. Total number of presentations is 380.000. Museum Louvre is the most visited museum in the world. In work day museum visit 15.000 people, from all over the world.

In description of good examples of artistic projects, this paper gives focus group with students and their opinions about artistic projects. In the paper their opinions are so valuable, modern and interesting.

Museum Louvre has profile on all social media, Facebook, Twitter, and Instagram. Professional marketing team lead these pages, in order to present cultural, historical, artistic values of museum to wide audiences, all over the world, especially to young people. Museum Louvre is in modern communications process. There are many virtual platform that present values of museum Louvre. People can discuss, ask and be part of interactive conversation about art and culture. Today, museum Louvre is open in traditional and modern way for all people.

In focus group, students told that museum Louvre has modern strategies of holistic marketing and that museum Louvre is open for modern technology platform, based on strategies of innovations and adaptations. Young people think that nothing can replace traditional visit of museum, but new technology gives opportunities to visit museum in virtual way.

Good example is museum Tate Modern in London. This museum get together modern and traditional ways in arts, as well as, get together traditional and modern generations, though artistic projects. In museum Tate Modern border does not exist. In focus group students told that museum Tate Modern is so innovative and inspirational. Students especially like installations as way of artistic projects, as well as, digital exhibitions. Young people told in focus group that they can go in Tate Modern and spend beautiful time thinking about arts, be a part of artistic projects, discuss about artistic projects, be inspire to present their own art's work, listen music, play with arts, watch digital exhibitions all around world and be a part of artistic, cosmopolitan planet. Digital presentation of museum Tate Modern is present on Figure 2 and Figure 3.

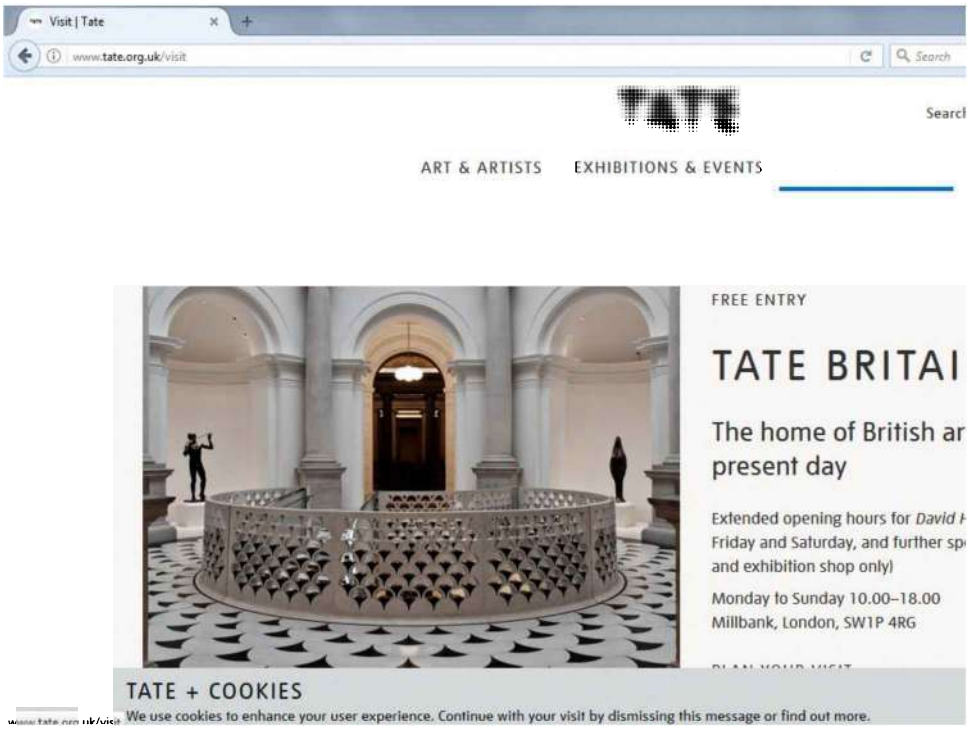

Figure 2: Museum Tate Modern on Social Media

Young people told that Tate Modern is the most modern museum in the world. Museum has profile on Facebook, Twitter and Instagram. Students told us that it is excellent opportunities to interactive communicate with other young people.

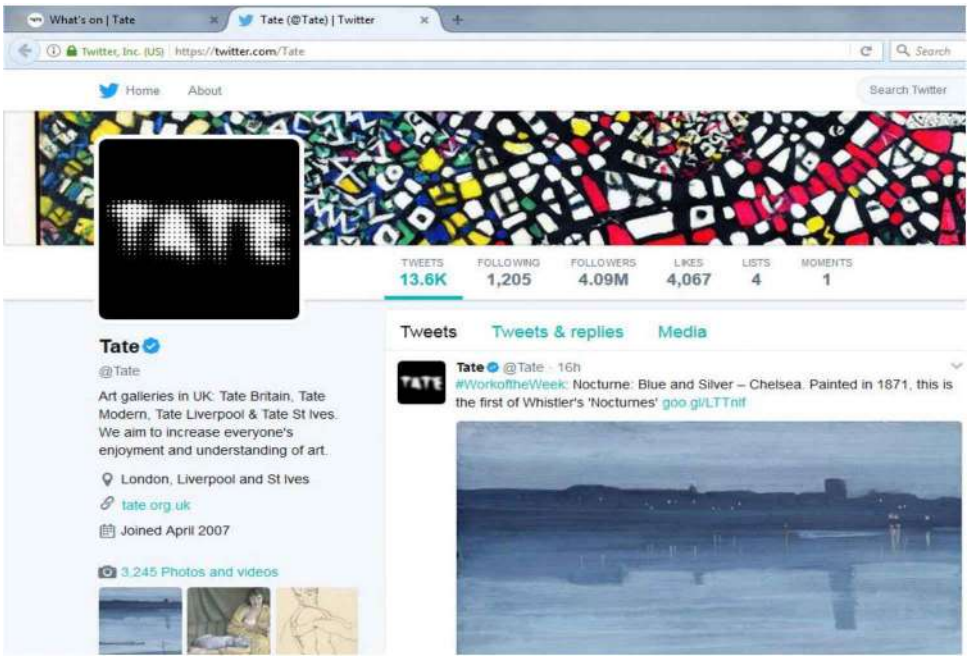

Figure 3: Museum Tate Modern on Twitter

Historical example of Luddite revolution in London, gives facts that modern technology has to be accepted in new way. Modern technology gives opportunities for development. People have to raise awareness about new approaches and new technology, as well as, to use new technology in their ways. For artistic projects, new technology gives opportunities for share opinions, for new experiences, for new approaches, for new inspirations, for new ways of educations.

Museum of Cycladic Art in Athens gives opportunities to visitors to see digital, interactive movies about sculpture reconstruction, as well as, archeological researches in ancient Greece. In museum, visitors can

use media, interactive players, where they can learn about history, archeology, sociology, philosophy, culture and art. Museum has profile on all Internet platforms.

Modern way of development of artistic projects is combination of digital media and arts. Last modern exhibition in the world was digital, interactive exhibition about life of Vincent Van Gogh, which includes traditional exhibition of paintings, as well as, digital, multimedia, interactive movies about Vincent Van Gogh life, thoughts, dilemmas and family life. Social media followed exhibition with good comments and expressions. This project is the whole digital implementation of artistic projects.

4. CONCLUSION

Theoretical analysis, comparative analysis, examples from practice and focus group with students about challenges of holistic marketing implementation in artistic projects, give conclusion that it is necessary to innovated marketing strategies in the field of leading of artistic projects. Conclusion is that it is necessary to improve support of society about artistic projects. Conclusion is that holistic marketing approach has impact on social movement.

Young people, as part of focus group, emphasize that it is important to improve knowledge in fields of history, sociology, culture and arts, through modern media, multimedia and digital, interactive movies. Young people emphasize that it is necessary to make connection between artistic projects and target audiences.

Modern museums and galleries accept multimedia, digital approach, as well as, holistic marketing approach. Conclusion is that good traditional ways of marketing planning of artistic projects have to stay, but it should be improve with modern, multimedia, digital approach.

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INTEGRATION OF PERFORMANCE INDICATORS FOR DIGITAL AND TRADITIONAL ADVERTISING

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Abstract: *Imperative of modern company management, especially nowadays, when the market is liberalized and completely new systems are being created known as "post-industrial society", era of knowledge and information age, represent different types of advertising, especially emphasizing the importance of digital advertising. Budgets intended for different types of advertising are often limited, and this raises the question of efficiency of the selected promotional mix and communication channels for the target segments. The paper points out the fact that the best promotional results are achieved through a combination of advertising channels, integrated communication, adjustment to target segments and application of advertising performance indicators which determine the efficiency of digital and traditional advertising. The mentioned set of activities contributes to: strengthening the strategic position brand through various activities of improving both communication activities and company offerings, increasing brand visibility, increasing its market value, and achieving of superior management performance.*

Keywords*: advertising, marketing metrics, strategy, competitiveness, web and media indicators.*

1. ADVERTISING IN MODERN MANAGEMENT CONDITIONS

Advertising, labeled as one of the most expensive marketing communication tools, is the basis of marketing strategies with a significant impact on other marketing activities of companies, which is also indicated by the fact that promotion and advertising have been considered as synonymous for a long time, although there is a significant difference between the mentioned terms (Kotlr& Keller, 2017; Moriarty et al., 2012). Modern advertising is increasingly characterized by focused and moderate performance, as well as the fragmentation of auditorium and target media (Perez-Latre, 2009).

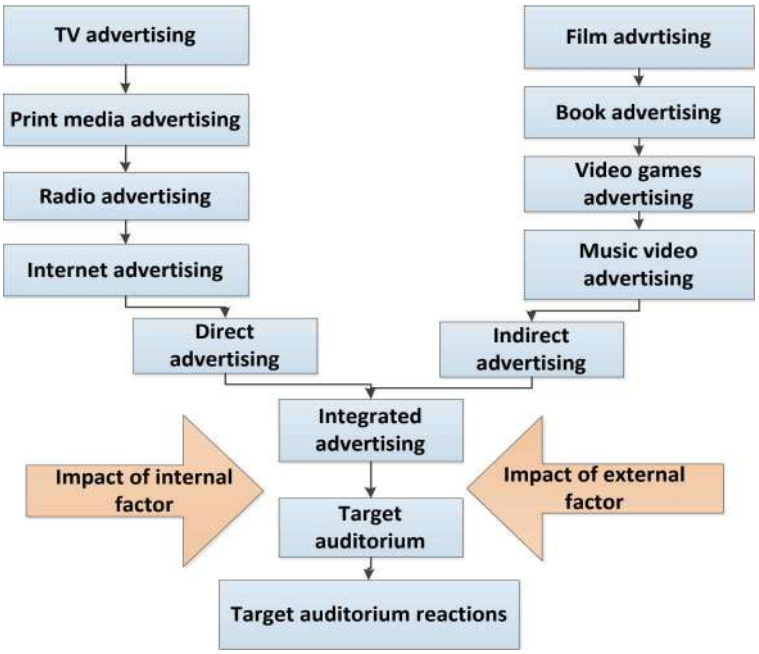

Figure 1:. Model of integrated advertising

Nowadays increasing attention is paid to integrate advertising that combines direct and indirect advertising tools as shown in Figure no1. Direct advertising means the usage of traditional advertising instruments

(advertising on television, radio, newspapers, etc.), while indirect advertising implies instruments categorized by the format in which they are broadcasted, such as: advertising in films and series, advertising in books, video games, music videos etc. (Cvijovic, 2016).The two opposite views indicate that implementing advertising activities have an impact on target segments, and thus management performance. The first one is a rational view which refers providing assistance to the target audience when estimating the value of the product / service displayed through the price, quality, location etc. Another approach focuses on the psychological reactions of consumers and points to the fact that the purchasing process is conditioned by both the psychological and emotional state of consumers (Farris et al., 2014; Moriarty et al., 2012). In addition, when creating and implementing integrated advertising, the analysis of the impact of internal and external factors is one of the most important elements of success of created strategies, which is conditioned by the modern business environment (Petresen et al., 2009; Seggie et al., 2007). Collecting data on impact of internal and external factors, determining the causative-consequential connection between circumstance and business performance (Voiculet et al., 2010; Atanasov, 2016). Essential steps in differentiating internal and external factors are (Larkin, 2003; Atanasov, 2016).:

- Ifluential factor definition,
- Influential factor identification,
- Analyzing influential factors analyses,
- Factor evaluation and possible sequences (adapting to the circumstances of management, attempt of change of the resulting circumstances and the absence of reactions)).

Considering these characteristics, it is necessary to determine the productivity of advertising activities, on one hand, and invested funds on the other hand(Farris et al., 2014; Zarkic-Joksimovic 2013). The effectiveness of advertising is determined by the application of appropriate performance indicators of marketing communications.

2. EFFICIENCY OF MEASUREMENT SYSTEM / DIGITAL AND TRADITIONAL ADVERTISING INDICATORS

Considering the fact that companies are investing significant funds in the market communication, especially advertising, measurement and analysis of advertising efficiency by using adequate performance indicators has a very practical significance (Kostic-Stankovic et al., 2017). Evaluation of success can be related to the marketing campaigns in the whole or to the different elements - advertising message, using a variety of media (Hanic et al., 2012). The effectiveness of advertising activities is assessed through three different time periods: before, during and after the campaign (Ewing et al., 2009).

The goal of pre-testing is to evaluate the efficiency of different advertising elements, their composition and the creation of the advertising message. Rationality of pre-testing is shown in the fact that it is better to determine previously the inadequacy of the message at a lower cost, than to state it after the completed campaign. Researches before the start of the campaign are carried out on a small number of potential targets, and the most appropriate research techniques are: focus groups, techniques of incomplete sentences, associations, portfolio tests etc. (Farris et al., 2014; Hanic et al., 2012). Researches during marketing campaigns are usually conducted during the propaganda broadcast on the radio or television or shortly after the end of the broadcast. Researches are carried out by telephone based on a questionnaire containing a small number of precisely defined, short and clear questions in order to obtain certain information from respondents who have been exposed to a particular ad message (Ewing et al., 2009; Hanic et al., 2012) . The above mentioned surveys provide an insight into the preliminary results of campaign efficiency. If preliminary results are below the planned level, simple corrective actions are undertaken that aim to promote campaigns during the implementation of the mentioned advertising activities (Velimirovic, 2016; Domanovic, 2013).

After the campaign, research focused on the effectiveness of campaign as a whole and less the individual elements of the advertising message that contribute to the achievement of the goals of the advertiser are carried out. Depending on the objectives of the campaign, researches may be targeted at collecting information relating to: identifying the degree of image enhancement (image) of the brand (measured by the difference in attitudes and opinions of the target group members on advertising product "before" and "after" propaganda campaigns), identifying the degree of exposure of the target segment (measured by the number of target group members (propaganda targets)), who observed the message (identifying the retention (memory) degree of the message, measured by the number of target group members who remember the message) (Farris et al., 2014; Quevedo et al., 2015; Cvijovic, 2016).

The techniques that are most commonly used in collecting information necessary to determine the effectiveness of advertising are: recognition tests and memory tests. Recognition tests are conducted in a way that specific ads are primarily shown to the participants, and then they are asked to identify those they

recognize. The main disadvantage of recognition tests is the inability to conclude on the positive and negative attitudes of the respondents about a particular brand. Memory tests are carried out in two ways with the help of reminding (along with the question asked, and certain brands are listed) and without the help of reminding. Tests of memory provide information on the affection of the respondents to the specific brand (Cvijovic, 2016). There are also different advertising indicators used to measure, monitor effectiveness and promotion of advertisement (Figure 2). For the purpose of simplicity of the analysis, the advertising indicators are divided into two groups: media advertising indicators to determine the effectiveness of traditional advertising and web advertising indicators to determine the effectiveness of digital advertising (Farris et al., 2014).

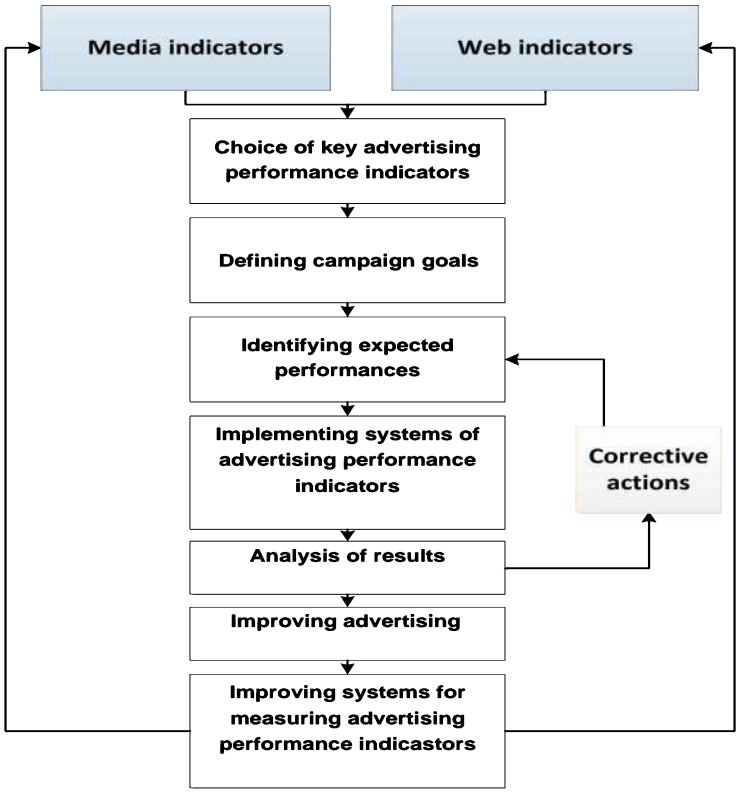

Figure 2: Identification and implementation of advertising indicators

After identifying key media indicators (display, gross scoring, net scoring, cost per thousand display, visibility) and web Indicators (page views, click rates, cost per click / display / orders) it is accessed to the process of selecting adequate performance indicators of advertising in compliance with the needs and circumstances of the business. In line with the needs of stakeholders and user expectations, it is assessed to defining the advertising goals and performance of the business, to which the company seeks.

Implementation of the performance indicators is the central part of the system shown. Table No.1. (media indicators) I (tables no.2 web indicators) shows the method of calculating the indicators as well as the limitations and possibilities of these indicators, which should be considered in order to achieve the highest quality analyses on which results improvements and achievements of superior business performance will be based (Neely et al., 2000; Farris et al., 2014; Atanasov 2016). Sometimes advertising through traditional media (televisions, radio, newspapers, etc.) within the domestic market was the basis of communication of companies with the targeted groups and throughout the public. Technological progressive and market liberalization have influenced that the use of web advertising occupy a primary position (Quevedo et al., 2015; Reid et al., 2015; Lovreta et al., 2013). Digital media efficiency is determined by using appropriate web indicators (Farris et al., 2014). Digital channels support the ability of accurate applying the appropriate web indicators to determine the effectiveness of digital advertising through sophisticated software which helps to follow wishes, needs and behaviour of the consumers (Homburget al., 2009).

Web advertising also enables the establishment of two-way communication with existing and potential consumers (Kostic-Stankovic et al., 2017), with great importance in creating profitable brand strategies and achievements of market dominance of companies (Milojevic et al., 2016). After calculating the key advertising indicators, an analysis of the achieved results is approached, i.e. whether the achieved results are in accordance with the planned values or below the level of planned values.

Table 1: Web indicators

Indicator	Method of calculation	Questions for discussion
Pageviews	**Pageviews=** $\frac{Hits}{Fils\ on\ the\ page}$	Neglected difference between presenting and coming to the website
Clicktrough rate	**Clicktrough rate=**$\frac{Clickthroughs}{Impression}$	Clicks are an intermediate goal of advertising (a step in the buying process)
Cost per click	**Cost per click** $= \frac{Advertising\ cost}{Number\ of\ clicks}$	They are often used as payment mechanism.

Table 2: Media indicators

Indicator	Method of calculation	Questions for discussion
Impression	**Impression**= Reach (number of individuals exposed to ad) x average frequency	As an indicator, it does not accept the quality of ad review
Gross rating points (GRP)	**Gross rating points** $=\frac{Impression}{Defined\ population}$x 100	Inaccuracy of precise data for calculating indicators.
Net reach	**Net reach** (the number of people who remembered the ad)	Equivalence to display / reach; measures unique monitors
Cost per thousand impression (CPM)	**Cost per thousand impression=**$\frac{Cost\ of\ advertising}{Impression\ generated\ (000)}$	Simplicity of calculation
Share of voice	**Shares of voice** $=\frac{Brand\ advertising}{Total\ market\ advertising}$	Estimation of advertising within the home market

Significant exceptions of the actual from the planned sizes require the implementation of corrective actions aimed at promotion of communication activities of digital and media advertising, advertising messages, media choices as well as the improvement of the products or services of a particular company (Velimirovic, 2016, Reid et al., 2015). Corrective activities enable expanding knowledge to the companies both on communication activities and on, consumers themselves, their needs, desires and habits in order to adjust the offer and the way of communication of the company with the target segments. In addition to this, corrective actions are a process of reinvestment that must be economically justified and time-limited (Constantine et al., 2016; Radun&Djuricin, 2012). In a situation where the achieved values are in a level with the expected ones, simple corrective actions are also undertaken.

They aim at continuous progress and innovation that are a requirement for the sustainable competitive advantage of the brand on modern markets. At the end of the process of managing system based on the application of the performance indicators of advertising, checking, evaluating and improving the presented system is performed. These activities are conditioned by the constant change of the market as well as the respect of the concept of innovation as an imperative for the creation of profitable brand strategies (MC Donald &Mouncey, 2009).

3. EVALUATION AND IMPROVEMENT OF PERFORMANCE INDICATORS

The former prerequisite for achieving dominance on the market and superior business performance was to possess the specific resources necessary for conducting activities. Today, the situation has been drastically changed. Resources are increasingly more available, markets are liberalized, customers are better informed, and products or services are becoming more accessible (Kostic-Stankovic et al., 2017). Considering that major global companies invest significant funds in advertising activities and consider it the source of brand competitiveness and achievement of market dominance, it is necessary to look at justification of long-term investment, which conditions the application of appropriate digital performance indicators and media advertising (Seegie et al., 2007; Ling-yee et al., 2010; Ambler, 2003). The generally accepted attitude is that traditional measurement systems are based exclusively on the application of financial indicators, which requires the improvement of advertising indicator systems and the equal application of financial and non-financial indicators related to quality advertising, media selection, message creation, consumer satisfaction etc.(Seegie et al., 2007; Gupta &Zeinthmal, 2006; Ambler et al., 2004).

Based on the above mentioned advertising indicators can be divided into two groups: indicators of results (financial indicators) and indicators determinant of the result (non-financial indicators), as shown in Figure 3 (Atanasov, 2016; Fitzgerald et al 1991). This classification of indicators is particularly important because it indicates that non-financial indicators (determinants) of advertising performance are primary and that without their realization it is not possible to achieve the financial indicators related to achieving profit, competitiveness and domination of the particular brand (Kaplan & Norton, 2001; Corman et al ., 2011). The system of advertising performance indicators enables quantification both of the efficiency and effectiveness of management actions (Neely & Adams, 2000).

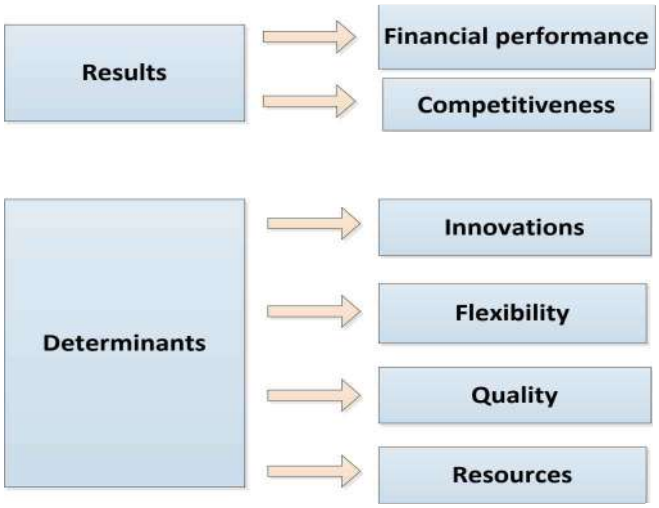

Figure 3: Financial and nonfinancial advertising performance indicators.

The mentioned system is also characterized by rationality and numerical expression, which has a huge positive impact on making profitable business decisions.By applying key performance indicators for media and digital advertising, company managers can look at current positions, determine future business goals and operate in the most economical and effective way. These systems also allow company managers to see if the planned goals have been achieved and whether the company has made progress in the whole (Reid et al., 2015; Farris et al., 2014).

4. CONCLUSION

The goal of this study is to point out the importance of the application of media and digital advertising as the most effective marketing communication tools completely adapted to the modern business conditions presented through the trend of galloping globalization, trade and investment liberalization, technological innovations, information revolution,intense competition, and unlimited choice of customers. Since companies are investing significant resources in advertising activities, it is necessary to calculate the return on invested funds by using key performance indicators for digital and traditional advertising. These measuring systems enable rational and numerical expressive quantification of the efficiency and effectiveness of management decisions, based on which directions of operation are determined in the future, improvement of both the advertising process and offer of certain companies.

Modern business conditions imply the need to innovate the system of advertising performance indicators presented through the equal application of traditional (financial) and modern (non-financial) advertising indicators. One of the basic prerequisites for successful implementation of the advertising performance indicators is based on the application of an optimal number of advertising indicators in order to avoid "suppression" analyzes. In domestic companies, the trend in the application of various financial and non-financial advertising performance indicators has not yet been fully accepted, which is one of the existing limitations reflected on both the competitiveness of companies on domestic and international market. The presented system would solve the problem of "short-sightedness" of company managers, enabling them to predict threats and business opportunities in order to create profitable business strategies.

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TENDENCIES OF CONTEMPORARY MARKETING COMMUNICATION IN DIGITAL ENVIRONMENT

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Abstract: *Due to intense technological development and the shift of focus from traditional to digital media, marketing practice has undergone specific transformations with the aim of adapting marketing strategies and tactics to the online environment. Considering the interactive nature of Internet communication which resulted from social media and other online platforms occurence, marketing communication has become interactive as well, with growing significance of customers' role within it. Therefore, this paper examines contemporary marketing communication tendences as well as the possibilities of combining specific aspects of digital marketing communicaton with the aim of estblishing and improving long-term relationships with customers.*

Keywords*: contemporary marketing communication, digital marketing, social media marketing, mobile marketing, e-WOM.*

1. INTRODUCTION

On a global market which is characterized by intense competition and dynamic changes, organizations are making efforts to find the most efficient way to communicate with customers in order to present them with the specific benefits of their products or services (Clow, 2010). As a consequence of this need, marketing communication has become fundamental aspect of marketing, as well as organization's vision and strategic aims, since companies are striving to achieve their financial and non-financial aims by implementing different forms of marketing communication (Shimp, 2003). However, since contemporary customers are exposed to thousands of marketing messages on a daily basis, their attention has become limited resource. Bearing that in mind, companies are trying to find new methods for establishing communication with customers in order to ensure that their message is noticed, accepted, and remembered (Ognjanov, 2013).

Intense development of information and communication technologies and changes in consumer behavior have led to changes in marketing field and the need to digitize marketing activities (Rakić & Rakić, 2015). Observing from the customer perspective, the use of information and communication technologies offers numerous advantages, such as efficiency, convenience and cost reduction in collecting information which are more specific and comprehensive, as well as the access to a greater variety of products at more competitive prices (Bayo-Moriones and Lera-Lopez, 2007). Rapid development of digital economy raises the question of existing marking practices relevance and demands a radical redesign of marketing theories in a way that adapts them to the needs of the economy and consumers of the 21st century (Wymbs, 2011).

Sass (2006) in Tanyel et al. (2013) states that the changes regarding the use of media, especially by younger generations of customers, caused advertisers to rely less on traditional media and more on other types of marketing communications, such as Internet advertising, product placement, advergaming, consumer-generated advertising and buzz marketing. As a result of social network sites occurrence and their fast-growing popularity as platforms through which an increasing number of users is expressing their views and interests, and exchanges multimedia content, organizations have shown interest in using these media as means of sending promotional messages to customers (Duffett, 2015). Wymbs (2011) states that the development of digital technologies has resulted in the emergence of new sales channels of products and services, but also led to a fundamental change in marketing dynamics by placing customers at the center of marketing activities. Furthermore, the author explains that the essence of digital marketing is to find the best way to communicate with customers, adapt to changes in their needs, and build a loyal and sustainable relationship with them.

In accordance with the aforementioned claims, this paper examines the role of new media in creating contemporary marketing communications, their characteristics and advantages in relation to traditional marketing communication. By reviewing current and relevant literature sources in the subject area as well as analyzing the results of the research on trends and tendencies in the application of social media in creating

marketing communications flows, this paper presents the conclusions about the possibilities of establishing and improving relationships with consumers in the online environment.

2. THE IMPACT OF SOCIAL MEDIA ON DIGITAL MARKETING COMMUNICATION DEVELOPMENT TRENDS

Due to the fact that, by their occurrence, social media changed communication trends in the world causing globally networked users to control market movements, and especially their communication aspect, Schultz (2010) states that in these conditions customers determine what kind of marketing content they will hear, see and process. More specifically, customers have proactive attitude in terms of seeking information from companies through the Internet, searching websites, using social media and consuming and creating content on blogs and forums. Also, new communication trends are characterized by the fact that, on a global level, customers are exchanging information about products and services which are based on their experience. These activities have resulted in development of digital word of mouth communication that often takes place without the knowledge of companies or marketing experts who create communication strategies. Furthermore, new communication systems allow customers to access information about products and services at anytime and anywhere that additionally disables marketing experts in controlling the content that will be created and distributed. Therefore, the author points out that the 4P concept in which the focus of organizations was on the product, promotion, price, and point of sale should be replaced by the approach in which organizations listen to customers as they are now the ones leading the marketing dialogue.

Based on their technological characteristics as well as communication trends that they provoked, social media have resulted in significant changes in practice of planning and implementing marketing communication. Kaplan and Haenlein (2010) define social media as a group of applications based on Internet technology, which are created on ideological and technological foundations of Web 2.0 and which are enabling the creation and exchange of user generated content. Wagner and Jiang (2012) state that social media are social structures that are based on the usage of Internet and defined by interaction and relations between individuals, groups and organizations. Mangold and Faulds (2009) claim that communication essence of social media is dual, given that they enable organizations to communicate directly with customers, but also provide customers with opportunity to communicate mutually. Coursaris et al. (2016) emphasize the significance of social media in creating and improving brand image through the creation of specific online experiences and values for customers, which indirectly influence the attitude and affection of customers towards the brand.

Social media as virtual communities allow Internet users to create and share content mutually (Thackeray et al., 2012) whereby user engagement is observed as one of the most important features of social media (Morgan et al., 2010). Lipsman et al., (2012) claim that key aim of implementing successful interaction with customers through social media is to encourage their engagement with brands, and then expand the scope of consumer generated content distribution towards other social media users. Bearing that in mind, it can be said that realization of marketing activities on social media can be divided into three phases:

- Converting social media users to fans or brand followers and increasing their number;
- Encouraging brand fans or followers to actively engage with the brand, which should result in increased word of mouth communication, increased brand awareness and turning brand followers into brand advocates;
- Making profit as a result of these activities (Wildfire, 2012).

Since contemporary marketing communication is based on mutual information exchange between organizations and customers, and dialogue between customers which implies exchange of experiences and attitudes towards brands, products and services, social media have become central channel of marketing communication since their architecture allows this kind of information exchange. Rakić and Rakić (2015) claim that social media provide organizations with multiple opportunities for development of marketing activities, among which following can be stated:

- Establishing direct communication and interaction with customers;
- Informing, persuading and reminding consumers about the company's products and services;
- Establishing and retaining customer relationship;
- Providing feedback on consumer complaints and suggestions;
- Establishing customer communities that are gathered around an organization or its brands;
- Creating digital WOMM content;
- Generating unpaid publicity for the organization, or its brands, products and services from social media users by encouraging e-WOM communications between them by implementation of e-WOMM activities;

- Creating and distributing digital content that presents customers with a new product or service, or in order to improve preferences for existing products and services;
- Positioning the company and its products or services in customer awareness, and creating and improving favorable attitudes about them;
- Creating brand advocates, generating buzz communication and customer referrals, development of viral marketing.

3. THE IMPACT OF SOCIAL MEDIA ON THE DEVELOPMENT OF NEW PARADIGM IN MARKETING COMMUNICATION

Duffett (2015) emphasizes the significance of marketing communication on social media as a valuable source of information based on which organizations can anticipate trends in consumer behavior and evaluate customer affection for their products and brands. The reason for such claims can be found in the fact that today about 7 out of 10 Americans use social networks for mutual communication, informing, information sharing and entertainment (Pew Research Center, 2017). According to the data provided by this research center, from 2005 onwards, there has been an increase of 64% in terms of the number of adult Americans social network users. When it comes to the use of social networks in Serbia, a survey conducted on a sample of an online population of 1000 citizens aged between 18 and 64 indicated that 89.5% of respondents had an account on one of the social networks. The respondents stated social network Facebook as the most commonly used (94.1%), followed by Instagram which is used by 36.7% of respondents and Twitter which is used by 31.3% of respondents. Meanwhile, 75.3% of the respondents stated that they always or very often checked their social network accounts as soon as they get up (pioniri.com).

Coursaris et al. (2016) claim that these statistics and data about frequency of social media accounts usage indicate that these platforms generate large databases of like-minded people, making them the ideal medium for establishing, maintaining and improving relationships with target groups of customers. Furthermore, authors emphasize numerous advantages of digital marketing communication for organizations, citing, for example, its influence on decision making processes and creating positive attitude towards the brand among customers which directly affects the value of the brand. Likewise authors state that the process of digital communication implies active customer influence, since consumer generated content achieves 22 times more powerful communication effect on other customers than the message created by marketing experts (Goh et al., 2013 in Coursaris et al., 2016).

Duffett (2015) emphasizes the convenience and cost-effectiveness of these sites in directing marketing communication towards target markets since they provide organizations with possibilities for precise customer segmentation based on their gender, age, education profile and other characteristics since, through the use of these platforms, consumers themselves provide their personal information to organizations. Furthermore, organizations use digital communication with the aim of encouraging customers to create new types of value for the company that are not only related to the process of product purchase. More precisely, by encouraging customers to write recommendations and reviews as well as take part in the process of new product development through expressing personal preferences on websites, applications created by companies or their social media accounts, companies tend to improve their business results and generate profit. Smith (2011), illustrates these claims with the case of social media and blogs as channels through which consumers can intensively influence the positioning and sale of products, given the growing tendency that consumers are more likely to trust other consumers' recommendations than information provided by companies.

Foux (2006) states that customers perceive social media as a more reliable source of information about products and services, since content is predominantly created by other customers, compared to promotional messages which are created by companies and distributed through traditional media. Customers are increasingly focusing on the use of social media in gathering information and making purchase decisions, given that they enable them to have continuous access to information under the conditions they choose (Vollmer & Precourt, 2008). These claims can be confirmed by the results of the research about the impact of WOM communication on changes in marketing practice. The research indicated changes in customer perception and attitudes towards traditional advertising, since 75% of the research participants stated that they do not perceive the content of commercial advertising messages as truth, while 83% avoids them while watching TV programs. On the other hand, 63% of social media users considers recommendations of other users as the most reliable source of information, which is followed by organizations' websites as the second most reliable medium. Likewise, the likelihood that the product will be purchased amounts to 71% if there are references or recommendations about the product available on social media (blog.hubspot.com).

Bearing in mind the significance and impact that social media have on users today, marketing experts suggest focusing on the development of marketing communication strategies that will be based on the use of the Internet and social media. One of the basic characteristics of marketing communication through social media is the fact that created content is no longer under the control of companies and marketing professionals, which makes customer satisfaction and dissatisfaction easily noticeable. Mangold and Faulds (2009) state that the popularity of social media among users is based on the fact that they want to connect with other users with whom they share similar interests. Therefore, authors propose that companies should focus on creating communities of like-minded people who share similar values, since they claim that customers feel more connected with products or services of those companies which give them the opportunity to express their opinions.

When it comes to the use of social media in business communication in Serbia, a survey conducted by the Executive Group agency suggested that almost 80% of respondents considered social media as very important or important for their business. In addition, as the five most frequently used online tools and social media networks, respondents stated Facebook, online advertising, YouTube, Twitter and blogs, while 92.3% of respondents plan to increase the use of social media in the upcoming period. In terms of the purpose for which social networks are most often used, respondents stated brand promotion (83.5%), and the distribution of news and information (82.4%). With the aim of collecting customer feedback, social media is used in 54.9% of the cases, while in 51.6% of the cases social media is used for customer relationship management activities (eg.rs). Based on these data, it can be concluded that companies in Serbia do not have primary focus on establishing relationships with consumers or encouraging them to engage in the creation of marketing communication. Furthermore, since the results of the research conducted by marketing agency Pioneers (pioniri.com) indicated that social media users trust commercials on Internet sometimes and in case if they are relevant (56.7%), while 30.8% of the respondents do not trust commercials and would rather buy a product which is not being promoted on Facebook (53.7%), it can be concluded that companies in Serbia should follow trends set by foreign companies which achieve the relevance of marketing content and gain customer trust by including them in creating marketing content.

4. THE IMPLEMENTATION OF BLOG IN CREATING INTERACTIVE MARKETING COMMUNICATION

Blogs as online diaries which serve to publish views, opinions, comments as well as unfiltered and uncensored information on topics ranging from technology to politics or fashion (Jobber and Fahy, 2006) serve as suitable platforms for writing and publishing consumer reviews. Considering the fact that using blog as a platform for critical thinking results in generating ideas for differentiating products and services which is the result of attitudes, opinions and suggestions of individuals gathered around these online communities, companies use blogs as an integral part of their marketing strategy (Joel, 2011). Business blogs, as part of the marketing campaigns realization, aim to improve sales, reduce investment in promotional activities, create brand image and improve organization credibility (Radenković et al., 2015). Weinberg (2012) emphasizes the role of blogs for establishing and increasing consumer trust regarding companies' products or services. By encouraging customers to gather around blogs in order to discuss products or exchange opinions for product improvement companies show that they are interested in listening and answering consumer questions and requests.

Use of blogs in creating the concept of online communication with customers can result in multiple benefits for organizations:

- They contribute to humanization of brands - since web sites are usually a formal way of presenting the organization and its activities, the use of blogs can contribute to establishing more personal communication between companies and their brands with customers.
- The opportunity for organizations to be positioned as experts within an industry or market niche - as this platform allows dissemination of information and insights into trends and events significant for the industry within which the company operates, such activities can contribute to establishing expert position which results in building trust among consumers. Consequently, customers will choose the products of the company that has achieved top of mind position in their awareness.
- The opportunity for organizations to maintain its relationship and conversation with customers through creating content that is current, relevant and in accordance with their needs and, at the same time, presented in an amusing manner thanks to, for example, introducing video content.
- The opportunity for creating integrated online marketing communication, through sending content created on the blog in form of e-mail newsletters, linking with other social media, for example creating appropriate "hashtags" that provide the extension of certain content to other platforms and thus provide a greater range.

- The opportunity for engaging trusted users or experts from certain fields to lead the communication on the blog and communicate organization's marketing messages to other users, which is more authentic and honest than traditional promotional messages.

Based on Blogometar15 research conducted by BeeBlog Network, blogger network of Southeast Europe, it can be noticed that during recent years, at the regional level, interest in blogging is growing. The interest is increasing in terms of creating new blogs and generating more content and increasing the influence of bloggers in the online environment. This has resulted in greater interest of traditional media that increasingly cite blogs as source of information and the fact that blogs are used to a greater extent for marketing purposes through their implementation in different campaigns and activations (proceniweb.com). The research of British company Affilinet conducted in 2015 among customers in Great Britain indicated that bloggers are third most reliable source of information, after family members and friends, and are more trusted than brands, social media contacts and journalists (affili.net). Research conducted by Statista predicts that by 2020, there will be 31.7 million active bloggers in USA (statista.com) while HubSpot claims that by 2020, customers will realize 85% of their interactions with organizations through their web presentations or social media accounts. Therefore, blogs can be observed as one of the most convenient ways for providing customers with information about the organization and affect their purchasing decision (blog.hubspot.com).

Based on Wave research about the behavior, attitudes and needs of social media users worldwide which is annually conducted by Universal Media Network, an increase in social media users trust towards recommendations on products and services created by bloggers and vloggers can be noticed. The research conducted in 65 countries, including Serbia, indicated that 46% respondents perceived bloggers as role models, while 33% of respondents younger than 35 and 15% of older Internet users stated that they wish to be famous on the Internet (poslovni.hr). However, the results of the research about the state of social media in Serbia conducted in 2017 by marketing agency Pioneers indicated that respondents' attitudes about trust in recommendations made by influencers are divided. More precisely, 48.5% of respondents mostly do not trust in recommendations on social media that are created and distributed by other people, while a significant percentage of 40.2% mostly believes in content created by opinion leaders of the online environment (pioniri.com).

5. MARKETING COMMUNICATION BASED ON MOBILE TECHNOLOGY APPLICATION

Since numerous users approach communication channels used by marketers for sending promotional messages to customers such as Internet browsers, social media, e-mail, blogs, web television and online newspapers, it can be concluded that mobile marketing has significant potential in contributing to other forms of marketing communication programs. Mobile marketing can be defined as a set of activities that enable organizations to contact and communicate with their target audiences in an interactive and relevant way through any mobile device or network (Mobile Marketing Association, 2017). Furthermore, Ververidis and Polyzos (2002) state that mobile marketing is a form of marketing communication which uses mobile devices with the aim of informing customers about products and services as well as for sales promotion. Other authors such as Haghirian and Inoue (2007), have expanded the concept of mobile marketing by defining it as the application of mobile Internet media with the aim of sending personalized marketing message to customers regardless of their location or time when the message is sent. The definition of mobile marketing created by Huang and Symonds (2009) represents it as a process of sending promotional messages from businesses to customers by using mobile communication services based on interactivity and permission.

In addition to the fact that it enables marketing communication anytime and anywhere, the application of mobile marketing is characterized by the following advantages and trends:

- The widespread use of mobile devices gives the opportunity of accessing larger number of potential customers with a greater degree of certainty that marketing message will be delivered to them in comparison with other channels of marketing communication;
- Since younger generations prefer text messaging, unlike telephone or face-to-face communication, mobile phones allow sending of marketing messages in form of SMS content. Also, the rate of opening SMS messages is 98%, and 90% of the message recipients will read the message within the next three seconds (blogs.adobe.com).
- Time spent using mobile devices is constantly increasing – research conducted by eMarketer has shown that Americans spend an average of ten hours a day browsing content on the Internet or communicating via mobile devices, which increases the opportunity for companies to attract customers' attention and encourage discussion on their products and services in the online environment. The same source predicts that, on the basis of this trend, until 2019, 72% of the total amount intended for digital marketing advertising in USA will be spent on mobile marketing (emarketer.com).

- Thanks to its features, mobile marketing provides various types of marketing communications, such as sending text messages that contain coupons in form of links to mobile barcodes, sending ads in the form of apps as well as delivering video promotional content and reviews created by other consumers.
- The design of the mobile device has provided the possibility of integrating different communication channels within one device, and due to technology development, the possibility of creating quality interactive multimedia content is multiplied (Rakić and Rakić, 2015).
- Mobile marketing has enabled a greater degree of message content adaptation to customers' needs. Due to the possibility to collect information about customers' current location, they can receive relevant messages at the right time, such as information on current offers or the distance of the nearest retail store.

According to research conducted by Deloitte in 2016, sending SMSes and texting via mobile applications was the first morning activity for 35% of research participants, while 22% were starting their day by checking their e-mail accounts. Furthermore, 50% of respondents aged 18 to 24 stated that they use mobile phones during the night to answer e-mails, text messages and read news (deloitte.com). According to the results of the research conducted by Gallup (2014) about the new era of communication among Americans, 68% of generation Y members stated that they send text messages intensely, since they can be read and exchanged at any time, therefore giving the possibility for important messages to be spread instantly, unlike e-mails (gallup.com). The results of the research conducted by Business Insider (2017) about how members of generation Y change the future of communication, indicate that four most frequently used applications for exchanging text messages Viber, Whatsapp, Facebook messenger and WeChat have more than 3 billion monthly active users on a global level, which surpassed the four most used online social media platforms Facebook, Instagram, Twitter and Snapchat which have over 2.7 billion monthly active users worldwide (businessinsider.com).

These trends have changed the way in which people communicate not just mutually, but with companies as well. The research about the use of mobile applications for communication between customers and customer support service which Ovum has conducted on 1000 participants in USA and Germany during 2016, indicated that 50% of respondents prefer using chat applications while interacting with providers of consumer support services, since they prefer quick problem solving and using single application for all matters (tyntec.com). In that manner, Dutch airline company KLM conducted a pilot project in 2015, which gave the opportunity for 100 members of the most loyal travelers club to get in touch with the company's representatives through WhatsApp and raise questions about buying tickets and available seats on the plane because the company notices the transition from "more traditional" social media like Facebook and Twitter on new platforms such as WeChat in China and Whatsapp (usatoday.com).

The nature of using mobile phones, according to Pew Research Internet Project research, indicated that 67% of respondents who own mobile phone constantly check for newly arrived content, even when they do not hear sound notification signals (pewinternet.org), which gives the opportunity for establishing communication with users on a regular basis, since sending messages and notifications is somewhat expected. Consequently, as a particularly effective method of creating integrated marketing communication, the combination of mobile strategies with social media platforms is highlighted. Therefore, in order to achieve better effects, it is proposed to include options for sharing content received through mobile marketing activities on the profiles of social networks of users. When it comes to mobile technologies usage in Serbia, the research of marketing agency Pioneers and Smart Plus Research agency conducted in 2017, indicated that largest number of respondents (44.2%) access Internet through mobile phones. Furthermore, in using mobile technologies for achieving Internet access younger generations (18-24 years old) dominate with 74%, which are followed by members of the 25-34 age group (59%) (pioniri.com). The same research indicated that for messaging and correspondence, 89.5% respondents use SMS messaging, which suggests that sending marketing content in form of SMS messages continues to be the most effective way of communicating with consumers when it comes to mobile technology.

6. CONCLUSION

Since organizations are striving to create an interactive, personalized and individualized relationship with consumers, they are encouraging customers to independently create content on various online platforms of the organization through WOMM activities. Organizations observe customer activities as a valuable source of information for the adaptation and improvement of the existing marketing mix as well as generating ideas for new products and services development. Likewise, organizations use the benefits of online communication to develop a more direct and long-term interaction with customers, which should result with customer feedback reaction about organizations and their brands. Furthermore, by encouraging communication among

customers through social media platforms, organizations can increase their presence in customers' awareness in order to gain their affection and consequently cause loyalty to the brand.

Even though there are numerous researches in foreign marketing literature about the role of social media in marketing communication transformation that is not the case in Serbia. Although several researches from the field of digital marketing communications have been conducted, the role of customers within these processes was not given the importance that it deserves. Organizations and marketing experts should take into account the fact that customers create most of the information and marketing activities which are related to their products. Furthermore, these information affect all types of consumer behavior starting from the collection of data on products and services before making a purchase decision, to expressing satisfaction or dissatisfaction regarding products or services after the purchase is realized. Likewise, customers are becoming less reliant on advertising as a source of information that would help them in the decision making process.

Available researches on the use of social media in Serbia do not include examination of social media users attitudes about the level of trust in the content published by companies on social networks, whether it would motivate them to buy a particular product, and whether they believe in content created by influential individuals, ie bloggers and influencers. Likewise, the available researches did not address the attitudes of social media users about their engagement in terms of writing reviews, recommendations, or expressing satisfaction or dissatisfaction with consumed products or services. For this reason, it is necessary to thoroughly investigate the role and significance of digitally literate and active consumers in creating and transforming communication flows in marketing, because they do not only change marketing practices but also affect sales growth, profitability and competitive advantage of companies creating their future economic performance (Brodie et al., 2011).

More precisely, it is necessary to thoroughly explore the motives for the use of digital mobile devices as well as social media, mobile applications, and digital forms of traditional media to create marketing communication concept that will be adapted to the needs, preferences and characteristics of contemporary customers. Also, research should include the attitudes of social media users about user generated content, evaluation of its authenticity and the impact that it might have on creating opinion on organizations, their products or services. The results of the research should contribute to gaining insight into the communication specifics of modern customers caused by extensive use of social media, with the aim of achieving a greater degree of personalization and customization of messages to the specifics and preferences of consumers, as well as the platforms that they use.

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SPECIFICS OF DIGITAL ASPECTS IN CREATIVE INDUSTRIES

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Abstract: *Due to the social and economic changes caused by globalization, the importance of creativity and creative industries in addressing numerous economic and social challenges has become a focus of attention. Creative industries are the driving force of economic growth and development, social inclusion and acceptance of diversity. However, the precondition for the development and expansion of creative industries in a society requires knowledge of their specificities that create a set of preconditions that are necessary in order to set the base for the future development and expansion of creative industries. Therefore, the aim of this paper is to identify and demonstrate the specificity of creative industries, which will allow for a more complete understanding of the specific nature and characteristics of creative industries with focus on digital aspects of digital industries. In addition, the paper deals with the consideration of key concepts of the concept of creative industries and their importance for economic and social development.*

Keywords*:* marketing, creative industries, economic development, characteristics, digital aspects of creative industries

1. INTRODUCTION

Scientific and technological development and technical achievements from the beginning of the last century have caused changes in the socio-economic processes that are accompanied by constant demands for adjusting to the changes, which influence the significant transformation of organizational behavior and activity, primarily through the necessity of acquiring and implementing new knowledge, innovation and creativity. Contrary to previous times in which the success of enterprises and national economies was measured by the quantity of manufactured and sold products, the contemporary world society is turning to acquiring a competitive advantage through the concepts of knowledge, innovation and creativity, whether it is an enterprise, a company or a state. Although creativity is present in most human activities, it can not be said that short-sightedness is the dominant feature of most industries, which have traditionally been focused on exploiting opportunities on the market and generating profits. Creativity can be understood as process of creating something new by combining existing elements, and it depends on the ability and willingness of individuals and organizations to engage in activities that are not routine but experimental, and often with uncertain outcome (Sternberg, 1999). Given the steady and rapid changes in the modern business environment, which are being adapted, creativity has been imposed as one of the tools for overcoming this problem in the last few decades. Creativity is crucial for the successful operation of the organization, its rapid adaptation to changes in the turbulent environment, the design and introduction of innovations, the entrepreneurial spirit of employees and the personal processes that are the key to the survival of the organization today. Without creativity, the economies of a given country or region collapse and lag behind other economies, and organizations are not able to preserve competitiveness on the market.

In order to be able to develop creative industries and fully understand their importance for urban economic development, it is important to know and understand the nature of creative industries and their specific characteristics that separate them from other industries, creating a special set of conditions that are necessary for its expansion. The aim of this paper is to present the key characteristics of creative industries in a comprehensive and concise way. In the first part of the paper, the concept of creative industries, and then the significance of creative industries for the economic and social development of the society, will be presented. The central part deals with the specificities and characteristics of these industries, which distinguish them from traditional industries. Taking into account the subject of the research as well as the topic of work, the research methodology will rely on a literature review, and in addition to this method, a comparative method will also be used, which will allow comparison of the specificity of different companies belonging to the creative industries, in order to identify the key common characteristics and prerequisites for the development and expansion of creative industries.

2. CONCEPT OF CREATIVE INDUSTRY

The concept of creative industry begins to noticeably overwhelm the attention of theoreticians, researchers, and policy makers over the last few decades. However, despite growing interest in the concept of creative industries, and its undoubted contribution to the understanding of modern economics, in theory there is no generally accepted definition of this term. The first definition of the term of creative industry emerged in the British Creative Industries Mapping Document in 1998, and creative industries are characterized as being made up of activities that originate in individual creativity, skills and talents, and which have the potential for creating well-being and job creation through the generation and exploitation of intellectual property (Flew, 2012: 7). This document has predict which industries can be called creative: architecture, advertising, art and antiques market, computer and video games, crafts and design, fashion design, film and music, performing arts, television, radio, publishing and software. The concept of creative industry is often used interchangeably with the term cultural industries, but it actually includes a much wider field than the cultural industry, because it goes beyond the field of art and includes all creativity-based products (Kisić, 2011). One of the definitions of creative industries has been the United Nations Development Program (UNDP) and the United Nations Trade and Development Commission (UNCTAD) in the 2008 Creative Economy Report. These organizations under creative industries are looking at those that link the relationship between creativity, culture, economics and technology, expressed as the ability to create and expand intellectual capital, with the potential to generate revenue, new jobs and earnings from exports, while promoting social inclusion, cultural diversity and human progress (UNCTAD and UNDP, 2008).

Galloway and Dunlop (2007) point out that creative industries are a new analytical definition of an industrial component of an economy, in which creativity is input, while output is an intellectual property. Tomka (2014) points out that despite the fact that the notion itself is relatively new, it represents an extension of the strengthening of industrial logic in culture, which has led to new measures such as strict economic valorization, the growing importance of statistics in culture, privatization of media, protection of interests of large corporation through the protection of intellectual property, the promotion of public-private partnerships and more. In general, the term of creative industries is understood as a set of economic activities that use the creativity, capability and talent of individuals to potentially create economic value through the exploitation of intellectual property (Fahmi et al., 2016: 67). Creative industries include a complete range of organizational characteristics and activities, from large multinational companies, through national and regional enterprises, to micro companies; which belong to different and new and traditional economic sectors, with a series of new business models developed by transforming traditional sectors to digital technologies (such as the case of the advertising, design and music sector) (Messeni Petruzzelli and Savino, 2015). On the other side, there is a trend of continuous expansion of creative industries to other sectors of the economy in which they have not been present (Lampel and Germain, 2016).

There are authors pointing to the fact that the concept and term of creative industries are understood differently in some regions of the world. Thus, for example, in Europe, creative industries are classified into two categories: pure creative industries, pervading art-related activities, and partly creative industries, which include advertising, architecture, design, media, etc. (O'Connor, 2007). On the other side, in Asia, creative industries include a variety of activities such as theme parks, furniture production, and even the work of hairdressers (Cheng, 2006). However, despite the various notions of creative industries, in most definitions this concept has certain common elements, which include: 1) the basic resources are people (intellect, skills and imagination); 2) the input of the industry involves the creativity, skill and talent of an individual; 3) Since output is an intellectual property, the concept of intellectual property rights is central in order to achieve economic value. Also, in theory, there is a certain consensus regarding the industries that are considered to be creative ones: advertising, architecture, art and antiques market, design, fashion, art crafts, film and video industry, gaming industry, sophisticated industry, publishing, music industry, radio and television (Jovičić i Mikić, 2006: 22).

3. SPECIFICATIONS OF CREATIVE INDUSTRY

Hartley, Wen and Siling Li (2014), in the Creative Economy and Culture Challenges, Changes and Futures for Creative Industries, explore the concept of creative industries with all their specifics, and emphasize that the creative industries today have reached the status of a global phenomenon. In considering the specificity of creative industries, these authors focus on three attributes: 1) Creative industries are not limited to the elite of trained artists or companies but already include (or can include) anyone with enough creativity and innovation; 2) Creative industries are not limited to a single sector of the economy but are characterized by (or can characterize) all economic sectors, and 3) creative industries are not a characteristic of developed or wealthy countries but have been developed (or could be developed) in each country. Thus, it can be concluded that the creative industries are characterized by the breadth and comprehensiveness of various economic sectors and the possibility of expansion in different social and economic conditions.

However, this does not mean that creative industries are by their very nature simple, on the contrary, they are characterized by a number of specificities in relation to traditional industries.

An overview of the literature on the nature and characteristics of creative industries suggests that there are some general characteristics that most authors point out when considering the concept of creative industries or research in this field. The first characteristic of creative industries cited in theory relates to their ability to create additional innovation-based innovation. Creative industries provide various innovation services and products on the market, and as part of the innovation system, they play an important role in the socio-economic process of adopting and developing new ideas (Lange and Bürkner, 2013). Creative industries are seen as producers and bearers of symbolic content and meaning, they use human creativity, skills and talent, and therefore have intellectual capital as their primary production input. The result of the work, or the product of creative industries, thanks to these characteristics, is highly differentiated and can be characterized as artistic, cultural or creative. Intangible values related to product symbolism are highly valued by consumers, which makes the creative industry a high-value sector (Rozentale and Lavanga, 2014). Flew (2013) on the creation of creative / artistic products, as well as the specificity of creative industries, also indicates the necessity of protecting intellectual property rights. Nikodijevic (2015: 90-91) gives a concise overview of the most important characteristics of creative industries, which includes the following:

- creative industries are trying to create wealth from what constitutes universal human traits;
- creative industries are characterized by risky business (since they are symbolic, their products are used in an extremely unpredictable way);
- the products of creative industries behave as semi-public goods (these are good that many users can reuse and which, unlike other goods used for consumption, are virtually not destroyed at such use);
- some of the products of creative industries are easy to reproduce, even in home conditions (this makes it difficult or impossible for the manufacturer to control the product on the market);
- processes of creation of products of creative industries are characterized by high fixed and low variable costs (the creation of the original product is demanding and expensive, but therefore its reproduction is cheap).

Some authors point to the specificity of creative industries in terms of high risk business. Namely, the market conditions for the products and services of creative industries are viewed differently in relation to the products and services of traditional industries because of the fact that creative industries face greater demand uncertainty, high variability in taste and therefore high risk of doing business. In order to cope with this type of risk, creative industries must continuously maintain a high level of innovation and innovation (Rozentale and Lavanga, 2014). Hartley et al. (2014) draws attention to the specificity of the very structure of creative industries, considered polarized, i.e. organized by several large corporations, often multinational companies, and a large number of medium, small and micro companies with one employee. Large enterprises and multinational companies occupy the largest share in total production, but given that multinational companies and large enterprises are more vertically integrated, they are mostly involved in mass production. Therefore, although small and micro enterprises are less able to compete with the market through the benefits of economies of scale, they can gain an equally large market share through niche market specialization.

The next characteristic of creative industries relates to their concentration in a certain space, because, according to Turok (2003), the creation industries require specific knowledge and skills of human capital, which is grouped and developed at certain locations, leading to the creation of regional clusters. In this sense, creative industries are territorially (geographically) linked to urban environments, i.e. big cities, showing that the creative economy has become an important instrument in the regeneration of cities (He and Gebhardt, 2014). The fact that creative companies often develop in special environments characterized by rapid social and technological changes, serious competition and ephemeral relationships with customers, creative industries require human capital that is highly motivated, creative, innovative and capable of adapting and following technological changes, considering that creative industries have to adapt to new technologies that support creative processes (Bujor and Avasilcai, 2016). Given that it is not questionable that creativity and innovation are key preconditions for the development of creative industries, the development and expansion of creative industries, through them and creative economies, require human capital with a high level of expertise and specialty, and different business skills based on creativity and innovation, which necessitates the development of new solutions and opportunities in the practice of educational institutions, i.e. introduction of the concept of education for creative industries. This practically means that the education system must focus less on the development of specialized skills, and more on the acquisition of skills for problem solving, creative thinking, adaptability and innovation, with the simultaneous development of social and communication skills.
In addition to the fact that large urban environments offer human capital that is indispensable to creative industries, the link between creative industries and cities can be seen through the following four dimensions,

which are the preconditions for the successful development and expansion of the flowering industry (Comunian et al., 2010: 6):

- Infrastructure: a very wide dimension that includes a number of external factors that affect the creative economy per se. These include, for example, the availability of office space, traffic infrastructure, the structure of the local population or the development of tourism.
- Local self-government: the aspects of national and local strategies and policies and interactions between institutional and non-institutional actors at different levels are included. Like other economic actors, creative industries can engage in various projects that have a political aspect, such as local regeneration, economic development and social inclusion, which is why policies are vital to their business;
- Soft infrastructure: a specific dimension of space that is of great importance for the development and expansion of creative industries. These are factors such as networks, a certain image or identity of a place, the presence of cultural heritage and a tradition that could become a significant factor in supporting creative and cultural industries to develop and grow, as an attraction to a particular place that attracts creative people to live and work there;
- Market - It is clear that creative industries are evolving in an area where there is an adequate market for their products and services, and that enable interaction with customers and consumers. In addition, the space should be such as to allow the development of the link between creative industries and other related aspects of consumption, in particular tourism and image of the city.

4. DIGITAL ASPECTS OF CREATIVE INDUSTRIES

Mass expansion and the adoption of related digital technologies and applications by consumers, businesses and governments is a global phenomenon that has affected every industry and almost every consumer in the world.

Digitalization in each industry has changed the way of production, the way of promotion and sale, distribution, formed new forms of business and competition, and especially the way of communication and interaction with consumers. The sector of creative industries is among the sectors most affected by digitization. Consumers today expect to find information about media and entertainment on the Internet; they often buy the product online in a fully digitized form, such as, for example, downloading a movie, software package, publication or audio / video. However, some creative industries are more dependent on digital media (a digital sub-sector of creative industries such as gaming industry or the reproduction of digital media), therefore it is inevitable that digitization in various ways affects business strategies and innovations in various creative industries sub-sectors (Potts, 2013).

All creative industries, for example, film industry, television and journalism, architecture, advertising, etc., do not rely on digital media in their creative process, while some creative industries are fully based on digital technologies (eg gaming industry, software industry etc.). Therefore, there is a difference between the digitalization of the creative industry sub-sectors, which is reflected in the degree to which the industry includes traditional products and services with digital products and services. For example, book publishers still produce printed editions of books, but also so-called. e-books. Movie and television industry have introduced a range of digital products, such as IPTV, video on demand, while the music industry has undergone dramatic changes in distribution and consumption patterns. Journalists and magazine publishers are facing a similar situation as book publishers, because journalism has gained a new form, so-called Internet journalism, which is defined as the transmission of information via the Internet in the form of text, sound, images and various multimedia records (Radovanović-Šarenac, 2012: 258). The latest trends show a successful mobile media journalism, specific types of news production in various forms (text, audio or video clips, etc.) distributed over the Internet and displayed on screens of portable devices, mainly mobile phones and tablets. According to Westlund (2013: 6), the release of news via mobile phones includes various ways to distribute journalistic content, from sending notifications via sms or mms messages, sending notifications through the portal, to the use of specialized applications for mobile devices. In the music industry, after the music download service, a new digital business model, the so-called services for streaming music. For example, one of the most famous streaming services in Europe is Spotify. Spotify has been operating since 2008, and today it provides services to over 15 million users in 16 countries, each year doubling the profit achieved over the previous year. Users have a choice between the free basic streaming service that is funded by advertising, and premium subscription services (€ 10 per month for full access, including streaming on mobile devices) allowing music streaming to multiple devices, an offline way of listening to music, better sound, quality and exclusive content without commercials (Eldon, 2012). Spotify users can search for a huge database of music, listen to personalized radio, and integrate their profile on Spotify with profiles on Facebook and Twiter, and thus share music and playlists with friends.

Generally speaking, digitization has brought great benefits to both consumers and creative industries themselves. Digitization has brought creative industries closer to consumers, as the distribution of creative content is significantly facilitated, and mediators between creators of creative products and their consumers today are less needed. This is conditioned by the significantly changed economic model in most creative industries (which is not always easy to implement in practice and requires time), which provides the opportunity to build closer relationships with consumers, better knowledge of the needs and wants of consumers and, therefore, adapt products to the needs of consumers. Also, digitization allows a greater flow of creative material and consumer ideas that have the effect of wider creative involvement, as many people can become content creators. In other words, the distinction between consumers and content creators has become obscured, and as Peter Tschmuck observes (2013), the genuine aspect of the digitization of creative industries is that it has enabled consumers to participate in cultural and creative production and sharing, which actually led to a markets of creative industries transformation. Digital innovation has made creative production and distribution more efficient, which is most evident in the music industry, the creative industry sub-sector that has made the most digital progress. With the establishment of digital downloads (so-called download) as alternatives to footage on physical media, the economy of the music industry has significantly changed. Today, about 66% of sales revenue of music recordings goes to artists, compared with 32% of the amount of artists they earned from selling CDs, all thanks to the reduction of mediation and distribution costs (Booz & Company, 2013: 28). Another important aspect of digitization in creative industries is reflected in the advertising industry. Namely, traditional marketing remains in the shadows due to the expansion of internet / online marketing (investment in digital advertising is continually growing - for example, digital advertising revenues in the UK in 2015 amounted to 10 billion, in Japan 9.2, and in Germany 7, 9 billion dollars (Filipovic, 2015)).

It can be concluded that creative industries have successfully established new digital models, and that revenues from the payment of digital content and services in creative industries will continue the trend of growth. Digitalization has influenced the increase in the quantity and importance of creative products, the reduction of barriers in business models of creative industries, and the emergence of new forms of consumption of creative products / services (Internet, mobile). As with the new media in the past, digital media will not replace the traditional ones, but will complement them and influence the overall value chain and the creative process, mainly in a positive way.

5. CONCLUSION

The key objective of this paper was to create new insights into the nature and specific characteristics of creative industries. A review of the literature dealing with the problem of the concept of creative industries and their specificities identified general characteristics specific to the creative industries, which primarily relate to the nature of their production and products and services sold on the market, as well as the prerequisites necessary for their successful development and expansion.

This means, it can be concluded that creative industries are based on the creativity and innovation of human capital, and as a result of creative work an artistic, cultural or creative product is created which represents intellectual property. These are high-value industries, business is highly risky, due to the constant change of environment, the unpredictability of demand and the changing taste of consumers. Prerequisites for the development and expansion of creative industries are in the first place for space, which needs to meet human capital requirements with a high level of expertise and specialty, and different business skills based on creativity and innovation, as well as adequate infrastructure, the market, as and adequate economic and development strategies and policies. The paper also reviews the importance of creative industries, which can essentially be viewed as a set of external specificities of creative industries, through the way in which they contribute to economic and social development and progress in the communities in which they operate.

Taking into consideration that the economic aspects of creative industries and their role in the wider social system, the power of imagination and imagination possessed by creative industries, combined with creative practice, it represent the current but also a future phenomenon of vital importance for economic and social development, as well for the success of organizations in almost all sectors of the industry, which use creative inputs and innovations developed in creative industries.

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CHANGING THE MARKETING TERMINOLOGY IN DIGITAL AGE

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Abstract: *In the digital era, modern English has become the dominant language or even the required international language of business communication and therefore, one may say a necessity in online and offline strategic communications. This paper deals with the state of marketing terminology by analyzing the newly-formed terms adopted from the English language and then adapted and incorporated into the linguistic system of the Serbian language. It analyzes the necessity of establishing conformance between the terms in multilingual communication, by presenting the examples in which it is possible to standardize the terms. It has been emphasized that preciseness and accuracy in using the terms are demanded in the scientific field in question. The key aspect of our survey shows that the lack of managed terminology in business can reduce understanding, which is one of the goals of business cooperation and an important communication factor for international collaboration.*

Keywords*: terminology management, marketing, international relations, business, communication.*

1. INTRODUCTION

The digital era in the world of increasing globalization has permitted crossing the borders and communicating around the globe. Perhaps the most dominant view of globalization is that the world is reduced to a 'global village'. As Said (1993) observes, "all cultures are involved in one another, none is single and pure, all are hybrid, heterogeneous, extraordinarily differentiated, and unmonolithic. No one today is a pure thing. Labels like Indian, or a woman, or Muslim, or American are now no more than staring points" (xixx). Although it is true that globalization may be making the world smaller, it is also opening the new global routes of communication, which is of great importance in almost every field of human existence. Since effective communication, as the exchange of information and ideas from the sender to a receiver, can occur only if the receiver understands the exact information or idea that the sender intended to transmit, it is of primary relevance in online and offline strategic communications in marketing, due to the need for precise communication and of necessity for sharing various announced, communicated, combined, and analysed results of researches on a global basis. Business relations that cover all spheres of life represent the act of bringing people together in order to accomplish desired goals and objectives by using available resources efficiently and effectively.

Although language is a means of communication, it is not only a means for expressing ideas. According to Ferdinand de Saussure (1974), language provides a foundational structure for the world around us by organizing it into tangible entities that we can, as an effect of that language, then describe and discuss. Without language, Saussure argued, "thought is a vague, uncharted nebula" (p. 112). Language does not only name the objective reality, however, it plays an important role in realizing reality, as well as its meaning for us within the linguistic communities we inhabit. Different cultures, that is, different linguistic groups, think about the world in different ways. As a result, the problems of translation can arise and have wide-ranging implications. It is the fact that language is one of the means of communication, but it can also be one of the greatest obstacles and a barrier that is manifested in every aspect of global communication. As a consequence of ever-growing globalization in almost all aspects of living, a series of changes and adaptations in the majority of languages of the world has occurred. Language terminology, as Budin (2001) argues, is affected by at least three factors: the need for linguistic improvisation, which introduces change; internal and social pressures to preserve ethnic identity through preserving even small languages and language traits in the environment of larger language communities; and the importance of standardizing meaning in order to enable understanding (p. 7). The views on terminology as a scientific discipline vary considerably, and there are currently a number of treatments of this field as well as several debatable questions surrounding it. Terminology is regarded as an aspect of language planning, with important links to other aspects of this activity, particularly in organizational and decision-making structures.

2. TERMINOLOGY MANAGEMENT IN MARKETING

Due to its international character, business terminology is being even more rapidly and severely influenced and changed. Since language is prone to change, terminology in marketing is also overloaded by the massive production of newly generated terms. Therefore, terminologists find it hard to keep pace with the

linguistic, technological, and terminological development inside the field. Additionally, dissimilar terms very often designate the same concept, which results in amassed terminological reference.
In Serbia, the prevailing terms are Anglicisms, and they are either adopted in the original form or adapted up to a certain extent by applying the rules of the Serbian language. It is no wonder because numerous strategies entered Serbia from the English-speaking countries. Some existing terms have been replaced by newly adopted Anglicisms and in case of marketing terminology it is being even more rapidly and severely influenced due to its international character. Rapid economic and cultural transition affects all aspects of communication. Economic foundation system of public and private ownership has been changed in Serbia, and therefore, the transformation has caused a number of other, subsequent activities in the development of society. Political and monetary requirements imposed by the EU, being compatible with preconditions for a successful transformation of the country, are perceived to be a developmental means to this end. Thus, the accession of any country to the EU also raises the question of the importance of the use of languages and need for proper communication.

During the work of EU institutions new concepts and terms have constantly been generated and English, as a source language, which accounted for 75% of all the texts, provides the base for the production of newly generated terms in other languages. The fact that the terms in the Serbian language show an increasing tendency towards lexical borrowings and that sometimes several terms for the same concept enter the Serbian language depending on the preferences of the users, imposes a need to the linguists, terminologists and translators to take control over these established set of rules (Jakić, 2014). Consequently, the linguistics community of Serbia has long recognized the need for terminology management for the purpose of ensuring reliable and high quality communication. Serbian linguists and terminologists show their readiness and a willingness to participate in the further development and improvement of all forms of cooperation, initiatives and proper language communication. Their aim is to establish terminology as a separate discipline in Serbian culture and science by raising awareness of the terminology, i.e. the awareness of the meaning of the language and its terms, and by studying its systems of terminology. In many scientific fields managing of terminology is still lagging behind, which causes problems and leads to the inconsistent use of terms in a number of specialized fields, as well as in marketing.

In the process of striving for language precision, the terminology of each language needs to be accurately defined and consistently used. Harmonized language requires uniform methods to efficiently establish consistency with other scientific fields, and to therefore allow for easier access to various fields of knowledge, improves the precision of data and helps subject experts in achieving and sharing more effective terminology. All terminological work is based on the conceptual system of the professional fields to which it refers. In non-specialized language use, two or more words having approximately the same meaning are reciprocally related due to the fact that one expects some variety in the vocabulary choice of common language. In such cases, terminology management does not appear to be that necessary, since the use of terms which are different in formation shall not be the same. As opposed to unspecialized fields, the terms in the specialized ones having more or less the same meaning should not be used interchangeably since the terminology of a given field of knowledge is not an approximate collection of terms, but rather a system of terms expressing the members of a system of concepts and creating a single system of terms for their broader use. In specialized areas the specialist is supposed to use more precise terms because they involve much wider usage.

The need for well managed terminology is shown generally in the globalization and digitalization of businesses and services, as well as in the increase in cross-border investments and borrowings, as it contributes to a more coordinated certification of products and the administration of standards and, ultimately, leads to uniformity for the benefit of all. Managed terminology in business relations involves an understanding of and an agreement to use specific definitions for terms and concepts ensuring that terminological data collected from different studies, research centres, or other institutions carry the same meaning. It is a fundamental step towards collecting and comparing data exchange, and requires a consensus among its users as to ensure successful communication. If these requirements cannot be equally met because of some practical limitations, a careful selection of 'given priority' requirements in each individual case must be carried out, in order to establish clear principles that lead to the development of practical, applied terminology and produce comprehensible and consistent terminology in this field.
In marketing, terminology management should include both linguists and non-linguists, that is, the experts in the treated area. We tend to believe that the current state of Serbian terminology for the most part has resulted from the lack of linguistic awareness among experts. Therefore, more careful and consistent use of terms in marketing would contribute to the process of terminology management. With this greater awareness, organizations, countries and language communities are increasingly feeling the need to formulate systematic terminology policies. According to UNESCO's Guidelines for terminology policies, this trend coincides with the requirement that today's accelerated globalization needs to be complemented by accelerated localization, that is, translation and adaptation to comply with local cultural and linguistic terms. This is also the case in marketing in the world of digital communication, when a lot of new terms are adopted and adapted from the English language.

3. SURVEY

The aim of our survey was to provide an insight into the current state of business terminology while its particular aim was to gain insight into the issues related to which extent and in which way the business terms are in use in communication when the respondents are students of business and management in the organization that educates for work in this area. As its major focus, the results of this analysis may help facilitate the mutual use and acceptance of terms, save resources for both governments and industry (as they are the target groups for the terms at all levels), and predominantly contribute to the harmonisation of business terms for accurate online and offline communication in marketing.

A specific target group has been questioned – a poll of 50 students of undergraduate academic studies of the Faculty of Organizational Sciences in Belgrade, University of Belgrade, Serbia. Since they are the future specialists in management, marketing, and HR, the main point of interest has been to strive for examples of inconsistency in use of business terms and to determine their perception of their future professional language. The terms were selected from the ISO IEC 9000:2007. A survey in the form of a questionnaire was conducted and conclusions were drawn on respondents' answers. The questionnaire consists of questions divided into Block A and Block B. Block A comprises questions that directly relate to personal information about respondents, while block B examines their views and answers to the posed questions. We obtained interesting results and identified several problems. For the purpose of this paper we are presenting three important graphs showing the results of the treated problems: Figure 1 – *Term use*; Figure 2 - *Term preference;* Figure 3 – *Evident loans*.

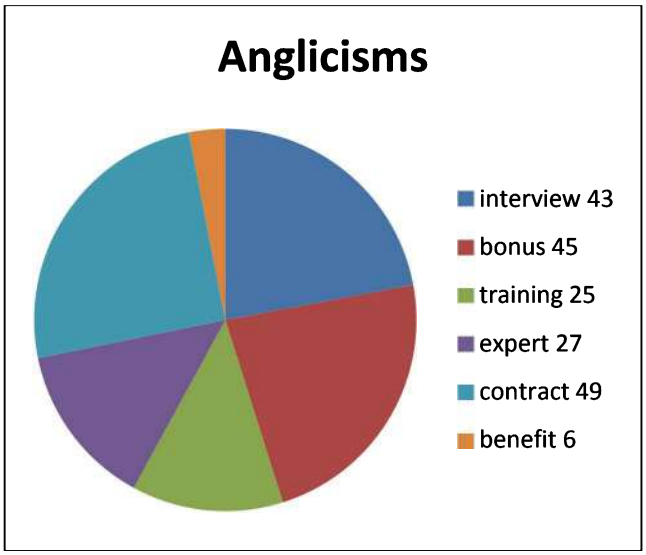

Figure 1: Term use.

The question of term use aims at the examples of the influx of anglicisms into languages other than English, in this case the Serbian language; whether they are used in their raw or adapted form and if they are used instead of or in parallel with the already existing domestic or naturalized terms. Graph 1 shows how a new trend of straightforward acceptance of anglicisms is pertained in Serbian: *interview* (43 respondents) vs. the Serbian translation *equivalent* (7respondents); and *bonus* (45 respondents) vs. the Serbian translation *equivalent* (5 respondents). Equal or almost equal use of anglicism and the Serbian terms is shown in the following examples: *training* vs. the Serbian translation *equivalent* (25 vs. 25 respondents) and *expert* vs. the Serbian translation *equivalent* (27 vs. 23 respondents).

It is noteworthy that all respondents selected the descriptive forms for the term *short listing* and *recruitment* - (50 respondents - 100%). In the example of the term *contract,* 49 respondents suggested Serbian translation *equivalent* while one respondent was for the anglicism). Similar is the case of the use of the term *benefit* where we had 44 respondents for the Serbian translation *equivalent and* 6 respondents for the Anglicism. Other opinions of the use of other sources are differentiated, indicating openness to new forms of gathering information.

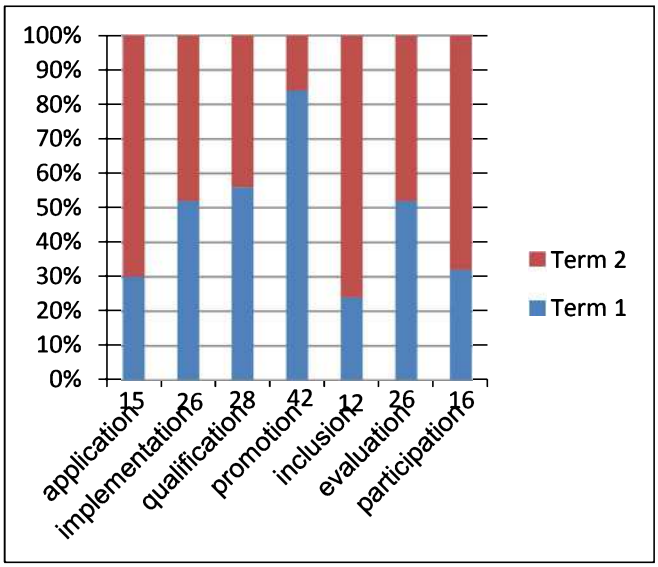

Figure 2: Term preference.

The graph 2 shows the relationship between the terms offered. It also shows the respondents' preferences in use of one term over another. Attention is focused on the degree of adaptation of assimilated loanwords structurally integrated into the Serbian linguistic system. The graph shows that all the terms are almost fully adopted and adapted into Serbian and are literally translated - English phonemes are replaced by native phonemes (in part on spelling and in part on pronunciation) and free morphemes are fully integrated into the language. In most cases the English suffix is replaced by the Serbian suffix of a similar semantic content: the suffix -*tion* got Serbian suffixes -*acija* or –*ija*. Respondents offered in minor percentage their own replacements in Serbian for the given terms.

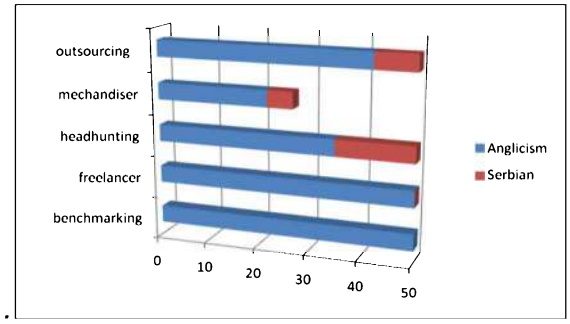

Figure 3: 'Evident loans'.

This graph represents the list of most often used *'evident loans'* from English. Since the process of borrowing is a simple process, one language adopts an object or a concept from another language for which it does not have the term in its lexicon and borrows the respective foreign term and later on, adapts this borrowing into its linguistic system. The graph shows that two terms (*benchmarking* and *freelancer*) are fully adopted and adapted into Serbian - English phonemes are replaced by native phonemes (in part on spelling and in part on pronunciation) and free morphemes are fully integrated into the language. The term *headhunting* is literally translated into Serbian, while the percentage of newly formed terms in Serbian for the terms *outsourcing* and *merchandiser* is insignificant. The loans, above all those that denote the concepts that last for some time will either disappear or become fully integrated into the linguistic system of a recipient language.

4. CONCLUSION

There are several conclusions arising from the results of this small-scale research conducted at the Faculty of Organizational Sciences in Belgrade. Firstly, when faced with a choice between two terminological synonyms - an anglicized term and its domestic equivalent denoting the same concept from business terminology, students tend to use both equivalents, but are slightly more inclined to domestic ones. This opposes a common belief that anglicized terms prevail among business professionals since they are regarded as prestigious alternatives to plain domestic ones. The result gained is due to the fact that Anglicism's tested in the questionnaire have just recently entered the Serbian language, are not yet fully integrated and, according to terminology standardization experts, redundant and unjustified since there is an already existing Serbian equivalent. Some authors even believe that one of the most important criteria for the

adequacy of a term is the absence of synonyms (Bugarski, 2009). The results of the second part of the questionnaire imply that most respondents understand the concept behind the tested English business terms and can provide Serbian translations, but when presented with an anglicized and a domestic equivalent for the same term, again tend to use the domestic ones more often. Secondly, our most important conclusion of this small scale survey is the one that confirms the existence of terminological confusion in the Serbian language, i.e. semantic differences in the way Anglicisms are used in English and in Serbian. The results gained proved that the Serbian language is lacking terms for many newly created business concepts and is therefore turning to Anglicism as a quick solution for fulfilling the lexical and/or conceptual void. Having in mind that our respondents are not experienced professionals but students that still lack specialist knowledge and are yet to enter the world of business, we tend to believe that they are unfamiliar with the semantic meaning of the English terms tested in the third part of the questionnaire, which proves that the terms in question are not fully accepted and integrated into the language, and therefore not yet adapted to Serbian grammatical and orthographical system.

In short, the results confirmed parallel existence of domestic and anglicized terms for the same business concepts and pointed out to the respondents' preferences as to which equivalents they tend to use. The questionnaire also proved the inability of the Serbian language to keep pace with ever growing development of terminology in the field of business in general, and is therefore adopting global, international terms that need time to be fully incorporated into the language and often cause confusion in the process. Most importantly, a significant number of false friends and synonyms indicated the urgency for terminology management in the field in question. The rapid change in the digital era represents a major challenge to achieving the consistency in terminology in marketing necessary for good communication. There is a growing need for companies to identify terminology in their internal communication and plan a course of action in order to enable the success of work in the future. Furthermore, it is of great importance to develop corporate standards, but also to align them with external standards and practices, especially when cooperating with governments, international companies and Academia.

Even though the survey presented in this paper is a small scale one, it can be regarded as an initial step towards more detailed survey of Serbian terminology and steps towards its management.

Namely, further study of the topic in question may include corpus-based study of other word classes (in addition to nominal loanwords presented in this paper) to determine which word class is most susceptible to the use of Anglicisms and the resulting terminological synonymy and confusion. Secondly, terminological confusion resulting from the unjustified use of English loanwords in their adapted or non-adapted form can be viewed in a historical perspective and by considering some sociolinguistic factors. Another possible study may include the comparison of the state of the terminology of the Serbian language and in the neighbouring countries with the purpose of determining and comparing tendencies and trends, as well as suggesting solutions

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BUILDING DIGITAL BRAND AWARENESS FOR KFC SERBIA

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Abstract: *The development of technology has led to a change in the way companies operate, as well as to the advancement and increasing use of digital media as a means to increase consumer brand awareness. This paper investigates digital marketing and the development of Internet technologies that have led to a change in brand strategy of major company KFC in Serbia. The purpose of the paper is to indicate the possibilities that digital marketing provide to companies, and how they can successfully perform online strategies and increase consumer engagement, thereby increasing brand awareness. The paper includes some of the most important conclusions of global researches on the subject of digital media, with a special focus on the generation of Millennials, while KFC example provides insights from practice from its business in Serbia.A comparative analysis of selected periods was made using reports from Facebook, Google Analytics, and a mobile application analyst. Through analysis of current digital marketing strategies performance, the goal of the paper is to point out the most important factors that influence brand awareness, focusing on the challenges they face, and the benefits companies have if they decide to go online. More precisely, the aim of the paper is to present the impact of technological changes on improving brand performance using social media, on the profitability of such a business by creating long-term value for consumers, as this creates loyalty - the largest intangible assets of each brand.*

Keywords*: digital brand, brand awareness, Millennials, social networks, Facebook, mobile app, KFC, Serbia*

1. INTRODUCTION

In the era of mass production and growing competition among manufacturers, consumers are forced to search for information that will facilitate their purchasing process. The main characteristic of offline consumer era were information consumers received exclusively through a brand's advertising campaigns. Thus it was the main source of information about the company's products and services. However, with the emergence and increase in use of the Internet and the development of technology, consumers got a completely new dimension in terms of using information. Information became easily accessible to everyone and at any time. The one-way communication between companies and consumers got a new form by the appearance of multiple sources from which consumers can create a fuller picture about the brand. Digital or online consumers are generations of consumers born in the aftermath of the 1980s, which, due to the development of digital technologies, expanded their skills in using the Internet (Bolton et.al, 2013). Generation born after the '80s is known as the "Y" generation or the Millennials (Wesner& Miller, 2008). Today, Millennials present almost 1/4 of the world's population and a very strong community that dictates new trends and a new way of exchanging information. Generation Y primarily seeks transparency, and accordingly, companies have to harmonize their values with messages they send through advertising, because otherwise companies will lose value in the eyes of consumers who manage the perfect competition market. (Aitken, 2007)

A typical representative of Millennials is a person who is twenty years old, actively uses new technologies and enjoys meeting people on the Internet. They use mobile applications every day, visit websites and likes to try out all the innovations in the field of digital and mobile technologies. Millennials are inclined to change their jobs, have confidence and like to photograph themselves and publish photos/videos on social networks such as Instagram, Twitter and Facebook (Bolton et. al, 2013). For them success is especially important, as well as to have enough money and to be financially independent. While the previous generations found security in working in large companies, Millennials are striving for entrepreneurship, or the establishment of one's own business (Goldman Sachs Global Investment Research, 2018). They daily browse the Internet, do online shopping and get informed exclusively online. Millennials are using applications such as TripAdvisor instead of traditional travel guides, AccuWeather instead of traditional weather forecasts in print media or on TV, and they read online newspapers instead of printed ones. What is the most important for companies is the fact that a person from the generation Y is immune to promoting brands in the traditional way, which is almost without affect in their purchasing decision (Deloitte, 2017).

2. DIGITAL BRAND AWARENESS

Brand awareness is one of the most important dimensions of the brand and one of the key objectives in the process of brand building. Brand awareness includes both brand recognition and brand associations (Keller, 1993). It refers to the ability of consumers to remember and recognize the specific brand and its elements. According to Aaker (1991) the essence of recognition is that the brand associates consumers to the different characteristics of a branded product in relation to the competitors and that consumers recognize its basic characteristics.

In order to define what consumer brand awareness is, we need determine whether the brand is present in minds of consumers and do they relate it with the product category. Kotler et.al (2005) state that there are several categories of brand awareness in relation to the intensity of recognition:

- Without brand awareness - consumers have never heard of the brand;
- Brand recognition - consumers recognize the brand among listed brands;
- Brand recall (with help)–consumer can recall brand when it is mentioned;
- Recalling a brand without help - it's not necessary to mention the brand for consumer to recall;
- Top of mind - The first brand in consumer's mind when a product is mentioned;
- The dominant brand - the only brand that consumers remember when a product is mentioned.

The importance of the digital marketing impact on brand awareness can be best perceived through data obtained in research conducted by eMarketerRetail agency, which focused on US online consumers habits. The results haveshown clearly the influence of digital media, especially when consumers were asked how they heard about the site of a particular brand (see Table 1). According to the data from the research), social networks and the entire digital presence of the company bring consumers to the website. On the other hand,traditional approach of influencing consumers' minds such as: friend recommendations, traditional marketing channels, and visits to stores of a given brand, have less impact(eMarketerRetail, 2017)

Table 1: Communication channels that drive US digital shoppers to visit a brand manufacturer's site

Social media advertising	51%
Ads in search engines	47%
Recommendations from friends/family	38%
TV/radio	35%
In-store visits to a brand manufacturer's physical store or retailer	31%
Emails that include a personalized offer	25%
Newspapers and magazines	25%
Promotions (coupons/discounts)	25%
General email from a brand manufacturer	24%
Printed catalogs	23%
Banner ads on content sites	22%
Mobile ads	22%
Billboards	9%
SMS or text messages from brand manufacturers	9%

Having in mind the importance and the impact social media have on brand awareness creation, following section will bring more insights into the matter.

2.1. Social media

Social networks are online communities based on membership that allows users to interact with each other on the basis of common interests (Boyd & Ellison, 2008). These social platforms give people the opportunity to express themselves and to have fun in the social environment.In recent decades, social networks evolved into digital social networks where technology analyzes human behavior and, on the basis of it, helps people to connect with other people of similar interest (Park et. al, 2009; Weber, 2009) The incredible growth rates recorded by social networks in past years prove that people still have a need to belong to some sort of social community, and that the social web is the closest approximation to real social life, without the need for a physical presence (Social Media Today, 2018).
A study carried by Universal McCann explored a popularity degree of various activities that people deal with on social networks (Weber, 2009). The main conclusions from the study are:

- The most popular activity is sending messages to friends 81.5%;
- Photos sharing is second rated social activity with 76.3% of total responses;
- Joining different online groups is on the third place with 47.9%;
- Installing useful applications or widgets is the favorite activity of 33.5% of surveyed social network users;

- 33.1% of respondents prefer to upload videos;
- Nearly 30% of respondents use social networks to create contacts for business reasons;
- 24.4% of respondents install applications or widgets on their profiles to see others;
- 23.7% of them stated the organization of events as the most important reason for their presence on social networks.

Analyzing the results from this study implied that a number of popular social media activities provide marketers with numerous opportunities to promote their brands. However, in order to grasp influence of social media, marketers first need to create adequate digital strategy, which will evoke the interest of users through social networks. But the question remains what is the best and most accessible communication channel to communicate brand message.

2.2. Mobile marketing

Until a few years ago, the mobile phones were used only for conversation and short communication. Today, mobile devices are integral part of people's lives: from education to financial services and trade and even to entertainment. The development of mobile services brought the transformation of lifestyle, learning, work and entertainment, so whole society become dependent on the help provided by these services in carrying out everyday tasks (Bauer et. al, 2005). Also, the use of mobile phones has completely changed the way of daily communication among people, because interactions with others become easier than ever, and its frequency and duration is increasing daily (Forbes, 2017). Communication became omnipresent, possible everywhere, at any place and at any time. According to ITU estimations from 2015, around 3.2 billion people has PC Internet access, out of which approximately 90% actively uses e-mail services. When we compare this data with over 4 billion active mobile users, it becomes clear why the mobile phone is considered number 1 communication channel on the planet (ITU, 2015).Baring in mind the fact that the number of mobile phone users is constantly increasing, the figure probably exceeds the limit of 5 billion active users.

In order for mobile marketing to succeed, each mobile device, service or application needs to possess features popularly called "6M"(Ahonen, 2008). 6M features are crucial for mobile users experience and consist of:

- *Movement* – use the best possible way to communicate when consumers are on the go, away from their TVs, radios or computers;
- *Moment* – enable users to manage time and timely information how they want,
- *Me* – for many users the mobile phone becomes their alter ego over time. The continuous process of personalization and adaptation of mobile phones can be used by smart marketers to offer customized services to users;
- *Multi-user* – giving users the opportunity to participate interactively in the community in which he/she want;
- *Money* – the ability to perform various types of transactions through mobile phones;
- *Machines* – the technological advancement of mobile phones provides a wider range of mobile marketing opportunities.

Therefore, mobile marketing represents the best communication channel that connects business with every consumer who uses mobile devices at the right time and in the right place with the right message. With the development of the mobile industry and an increase in the number of active mobile phone users, companies are struggling with new tasks - how to successfully take advantage of mobile marketing and create a brand awareness through mobile devices.

3. KFC COMPANY BACKGROUND

Kentucky Fried Chicken, or KFC, popular, global fast food restaurant chain, is present in over 100 countries around the world, and is visited by nearly 20 million people every day. (KFC official site, 2017) The first KFC restaurant was founded in 1930 by Colonel Harland Sanders by purchasing motels and coffee shops in Kentucky. Sanders had only the recipe for excellent chicken stored in a specific mix of spices and herbs, as well as a great belief in achieving success. From the beginning, the guiding star was the principle "Put your heart into what you do and do the best you can." (KFC official site, 2017) The principle is still being followed in all KFC restaurants around the world. In Serbia, began its operations in 2007, and in 2009 the first steps were taken regarding KFC's digital presence. The first step was developing social network profiles, a website, and the first mobile application for food delivery in Serbia. (Internal company data)On the market, full of challenges, the KFC brand is now positioned as one of the best and most recognizable fast food restaurant chain in Serbia. KFC brand awareness in Serbia is mainly created through digital communication channels. Today, KFC Serbia has 107,952 fans on Facebook, 4,237 attendees on Instagram and 1,270 followers on Twitter. (Internal company data)

On the example of the KFC brand it will be show how to use digital communication channels in order to raise brand awareness among consumers on a challenging market like Serbian. The main sources for research presented in this paper are internal data collected from Facebook, Google Analytics and mobile application analytics. The data presented in the paper are acquired from KFC Serbia official Facebook account, official website and mobile app in period from 2016 and 2017. Based on analyzed data the most important conclusions regarding KFC's digital marketing strategy and how they rose brand awareness will be presented in the paper.

3.1. KFC Facebook strategy

As Facebook is the most popular social network in Serbia, KFC Serbia focused most of its digital marketing efforts on this social media platform. Although men and women are almost equally present in fan base of KFC Serbia (see Figure 1), company decided to focus its digital communication on women between the ages of 18 and 34. Women were selected and precisely targeted in KFC Facebook communication because they are ones who most commonly make decisions about eating options and are more accessible online.

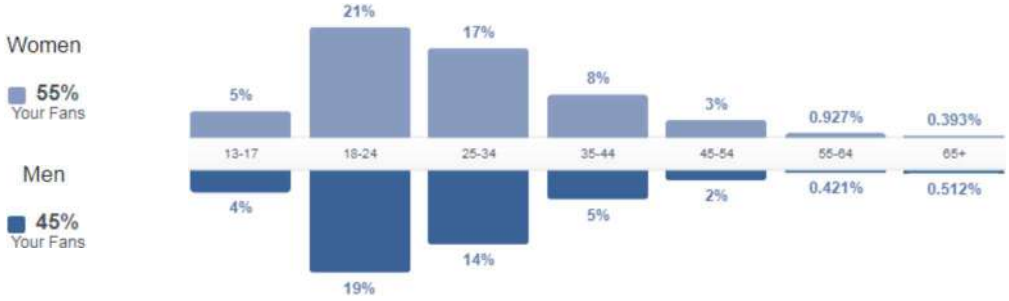

Figure 1: Demographic characteristics of Facebook fans in 2017 - division by gender and age (Source: internal company data)

Data from 2017 suggested that fans are usually online in the evenings, and then they have the most reactions, shares and comments on KFC Facebook posts (see Figure 2).Further analysis of KFC data on users' activity on Facebook, pointed that fans are usually online around 9p.m. in autumn and winter, and around 10p.m. in summer.

Figure 2: The period of day when fans are most often online (Source: internal company data)

In KFC's digital advertising, focus is primarily on Facebook advertising. The main reason for this approach could be found in the fact that Facebook offers a very wide range of advertising and consumer targeting options. The Facebook platform provides a wide range of publishing formats that can be placed on the brand page. (see Figure 3 and Figure 4) Accordingly, the KFC page combines various kinds of posts. In order tomaintain fans' attention and to increase brand awareness KFC Serbia decided to combine various types of advertising on its Facebook page. According to internal KFC reports, Facebook posts were promoted in an innovative way through:

- *Engagement* - when promotion aimed to generate as many consumer reactions as possible, and
- *Reach* - when promotion aimed to raise brand awareness and maximize consumers' reach.

Figure 3: Carousel

Figure 4: GIF

In order to monitor and measure the impact of its digital presence, KFC Serbia is tracking following metrics on Facebook:

- Traffic – the goal is to generate as many website visits as possible;
- Website click conversations – the goal is to direct visitors to the site, and then measure purchases made through the visit;
- Facebook page likes – generate as many Facebook followers as possible;
- Instagram page likes – generate as many Instagram followers as possible.

KFC Serbia is tracking the success of its Facebook strategy also through page like campaign performance and Table 2 presents overview of all campaigns implemented in 2017.

Table 2: Page like campaign performance in 2017(Source: internal company data)

Year 2017.	Impressions	Reach	Clicks	Page likes	€	CPC (cost per click)
January	125,587	43,680	1,048	587	49€	0.08
February	82,242	32,525	833	502	50€	0.10
March	55,251	30,542	813	561	50€	0.09
April	68,682	29,435	890	586	50€	0.09
May	57,053	23,950	676	452	50€	0.11
June	72,499	29,641	758	465	71€	0.15
July	40,863	19,134	553	378	57€	0.15
August	39,144	17,622	492	307	41€	0.13
Total				**3,838**	**565€**	

The most important indicator of Page like campaign is the ratio between the money invested and the results achieved (number of new Page likes). This indicator is called CPC (cost per click) and the optimization of the campaign aims to reduce its value. When analysing the results of the Page campaign in 2017, it can be concluded that in January the price of the click was the lowest. As noted above, in July the design of the Page like campaign was changed with the purpose of attracting users to like the KFC Facebook page (see Figure 5). By August 2017, for 565€ that were invested the 3,838 new fans were reached.

Figure 5: Page like campaign (Source: internal company data)

Another way to attract new fans and measure their activity on the page is creating Website click campaign. It is optimized to drive traffic and generate conversions on brand's website from Facebook targeted to specific audiences of users. These campaigns allow to feature your website content within a Facebook in a way that is designed to maximize click-through to brand's website.

Table 3: Website click conversions campaign performance in 2017 (Source: internal company data)

Year 2017.	Impressions	Reach	Clicks	Page likes	€	Conversions
January	507,962	149,312	2,478	41	121	86
February	122,458	53,673	601	11	67	28
March	69,344	35,211	514	6	47	25
April	92,147	35,605	799	10	50	31
May	200,794	54,048	1,600	27	135	99
June	121,696	6,442	541	11	89	111
July	151,913	6,919	652	9	119	120
August	169,080	21,492	754	12	116	104
Total					744€	604

The goal of Website click conversion campaign was to measure online conversions generated by visits from Facebook. The Facebook analyst of this type of campaign allowed us to see how many users clicked on ad, then visited website, and how many of them made purchases on that occasion. From the beginning of 2017 till August, 604 conversions on the site were made as a result of the website's arrival through the click-through campaign in which KFC invested 744€. The campaign has been optimized since June, and consequently we can see a higher number of conversions in that period.

3.2. KFC brand website and mobile app

The KFC website was analyzed through Google Analytics, which provided us with a wide range of information on consumer activities on the website, and they were a great tool for planning future digital marketing activities.

Table 4: Number of sessions and users in 2016 and 2017 (Source: internal company data)

Year 2016		Year 2017	
Sessions	8,438	Sessions	23,970 **(+15,532)**
Users	6,702	Users	17,527 **(+10,805)**

During August 2016, there were 6,702 active users who visited the website and 8,438 visits (sessions) were generated, while in August 2017 website had 17,527 users and 23,970 sessions. In August 2016, out of the total number of visitors 26.7% were returning visitors (those who had previously visited website) and even 73.3% of new visitors (first time on KFC brand website). In comparison with same period previous year, in August 2017, the ratio was a little different, 33.4% were returning visitors, and 66.6% were new visitors. This

pointed to an important fact, the whole effort of raising brand awareness through digital channels gave positive results. According to company's data in 2017 the number of new website visitors increased in every month. Additionally the analysis of devices through which consumers accessed their website was very important for KFC. Analysis pointed that consumers most commonly access KFC website through mobile and smart phones – 75% of all visits were made through mobile phones (see Table 5).

Table 5: Number of sessions by device category in August 2017(Source: internal company data)

Device type	No. of sessions	%
Desktop	5,579	23.27%
Mobile	**17,988**	**75.04%**
Tablet	403	1.68%
Total	23,970	100%

Bearing in mind these important findings, KFC Serbia decided to focus all its digital marketing activities on mobile marketing and try to provide consumers with easy, pocket accessible and fast consuming messages. As a solution to this new situation, company made one of the most important strategic decisions and started to move all purchases onto existing mobile app.

The mobile app was primarily created to ease the delivery of KFC products back in 2013. From the day one the app recorded excellent results and growth in orders. From the beginning of 2017 until August of the same year the total value of all 5,847 orders amounted to 7,505,928 RSD (see Figure 6 and 7), which was significant increase compared to total income in 2016.

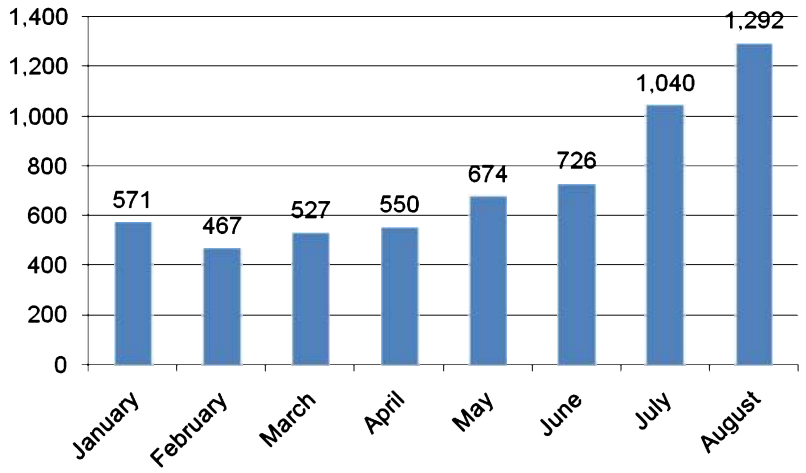

Figure 6: Number of purchases generated through mobile app in 2017(Source: internal company data)

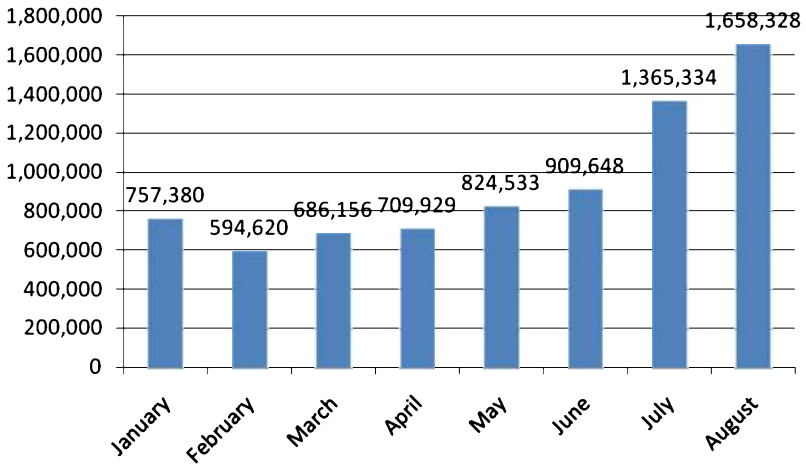

Figure 7: The value of purchases generated through mobile app in 2017(Source: internal company data)

In the case of the KFC brand, we can notice how important it is to constantly invest in digital brand performance, even if the company already has a good image among consumers. The example of KFC Serbia emphasises the need of every company to keep up with the innovations primarily driven by the development of Internet technologies, social media in order to answer the need of modern consumers.

Digital media offered great opportunities to KFC Serbia to raise brand awareness. As presented in the paper KFC brand has detailed plans for implementation of its digital strategy and takes into account the needs and aspirations of its consumers as an imperative when creating its online presence.

4. CONCLUSION

For each brand, the orientation and consistency of marketing strategies are crucial. The digital strategy of a brand should be designed in a creative and innovative way, and to contribute to increasing brand awareness. Creating an online community of brands among existing and potential customers can be a cost-effective way of increasing brand awareness, expand consumer base and improve brand loyalty. The Internet, digital marketing and especially social media play a vital role in creating powerful brands of today.

The Internet has become the most trusted medium and consumers increasingly make decisions based on the search, comments and experiences of other consumers. In the era of consumers' interconnection through the Internet and social media, brands are force to create interesting content that users want to share among themselves. Successful digital marketing is based on a tradition that is adapted to the environment set by digital media in synergy with new techniques used in digital communication. The example of KFC Serbia is one of the best practice examples how a company successfully integrated digital marketing and social media in its business, with the purpose to answer to changing consumers habits and needs. As a result, KFC Serbia increased its brand awareness, primarily through social media communication and mobile marketing. Also, company has shown that it is of outmost importance to find adequate communication channel for presenting its offer and brand. For KFC Serbia the solution was found in mobile marketing and development of mobile app. Even though, presented example focuses only on the application of digital marketing it can serve as a guidelines for companies facing similar situations.

In the past companies were cautious with digital marketing budgets, while today almost every company is focusing its marketing efforts on digital marketing and digital budget exceed traditional advertising budgets. As the Internet penetration in the target consumer group is growing companies are turning to more direct communication and timely solutions like mobile apps. In digital marketing, there are no borders and with the help of digital marketing, smaller brands have the opportunity to "make name" for themselves, while big, global brand like KFC are using it to strengthen the brand.

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CASE STUDY: DIGITAL STORYTELLING IN BRAND MANAGEMENT OF MOXY HOTELS

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Abstract: *This case study brings practical insights into strategic business shift of one of the leading players in hospitality industry Marriott International Inc. Authors of the case study present new business concept that targets especially Millennials, Moxy hotels – affordable but quality, fast consuming, and sharing economy hotel concept. Developed as Marriott's answer to changing demographic and lifestyle trends, as well as growing competition like Airbnb, Moxy is the best example how hospitality industry is changing. The focus of the case study is on application of digital storytelling in developing a new hotel brand. Innovative approach in building a brand is presented through analysis of Moxy's digital strategy, social platform selection and content creation. The case study particularly emphasizes the use of creative digital tools like Instagram, a social platform for sharing photos and videos, YouTube and Snapchat for vlogging, and collaboration with local influencers to raise awareness and gain significance among Millennials.*

Keywords*: digital storytelling, brand, Instagram, Millennials, Moxy Hotels, Marriott*

1. INTRODUCTION

April 2nd 2013, Bethesda, Maryland, Jennifer Utz Ilecke, Marriott International Vice President/Buzz Marketing and Partnerships, was looking at the market report from previous quarter. The figures were clear, Marriott International was not gaining profit in young travelers segment, known as Millennials. Market reports were also suggesting the rise of Airbnb, a new competitor that is in fact a community based, two-sided online marketplace that helps connect travelers with local hosts. With Millennials coming into prime spending years, as well the rise of growing unconventional competition, Jennifer knew something radical had to be done. While she was preparing a presentation for her Board meeting, she was thinking what should be the next, big, strategic step for Marriott in these challenging times. Thus, she called young members of her team to get some insights of how they perceive the future of hospitality and travel in general. Mike, a graphic designer - aged 22, Mary, marketing manager assistant, age 25, and George, digital content specialist, age 28, share their thoughts with Jennifer.

"Young travelers nowadays want flexibility, freedom, adventure, a close connection with the destination they travel to and a chance to get to know the locals. They want to have accommodation that will feel like home away from home, rather than a sterile room. Millennials want to get authentic local experiences and all that at an affordable price. The most important thing is that they want accommodation tailor-made to their needs and they want it to be online and digital" – this was the feedback Jennifer got from her young associates. Having all this in mind, she drafted a new proposal for the managing board – a new hotel concept which fits Millennials' needs and breaks the chains of the old fashioned hospitality approach. Jennifer called the concept Moxy – adventurous, boutique hotel and affordable luxury especially created for Millennials.

Jennifer knew how to develop a new hotel with all facilities, but she was troubled by how to create an attractive online brand voice and how to create an appealing digital story for Millennials. So she went back to her desk and started researching again.

2. COMPANY BACKGROUND

Marriott was founded over 90 years ago by Willard Marriott and his wife Alice, outside Washington, D.C. in Bethesda, Maryland. The business is guided by family leadership since the beginning. The story about a small company business started in 1927 when J. Willard Marriott opened the nine-stool root beer stand that grew into the Hot Shoppes Restaurant chain which evolved into today's Marriott International hotel company. For the next 58 years, Willard built the Marriott brand on a foundation of guiding principles that remain embedded in the company's culture today. Marriott made a historic shift into the hotel business in 1957. The world's first motor hotel opened in Arlington, Virginia, under the management of Willard Marriott's son, Bill. Over the next 25 years, Marriott became a diverse global enterprise, and Bill Marriott became a visionary CEO whose leadership transformed the hospitality industry. Today, Marriott International, Inc. is a leading global lodging company with more than 6,500 properties across 127 countries and territories, reporting revenues of more than $22 billion in fiscal year 2017 (Marriott, 2018).

3. BRAND PORFOLIO

Fulfilling the needs of today's customers is increasingly becoming a main challenge in the hospitality industry. Besides the financial criteria of market segmentation, Marriott International Inc. is using many other criteria like: traveller preferences, lifestyles or age groups, in order to deliver better customer experience. In accordance with customer preferences and lifestyles, Marriott divides its 30 brands into two core brand categories: **Classic** and **Distinctive**, which are further divided. Classic brands represent time-honoured hospitality for a modern traveller, whilst Distinctive brands are targeting those who lean towards memorable experiences with a unique perspective. Both categories are further split into specific groups: 1) *Luxury - Bespoke and superb amenities and services* (Classic: Ritz-Carlton, St. Regis & Distinctive: BVLGARI, W Hotels, Edition), 2) *Premium - Sophisticated and thoughtful amenities and services* (Classic: Marriott Hotels, Sheraton & Distinctive: Le MERIDIEN, Westin, Design Hotels), 3) *Select - Smart and easy amenities and services* (Classic: Courtyard Hotels, Protea Hotels & Distinctive: AC Hotels, Moxy Hotels) and 4) *Longer Stays - Amenities and services that mirror the comforts of home (*Classic: Marriott Executive Apartments, Residence Inn and Distinctive: element) (Marriott, 2018b).

Figure 1: Marriott Hotel Brands (Source: https://hotel-development.marriott.com/brands-dashboard/)

3.1 MOXY hotel and the brand

Before 2014, Marriott was perceived as a luxury brand which was available only to people with exceptional incomes. Changing trends in demography and lifestyle of Marriott customers, as well as competitors like Airbnb, forced Marriott to think hard about its next move. After much research regarding the future of hospitality industry and travel in general, management arrived at a conclusion: the main target group for Marriott in the years ahead will be Millennials. Many studies (Deloitte, 2017; Nielsen, 2017; Goldman Sachs, 2018) tend to focus on behavioural and psychological perspective for Milennials, suggesting that they are becoming even more important. The fact that Milennials are, or they are moving into the prime years of spending, was a significant indicator for the future strategy and business development of Marriott's offer. The problem Marriott faced was that they didn't have anything to offer to these young and complicated consumers. Marriott's answer to the rise of Milennials was launching of the Moxy brand (see picture 2). Moxy hotels represent Marriott's first budget hotel, even though it belongs to the Premium division in Marriott's portfolio. The first Moxy hotel was launched in 2014 and opened in Milan (Marriott, 2017). The new concept of budget hotel was designed particularly to target Millennials all over the world. The inspiration for Moxy came from Europe where Marriott joined forces with IKEA, who developed the idea and designed the hotel concept. Today Moxy has 25 hotels in 10 countries, operating in North America, Europe and Asia.

Figure 2: MOXY hotels logo

What differentiates Moxy in the market is the offer which focuses on the most creative solution for hotel infrastructure. Before construction of the first hotel started, analyses have shown the most common problems, needs and factors that will weigh in on personal values and ambitions of future travellers. Exterior and interior design were completely adapted to the needs of Millennials from rooms and personal space, to common areas, daily entertainment and staff. Whether Moxy offers one single bed or four twin beds in a room, its main characteristic is a smart design of a small space. Moreover, one of the most unique features of Moxy hotel product is that there is no closet, only a peg wall. Keeping in mind the fact that Millennials don't have time for boring processes of any kind, peg walls are encouraging travellers to hang their stuff on the wall, without losing their time on perfectly wrapped clothes in a limited space (closets). In rooms, guests can also find removable tables, bean bag chairs, many electrical plug-ins for various devices, fast Wi-Fi and a big TV. Moxy also took the opportunity to focus on great showers with rain-head options and comfortable mattresses.

Offering small cosy rooms means that Moxy had to find another way to stand out when it comes to the capacity – enormous and multifunctional public spaces. Knowing the preferences of Millennials, Moxy added value to experience by spotlighting different kinds of restaurants, bars and DJ's every night. In this way Moxy represents for its guests a very social place with lots of plug-ins and play options. Furthermore, depending on the occasion, the hotel lounge can change its character, so guests can relax and have a coffee, play foosball, have a meeting or set up their office.

Modern, casual concept and flexible space regardless of the purpose, fulfils the needs of Millennials and illustrates in the best way the innovative approach in distinguishing itself from competitors. Cutting out the unnecessary spaces and at the same time assigning this area to the parts of the hotel which can be used by many guests at once is mirroring the trends that are coming and which are recognized to be very important and highly appreciated by Millennials (WARC, 2016). Changing the traditional focus and keeping the requirements of the guests front and centre, has resulted in a ground-breaking new business model with one of the crucial factors on the top – low prices for customers and big revenue for the company.

4. MARKET SEGMENTATION – WHO ARE MILLENNIALS?

The Millennials, generation Y, are in the focus of every marketing campaign, presentation, conference, research, sale and marketing department in general. Everyone is talking about the lifestyle, habits, preferences and how to engage with the most complicated generation. The global market and every industry for itself are in the process of adjusting business models, hoping to satisfy the needs of the new, future customers. Generation born between 1980 and 2000 is called Millennials. It is a generation of future travellers with specific demands, expecting from companies to recognize and adapt to their needs. High quality technology and design are two essential features for making Millennials happy. But even though Millennials are demanding quality, price is a more important factor (see Figure 1) making affordability the number one priority for the group. In conclusion, Millennials crave for new travel experiences and adventure at affordable price that they will share across social media with their followers (Goldman Sachs, 2018).

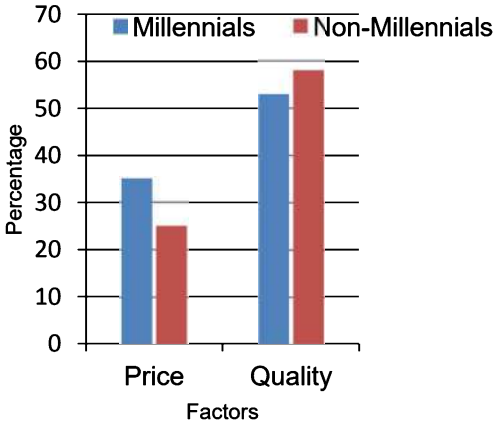

Figure 3: Price as important factor for the Millennials (Goldman Sachs, 2018)

Like all other industries, hospitality had to take a big step into a transformation based on the new demographics trends set by Millennials. When it comes to hotels Millennials want a unique, innovative, but personalized hotel experience, which opens a door to new opportunities. Reports from Deloitte (2017) and Nielsen (2017) have shown that Millennials appreciate a personalized offer which includes high energy, eco-conscious and tech savvy opportunities. Millennials are demanding 24/7 high speed Internet connection so they can smoothly browse the web, read news, be informed, and stay connected with friends. Various

individual requirements put the hospitality industry in a position where they must provide guests with what they want, whenever they want it. Generation Y also wants to get involved with the process of making a dynamic environment (Goldman Sachs, 2018). As the perfect solution, open and public spaces are increasingly set to become a vital factor in socializing.

Moxy hotels successfully responded to Millennials' demands, integrating affordability, tech-savvy solutions, open spaces and quality into infrastructure. The best example of Moxy's proactive approach can be found in hotel's lobbies which grow into the center of all social activities for these new, urban customers.

5. MARKETING COMMUNICATION ON SOCIAL MEDIA

Nowadays, if brands are not present on various social media, it's like they don't even exist. Companies select digital marketing communication channels in accordance with preferences and habits of their core target group. When it comes to Millennials – they love to know everything and follow favorite brands. Having in mind Millennials addiction to technology, they are communicating in any available way - almost equally using text messaging, social media and instant messaging platforms like Whatsapp (see Figure 2).

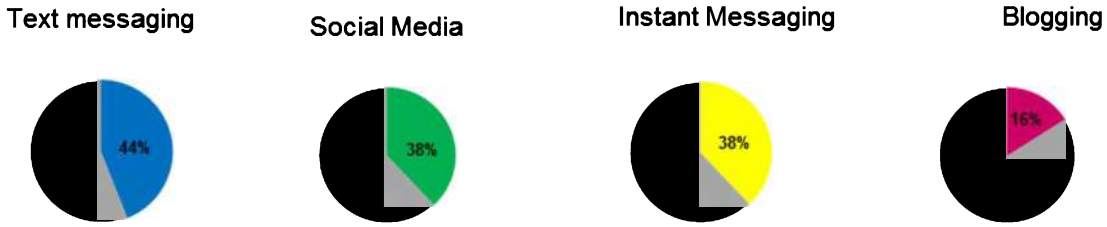

Figure 4: Preferences about social media by the Millennials (Goldman Sachs, 2018)

When it comes to brands, it is even more important to Millennials whether a brand is using social media or not. The Goldman Sachs Global Investment Report (2018) suggests that 34% of Millennials love brands that are present on social media more. Having in mind the importance of social media, selecting adequate platforms is essential for the success of a hotel brand. While Facebook was found to be more popular with non-millennials than Millennials, every other measured social media platform (like YouTube, Instagram, Snapchat, Pinterest, Twitter and LinkedIn) was found to be more popular with Millennials (AdWeek, 2016).

Therefore, Moxy chose a digital strategy where they focus all digital communication activities to one platform – Instagram. Moxy's plan was to use all other platforms such as Facebook to gather all Millennials on one place – Instagram.

5.1. MOXY – Facebook and Twitter strategy

Moxy's Facebook page was not very active or popular among Millenials. Besides informational nature of the Facebook account, Moxy's Facebook strategy was to use this platform to redirect all Facebook fans to follow them on Instagram (@moxyhotels) and to promote #atthemoxy (see Picture 2). Even though Twitter is popular among Millennials, it is not really a fun way to talk about hotel industry. A similar strategy like one on Facebook was applied on Twitter (see Picture 2). The aim was to use a big audience from two social accounts and pull them towards the most popular platform among young Millennials – Instagram (MarketingProfs, 2017). Thereby, Moxy had a bigger power and influence on its followers there.

Figure 5: Moxy's Facebook and Twitter page
(Sources: https://www.facebook.com/MoxyHotels/, https://twitter.com/MoxyHotels)

5.2. MOXY – Instagram strategy

Photos and videos are the best way to cherish memories from a memorable travelling experience, as well as an easy format to share online. Thus, it does not come as a surprise that Millennials perceive platforms for photo and video sharing like Instagram, a perfect way to present special moments and to connect with places they never travelled to – like a part of the future journey. Therefore, Moxy decided to focus all its online efforts to one platform – Instagram (see Picture 4). Moxy's Instagram profile presents attractive content, allowing Millennials to easily relate to as well as to visualise atmosphere and energy of Moxy experience (WARC, 2016).

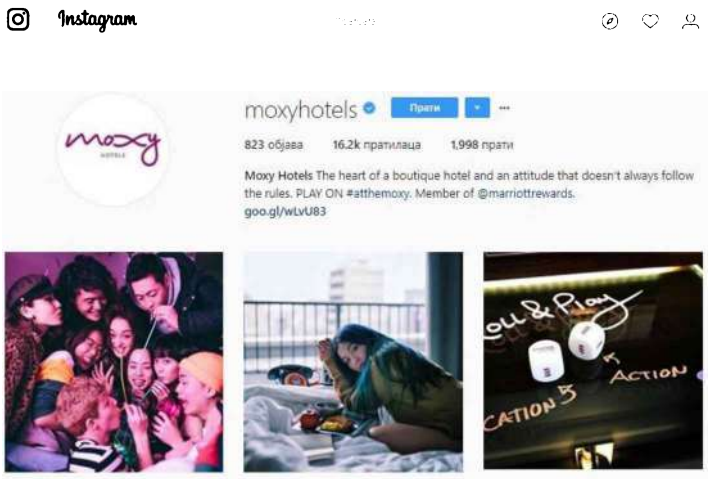

Figure 6: Moxy's Instagram page (Source: https://www.instagram.com/moxyhotels/)

The most popular hashtag which Moxy promotes is #AtTheMoxy. The purpose of the hashtag is to draw Millennials' attention to a single online location and create Moxy's community. At the same time, the official hashtag represents an online guestbook. In this way, travellers who are staying in Moxy hotels at different locations worldwide, have the same opportunity to share experience and talk with each other. A significant benefit for guests is online community through which Millennials have a chance to get some extra followers and popularity. Namely, Moxy has connected the official website to the hashtag on Instagram giving everyone an opportunity to be in the spotlight. Using the official hashtag, users can share videos or photos which describe their memorable experience on their profiles. Immediately afterwards, this content can be seen by everyone else on the Moxy's website (see Picture 5). However, Millennials desire to "be seen" and "be in the spotlight" is not surprising, because they want to be a part of the process and strategy of every brand. Generally speaking - Millennials love being online and love to share moments from everyday life with others, including a specific brand experience (WARC, 2016). Moxy seized opportunity by letting guests to speak out.

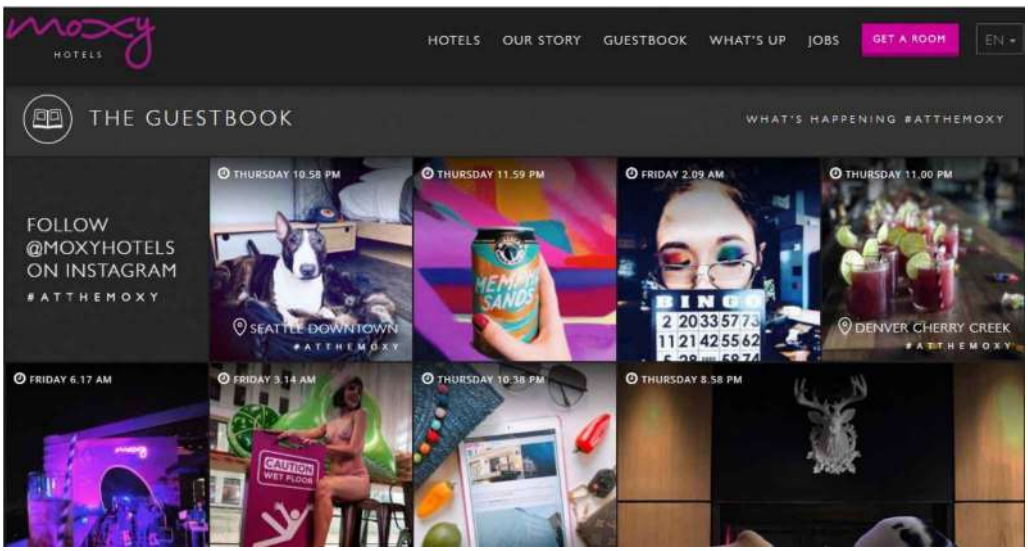

Figure 7: Moxy's official website (Source: http://moxy-hotels.marriott.com/en)

5.3 MOXY – YouTube and Snapchat strategy

As said before, Millennials are digital natives and simply cannot function without mobile devices. Short, interactive, mobile digital content is typical for generation Y. Millennials prefer to be content creators and take an active part in creating the digital brand strategy (WARC, 2016). By using video formats to communicate and engage young group of travellers, Moxy successfully integrated this behavioural trend into its online strategy. Moxy is constantly adopting its online appearance as a response to shifting online trends.

Young travellers do not use YouTube to find a picture-perfect version of their lives—they use it to watch videos and connect with supportive communities (Think with Google, 2017). Therefore, Moxy's YouTube channel has two different types of the content. The first type is centralized content presenting moments from opening events of Moxy hotels from all around the world. By using this type of content Moxy creates brand's voice, energy and positive vibe among Millennials who are perceived as potential guests all over the world. Highlighting the best parts of an opening event through videos makes followers feel like they attended the opening and putts them in "can't wait to experience this" mood. In both cases, an impact on fans brand commitment and loyalty is increasing.

The second type of content are videos that engage local influencers. Moxy used local influencers as a type of performance to get closer to fans. The first step is to analyse who are the most famous influencers in local markets and to create a list of potential partners. Afterwards, Moxy contacts the selected influencers and gets straight into collaboration. The results were overwhelming, influencers brought Moxy an increase in video content shares and encouraged fans to create content on different topics. Overall, YouTube influencers were promoting different kinds of challenges, tasks and assignments all while recording every reaction (AdWeek, 2018).

Marketing department at Moxy decided to create two online series that were presented on their YouTube channel (see Picture 6). The first series was titled "Do Not Disturb", in which comedian Taryn Southern chats with people from the entertainment industry. While second series - "Hotel Countdown", consisted of six half-hour episodes which provided a behind-the scenes glimpse at the period just before the opening of a new hotel.

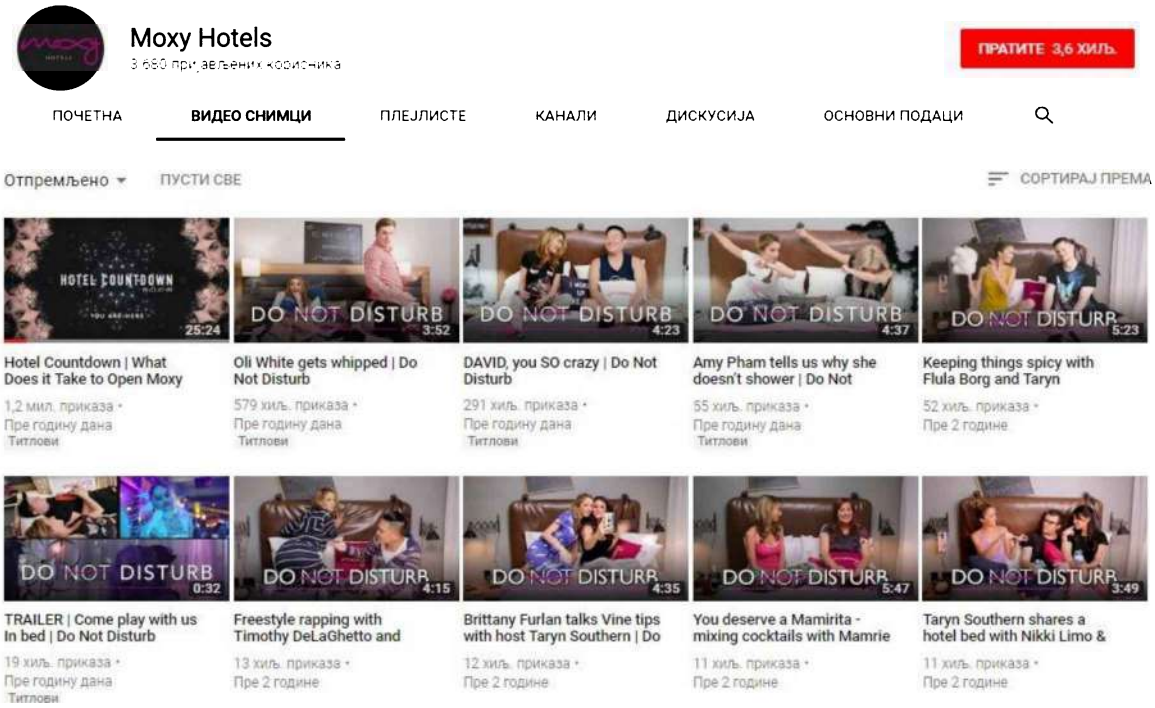

Figure 8: Moxy's YouTube Channel
(Source: https://www.youtube.com/channel/UCCSZDRdTNqWi9WDNrSiWU2w/videos)

A similar tactic was applied on Snapchat as well. When the hotel in Berlin was opened, Moxy once again made a partnership with another influencer - Jen Levinson. Thanks to the global Marriott Rewards program, she stepped into a „6 days, 7 nights" challenge (WARC, 2017). Through Jen's vast community of young Millennials Moxy had an opportunity to gain new followers, bigger impact and most important – to convert online fans into potential offline guests. „6 days, 7 nights" challenge video was posted on Marriott's official YouTube channel and viewed more than 9,000 times (see Picture 7).

Figure 9: Snapchat video on YouTube (Source: https://www.youtube.com/watch?v=ZdVgc2v11o0)

Marriott's market research had demonstrated that next-generation consumers place a high value on rare and interesting experiences. Thus, YouTube series were intended to introduce the Snapchat audience to locations, hotel properties, and rewards-program benefits that can lead to special experiences. Each three-minute episode explored a destination and its culture. The unscripted series putted influencers in situations which pushed them outside comfort zones to create memorable experiences (WARC, 2017). Designed to be both interesting and relatable, videos were putting influencers into the centre of attention, so they could speak directly to the camera and share their experience and opinions (AdWeek, 2018). Brand promotion through vlogging was perceived as a chance for followers to get know hotel's location, rather than the hotel's lobby. All ads in the video were organic. Because of influencer involvement with discovering new things to do in cities where Moxy is located, fans kept watching the video until the end and did not mind ads.

6. CONCLUSION

Nowadays, building the brand requires a good digital strategy which includes inspirational and innovative storytelling, a strong community and continuous support from fans. In order to fulfil this mission, Moxy adapted its online brand presence on each social platform with unique purpose. Having Millennials as the main target group, Moxy had to conduct extensive research before stepping into their online world. Based on data gathered about Millennials, Moxy predicted that Instagram would be the most powerful social platform for communicating the digital story of their hotel. Moxy had recognized the shift in online behaviour, types of content and focused on photos and videos, which became instantly popular among Millennials. In this way, Moxy created an attractive image, appealing brand voice and reached its audience. Emphasizing adventure by putting people in videos to tell stories from their angle and keeping the ads behind the scene, proved to be a great solution to engage with Millennials and to grow as a brand.

While Jennifer was presenting Moxy's business results at the end of 2014, she summarized why Moxy's digital storytelling was so successful in five key points (WARC, 2016). First, *Create Experience*: Moving from creating just general relationships with customers to loyal, raving brand fans for life. The way Moxy does that is by creating these memorable experiences. Second, *Enable Personalization*: Moxy has a great opportunity with social media to literally listen to what people are saying, what their interests are, and what their likes, or their dislikes, are. Third, *Listen to Feedback:* The advantage of carefully listening to feedback is the chance to create a better experience. Fourth, *Leverage Influencers*: It is so much better to have somebody else tell your story than you telling it yourself over and over again. A huge part of Moxy's strategy is tapping into social influencers – and tapping into celebrities – to help share the story. And final, *Attract Attention*: When all of the above work in synchronicity, Marriott captures an increasing share of Millennials engagement.

In the future, the core benefit for the hospitality industry will be possibility to inspire travelers' creativity as much as possible and to include them into making the brand's digital content. In the long run, engaging followers with influencer-driven content will make a large part of the community happy and satisfied. Thanks to delivering the right message in the right way and deeply understanding values of their customers, Moxy is in the process of making a strong brand. The biggest contribution in making the Moxy brand so attractive to Millennials was creative digital storytelling.

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INFLUENCE OF COMPUTING MODEL ON PUBLIC OPINION-*DYMATICA*, DIGITAL COMPUTING SYSTEM FOR MANAGEMENT OF PUBLIC OPINION

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Abstract: *Public opinion is complex, dynamic and hybrid phenomena. Globalization, digital development and technology expansion, contribute to the development of digital models for analyses of social models such are behaviour's reactions and communication strategy. Public opinion is flexible and suitable for influence and at the same time is a subject of strategic communication, as a base of behaviour reaction rises. Furthermore, in development of communication strategy, its obvious necessity for usage of digital computing platforms, as complex case build tool. In work, it's presented digital computing system for prediction of behaviour reaction, as supporting contribution for the creation of communication strategy that influence on public opinion.*

Keywords*: public opinion, strategic communication, digital communication, behavior reaction, DYMATICA.*

1. INTRODUCTION

With no doubt, public opinion is complex and hybrid phenomena. Black (Black 2003:51) recognise public opinion as dominant, prevail attitude of some collective entity, society, collective desires and summarised value orientation of people regarding some issue or phenomena. Barnays is recognised as 'father' of wide spectra of disciplines which are dealing with a public opinion such as public relation, propaganda, and marketing genesis. In one of his early works *Crystallizing Public Opinion*, which the first edition was in 1923, declared (Barnays 1961:61-62) public opinion as depraved defined, unstable and for changing the suitable group of individual identical or confronted attitudes of individuals, which are organised in some entity or group in society. He insists on the necessity to understand the individual in purpose to understand public opinion.

Public opinion (PO) isn't separate, self-generated category, but complex and multiyear phenomena which are in generic correlation with overall cultural values and political culture references (Pantić, 2007:54-62).

Main characteristics of PO are openness and suitability for fast changing and modelling (Wilcoks et al. 2006:217). Those management suitable characteristics indicate possibilities for different interest groups or centres of power to create, develop and implement a strategy based on communication strategy with an aim for the achievement of the desired reaction of the wide public, as a unique target group. Purpose of that strategic communication development is to predict and achieve appropriate reaction of the wide public, which will support the interest of power centre which is the owner of the project.

2. MANAGEMENT WITH PUBLIC OPINION AS A PART OF COMMUNICATION STRATEGY

One of the strategies that are implemented in PO changing is continuously exposing pressure with various communication tactics and tools acting on some common values and opinion-drivers through propaganda (Mitrović, 2018a), public diplomacy (Mitrović, 2018b), or lobbying (Mitrović, 2017). On this way, PO is in a situation of constant pressure where that some new, undeveloped or unstable values will be accepted as new system values. Continuously pressure on same 'triggers' contribute to rising of a new, previously none existing values, that became parts of new culturally values puzzle. Creation of desired reaction present strategic communication, based on quantification methods development of dynamics and reaction unification consequences, derived from some population as a target group.

Some of the previous methods, but also actual today, are *system dynamics model* and *agent-based model*. System dynamics model approach is developed upon high levelled indicators, system assessments, statistics and descriptive variables incorporated in mathematical models (Forrester 1961; Sterman 2000; Ford 2009). This approach is useful in developed of ''wide perspective'', but the main failure is restriction and deficiency of concert and direct indicators. It could be said that agent-based model present developed approach from system dynamics model and it is presented by aggregated systems assessment. This approach is based on the inner evaluation, using of direct agent-based model assessments that simulate interaction on an individual level and assessments of complex group's reaction against projected pressure (Macy and Willer 2002; De Marchi and Page 2014).

System dynamics and agent based models are similar upon some generic parameters (explaining values and political culture, economy, behaviour, etc.) which dedicate both of them in development of socio-cultural reaction prediction in separate, hybrid simulation models. System dynamics is based on group reacting prediction, and agent-based on individual reaction prediction. Since the PO present reaction of gathering individuals, the booth of approaches has a significant contribution to communication strategy development. One of contribution to the development of high successes communication strategy should involve prospect theory, as a descriptive model of decision making. The core of prospect theory indicates deferent aspects of decision making risks assessments in the scope of a potential sense of win or lose situation regarding decision consequences. This is based on different patterns of desirable group reaction which are aimed at an individual as part of the group. Namely, individual and cultural differences could product different reaction on same impulses which could stimulate different individual cognitive perceptions (Wisniewski 1995). When cognitive perception become on actual reaction with real consequences, it's compared with basic patterns as a comparative value. These patterns are in categories of self-assessment and environment assessment semantics expression of individual relation toward wide social environment (Markman, 1999), and could stimulate other cognitive reaction such as emotions, expectations, values, perceptive social norms attitudes and acting reactions. Understanding of this process has a contribution to motivation and stimulation of desired reaction pattern. Namely, if motivation is high enough it could become attend or even, all attend-package for the achievement of desired reaction pattern (Fishbein and Ajzen 1975). The delivered reaction is under of inner and out generated correlated influences, which in synergy with emotions could generate some sort and degree of reaction risk (Bernard & Smith 2006). Also, added factors which should be calculated in communication strategy development are related to the previous (recently or in time-projection) reactions, as indicators of possible future response patterns (Bagozzi and Kimmel 1995).

Basically, theoretical frame of modelling for desirable reaction is managed by suitable reaction on delivered narratives and messages, with required PO support, upgrading of existing or building of new values, is founded upon *The theory of planned behaviour (TPB)* (Ajzen 1991). Upon TPB, attitudes and attends are in strong interactive connection with acting behaviour, and could be analysed as resulting variables delivered by influences of: (1) actual attitudes regarding specific behaviour, (2) subjective norms that delivered specific behaviour and (3) perception that acting behaviour is in individual control limits. Combination of listed factors presents condition of behaviour intention that express basic for prediction of individual reactions (Ajzen 1991; Madden, Ellen and Ajzen, 1992). Behaviour reaction profiling is support with Perugini and Bagozzi's work They work (Perugini and Bagozzi, 2001) have contribution in understanding of extensile volume of behaviour variable variation, with goal-directed behaviour model, which include variables of relations, positive and negative emotions, subjective norms perceptions, and cognition behaviour control. According them, desires are drivers for attends.

3. DIGITAL BASED COMPUTING MODELS IN MANAGEMENT OF PUBLIC OPINION

In overall, designing of digital based models for management with strategic public relation in purpose of shaping public opinion, is based on cross section analysis of psychological, geopolitical and economic relation with cultural, cognitive and behaviour reactions of individuals as a part of (target) group. System is based on modelling of simulation of reactions which have influence on decision making process and designing of complex individual's and group's interaction, which are producing some attitudes. One of actual computing models for prediction of reaction of PO, groups or leaders that have strategic public relation value, but also strong contribution for strategic management is DYMATICA[1]. Role of model is to support managers in creation and development of an appropriate and the most possible successful communication strategies. This application is form of unified analytic platform that simultaneously use system dynamic indicators and agent-based approaches[2]. Software has been developed upon models of synthetically integration of various databases such are behaviour, economic, political, psychological and socio-humanitarian behaviour theory. It's designed as supporting toll for strategic management in purpose to inform and provide necessary prediction of reaction and behaviour of targeted audience and probably dynamic repercussions of involved actions (Bernard, et. al, 2017). Resulting product of calculation is elaborated unify frame which will correlate individual reaction and behaviour of individuals as a part of group and group as all. Program tracks multi variables approach trough analysis and simulation of interactions, processes of decision making, and reaction of leaders and groups. Analysis Process of analyses is consisting of macro and micro level (Bernard, et.al, 2017:452-453). At macro level, application analyses fundamental level of dynamics variables in and between subject entities. At this point, sub-levelled analysis is involved, with purpose of involving of non-cognitive processes, such as economy, resources, etc. Specifications of every influence regarding to reaction or behaviour, are based on expert's assessments and databases information. Experts are allowed to delegate new phenomena, hypothesis and variables, which are characterising subject entity's area. Analytical model is partially based on hypothetical founds of previous and recently patterns of group's

reactions and behaviour. Macro information presents social and political system with included economy, behaviour trends, while micro information are indicators of group or individual leaders, decision makers.

Micro information which is documented trough DYMATICA structure is composed of specific psycho-social decision making theories. The structure is organised to characterise leader's process of decision making and action and behaviour, as multi levelled gradient psychological process. In estimation are used memorised knowledge and findings, delivered from field-experts about cognitive perception, motivation, norms, rules and individual reactions. Since every field-expert introduce subjectivity of their own point of view, in assessments are used the finding of more engaged experts regarding same subjects, as well as general logic based upon system's generated assessments.

Macro level synthesised psycho-social theories which could be: 1) integrated into predicting of behaviour, 2) transformed in computing equations, and 3) institutionalised, tested and verified by using of available data. On this way, DYMATICA by using of complex socio and socio-psychological theories attempt to describe initial characteristics of individual behaviour reactions in a specific group. Since that subjected theories couldn't be empirically approved on all societies and cultures, they need to be interfered on numerous cases, as an indicator for a pattern of individual's reaction and behaviour. Psychosocial and behaviour-economic are supported by evaluation empirically research and historical data and integrated into DYMATICA algorithm. This approach is based on authors opinion that behaviour economical characteristic describes a way of individual decision making process. Namely, by authors (Bernard, et.al, 2017:455), theories describe a way of how behaviour results by decision, but also, how choices of reactions will be created to determine those decisions.

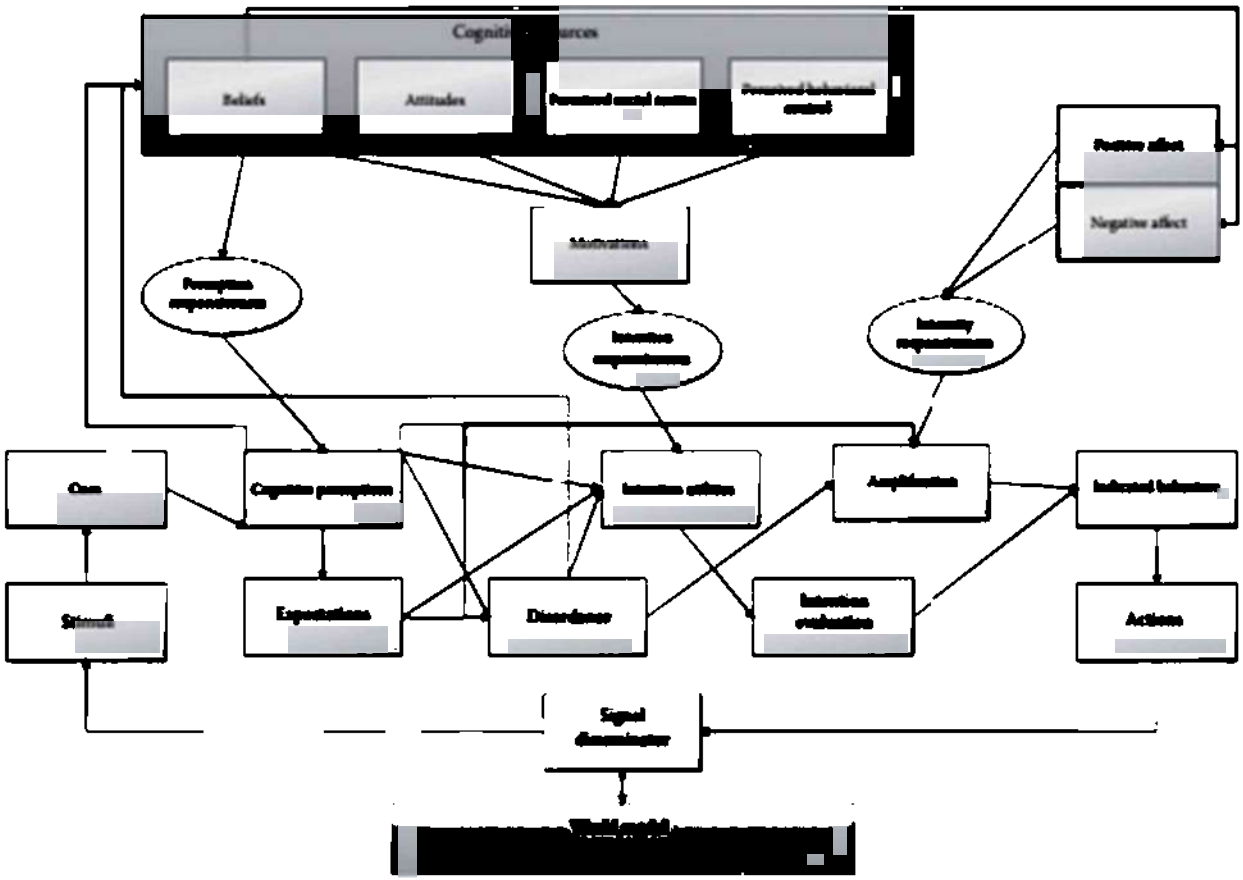

Figure 1: Overview of DYMATICA structure (Bernard, et.al, 2017:459).

The crucial phase of decision making process is filtration of information and its relations with empirical experience. At group level it's expected to prevail decision, attitude and behaviour reaction which is compatible with dominate values, because of the randomised variability of balancing values orientation of individuals in the selected group. This logic has a proof in theory that one population, society or group have dominantly attracted relations regarding same values. On this way, the selected group has collective references related to the behaviour as a reaction to some influences.

DYMATICA application uses a dynamic modelling approach to simulation of the interaction of cognitive entities in the context of the concrete case. It's compound of cognitive models which are using characteristics of socio environment for determining of the behaviour of case entity as well as general or world model sectors, which compile all non-cognitive elements involved in simulation (economy, resources, demography, etc.). Assessment begins with scenario development which comprises initial case with particular characteristics. Subjected entity interprets case as cognitive perception, determined by groups of linear characteristics that are based on sub-entities awareness. Forms of entity's expectations are based on its cognitive perception of the general model. Difference between expectation and perception is stabilised difference, or 'disordance', and it's mathematical model presents an interpretation of social-psychological and other social theories. Data are determined parameters which have a role in controlling the progression of simulated variables in time. Statistical techniques determine parameters and prediction toward case scenario. Quantitative data are generated from data bases, research analyses, economic statistics, analyses, etc. At the group level, application use assessment of sets of cognitive characteristics and statistic data, and for individual level, personality characteristics are calculated as well. (Bernard, et.al, 2017:460).

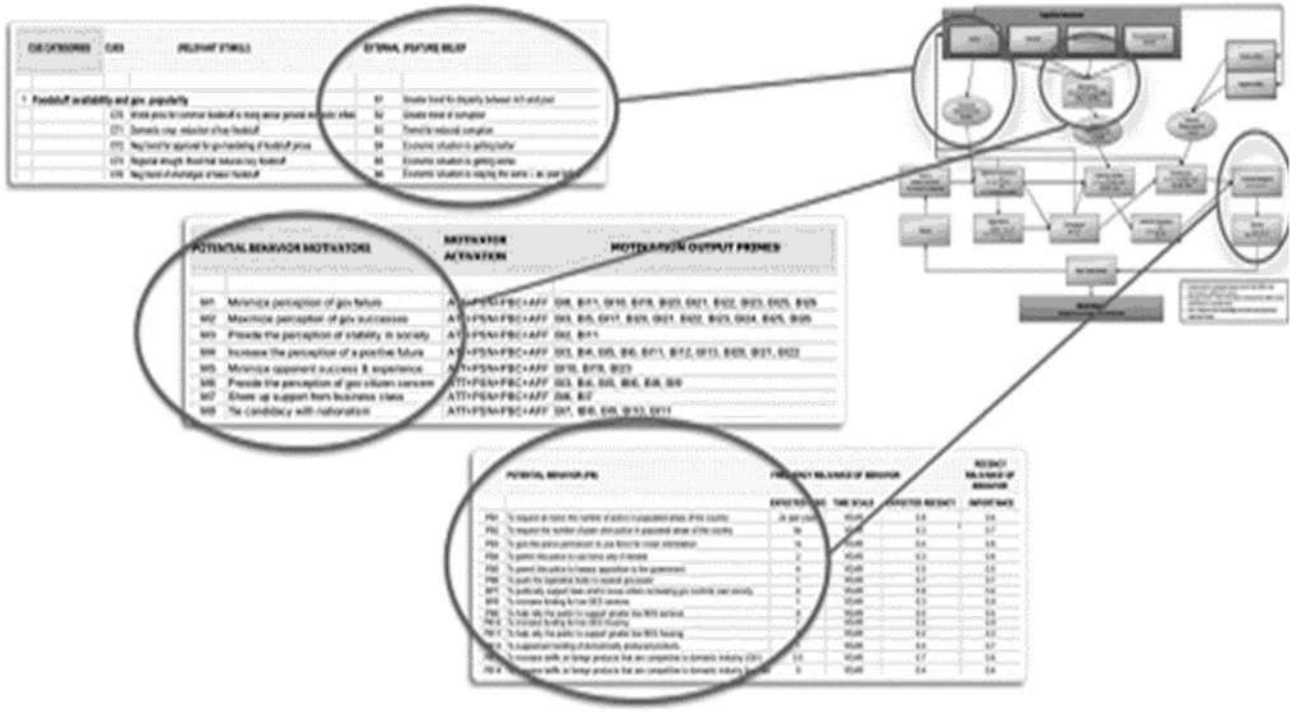

Figure 2: Example of a knowledge structure showing cognitive perception, motivation and potential behaviour information (Bernard, et.al, 2017:461).

Computing model DYMATICA present macro level of socio related interactions as well as the micro level of behaviour reaction of a specific entity. It determines correlations among entities, with generated potential expected reactions, behaviour, motivation, and characteristics that could influence on motivations, as basic of modelling. Areas of usage of DYMATICA as hybrid computing system which present digital form of supporting to strategic communication for prediction and modelling of behaviour and public audience reaction are:

1. Estimation of the potential effects of proposed interventions (including unintended consequences) that seek to alter behaviour by affecting the cognitive domain (e.g., information operations, deterrence scenarios, proposed engagement options to arrest or avoid conflict escalation) before they are executed;
2. Modelling of latent instability within a society (or group of societies) by modelling tensions between groups (in terms of their beliefs and behaviours) and simulating to understand what types of trigger events could ignite conflict;
3. Definition of the temporal sequence and the timing of steps in more complex interventions to achieve the highest likelihood of success (however that is defined).
4. Exploration regarding what sets of system-level scenarios might lead to virtuous or vicious cycles (situations in which behaviours create positive [vicious] or negative [virtuous] feedback into the system and cause or prevent behaviours of the same type) (Bernard, et.al, 2017:467).

4. CONCLUSION

Public opinion is complex, hybrid and subject to change related social category. On the contrary of two of its genesis factors, cultural values, and political culture, public opinion is very eligible for changing and exposed to influence. Until now developed theories of management with public opinion and expected behaviour reaction which is related to it, approving logic of necessity for the development of hybrid digital computing systems for PO management support. One of the recently introduced modelling systems is DYMATICA. In presented system are incorporated logic of interactions between the subject entity and dedicated goal. Behaviour reaction of group incorporated cultural values, cognitive and non-cognitive indicators, micro and macro level of analyses. Approach suggest case-based behaviour reaction of the entity which calculate mathematical models of algorithms for interaction in a pool of cultural patterns, differences in attitudes, believes, relations, norms, motivations and attends in emotion expressions. On a macro level, model present socio level of interaction and on the micro is related to the concept characteristics of the predicted behaviour of individual or group.

The contribution of digital computing systems for prediction of behaviour reaction is more than significant. Namely, modelling and scenario creating of behaviour reactions of public propose necessary supporting and constructive data for development of appropriate communication strategy, in purpose to achieve the desired reaction according to our goals. Moreover, behaviour reaction supported with adequate strategy communication open possibilities for future influence management with a public audience in accordance with future, strategic goals. This approach is convenient for implementation in societies with conservative basic values, a cultural matrix with a high orientation to the authority where the leader of the institution in the same time is the leader of public opinion and with undeveloped political culture.

NOTES

1. Dynamic Multiscale Assessment Tool for Integrated Cognitive behavioural Actions - DYMATICA has been developed in *Sandia National Laboratories', the* USA, as a part of Behavioral Influence Assessment program with aim of modeling of hybrid appraoch for influance on decission making and preedicting of behviour reaction of specific groups.
2. Agent-based an approach is based on results of field research which conduct by subject meters expert in some society about some topics which are of importance for the creation of DYMATICA models.

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INTEGRATION OF ONLINE AND OFFLINE COMMUNICATION ACTIVITIES IN EVENT MANAGEMENT

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Abstract: *The research subject of this paper is event management as a set of complex activities that need to be taken when planning, organizing and executing events. The goal of the research is to review and highlight the basic guidelines and methods in the process of planning, organizing and executing events, so as to demonstrate the importance of event management and its integration of online and offline communication activities. Starting from the research objectives, the concept of events, their typology and key features are first to be discussed. Then, an overview of the key items and understanding of event management is given, along with the analysis of management functions: planning, organization, implementation, control, evaluation of events as well as the integration of online and offline communication activities.*

Keywords: *management, marketing, event, digital aspects, online and offline communication activities*

1. INTRODUCTION

Today, the concept of an event includes a wide variety of social gatherings, meetings, sports and cultural events, shows and performances. The word "event" started to be used for marking anything that happens and brings together a number of people. Although the events have been present in society for centuries, in recent years the number of events has achieved a significant growth, which caused the development of the event industry. In the context of the expansion of the event industry, different aspects of events organization and event management are gaining in importance. Therefore, the initiation of online and offline aspects of events becomes a very important item If we look from the perspective of entertainment, social, cultural, economic and other needs of people, events have a social function and a number of positive effects on the improvement of the economy in communities in which the event is organized, which reflects through the development of infrastructure, employment, the increase in GDP, social interaction, cultural and tourist affirmation, etc. (Ceković and Muhi, 2012). In order to show the positive effects of organizing an event in the social and economic community, development, planning, organization and implementation of events require a professional approach of management and human resources engaged in the preparation of the event, which caused the expansion of event management (Barron and Leask, 2014). Finkel (2008) explains that the potential for errors in the organization and implementation of events can be disastrous both for the organizers, the future of the events and the community, which is why there is a need for qualified managers within the event industry. Loos with associates (Loos et. al., 2008) points out that the success of the entire event depends directly on the efficiency of the management, since the event management involves *"coordination of all tasks and activities necessary for the realization of events including event strategy, planning, implementation and control, based on the principles of event marketing and methods of project management"* (**p.54**). Organization of events requires adherence to the key principles of management and fulfillment of certain preconditions, without which it would not be possible to organize an event. It is very important to study and take into account every detail when organizing any event by taking into consideration the four functions of the event management, including: planning, organization, execution and control (with the event evaluation).

2. THE CONCEPT, TYPES AND CHARACTERISTICS OF AN EVENT

Events, in the form of organized execution and performance, trace their roots back to ancient times. Historically, even before the fall of the Western Roman Empire in 476 BC, events and festivals appeared that had specific functions within the society, with the aim of sharing rituals and celebrations and affirmation of common identity (Raj, Walters and Rashid, 2017). Religious events have been an inevitable part of human society in all eras and in the XVII and XVIII century, rulers often organized events as a way to control the public. Today, events have different functions, which are reflected in meeting the needs for fun, relaxation and leisure, that is to say, they have cultural and economic role in the development of communities that organize the event. The events are explicitly linked to people's fundamental values - social and cultural

values, a need for social inclusion, a sense of common identity and belonging. Some authors define an event in a simple way, as any temporary event, planned or unplanned (Getz, 2005:4).

Bowdin, Allen and Harris (Bowdin, Allen and Harris, 2012: 14) define an event as a certain organized occasion such as a meeting, convention, exhibition, special event, gala dinner and the like, which consists of several distinct yet related functions, and regardless of the diversity of events, always includes a combination of management, programmes, people, and a specific environment. Somewhat more practical definition of the concept of an event entails transient events and phenomena, which are usually planned, announced beforehand, have limited duration and are fixed in terms of space and time of the event (Aljeaidi, Vignali and Raj, 2015). The nomenclature includes mega events, special, social and large events in the community, with regard to the criteria of their size and scope. In addition, the typology of events is most often made according to the type or the sector in which the event is organized, and in this respect it includes: religious, cultural, sports, private, political, corporate, music and business events (Raj, Walters and Rashid, 2017:9). In theory, as the most common characteristics of events, their uniqueness, transience, intensity of work, intangibility, fixed-time, interactivity and ritual are listed (Shone and Parry, 2013: 13). It is understandable that uniqueness is one of the main features of all events, regardless of their purpose. Consecutive repetition of an event is not recommended, although the events may be repeated continuously in terms of format and time interval, for instance, the Olympics. Nonetheless, organization of an event should not be a routine and the event organizers and coordinators must strive for constant improvement, even in case of events that are held annually (Shone and Parry, 2013: 14).

3. EVENT MANAGEMENT ANALYSIS

Some authors define event management simply as a process whereby events are planned, organized and performed (Burbank, et al., 2012; Yeoman, et al., 2012). Silvers (2012) sees event management as coordination and planning of all elements of the event, of people as the team members who participate in the event organization and execution, as well as the participants and visitors who attend the event.

There are authors who consider that event management essentially consists of planning the event itself, human resources management and risk management during the planning, organization and execution of the event (Hede et. Al., 2002). As mentioned earlier, the organization of any event requires detailed planning and strong coordination between all the participants (Najdić and Lukić, 2016), since every autonomous action at any stage of the event organization and execution would pose a risk to the success of the event itself, which is why event management is necessary, because it allows the integration of all elements of the event and the resources towards a common goal (Radosavljević and Radosavljević, 2010). By observing the above given definitions of event management, it can be seen that the primary functions of event management are related to the classification of the management functions that actually entail business functions performed by managers (Gušić, 2012). Some authors consider planning, organization and control as management functions, while others also include human resources management and control. Although there is no general agreement in the modern professional sources when it comes to management functions, it can be said that today, a dominant classification of management includes the following functions: planning, organization, human resources management, control and management. In respect to the specificities of event management, which arise from the nature of the event, the following were selected as the key elements of event management to be presented and analyzed in this research paper: event planning, event management, implementation, and control and event evaluation.

3.1. Event Planning and Organization

In order for all the functions of event management to be fulfilled, first it is necessary to plan out all the essential elements of an event, to determine main course of action that defines what, when, how something needs to be done and who needs to do it. Consequently, the planning, as the first phase of event management, can be seen as a function which performs a selection of a course of action in terms of the acquisition, allocation and use of resources that are necessary for the organization and execution of events. All key issues in the process of event planning are included in the strategic plan, which defines the *"objectives of the organization that deals with offers designing for the event, as well as the selection of specific means that will help to achieve the defined objectives"* (Andrejević and Grubor, 2007:85). Through strategic planning, the manager defines the size of the event, the selection of environment for the event, its market positioning, the event marketing plan and the financial plan for organization and execution of the event. Financial issues are very important when creating an event because, as Brakus (2017) explains, *"initial assessment can easily get out of control, and it is necessary to monitor and correct the financial structure, should there be any unforeseen problems"* (p. 28). After the strategic plan development, the operational planning phase follows, where practical plans and the budget for the event organization and execution are set (Prodanović Stamenović, 2015). Tum, Norton and Wright (2006) point out that one of the

key responsibilities of event managers in the planning stage is the management capacity, i.e. their responsibility to anticipate and make decisions about all necessary items for the event organization and execution, including the organization of resources to satisfy the demand. In this regard, the capacity management also includes the acquisition of all essential resources (venue, time, human resources with adequate skills, etc.) and if necessary, human resources training. In the event industry, if the capacity is not used when available, then it is lost forever; it cannot be reused or stored. For example, the seats at a concert or a conference cannot be stored, i.e. once the conference or concert starts, all the empty seats cannot be sold later. When organizing an event, apart from the selection of the venue, the time of the event and the assessment of the event environment, the appropriate division of labour, the organizational structure and coordination are also essential from the aspect of the management. By grouping the activities in organization and execution of the event, a division of labour is made, resulting in organizational structure. Due to the grouping of activities and the organizational structure creation, a certain number of hierarchical levels and forms of the coordination between the individual parts and the hierarchical levels are made.

3.2. Implementation, Control and Evaluation of an Event

After the phase of event planning and organization, the implementation phase follows i.e. the physical coordination and execution of the event and all the activities that the execution of the event includes (Raj, Walters and Rashid, 2017: 196). Essentially, the event execution entails the execution of the operational plan and all the activities anticipated in it by the staff and volunteers who are involved and responsible for the execution of the event plan (Adams, 2008:98). Setting up and executing an event is not simple, regardless of the fact that it proceeds according to the predefined plan and with a clear organization and labour division because the environment is changing and the event manager is expected to respond to these changes and manage them. It is crucial for the manager to prepare in advance the procedures that will allow him to monitor deadlines, arrangements, operational and marketing plans, etc. (Shone and Parry 2013: 94). An effective way to establish such procedures can be, for example, the making of a checklist of tasks (Wagen, 2010: 198). Clear procedures allow event managers to reduce stress and to ensure that various activities and numerous tasks delegated to associates fit in, are coordinated and executed in accordance with the envisaged timeframe.

Moreover, all activities during the setup and execution of an event should be carefully recorded, so that the event evaluation can later be performed. Adams (2008) states that keeping track of deadlines and progress are the two main tasks of event managers in the process of event execution. For instance, during the event execution, the manager has to monitor whether the planned activities and tasks take place at the time they were planned, or whether the staff that was assigned to perform multiple tasks in different places has plenty of time to get from one place to another. Essentially, the event manager performs the process of monitoring the progress of the event and the deadlines through the control function. Control as a function of management is of great importance because it provides support and coordination of all other management functions at all levels and includes coordination and connection between planning and information, followed by analysis and control of human, material, financial and information resources in order to achieve the objectives in an efficient manner. The function of event evaluation should not be seen as the final stage of the event management model because it should cover the entire process of event management, from planning, organization, execution and control to assessment of the success of the event. Therefore, Getz (2005) states that there are three stages of event evaluation: 1) formative evaluation (in the planning and organization phase); 2) process evaluation (during the event execution) and 3) summary evaluation (after the event in order to evaluate its success). The first two phases of evaluation are performed simultaneously through the process of event control, as soon as the feedback on deviations from the previously made plans is received. The last phase of the evaluation is carried out after the event is over and its aim is to evaluate the success of the executed event. The success of the event can be measured from various aspects, depending on the performance assessment criteria that are taken as the starting point. However, even if the event evaluation shows that the tangible criteria were successfully fulfilled, the evaluation must also include the intangible criteria that influence the decisions of the visitors, whether or not they will once again attend the event and give a recommendation for the stated event (Aljeaidi, Vignali and Raj, 2015).

4. INTEGRATION OF ONLINE AND OFFLINE COMMUNICATION ACTIVITIES OF EVENT ORGANIZATION

The expansion of information and communication technologies and the digitization process have brought some changes in all spheres of modern organization business: traditional forms of business have taken on new forms and a large part of business processes is transferred over to the Internet and runs electronically. In terms of event management, changes made by the digital media are reflected primarily in the promotion and advertising of events, i.e. the way the potential audience / visitors today look for information about the event: the promotion is significantly transferred over to the Internet and digital media. Additionally, technology development allows people around the world to enjoy an event remotely, watching live streams

on YouTube, while old-fashioned event instructions are replaced with attractive mobile applications that provide not only instruction on the event, but also interaction with other visitors and staff during the event.

What is more, thanks to social media, participants no longer receive polls to share their opinions about an event, but they can do so through the aforementioned mobile applications or social networks (Solaris, 2012). Thompson (2013) states that the use of the Internet and digital media in event management can help small agencies deal with organizing mega events, transfer the full value of the events to the audience, achieve competitiveness and survive on the market. In addition, technology has a key role in supporting innovative ideas used in organizing many events. Thus, 3D project mapping is a perfect example of using technology to create additional value for event visitors. Essentially, 3D mapping is a display of three-dimensional video on a large projector platform that is used in many special events to tell stories, display the event itself, or simply to increase the effects of events and provide visitors with tremendous satisfaction (the so-called wow effect brought about by surprising the audience). One of the great examples of using 3D mapping technology was a special event organized by Toyota to promote Toyota Auris cars in London in 2010. It was an outdoor event that took place in a large valley in London and was presented to a wide audience through a large number of projectors, which were used to map the figures on the wall, as well as the hybrid Toyota Auris that was in front of the wall, which surprised and impressed the audience (Hepburn, 2010).

The website of special, particularly mega events, has now become an integral part of planning, organizing and marketing events. Website events can be considered the most useful method a company can use to access its target market (Bowdin et al., 2012: 430). However, the decision to design an event website depends on the objectives, functions, the size and budget of the event. When it comes to special mega events, an interactive event site is an optimal solution, as it allows potential visitors to see an interactive event folder, buy online tickets, ask questions, contact customer service, etc. The use of the website is suitable for all stages of event management, both in the planning and organizational stages, as well as the performance and evaluation stage of events. Similarly, today, social networks are an indispensable part of the organization of special and all other events.

For Event Management, it is critical to be active on social networks before, during, and after the event. The basic importance of using social networks in organizing an event lies in their effectiveness, accessibility and proactive attitude. In the process of planning a social network event, they can serve as a source of important information about the opinion and reaction of the target market to the new / published event. For example, it is possible to create an event page on Facebook and invite potential audience to like the page and give their impressions of the planned event, and then individuals will further share the page, allowing information to be gathered, but also achieving free promotion of the event. Social networks have the same significance, even during the actual implementation of the event, since participants and visitors often use social networks to update their status and engage in interaction with other visitors. Therefore, the social networking events provide a unique opportunity for direct interactive communication with the audience events, which increases their satisfaction and loyalty in case of repeated events.

Consequently, it can be concluded that the Internet and digital technologies inevitably have to be integrated with the standard offline aspects of organizing the event because the desired results in terms of the success of the event are obtained by the effective combination of various online and offline aspects of event organization.

4. CONCLUSION

The paper sought to review and point out basic guidelines and methods in the planning, organization, implementation, control and evaluation of an event. Today, with the increasing number and the significance of different events that are organized at all levels (from local, national, regional to global), organizing events has become demanding and complex, causing the need for a new type of management, which is dedicated to events organization and management. Given the complexity of the event management process, the number of challenges the event managers face as well as the numerous factors that determine the success/failure of an event, the importance of event management for the success of the event is now indisputable.

The general conclusion we arrived at in this paper is that event management is a process that goes through the same stages as management in general. The management functions can also be said to constitute an integrated and complementary whole, where each of the functions is connected to the other and allows the event objectives to be achieved through a series of activities that are a part of it. Since management is a process and management functions represent processes themselves, all activities carried out under the management function are controlled and evaluated in order to improve the practice of event management and to achieve the maximum possible success of the event. All five basic functions of event management

that are presented in this paper, with their synergetic actions, are aimed at the realization of a successful event and the reduction of the adverse situations in their setup and execution. Studying the problem of the functions of event management and reviewing the literature allowed for a deeper understanding of the dynamic and complex nature of event management and for the significance, place and role of each of the management functions in the success of the event.

Furthermore, it is very important to understand that the Internet and digital technologies inevitably have to be integrated with the standard offline aspects of event organization, because it is the effective combination of various offline and online communication activities of event organization that gives the desired results in terms of the success of an event.

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THE ANALYSIS OF CONTENT USED IN POLITICAL CAMPAIGNS: DOES CONTEXT MATTER?

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Abstract: *In recent years, social media has become an indispensable tool in political campaigns. This paper deals with qualitative research of the context of content that political actors post on social media during election campaigns. In the first part of the paper, political marketing and its evolutionary periods are described. Since the final stage of its evolution involves the use of social media in political campaigning, particular attention is given to this topic. Due to the high relevance of content on social media, the concept of content marketing is explained as well as qualitative analysis of content in political campaigns. Finally, a methodology is proposed for qualitative analysis of the context of political actors' posts on social media. The proposed methodology was tested during political campaigns of local elections in Belgrade in 2018. The results provide a strategic approach for content planning in political campaigns on social media.*

Keywords *social media, content marketing, political marketing, qualitative analysis, content marketing matrix*

1. INTRODUCTION

In the past few years, new marketing trends have entered the field of politics and thus transformed communication in political campaigns. Social media is one of the tools that political actors, such as political parties, candidates and/or lists (all of these terms will be used in the paper, and depending on the context the authors will chose the most appropriate one), have started to use increasingly in election campaigns. Recently, there has been a huge increase in the number of people using social networks, and social media have become an integral part of the lives of the world's population. The networked population is becoming more significant and gaining more and more power as social networks give them the opportunity to obtain a lot of information, share their opinions and participate in public debates as well (Okan et al., 2014). From the political campaign perspective, Barack Obama's campaign in the U.S. presidential election in 2008 established Twitter, Facebook, MySpace and other social media as integral parts of political campaigns. Many analysts even attribute his electoral victory to a well-run campaign on social media (Tumasjan et al., 2010).

Political actors intensely communicate with potential voters during campaigns, especially in the days before the elections in order to get them for their political options (Tumasjan et al., 2010). In the era of social media (according to the statistics portal Statista, there are 2.62 billion social network users in 2018 and the prediction is this number will amount to 3.03 billion by 2021), particular attention during political campaigns has to be given to communication via this platform. Political parties and candidates have to plan communication on social media carefully, in terms of the content they post on social media. This leads to the increased relevance of content marketing and its application in political campaign planning.

To the best of the authors' knowledge, a comprehensive qualitative analysis of the context of content that political parties and actors post on social networks during election campaigns has not been performed, leaving room for more research in this field. The methodology used in this research was proposed on the basis of the Content Marketing Matrix described by Opielka (2016) and it was used to analyse the context of the content that political lists posted on social networks during the local elections in Belgrade in 2018. Social networks that were analysed include Facebook and Twitter. The content was classified according to the context and tone of voice of the content posted by political parties which was then used to describe the analysed campaigns.

The paper is organised as follows: in the first part of the paper, political marketing and its evolutionary periods are described. Since the final stage of evolution involves the use of social media in political marketing, particular attention is given to this topic. Due to the high relevance of content on social media, the concept of content marketing is explained as well as qualitative analysis of content in political campaigns. Finally, a new methodology is proposed for qualitative analysis of the context of political parties' and actors' posts on social media.

2. THE EVOLUTION OF POLITICAL CAMPAIGNS

O'Cass (2001) believes that the value of political marketing is to promote constructive dialogue and enable political parties, as well as voters, to be a part of it. Okan et al. (2014) provided an overview of political marketing definitions. For example, Shama (1976) defines political marketing as a process in which political candidates and their ideas are directed to voters in order to meet their needs and gain their support, while Winther-Nielsen (2011) believes that political marketing deals with the mutual exchange of values between political parties and their surroundings. According to O'Cass (2001), the process of political marketing has been implemented by adopting the philosophy of a marketing concept where this philosophy has been defined as a concept in which political party decisions should be oriented toward voters and their wishes and needs, within ideological boundaries. The same author states that this leads to the conclusion that political parties will better achieve their goals through a detailed understanding of their target groups, or in this case, voters.

According to Slavujević (2007), the voter's decision which option to support in elections stems from his/her value system, attitudes and ideology, and not exclusively from the situation factor such as the election campaign. In addition to the quality of programs and candidates of a political party, a thoroughly planned and realized political campaign can decisively influence the winning of an election.

The development of democracy shows that campaigns have gone through a period of gradual modernization. Karlsen (2010) identified three periods of development of political campaigns. The first period is the news era (pre-modern campaign), the second is the television era (modern campaign) and the third period is the digital era (post-modern campaign). What distinguishes these three stages of development is technological progress and changes in media technology, in particular the development of television in the early 1960s and new information technologies in the early 1990s (Karlsen, 2010.)

The first phase is characterized by a strong connection between parties and voters. Campaigns were not intensive, and they were directed towards established social categories. Communication during the campaign was focused on newspapers, mass meetings and surveys. The use of consulting agencies in campaign planning was minimal (Karlsen, 2010). This way of campaigning involves the extreme readiness of citizens to participate, and the orientation of political parties was based on lifelong loyalty of their voters (Gibson and Römmele, 2001).

The rise of television ushered in the second evolutionary phase of the political campaign. From the first transmission of the inaugural speech by F. D. Roosevelt in 1939, and especially after "Eisenhower's Response to America" in 1952, television has been proven to be a very important channel used in political campaigns (Slavujević, 2009). In this period, campaigns began to be carefully planned and run long before the election. The number of people who were informed about campaigns increased significantly, since all citizens consumed the same news. Accordingly, political parties were developing campaign strategies focused on a single and unique national message to draw attention and voters from different social categories (Karlsen, 2010).

The contemporary period of political campaigns began with the introduction of new information technologies. The communication in campaigns is more voter-oriented, and their feedback is monitored in order to adjust campaign messages. In this period, campaigns are planned and run by experts, political consultants and agencies (Karlsen, 2010). In addition, an important characteristic is that people share, on a daily basis, news and information about political parties and campaigns which they find interesting (Moldovan, 2013). Taking this into consideration, the strategies of political parties and candidates have shifted from the previous "social" level to the "peer to peer" level (Okan et al., 2014). The third period of political campaign evolution has brought to the scene social media and networks as an indispensable part and channel of every political campaign today.

The use of social networks in political marketing has evolved over the past ten years. Facebook, Twitter and YouTube are used as inevitable platforms for political campaigns (Stieglitz and Dang-Xuan, 2012). Since the very beginning of the Internet, the world's networked population has increased and social networks have become an integral part of their lives (Okan et al., 2014). Twitter is considered to be the ideal platform where users do not only disseminate general information, but also express their political opinions and attitudes, while Facebook, on the other hand, is often used by political parties and institutions to foster political discussions and engage citizens in dialogue (Stieglitz and Dang-Xuan, 2012). As a result, the same authors believe that Twitter and Facebook have the potential to increase participation in political life.

According to Zeng et al. (2010), from the perspective of political parties, it is very important to participate in communication that takes place on social media, especially during election campaigns (Stieglitz and Dang-Xuan, 2012). Elahi (in Moldovan, 2013) emphasizes that social media has an increasingly important role in the way campaigns are run. Consequently, it allows candidates not only to communicate more effectively with a larger audience, but it creates two-way communication and interaction with constituents. Due to the benefits that social networks provide in communication with a large number of potential voters, politicians have quickly accepted them as a mean for engaging their voters in discussions and dialogues with them (Hong and Nadler 2011).Thus, social media is an ideal platform for assessing opinions and attitudes of the public, as well as building and gaining support for their political option (Stieglitz and Dang-Xuan, 2012).

An increasingly important question that various authors and researchers are lately posing is whether activities on social media can be used to assess and predict offline political behaviour of voters (DiGrazia et al., 2013). It also raises the question of the extent to which the context, type and format of post published by political parties on social networks during election campaigns are significant and to what extent they affect voters' behaviour. As this paper is focused on the qualitative analysis of the context of posted content, particular attention is given to content management and contextual analysis.

3. CONTENT ANALYSIS ON SOCIAL MEDIA

According to the Content Marketing Institute, “content marketing is the marketing and business process for creating and distributing relevant and valuable content to attract, acquire, and engage a clearly defined target audience, with the aim of driving profitable consumer action” (Baltes, 2015).

Social networks provide their users the freedom to create content without a formal structure, and the context of content on social networks depends on the users and the communities they belong to (Naradhipa and Purwarianti, 2011). Providing relevant and up-to-date content is one of the most important strategies for successful positioning on social networks (Çiçek and Erdogmus, 2012). As the current literature suggests that social networking activities have to be user-oriented and focused on the message itself, Chi raises the question of how the message can be transmitted to consumers to meet their needs (Ashley and Tuten, 2014). These authors believe that marketers will benefit from applying creative talk to consumers, where creative strategy involves designing communications in a way that can produce the desired effects for the target audience, which is in relation with the increased importance of creativity in economy and management (Petrovic et al, 2017).

Due to the importance and impact that the content of messages on social networks has on consumers, or in this case the content of political campaigns on voters, it is very important to conduct a qualitative analysis of that content in order to find out in which way political parties communicate with their potential voters and whether such communication affects those voters when choosing the option they will vote for. The growing importance of social media in political campaigns around the world has prompted some authors to analyse the content used during the campaigns. However, a very small number of papers deal with the qualitative analysis of content that political parties post on social media during a campaign, leaving room for deeper analysis. According to Cole (1988), content analysis is a method of analysing written, verbal and/or visual communication messages (Elo and Kyngas, 2007).

One of the studies was conducted by Tumasjan et al (2010). They analysed Twitter posts that had mentioned political actors during the elections in Germany in 2009. The emotional, cognitive, and structural elements of posts were evaluated using software. In particular, the software determined the degree to which particular knowledge and emotions (e.g. future orientation, positive or negative emotions) are present in the published content. For each dimension, the software calculated the frequency by which words related to a particular dimension appeared in a given sample of the release. To determine political sentiment, they took into consideration 12 dimensions: future orientation, past orientation, positive emotions, negative emotions, sadness, anxiety, anger, tension, security, work, achievements and money (Tumasjan et al., 2010).

On the other hand, in another study, Wang et al (2012) analysed the context of posts published on Twitter by candidates in the 2012 U.S. presidential election. They analysed the relationship between electoral events and public mood and public opinion. Participants in their research were shown posts on Twitter and their task was to determine the sentiment of a specific post. The categories in which they classified the content were positive, negative and neutral, then whether the tweet was sarcastic or humorous (Wang et al., 2012). Neither of the mentioned studies evaluated content in the context of communication goals of political campaigns.

In order to overcome this shortcoming, we used a methodology and tool for qualitative content analysis that had been introduced by Danyl Bosomworth (2014) on the SmartInsights blog and then explained by Opielka (2016) more explicitly. The initial purpose of this content planning tool is choosing the appropriate content form that will lead to establishing relationships and closer connections with followers or other stakeholders on social networks. By using a content matrix, one can plan the form and context of the online content, depending on the stage of the followers' journey. Accordingly, depending on the intent and goal to be achieved, the content may have different effects on the audience. The content matrix then classifies content according to two dimensions: narrative and purpose. The narrative dimension determines the emotional and/or rational nature of the content, while the purpose dimension is focused on raising awareness or encouraging purchase (Opielka, 2016).

The content matrix described emphasizes the form of content, while greatly neglecting the context of the content being posted. The same content formats may correspond to different categories, and the authors of this paper adapted the matrix for the purpose of a qualitative analysis of the content posted during political campaigns. The tool was tested on the case of the local Belgrade elections in 2018.

4. THE APPLICATION OF CONTENT MATRIX IN POLITICAL CAMPAIGN ANALYSIS

To adapt the content matrix to a new purpose, as the intention or goal to be achieved, instead of "purchase" we used "incitement to action", as well as "going to elections", and "vote for a particular party". As in its original form, content is classified into four categories: entertainment, education, inspiration or conviction. Content in a particular category should satisfy the follower's interest on an emotional or rational basis from the moment of first contact to the decision to go to the elections and to opt for a certain political party. An additional adaptation of the matrix for application in political marketing also included an analysis of the content according to tone of voice. Tone of voice was characterized as positive or negative, whether the political actors posted the content about themselves or other candidates. The categories of content analysis are described below (Bosomworth, 2014).

Entertainment implies an emotional approach to the audience through announcements that should cause a good mood and it is most often based on humour. This type of content does not necessarily promote the program and plan of a particular party and candidate, but with its intensity it allows positioning in the mind of voters.

Inspiration implies an emotional approach to the audience through content that is not necessarily fact-based. It is published in order to induce affective reactions in the audience and inspire the audience to accept "a priori" attitudes. This content is dominated by the direct addressing of the audience through calls for specific joint activities (support towards specific attitudes and values, public gatherings, protests, etc.), as well as through direct calls to support a particular party/candidate in the elections.

Education of the audience through content implies less emotional focus and greater orientation to different facts and arguments. The purpose of the content is reflected in informing and gaining new knowledge in a particular field or in relation to a particular topic. This type of content helps the audience to recognize the specific issue they have, which then means focusing all their attention on a particular actor.

Content to convince implies content based on facts or specific activities from the political actor's plan and program, which are presented to the audience in order to receive direct support. Contrary to the content that should inspire which is always based on arguments, this type of content is mostly based on a constructive and argumentative discussion, as well as on specific plans of political actors, which are guaranteed to be achieved in the future period.

The general testing of the methodology will be performed for the political lists which took part in the local elections in Belgrade in 2018. For the purpose of illustrating the way how the analysis will be done, this study presents the content analysis for two, randomly chosen political lists – PL1 (which did enter the City Assembly) and PL2 (which did not enter the City Assembly). The study analysed the content they posed on Facebook and Twitter, during the election. YouTube, another social media that is considered to be an unavoidable platform for political campaigns as well, was not taken into account due to resource constraints. The analysis was performed manually, without any software, in the period of one month, from 1st February to 1st March. All content was classified on a daily basis in a certain category depending on whether it was rational or emotional and whether it was a call to action or awareness. The content was also classified by the tone of voice as positive or negative. The results of the analysis for the two political lists are shown in Figure 1.

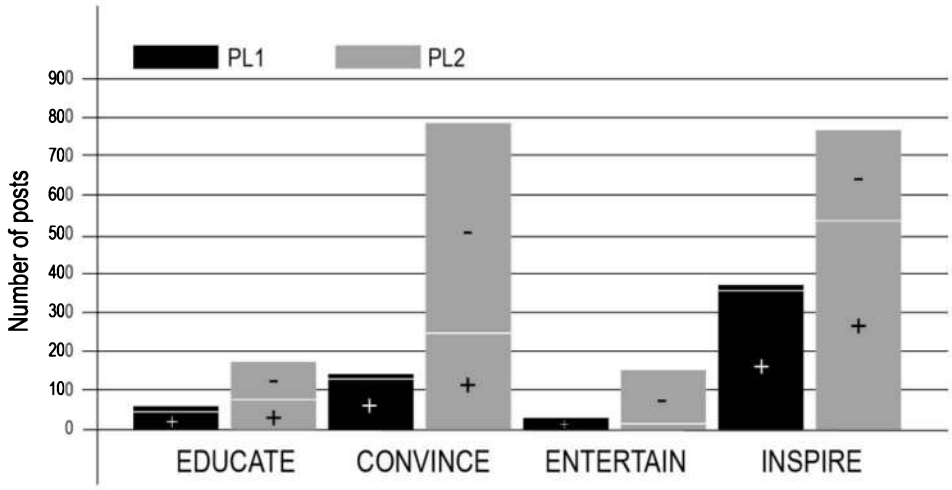

Figure 1. The qualitative analysis of PL1 and PL2 posts on Facebook and Twitter

With regard to the volume of posting, the campaign of PL2 was four times more intensive than the campaign of PL1. In addition to the absence of a pattern regarding the amount of daily posts, PL2's content could generally be classified into categories of emotional inspiration and rational convincing, with special focus on posts belonging to the latter category. On the other hand, PL1 posts' structure was mostly based on solutions and plans for social topics. Hence, most of the posts were based on positive emotional appeals, as this list generally posted content that referred to them. By way of contrast, a large volume of content posted by PL2 had negative tones as they generally posted negative content about the opposing political actors' activities and programs.

5. CONCLUSION

This research presents a qualitative analysis of the context of the content that political parties post on social network sites. The purpose of the conducted research was to test the proposed methodology by analysing the content published by political actors on Facebook and Twitter, during the pre-election campaign for local elections in Belgrade in 2018. For the purpose of illustrating the way how the analysis was performed, this study presented the content analysis for two, randomly chosen political lists – PL1 (which did enter the City Assembly) and PL2 (which did not enter the City Assembly). The context was analysed by employing the content matrix which was adapted for the purpose of political marketing.

The results of this research provide a strategic approach for content planning in political campaigns on social media. The methodology provides for more precise monitoring of digital campaigns of all political actors, thus making it possible to find gaps in the content to be posted, that are not covered by others. Furthermore, it provides more efficient types and forms of content and, additionally, the methodology can be used for the purpose of forecasting future posts of all actors on the political scene.

The limitation of this research is that results cannot be compared with other research as there are no previous studies of this type. Furthermore, since only these two coalition parties were analysed, we propose further analysis of the content published by other political lists in the Belgrade 2018 elections. This would provide a comprehensive overview of content on social media relevant for Belgrade voters. The methodology should also be tested in other elections. Finally, future research should focus on the development of software suitable for performing quick and large-scale analysis.

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THE SYNERGY OF SALES PROMOTION AND ONLINE ADVERTISING IN AFFECTING FMCG CONSUMER BEHAVIOUR

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Abstract: *Incentives for the purchase of products that include adding value to the basic product and boosting demand from buyers and consumers, are part of a consumer-oriented sales promotion strategy. These marketing communications activities are further expanded by integration with other forms of marketing communication such as advertising, whereby contemporary consumer behavior trends require a focus on digital media. The subject of this research paper was examination of effectiveness of different sales promotion instruments in the case of repeated, regular and unplanned, purchase.Based on the analysis of the results of the primary survey, it was concluded that sales promotion instruments related to the product price have great marketing potential on the market of the Republic of Serbia. Additionally, sales promotional tools - discounts, free samples and bonus packages – turned out to be extremely stimulating and efficient in integration with digital communication forms of these benefits.*

Keywords*: sales promotion, online advertising, web portal, social media, email marketing, SMS marketing*

1. INTRODUCTION

In the competitive FMCG market, marketing managers apply and integrate various communication tools to draw attention to their organization's offer and influence on consumers in the desired way (Perić, Milovanović & Bovan, 2013, p. 276). In this sense, a part of the marketing budget is often allocated for sales promotion activities, i.e. marketing incentives such as discounts, free samples, bonus packages, gifts, competitions, prize games, loyalty programs, etc (Jobber & Fahy, 2006, p. 247, Belch & Belch, 2004, p. 514). By applying them, direct influence on buying behaviour is enabled, thanks to the additional values that they provide to the consumer (Belch & Belch, 2004, p. 513). It is necessary to consider them as part of integrated marketing communications, a concept developed by modern marketing orientation which represents a scientific and practical approach for establishing relationships with target groups based on the synergy of various media and forms of communication (Vlastelica, 2007; Živković, 2012). Also, there is a need for a good knowledge of contemporary trends in strategic communications that, as a key imperative, set flexibility and personalization of communication tools and messages, considering not only reactive approach, but also taking over the role of initiator of change in the digital revolution.

The subject of the research in this paper is the influence of sales promotion techniques on decision making process in various purchase situations in the FMCG industry, as well as testing the effectiveness of various communication tools and channels for informing consumers about these instruments. Sales promotion tools, whose effectiveness has been explored in this paper are: discounts, free samples, bonus packages, gifts, contests, sweepstakes and loyalty programs. Purchasing situations that were observed were: purchase of a new brand, unplanned shopping, changing a brand that is usually bought, re-buying, buying an unplanned quantity and choosing a specific brand in a group of similar products.

The goal of this paper is to determine the real marketing potential, based on the analysis of data obtained from the primary research, for each of the mentioned communication techniques; point out their adequacy for achieving specific marketing goals; identify trends in the investigated market, and finally, formulate recommendations for marketing managers operating in the research market.

2. LITERATURE REVIEW

One of the key decisions that marketing professionals are bringing is determining the way in which the communication program with consumers will be designed and implemented. In addition to traditional communication tools, today's creation of a media plan is hardly imaginable without considering the involvement of digital media (Veselinović et al, 2016, p. 42). It is considered that with persuasive communication, using the appropriate mix of communication instruments, it is possible to influence on the consumers' process of making decisions, as well as reinforcing or changing their attitudes in the desired direction (Živković, 2012, p. 145). A synergistic approach, i.e. the integration of various mediums of

communication, has shown to be the most efficient way of transmitting the message to the target audience in the communication strategy and achieving the desired impact on consumers (Filipović & Kostic-Stanković, 2014; Cicvarić, 2006; Vlastelica, 2007). An important part of the communication mix are also a sales promotion techniques, that Kotler (2004, p. 164) defined as "incentives and rewards that attract customers to buy immediately, not to delay shopping". Sales promotion include a wide range of activities that are used in the strategy of communication with consumers, retail or own sales force (Filipović & Kostić-Stanković, 2014, pp. 249-250).

2.1. Contemporary sales promotion tools

Some of the most commonly used consumer promotion techniques are: discounts, free samples, coupons, bonus packages, gifts, competitions and loyalty programs and loyalty programs (Jobber & Fahy, 2006, p. 247, Belch & Belch, 2004, p. 514). Knowing the diversity of these activities and their benefits to achieve different marketing goals, such as: accelerating sales, encouraging more purchases of goods (creating stocks), attracting consumers of competing companies, testing new products on the market, building brand-loyalty etc (Shi et al , 2005 in Alimpić, 2015), marketing managers decide whether and which of them will be applied in the communication mix.

Discounts mean a temporary percentage reduction in product's price and provide an unambiguous stimulus for consumers because of the opportunity to save money (Jobber and Lancaster, 2005, p. 378). They are particularly effective in the case of a price-sensitive consumer group (Belch & Belch, 2004).

Free samples are small packages of the original product distributed to consumers in different ways: by "door-to-door" distribution or at the point of sale; by mail; by pairing with the packaging of another product; as part of print media, by online ordering, etc (Belch & Belch, 2004, p. 527-528). They are often used in the strategy of introducing new brands on the market, but also with existing ones, in order to differentiate the company from the competition and attract new consumers (Belch & Belch, 2004, p. 526; Jobber & Fahy, 2006, p. 247).

Coupons are paper/cardboard/plastic cards or electronic documents that provide some convenience related to the purchase of a particular brand (price cuts, the opportunity to participate in the prize game, collecting points and getting gifts etc), which is an additional stimulus for the purchase of that brand (Kumar, Rangachari, Jhingran & Mohan, 1998, p.2; Filipović & Kostić-Stanković, 2014, p. 254,). Coupons are distributed by: daily newspapers and magazines, direct mail, special printed publications of retailers, internet, free samples, product packages etc (Belch & Belch, 2004, p. 529, Boundless Learning Inc, 2017).

Bonus packs are a stimulus for purchase because, at a regular price, they offer a bigger quantity of products than the original package (e.g. "20% gratis") or a free product unit with the fulfilment of a defined promotional mechanism (e.g. "1 + 1 gratis", "2 + 1 gratis" etc) (Belch & Belch, 2004; Jober & Lancaster, 2005; Jobber & Fahy, 2006). *Contests and sweepstakes* are ways to attract consumers motivated by winning a brand-specific reward (Boundless Learning Inc, 2017). While contests require rivals to compete by demonstrating skill/knowledge/talent in the specified activity, the outcome of sweepstakes does not include the participation of a professional jury, but participants rely only on luck (Belch & Belch, 2004; Jobber & Fahy, 2006). Contests, sweepstakes and gifts are effective ways of encouraging consumers to visit a website or company's/brand's profile on social networks. By providing a proof of purchasing a product (e.g. codes, photos, etc), the consumer gets the right to a certain gift or participation in the contest/sweepstake. The company's website is usually the place where consumer can find out about the conditions of participation. In practice, it is becoming increasingly common for the entire competition to take place online: the participant puts his work (e.g. photo, slogan, answer, etc) on the company's website/profile on the social network, where together with other visitors of website/social network he she has the right to vote, evaluate and comment on other works, as well as to follow the results on the scoreboard.

Loyalty programs (loyalty cards) are the methods used by companies primarily to establish and maintain long-term relationships with consumers, with the ultimate goal of building lasting attachment for a particular brand (Dukić, Martinović & Dukić, 2015). With repeated or regular purchases, consumers collect points that will, at some point in time, provide them with the defined benefit - gift, discount, prize, etc (Belch & Belch, 2004, p. 542;). The basic reason why companies apply loyalty programs is to create a consumers' database. Based on the analysis of data of their previous purchases, with the help of specialized software, valuable information about consumers' preferences, habits and interests are being created, on which basis the marketing programs are being improved (Belch & Belch, 2004; Jobber & Fahy, 2006; Živković, 2012) .

2.2. Online advertising, e-mail and sms marketing

In practice, sales promotion instruments are often integrated with advertising. Sales promotion instruments should provide a direct impact on consumers' behaviour, while the role of advertising is to attract the

attention of the target audience to current sales promotion programs. In other words, the basic role of advertising, as a tool of marketing communication, is to inform potential consumers about the products of the advertiser and to provide the necessary information so that they should be able to compare them with products of the competition, to later create awareness in potential consumers that these products are adequate for purchasing and finally lead to a purchase in favour of the product being advertised (Vlastelica, 2007). Kotler (2004, p. 166) explains this in the following way: "Advertising explains *why* a customer should buy a product, and sales promotion *gives an incentive* to buy". Advertising appeals, rational and emotional, are part of a creative advertising strategy and they could be used as a basis for a certain advertised message in order to attract the attention of potential consumers, to effectively influence their awareness, beliefs and attitude towards the advertised product, and consequently, the purchase intention (Jovanovic et al, 2017). When used combined , advertising and sales promotion make a powerful combination. Belch and Belch (2004, p. 554) consider that the best results are achieved by combining these two communication tools.

Today, a complete marketing mix of media is hardly imaginable without the participation of digital communication channels. In addition to the precise measurability of the achieved results and the greater creative possibilities in advertising, their basic advantages against traditional mass media are: active participation of users, the possibility of two-way communication, more precise adaptation to the target groups (Vlastelica, 2007, p. 35) and formation of a community of fans of certain brand. It is estimated that in 2018 there are more than four billion Internet users, while close to 3.2 billion of them are active users of social media, and it is necessary to keep in mind that there is a trend of constant growth in this field. Thus, compared to 2017, an increase of 7% in case of Internet users and 13% in the case of social media was recorded worldwide (Smart Insights, 2018). According to *Direct Media MMO* (DIMAQ, 2018), the most popular social media channels in Serbia are: YouTube, with 3.86 million users, Viber (3.5 million) and Facebook (3.2 million). When it comes to the usage of the Internet for business purposes, in Serbian companies, according to research data from 2015, more than 86% of them had a developed website, while the most dominant market communication tool was Facebook. Namely, 63.2% of organizations in 2015 used this social network as a marketing communication channel, with a primary focus on advertising activities (Veselinović et al, 2016, p. 50). Digital advertising market records a constant growth since 2012, with net market ad spend 23.7 million euros in 2016, which is 17.6% increase year on year 2015-2016 (IAB AdEx, 2016).

In addition to advertising, other forms of digital marketing communication are also present, among which direct marketing is particularly important. Direct e-mail is one of the oldest forms of internet communication (Ferenčić, 2012, p. 45), and in the context of marketing, today it becomes the channel for sending highly-effective personalized messages with a sales goal. Popular e-mail sequences through which the potential consumer is gradually lead into the so-called "sales funnel", where at the beginning, most often for free, a certain value is offered in order to gain his trust and affection and, in the end, to make him profitable for the company.

Thanks to modern technologies, communicating with consumers is also possible through so-called "bulk" SMS messages (Algotech, 2017). In the context of sales promotion, this is an effective way to keep the target group informed and focused on the company's offer by integrating with sales promotion instruments such as discounts, gifts, etc. On the other hand, sales promotion tools such as competitions and prize games are more often associated with the so-called "SMS premium services" that allow users to register, participate, vote, etc (Algotech, 2017). A great marketing potential is attributed to this communication channel, due to the possibility of personalized access and delivery of relevant messages to the target group, which is confirmed by the fact that the open rate in the case of SMS marketing is very high (95%), most often within five minutes of receipt of the message (DIMAQ , 2018).

3. THE RESEARCH OF EFFECTIVENESS OF THE SALES PROMOTION IN THE FMCG INDUSTRY

The purpose of conducting the primary research was to determine the effectiveness of the sales promotion instruments in various purchasing situations in the Serbian FMCG market. The research was conducted in order to determine the motivational potential of these communication techniques, based on the analysis of the obtained data, with the aim to answer the questions: wheather, in which percentage and in which situations they are effective, as well as what type of marketing communication is most suitable for informing consumers about these benefits.

3.1. Methodology of research

For the purpose of the primary research conducted by the survey method used was an online questionnaire with 15 questions. Questionnaire was distributed to respondents via e-mail and Facebook social network, was available for completion in July 2017. The target group of respondents consisted of adult citizens living in the territory of the Republic of Serbia. The sample is simple and random, which means that each member of the basic assembly is provided with the same probability of being included in the sample, with the mutual independence of drawing members of the basic assembly - (Ristić, 2006, p. 391).

3.2. Structure of questionnaire

An questionnaire which contained 15 closed and open-closed questions was structurally divided into three parts. The first one contained two eliminatory questions: “Are you an adult?” and “Are you a resident of the Republic of Serbia?”. Only those respondents who responded affirmatively to both questions had further access to the questionnaire. By setting such a condition, it was possible to obtain an insight of habits and preferences in purchases for a specific geographic market, thereby avoiding inaccuracy and over-generalization. On the other hand, it was considered that minors, in most cases, do not make purchasing decisions independently. The other part of the questionnaire contained three questions (about sex, age, and working status), on which basis the demographic structure of the sample was analyzed. The third part covered ten questions about specific habits and purchasing decisions and motivators that lead to them.

In order to examine the compatibility of sales promotion and other marketing communication tools, and the effectiveness of their integrated potentials, respondents were asked the question: “How do you get informed about the special benefits for purchases you intend to do?” They were able to choose between 11 categories, among which there were different types of advertising, direct marketing and other forms of digital communication.

3.3. Demographic structure of the sample

Out of 166 persons who have accepted to fill the questionnaire, 162 respondents fulfilled both eliminatory conditions and their answers were further processed. Of these, 119 (73.5%) were female and 26.5% male. Survey found the following results as it relates to age of the respondents: 73 of them (45.1%), belonged to the age of 18-24 years; 54 (33.3%) respondents in the age group "25-34 years"; 11 (6.8%) respondents in group "35-44 years"; seven respondents (4.3%) in group “45-54 years”, and 11 (6.8%) were in group "55-64 years". The smallest number of respondents, six of them (3.7%), were from age group "65+". When it comes to working status, the majority of respondents, 62 (38.3%), stated that they were employed for a full time or stable, followed by unemployed respondents - 56 (34.6%), then those who were employed on part-time and temporary jobs - 37 (22.8%) and at a smallest percentage - pensioners who were only seven (4.3 %).

4. ANALYSIS OF SALES PROMOTION INSTRUMENTS ON PURCHASE INTENTIONS AND BEHAVIOUR

On the basis of the conducted primary research, it is possible to make a conclusion about the adequacy of investigated sales promotion instruments for achieving specific marketing goals, as well as the compatibility of these tools with other forms of marketing communication (online and traditional mass advertising, direct marketing, etc). This way an opportunity to maximize their individual and integrated potentials has been created.

4.1. Free samples

Free samples are a sales promotion instrument that has demonstrated the highest effectiveness in the Serbian market in the analysis of overall performance for all observed marketing goals.

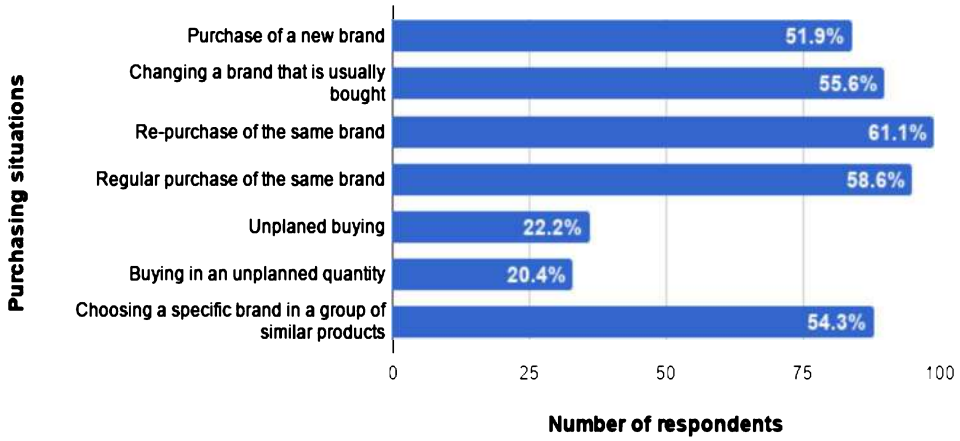

Figure 1: The impact of free samples on purchasing intentions

This sales promotion instrument is extremely well accepted among Serbian consumers, since 84% of respondents replied positively to the question: "Will you try a new product if you are offered a free sample of it ?". Primary research showed that the most significant effects with free samples can be achieved in case of encouraging repeated purchases, as 61.1% of respondents said they would re-purchase a particular brand due to their belief in its performance thanks to a free sample. The smallest effect of free samples has shown to be in persuading consumers to buy bigger quantity of product from the planned (20.4%).

The effectiveness of free samples in increasing sales can be explained by the fact that they provide consumer with a direct experience with product and the ability to personally verify its performances. Besides that, the free sample of the product is, as a rule, free of charge, which releases consumer of the financial risk. This can be brought in connection to the price sensitivity of Serbian consumers, which is why this marketing stimulus is susceptive.

4.2. Discounts

Discounts are sales promotion tool that show a great marketing potential in the Serbian market. After free samples, discounts proved to be the second most appropriate sales promotion technique for: attracting new consumers and consumers of competing brands; encouraging repeated purchases and building a brand-loyalty; raising the sale of a new product; encouraging unplanned purchases.

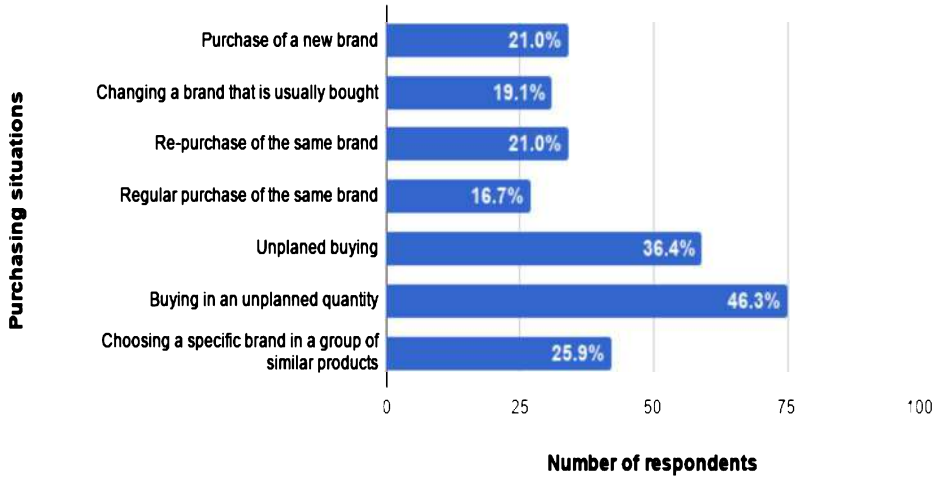

Figure 2: The impact of discounts on purchasing intentions

Discounts showed the greatest effectiveness in encouraging unplanned shopping. In total, 46.3% of the respondents stated that discounts are the reason why they leave shops with a larger amount of products than planned. Of the above mentioned marketing goals, discounts were least suitable for encouraging regular purchases (16.7%), but still among the five most effective tools used for this purpose. The reason for the effectiveness of discounts in a wide range of marketing goals can be in a fact that Serbian consumers are very price sensitive, due to the high percentage of unemployment and the unstable economic situation in

the country. In addition, this is one of the most commonly used sales promotion instruments in the FMCG industry, so consumers are accustomed to this type of shopping convenience.

4.3. Bonus packs

The study examined the effectiveness of the special offer "1 + 1 gratis", as one of the bonus packs options.

The best effects were noticed in encouraging unplanned purchases. Namely, 60.5% of the respondents stated that due to the offer "1 + 1 gratis" they would purchase a larger quantity of a product than planned, and 42% of them would be motivated by this convenience to buy items that had not previously been planned. These data also testify that bonus packs are a convenient tool for providing consumers with stocks, thereby reducing the ability to be attracted to the stimulus of competing companies, knowing they have enough quantities of this type of product. The survey showed that the smallest percentage of probability (13%) for this technique to be effective is in the situation of motivating consumers to replace the brand they are usually buying.

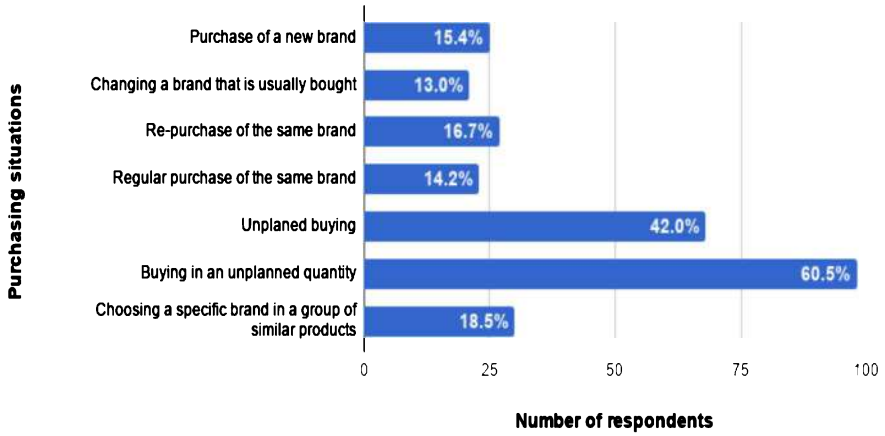

Figure 3: Impact of bonus packs on purchasing intentions

4.4. Contests and sweepstakes

These tools, which are described in the relevant literature (Belch & Belch, 2014; Boundless Learning Inc, 2017) as an adequate tactic for building brand-loyalty, has not shown significant effectiveness in the research for the Serbian market. The highest effectiveness of this instrument, with only 4.3% probability for attracting consumers, has been shown in the case of unplanned purchases and purchases of a new product on the market. Almost no effectiveness (0.6%) contests and sweepstakes have on the choice of a specific brand in a group of different brands of products with the same purpose. The explanation for the low effectiveness of these sales promotion instruments lies in: the frequent lack of confidence of Serbian consumers in the honesty and ethics of the organizer of such marketing activities; the reluctance to provide personal information (which is a necessary condition for participation), and the absence of the possibility of savings or an immediate and secure additional value.

4.5. Loyalty programs

Like in the case of gifts, loyalty programs, in the Republic of Serbia, in comparison with sales promotion instruments with current effect, do not show significant performance.
Although loyalty programs are described in literature as the most appropriate sales promotion instrument for building brand-loyalty (Belch & Belch, 2014;), only 14.8% of consumers said that this tool would motivate them to purchase a particular brand. The smallest number (5.6%) would replace the brand that it usually bought because of benefits derived from the loyalty program.

Price sensitivity, focus on financial benefits, favorability for special offers that do not require additional engagement and the provision of secure and immediate benefits are again imposing as potential reasons that Serbian consumers do not show affinity to long-term sales promotion tools, including loyalty programs.

4.6. Informing about sales promotion tools

Considering the noticeable presence of the concept of integrated marketing communications, both in academic literature and in practice, in this part of the research, attempts have been made to determine the degree of complementarity, that is, the synergetic effect of sales promotion and other marketing communication tools. From a wide range of marketing communication tools, those instruments that are most commonly used in the marketing communication in FMCG industry were examined, distinguishing between their traditional forms (TV, radio, print and other) and digital forms of communication (SMS, email, web portals and social networks).

In four of five (80%) cases, consumers in the Serbian market are informed about the extra-benefits for preferred purchases through company's advertisements. The results showed that most of the Serbian citizens (45.7%) are informed about the special benefits for purchases they plan to do via web portals and social networks, eg digital communication tools. This is yet another confirmation of the trend of the mass reorientation of Serbian population from traditional to digital media.

The research has confirmed that the most common way of informing modern consumers about the benefits that companies offer through various instruments of sales promotion is digital communication - SMS, email, web portals and social networks. Web portals and social networks have shown even greater impact than traditional advertising via television which, until recently, has had a priority in the field of promotional informing of general public (citizens aged over 18 years).

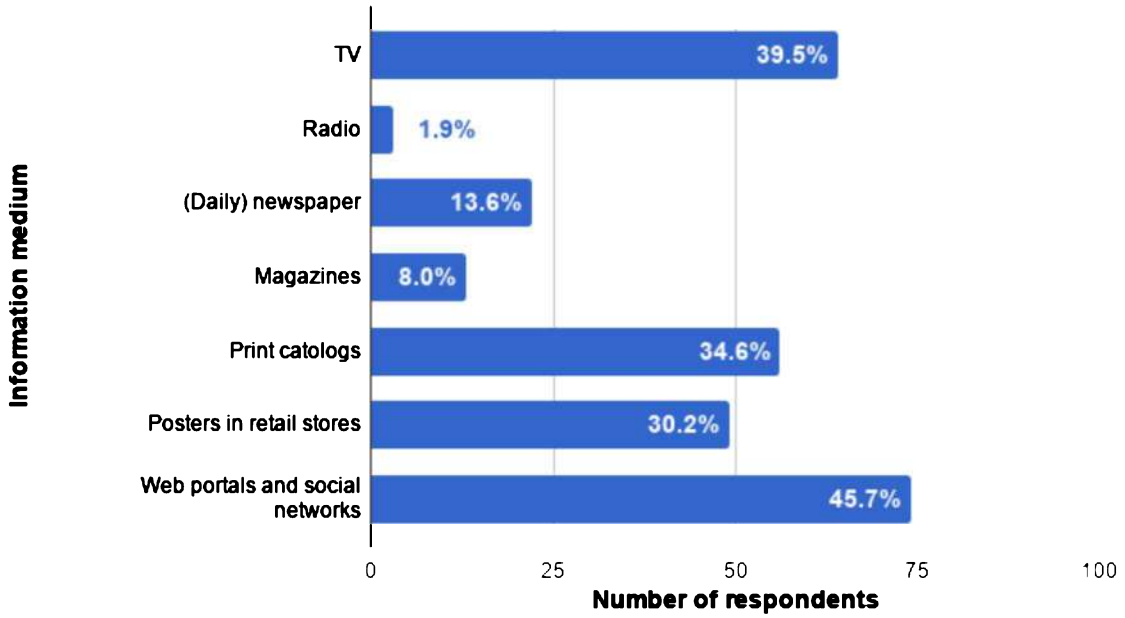

Figure 4: Presence of mediums through which consumers are informed about the benefits related to planned purchases

5. CONCLUSION

Based on the analysis of results of conducted empirical research, it can be concluded that the small purchasing power of the average Serbian consumer and, consequently, high price-sensitivity, are main causes of his orientation towards the so-called "short-term" sales promotion instruments, such as discounts, free samples and bonus packages. The reasons are: lack of financial or other risk in deciding for brands that include this type of promotional mechanism; avoiding additional engagement and time (e.g. collecting stickers and bills, sending creative solutions in order to win a certain prize, etc) and providing instant and obvious benefits - most often financial savings.

A general recommendation for marketing managers operating in the Serbian FMCG market is to focus on sales promotion instruments that are directly related to the price and immediate added-value for consumers, such as discounts and bonus packages. Based on the proven significant effectiveness in all of examined purchase situations (purchase of a new brand, unplanned shopping, replacement of a brand that is usually purchased, regular purchase, etc), it is recommended to frequently use the free samples, which proved to be an effective tool for achieving almost all investigated specific marketing objectives. In encouraging unplanned

shopping, it is also advised to use discounts, free samples and bonus packs, as well as gifts in case of stimulating the purchase of a particular product in a larger quantity than planned.

The results have shown the effectiveness of the integration of these instruments with advertising messages, with the focus on direct marketing via SMS and online tools - web portals and social networks that have proved to be the most appropriate for informing consumers about these benefits. Considering the fact that the trend of mass digitization in recent years is present in the Serbian market, it is advised to companies to take on the role of the leader of innovation in this dynamic field, where proactivity and originality are the most secure ways to win attention and the consumers' attachment to the brand. It is advised to focus on the authenticity and high quality of creative solutions. In that sense, production and usage of new media formats are encouraged.

Although they are described in the relevant literature as effective tools for building brand-loyalty, sales promotion instruments which are not connected with product's price reduction, such as contests, sweepstakes and loyalty programs, did not prove to be effective motivators for purchase in the Serbian market. As a limitation to this research, relative generalization can be indicated, as it relates to a very wide field of FMCG industry that includes products of diverse characteristics and financial value. The recommendation for further research is to test the effectiveness of marketing communication instruments in relation to the specific product type, as well as focusing on more specific target groups of respondents. In addition, it is proposed to focus on testing the effectiveness of digital versions of sales promotion instruments (online coupons, contests, loyalty programs, etc) which are increasingly used.

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CURRENT TRENDS IN DIGITAL MARKETING COMMUNICATION

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Abstract: *This document is an overview of current trends in digital communication. Digital marketing and it`s tools (online advertising, online video and interactive television advertising, mobile marketing, buzz marketing, websites and social media) are perfect for communication with all stakeholders, and at first place with customers. This days the main challenge of companies and digital marketing communication is being noticed. Digital technologies match traditional communication and media channels, beside that they span the marketing mix. Accordingly, digital communication become significant element of marketing communication. Companies can hardly gain profit without getting noticed, especially if the target audience is young people that are digital natives. The originality of this paper is its focus on new trends in digital communication and their impact on companies processes to explore how a strategic adoption of digital communication tools can influence creating company's strategies and action plans.*

Keywords*: digital communication, marketing communication, new trends, social media*

1. INTRODUCTION

Digital must become "part of what you do and who you are." (Kirk Borne)

Digital technologies intensified a global competition so the most important thing for companies is to implement it in its business and communication strategies. Digitization is rewriting the rules of competition, with incumbent companies most at risk of being left behind (Hirt & Willmott, 2014). Internet as the biggest communication cannel gives to organizations a vide spectra of digital communication tools they can use to approach target groups and stay in touch with customers.

Customers now days use various on-line tools to communicate. Tremendously big number of information are accessible as never before—from proprietary big data to new public sources of open data (Hirt & Willmott, 2014). Surfing the Web is todays must. As the use of smart phones and android devices become everyone's routine on a daily bases internet and digital media become a crucial part of every individuals lives. Customers become much visible and social media give them a voice that can be spread unbelievably fast worldwide. They build like-minded communities where they share their experiences, find information, network, and socialize.

Companies can send and receive multimedia content in order to communicate with different target groups, also they can reach new business partners. Even the digital and online radio, television, newspaper, magazines etc. have become available. Global society have a significant impact of social media, particularly of social networking sites (Facebook, LinkedIn, exc.) and microblogging sites (Twitter). Individuals, organizations, communities and different businesses around the world use social media to communicate.

Today companies must know when customers are making decisions to buy and then to react in real time. (The Economist Intelligence Unit Limited, 2014). Customers use new media to express or explore the opinions before and after the use of some products or services. Bearing that in mind it can be said that new media are playing an essential role in marketing communication process. Websites, applications, mobile phones (smartphones and android), e-mails, social media, banner ads, PDAs (Personal Digital Assistant), are the most frequently used tools by companies in order to communicate and collect information's. Today's consumers are spending over 85% of their time on their smartphones using native applications, but most of their time, 84% is spent using just five non-native apps they've installed from the App Store (Perez, 2015).

Digital communication is specific and increases the level of perception and remembering of the received information. Companies can easily get instant feedback from customers and respond to it. Companies use different tools in their digital marketing communication process. Some of them are personal computers, smartphones, cellphones, tablets TV and game consoles, etc.

In today's global markets, where ICT (Information Communication Technology) is now widespread, information and communication channels are primarily digital channels (adopting specific technologies that

continue to evolve in time), while communication flows are digital packages that can contain data, sound, images, film or various combinations of the same, indifferently

2. NEW DIGITAL COMMUNICATION TRENDS

Observing globally number of users of digital communication tools are increasing. At first place the total number of Internet users is increasing all around the globe. According to Global Digital Report 2018 the largest internet penetration has Northern, Western, Southern and Eastern Europe with 94%, 90%, 77% and 74% internet users compared to total population and North America with 88%. Also, total number of internet users worldwide in 2018 is 4.021 billion, up 7 percent year-on-year. That means that, over half of the world's population is now online. In the same report is stated that the number of social media users worldwide in 2018 is 3.196 billion, and it`s up 13 percent year-on-year. On the other hand, the number of mobile phone users in 2018 is 5.135 billion, up 4 percent year-on-year. In other words, more than two-thirds of the world's population now has a mobile, with most people now using a smartphone (Global Digital Report 2018, 2018).

Table 1: Mobile users vs mobile connections **(**Source: Synthesized Global Digital Report 2018, 2018**)**

Number of unique mobile users (any type of handset)	**5.135 billion**
Mobile penetration (unique users vs total population)	68%
Total number of mobile connections	8.485 billion
Mobile connections as a percentage of total population	112%
Average mobile connections per unique mobile user	1.65

Important to mention is data that the average internet user now spends around 6 hours each day using internet-powered devices and services (the latest data from GlobalWebIndex). Results of the other research shows that modern consumers spend over 85% of their time on their smartphones using native applications, but the majority of their time, 84%, is spent using just five non-native apps they've installed from the App Store. According to Forrester Research the smartphone category is no longer useful as all phones become smart. As Apple and Google arrived in the mobile market other companies were made to try to get into the smartphone business (2009). All mobile handsets are becoming smarter and Internet capable (Global Digital Report 2018, 2018).

According to GlobalWebIndex, 2014; Global Social Media Trends 2015, European Publishers Council a global time spent on media per day in 2014 can be seen in Table 2.

Table 2: Global Time Spent on Media Per Day, 2014 (Source: Synthesized GlobalWebIndex, 2015)

Media type	**Amount of time spent**	**Percentage of time spent**
Traditional TV	2.58 hrs	23%
Social networking	1.69 hrs	15%
Traditional radio	1.14 hrs	10%
Other online activities	1.06 hrs	10%
Gaming via console	0.81 hrs	7%
Micro-blogging	0.79 hrs	7%
Online press	0.71 hrs	6%
Online TV	0.70 hrs	6%
Online radio	0.61 hrs	5%
Traditional press	0.60 hrs	5%
Blogging	0.53 hrs	5%

The term digital marketing has become popular thanks to the inclusion of a wider range of digital and network communication technologies, including mobile phones and digital television. The widening application of digital technologies suggests that marketers should extend their thinking beyond the Internet to encompass all the platforms that permit a firm to do business electronically. (Chaffey & Ellis-Chadwick, 2012)

Authors Tuten and Solomon (2013) stated that the social element involves thinking about social media as the way digital natives live a social life (participation, democracy, freely interaction with other users, etc.). In

order to engage customers or to create brand awareness or to spred profesional network companies most comonly implemet Facebook, LinkedIn, Twitter and YouTube in their digital marketing.

Author Lincoln specify ten key tools of social media (Stavljanin, Filipovic & Kostic Stankovic 2011, Lincoln, 2009): Blogging, Microblogging, RSS, Widgets, Social Networks, Chat rooms, Message Boards, Podcasts, Video sharing and Photo sharing.

The technology is used to create an environment that facilitates different forms of online activity. For example:
• social community media (Facebook, Twitter, LinkedIn) The social community includes social networks, message boards, forums and wikis. - enable sharing of ideas, interests, socializing and having conversations (Tuten & Solomon, 2014),
• social publishing media (YouTube, Pintrest, Flickr, WordPress, Instagram) can be divided into four groups: individual users, independent professionals, professional contributors and brands - enable signed-up members to publish and distribute editorial content, movies, audio, photos (Tuten & Solomon, 2014),
• social commerce media (Yelp, Groupon, Etsy, TripAdvisor, Groupon and Facebook), which enable buying and selling, trading, building relationships (Hajli, 2015),
• social entertainment media (come2play, Zynga12, YouTube, Spotify, Reddit and various online interactive games like Trivia Crack, Candy Crush and other) - enable game playing and entertainment across communities (Whiting & Williams, 2013).

In other words, social (life), media (environment) and network (interconnections—technology and human) are three elements which have come together to create the latest and fastest-growing online phenomenon (Digital marketing and social media, 2012).

One especially important characteristic of digital technologies, considering marketing communication, is opportunity of controlled execution and feedback related with each communication.

The banners, pop ups, etc. that open up on almost every single web site, are forms of digital advertising whose aim is to prompt the surfer to 'click' to obtain information about a product, a brand or a company offer. They demand the user's involvement and he chooses to search for more information, thus making it possible to transmit the corporate communication in a personalized form, in a time frame and content that can develop an active interest in the user.

Web sites, mobile applications, social networks and other digital communication tools collect and analyze many aspects of their users – companies customers or potential customers. For example, by IP address (Internet Protocol unique for each user) companies get information about where are the user from, cookies give information about persons movements, also time spent on some page is measured, number of clicks, number of likes, shares etc.

YouTube and Vimeo are the platforms for uploading, publishing, streaming and viewing videos online (wpbeginner.com). There individual can watch the news, learn, follow favorite band, singer, etc.

Instagram is the platform for sharing pictures and videos publicly or among the followers is used as a portfolio or a photo album (socialmediaexaminer.com).

Snapchat is a mobile application that allows its users to exchange various media content that is only available for a short period of time (hubspot.com).

Spotify, Apple Music, Pandora and Tidal -- as well as Google Play Music and Amazon Music Unlimited are a music, podcast and video streaming social media platforms. They contain a large audio and video library, where users can explore various content and share music finds with their friends across the various social media platforms (cnet.com).

The case of online interactive games like Trivia Crack, Candy Crush and other is particularly significant for the young people. Advertising companies place their trademarks or products in them through product placement contracts, adding to the realism of the context in which the game is played. Players may actively choose the sponsor of their player (from several alternative sponsors envisaged by the game) while their opponents or the side of the court or track are defined by the software, or by product placement contracts which have helped to fund the product.

Digital communication technologies don`t require constant persistence of all participants in the same virtual space in order to establish the relation. They do not have time limit, without specific beginning or end of the process.

3. NEW DIGITAL COMMUNICATION TRENDS

According to El-Darwiche at. all (2017) WhatsApp, Viber, and Apple's iMessage already represent more than 80 percent of all messaging traffic, and Skype alone accounts for more than a third of all international voice traffic minutes.

Big Data applications facilitate personalized products and services and mining them opens up new opportunities for process optimization, the identification of interdependencies, and decision support. IBM's Watson computer and Apple's Siri understands human's, and Siri use Google Maps to lead you on the place where you want (Helbing, 2015).

The rise in social media advertising also marks a continued trend by marketers to establish more intimate relationships with their customers (Wright, Khanfar, Harrington, & Kizer, 2010). Research conducted by authors Swani, K., Milne, G.R. & Brown, B.P. (2013) have corporate Facebook pages in focus in order to better understand the effectiveness of social media content in leading to consumer responses. Authors Buratti, N., Parola, F. and Satta, G. (2018) conducted a quantitative research that provide empirical insights on their social media activity on three different social media platforms, i.e., Facebook, Twitter, and LinkedIn. The research results indicate the importance of the adoption rate of the most diffused SM tools, the size of the digital networks of stakeholders (number of followers), the intensity of the communication activity (number of posts, shares, photos, videos), and the level of customer engagement (number of likes and shares) (Buratti, N., Parola, F. and Satta, G., 2018). Other study reveals a positive relationship between "liked" brands on Facebook fan-page and brand love (Kudeshia, C., Sikdar, P., & Mittal, A., 2016). That means that liking a fan page can significantly influence brand love and word of mouth is found to be an outcome of fan page liking.

Modern customers, especially members of Millennial generation and generation Z, usually look for information about products and services on social media before making a decision to purchase and that is the main reason why social media has become very important for communicating with customers (Mamula, T., Radojevic, I., & Slijepcevic, M., 2016). Members of Millennial Generation in the are better connected, they have more friends online (social networks) as well as offline, and they feel their life is fulfilled when they are connected with people through social media (Radojevic, I., Krasulja, N., & Vasiljevic Blagojevic, 2014).

Facebook's core platform still dominates the global social landscape, with total users up 15 percent year-on-year to reach almost 2.17 billion at the start of 2018, followed by Youtube with 1.5 billion active user accounts (Hootsuite, 2018). WhatsApp and Facebook Messenger (with 1.3 billion users each) both grew twice as fast as the core Facebook platform though, with the number of people using each messenger app up by 30 percent year on year.

Here are the essential headlines for digital in Serbia in 2018:
The number of internet users in 2018 is 6,32 million, with penetration of 72%. The number of active social media users in 2018 is 3.60 million, with penetration of 41%. The number of mobile phone subscriptions in 2018 is 9,66 million, with penetration of 110% (Hootsuite, 2018).

4. CONCLUSION

Development of Internet, especially mobile Internet made a great impact on business and customers behavior. It offers a new way to create, publish and search for information. Together with the development of mobile Internet and its use in companies, marketing activities, including also marketing communication, started to be conducted with the help of this new medium.

The personal experience of individual consumers who has and use some product or service is more reliable in the opinion of many consumers than, advertising, research results, or marking products with various symbols denoting (good quality, safety) (Drzazga, M., 2013).

Digital media can contribute to the success of a company on the market. Marketing activities carried out with the help of digital media may lead to the creation and enhancement of market position of a company and its products. Digital media is a very important part of modern consumers' lives, which is why it should be taken into consideration while planning marketing communication activities. However, appropriate knowledge and creativity is required of the companies.

Unlike the traditional media, the social media is becoming companies important marketing tool for engaging with their customers. Using social media in digital communication marketing companies can benefit making good relations with their target market and learning about their needs. On the other side social media can be a threat to company's business as word of mouth spread fast and can be highly influential in viral environment. Companies must have a social media strategy in order to deal with the enormous challenges that comes along with social media.

New technologies changes rapidly so modern companies must invest in digital and find the way to track current changes and to be prepared for them. On the other hand, measuring the RIO (return on investments like these) can be hard because the traditional cost-benefit analysis is not propriate for businesses that are embracing mobile, social and big data, because (A report from the Economist Intelligence Unit, 2014).

Since this is a very important and contemporary phenomenon it is recommended that a further research to study this phenomenon would be appropriate.

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DIGITAL MARKETING STRATEGY FOR HEALTHY FOOD INDUSTRY

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Abstract: *The purpose of this paper is to present the proposal and the plan of realization a digital marketing strategy campaign. More precisely, the paper presents the framework for creating a website and presence on social media for the health food company. The theoretical concepts are presented through a practical example of fictious company which produces Serbian national preserved organic food. Theoretical concepts and practical examples presented in this paper can serve people in practice in creating a business model and implementing a digital marketing campaign.*

Keywords*: digital marketing, social media marketing, website, 7C concept, healthy food Industry, organic food*

1. INTRODUCTION

The technological revolution has influenced to great extent not only on people's life, but on every business model. The fact that people are using internet and social networks much in everyday life has caused great changes in the way of communication between business and clients – from offline to online. Although the implementing a social media in regular business model in Serbian companies hadn't stared at the same time as global trend has, nowadays for the vast majority of Serbian companies it is common to be present in digital world as well as real word (Bauer, 2012).

When it comes to production of organic goods, Serbia follows the global trends, too (*Organic Production in Serbia*, 2016). The population of Serbia has become aware of organic food benefits, creating a good opportunity for market expansion. However, the market hasn't recognized this opportunity – they haven't realized the power of social media yet, or they aren't even present on internet.

In this paper we present digital marketing strategy model for organic production, through theoretical concepts and practical example that could have had a positive effects on the business results in this field.

2. THEORETICAL BACKGROUND

Nowadays, "If you are not online, you don't exist." According to a survey from 2015 (Awad, 2105) 85.3% of buyers browse the Internet before making a purchasing decision, while 77.7% of buyers always start their research with Google. But business owners sometimes don't know how to set up their business online. The first step and the most important task is to create digital marketing plan, which includes following steps (Smith & Zook, 2011):

1. Situation analysis
2. Objectives
3. Strategy
4. Tactics
5. Actions
6. Control

When the plan is created, the internet presentation developing should begin. There are many approaches to doing this task, but one should not omit considering the 7C's concept (Rayport & Jaworski, 2001). This concept defines the most important rules and aspects of creating web such as: content, context, communication, customization, connection, community, and Commerce.

The content refers to all forms of multimedia content within the web site; content means text, graphics, sound, music, and/or videos that are presented on the web site (Jović, 2016; Jovic, Milutinovic, Kos, & Tomazic, 2012). Through the content, clear and concise information should be defined, and on the other hand, it is essential that information is interesting for the customers and make them stay on the web site until he finishes the purchase. It is also recommended offering some educational and entertaining content related to core business.

The context relates to the aesthetics appearance, the functional look and feel that web site provides to layout and design (Stavljanin, 2016). A website's layout and overall visual design needs to be uncluttered, easy to read and navigate, the color scheme needs to be appropriate for the marketing design. Having some white space will also aid in the overall design and readability.

Communication refers to the way the company talks to its customers; this can be done through signing up for special offers, email newsletters, contests, surveys, live chat with company representatives, and company contact information. The communication represents the web site's ability to maintain relationship whit its target audience. This can be achieved in three ways, or three directions (Stavljanin, 2016): (1) site to customer, (2) customer to site, and (3) Customer to customer. Nowadays, the use of artificial intelligence is becoming more and more popular in the purpose of communicating between the company and customers by introducing chatbots. The goal is to make responses more natural as well as provide quick answers to customers.

The customization gives the ability to the customers to modify the web site according to their preferences (Stavljanin, 2016). Companies can allow customers to personalize aspects of the website or it may tailor itself to different users, for example having different colors and graphics for people who speak different languages (Novak, 2015). Customers can subscribe to some specific topics, therefore avoiding information they don't want to receive (e.g. newsletters).

The purpose of the connection is to bring the customer from other websites, no matter if it is related to the business or not (Novak, 2015).

The community is defined as a common interest based relations (Novak, 2015). Good communication and deep relation with the target audience drive to a community. When a community is established it means that target audience of company is gathered and is sharing similar opinions. The advantages of the good community are numerous: It is easier to create loyal customers that can become brand ambassadors; also, the community allows share important information in no time. The website may allow interaction between customers through message boards and live chat (Novak, 2015).

An online store is an important element of web site that allows customers to buy goods online. It is essential to provide the information about products (name, size, price, composition, weight, payment, etc.) and good customer experience. If the website is intended for commercial transactions, then it has to be safe and the fact that is has been made safe must be communicated to the customer, most websites use a "lock" symbol in the corner to indicate that it has been encrypted (Novak, 2015).

3. PRACTICAL EXAMPLE

Following sections show a practical example of factious company which produces Serbian national preserved organic food.

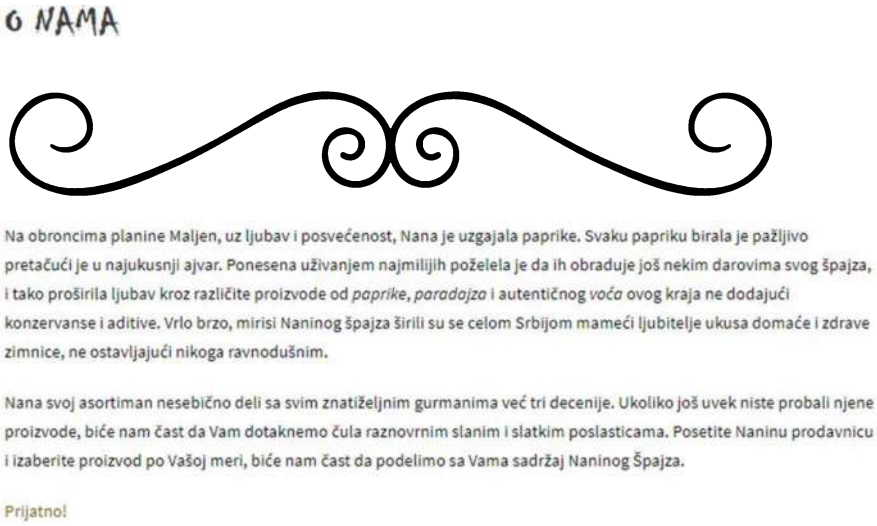
3.1. Web site

The Home page is the page where the first impression of the customer is created. So, for the positive impression, it is necessary to make this page look interesting and meaningful (Jović, 2013). Photos put in a slider should be carefully picked, because they are the first thing that catch the sight of a customer, otherwise he can happen to lose the interest in continuing exploring the website and purchasing from it.

The navigation menu allows users to move quickly and easily through the web site, reaching the information they are interested in. The navigation menu is often located in header of the website (Figure 1). It is recommended to add all the important pages in this menu, so the customers could find everything they want about the company, its management, finance, and about the product itself. Nowadays, for a successful business, it is essential to keep everything transparent. That will make a strong bond between a company and its customers.

Figure 1: Website preview

The mission and vision statements should not be omitted, as they are pointing out who and what the company really is (Kotler & Armstrong, 2014). In the section ''About us'', there should also be given a short story about how the company was established – some kind of a storytelling Figure 2.



O NAMA

Na obroncima planine Maljen, uz ljubav i posvećenost, Nana je uzgajala paprike. Svaku papriku birala je pažljivo pretačući je u najukusnji ajvar. Ponesena uživanjem najmilijih poželela je da ih obraduje još nekim darovima svog špajza, i tako proširila ljubav kroz različite proizvode od *paprike*, *paradajza* i autentičnog *voća* ovog kraja ne dodajući konzervanse i aditive. Vrlo brzo, mirisi Naninog špajza širili su se celom Srbijom mameći ljubitelje ukusa domaće i zdrave zimnice, ne ostavljajući nikoga ravnodušnim.

Nana svoj asortiman nesebično deli sa svim znatiželjnim gurmanima već tri decenije. Ukoliko još uvek niste probali njene proizvode, biće nam čast da Vam dotaknemo čula raznovrnim slanim i slatkim poslasticama. Posetite Naninu prodavnicu i izaberite proizvod po Vašoj meri, biće nam čast da podelimo sa Vama sadržaj Naninog Špajza.

Prijatno!

Figure 2: Website storytelling

At the bottom of every page should be provided some elementary information such as address, telephone number, e-mail, position on map, etc.

The visitors should be able to create their own account at the website, so they could receive interesting information such as news on website, events, new post on blog, and some other benefits. But it is also very important giving them an option to sign out from the newsletter at any time. An example of sign in to newsletter form is presented at the figure 3.

Figure 3: Sign in form

It is important to understand that the power of targeting is the power of a website. Therefore, creating specified groups of customers will improve the customer experience as well as the business results of the company. If the offer is specially tailored for each customer category, customers will be more loyal to the company, their products, and will be pleased to be the part of its story.

For an organic production company, certificates as a proof the food are produced organically. Also, the other certificates should be attached, if there are some.

The Gallery is a very important part of a website, since the visual elements are the most appreciated in the last few years (Figure 4). As mentioned earlier, the genuineness and the honest relation between company and clients are an imperative, so when choosing the photos for the gallery, the company should tend to represent itself in the best way possible, but also should not try to give a false impression of what it really is. Along with product photos, the gallery should consist also photos of whole process, events, and everything else that will fully describe the identity of a company.

Figure 4: Gallery

For the company which is selling goods online, it is necessary to pay attention to the online store. An online store must consist of product photos (Figure 5). Also, various information should be given: name of product, measurement unit, price, discount, composition, additional information and notes. All the product photos should be taken and edited in the same way, desirable by the one professional photographer. For even better customer experience, company can allow customers to see product form 360 degree angle. If there is lot of products, it is recommended to categorize them making the search easier. The Products should be wisely separated in meaningful parts. In the case of the organic food production, the convenient categories

may be: fruit, vegetables, processed fruit, processed vegetables, but there could also be categories for the ways of use of the products, for example. The customer should be allowed to simply add a product in his cart, and to continue with shopping from where he left. My cart is the part of the online store, where all the products a customer wants to buy are. There, prices and quantities of each product are listed, with the total amount of money. The customer should be allowed to make a purchase in two ways: as a registered user or as a guest, giving only information needed for the product delivery. Also, it is important to offer different ways of payment and describe them thoroughly.

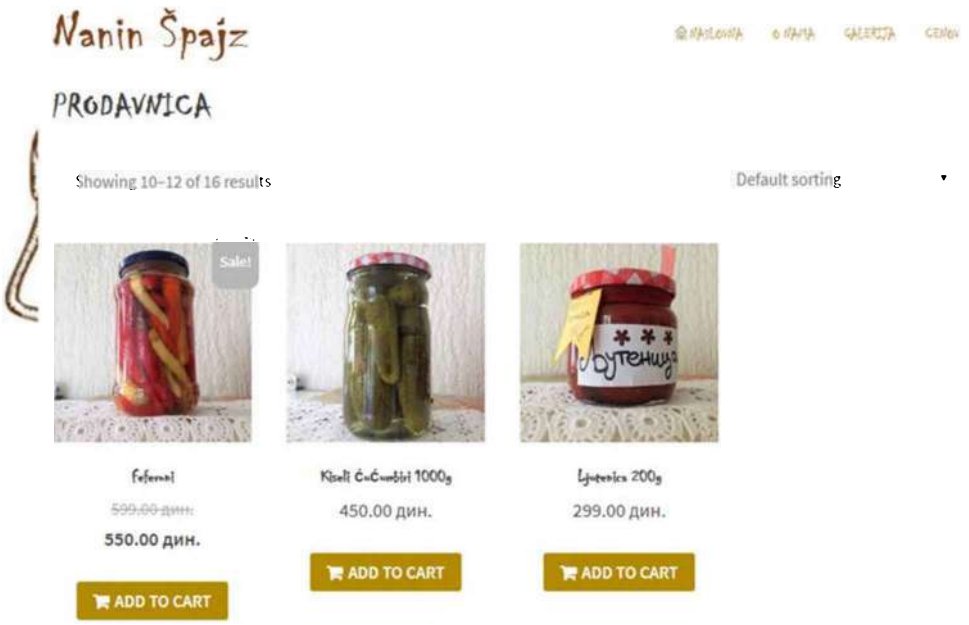


Figure 5: Online store

In addition to basic content that is closely related to the company's business, there should also be given the content that is useful and interesting to target group, but not related to business (Figure 6). That type of content could refer to healthy habits, recipes with organic products, events connected with healthy lifestyles and. There should exist a There should be a separate part of the website dealing with these issues. Such content is important because it helps create a good community that will often visit the site and be engaged.

Figure 6: Additional content

Given the fact that people are increasingly present on social networks, users should be allowed to simply reach a social platform, such as Instagram or Facebook from the website. There should be buttons leading from the company profile to the desired social network.

3.2. Social media

The importance of social networks is getting greater every day; in some cases more activities are performed on the social networks than on the websites. That is the reason why every company should make an effort to find out what social network the target groups are present at and what kind of communication they expect to have. Below, we will be talking about activities that can be taken on social networks that will contribute to the development of business.

It is recommended for a company that produces and sells organic goods to have at least Instagram and Facebook profile. Each of the profiles should contain basic information about the company as well as the link that leads to the company's website (Kostić-Stanković, Filipović, & Štavljanin, 2017). The power of social networks is that they allow a large number of tools both for targeting and for interacting with the target group. These two social networks essentially offer the same options for targeting tools. It is possible to define a very narrow group using a number of criteria (city, municipalities, education, gender, age, interests). However, the essential difference is in the way of communication. More precisely, communication on Instagram is based on minimal use of text, but on interesting photographs that show products and, also, any aspect of life in which the product is present. Interactivity is based on the ability to engage users at a higher level. Through various interesting posts requiring a user comments, prize games that require a user to take action in order to win a prize (which is often closely related to the product) (Gunelius, 2017). Another possibility of Instagram is sponsoring a photo. By clicking on a sponsored post, the user is redirected to a website, in an online store to easily make a purchase. One should not omit the great power of the hashtag, which can now be incorporated into all the company's activities. A company can create its own hashtag that carries a specific message that becomes recognizable and powerful, so the followers may wish to add a photo with company's product whit the same hashtag, thereby contributing to the promotion of the company's products. When an event is happening, the company can make a live video on the Instagram and allow followers to make impressions, comments and questions in the real time.

Although it seems less popular than Instagram, Facebook is still very important in digital marketing (Lieb, 2011). On this social network there is more textual communication between company and customers, than on the Instagram. Facebook posts can also be sponsored, so the greater number of people can see them and visit the web site. Live videos can be made on Facebook, for the same purpose as on the Instagram. But, the whole activity on Facebook should not be much oriented on the business itself, but on the social community interests.

There is a rule, which defines that within a week less than three and more than five posts should not be posted (Lee, 2014). This rule should not be blindly followed. What should only be taken into account is the amount of the content and how much it is interesting, as well as giving space to followers to reproduce the content.

Although at first glance managing profiles on social networks looks like a simple task, it is a very complex one, because it requires knowledge about the target group and also the ability to estimate when the new content is required. It is therefore very difficult to set up rules for a campaign on social networks.

4. CONCLUSION

At the end, it is necessary to conclude that every digital marketing campaign differs from others and there is no universal plan that could work in every business. However, everything written in this paper could be taken in consideration when planning a digital marketing strategy, since the basic rules are given. Every company should adjust this plan to its business goals, strategy and target group. This topic is very broad and complex, because there are lots of factors that influence the digital marketing strategies. It is the most important to analyze, plan, and monitor every activity, so the evaluation and applying corrective measures could be done in the right way. Digital world is extremely dynamic, with changes happening every day, therefore keeping up with technology and learning about the possibilities is essential in order to improve company's digital presence.

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MULTIPLE SWARMS ARTIFICIAL BEE COLONY ALGORITHM APLIED ON RETAIL SHELF SPACE ALOCATION PROBLEM

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Abstract: *As the number of products in retails continuously increase, shelf space is becoming ever more important resource. The allocation of shelf space in retail is NP-Hard problem and a few studies demonstrate usage of the bio-inspired heuristics in an attempt to solve it. Bio-inspired heuristics are great fit for parallelization as implicit parallelization already exists. In study presented herein, island based model was used for parallelization of Artificial Bee Colony algorithm. The main motivation for parallelization was achieving higher quality of obtained results. Beside main goal, the reduction of execution time was expected. The proposed version of parallel ABC, called Multiple Swarm Artificial Bee Colony (MSABC) obtained better results for the set of benchmark problems reducing execution time by nearly 75%.*

Keywords*: Shelf, Space, Allocation, Parallelization, ABC, Algorithm*

1. INTRODUCTION

Due to increasing number of brand lines and products in retail shops, the problem of shelf space allocation is getting more attention in the last decade. Shelf space in retail is mostly fixed and scarce resource, forcing retailers to choose which product to display and how much space to allocate to each product. Irion, Al-Khayyal, and Lu (2004) observed that the majority of buying decisions are made at the point of purchase which puts even more pressure on retailers to decide how products will be grouped and displayed since their stock levels and store profit depends on it. Wolfe (1968) showed empirical evidence that sale of clothing merchandise is proportional to the amount of inventory displayed. Larson and DeMarais (1990), introduced 'Psychic stock' as a new variable that influences sale dramatically. Based on their studies showing that higher sale could be achieved just by keeping shelves fully stocked, 'Psychic stock' represents full-shelf merchandising policy, which means that retail shelf should be always kept fully stocked. Silver and Peterson (1985) pointed out that the product demand in retail shops correlates with the amount of displayed inventory. The allocation of shelf space is NP-Hard problem. Hansen, Raut, and Swami (2010) illustrated that if there are 10 shelves and 100 products, shelf space allocation problem contains more than nonillion different configurations. Additional level of complexity is introduced by the fact that different products often have very different profit margins. This motivates retailers to promote products with higher profit margins.

In this study, model proposed by Corstjens and Doyle (1981) was used. This model considers profit margin per product unit, facing width of product unit, space elasticity and cross elasticity. This research uses Object oriented paradigm to mimic the model.

Yichao et. al. (2018) and Sundar, Singh and Ross (2010) showed that bio-inspired algorithms could be applied on NP-Hard problems. Ozcan and Sakir (2011) used Artificial Bee Colony algorithm and Particle Swarm Optimization algorithm for solving shelf space allocation problem. Bio-inspired heuristics are good fit for parallelization due to implicit parallelization that already exists inside those types of algorithms since each individual could be considered as separate thread. Subotic and Tuba (2014) demonstrated parallelization of Artificial Bee Colony Algorithm using island model and its application on numerical unconstrained functions which resulted in better quality of obtained results. NP-hard problems often have long execution times which makes them a good candidate for parallelization. Besides aiming for better results, parallelization has welcomed side effect, which is reduction of execution time.

This paper contributes to the literature as the first solution that uses island-based parallelization of swarm intelligence algorithm to solve the retail shelf space allocation problem.

The remainder of this paper is organized as follows: Section 2 contains model overview; Section 3 provides more detailed explanation of original Artificial Bee Colony (ABC) Algorithm; Parallelization of original ABC algorithm is presented in section 4, and Section 5 covers the design of the experiments and presents the results.

2. RETAIL SHELF SPACE ALOCATION MODEL

Model presented by Corstjens and Doyle (1981) incorporates four key determinants, named: product space elasticity, inter-product cross elasticity, profit margin and product facing width. Space elasticity denotes how demand for a product is changed based on the shelf space allocation. There are products of which sale decreases significantly when the shelf space allocated is reduced, so their elasticity is described as low. Cross elasticity shows relations between demands for two different products. In extreme cases, two products could be substitutes or complementary products. Profit margin represents retailers' profit per unit of sale. Facing width is a dimension of the product that is exhibited parallel to width of the shelf.

Additionally, this model includes category constraints, meaning that products from different categories should not be on the same shelf.

In this study n is used to denote number of different products (i = 1, 2, 3, . . ., n), m is used to denote the number of categories (j = 1, 2, 3, . . ., m) and o represents number of shelfs (k = 1, 2, 3, . . ., o). Objective function is given as:

$$f = \sum_{i=1}^{n} \alpha_i * S_i^{\beta_i} * \prod_{l=1}^{n} S_l^{\beta_{i,l}} * P_i \quad (1)$$

And constraints of the model are given as:

$$\{x_i = x_l \mid x,i,l \in N \wedge x > 0\ x\ y \leq o \wedge i > 0 \wedge i \leq n \wedge l > 0 \wedge l \leq n \wedge (\forall y : y_i = y_l \wedge y > 0 \wedge y \leq m)\} \quad (2)$$

$$\forall x_i, \sum A_i * S_i \leq T_k \wedge x = k \quad (3)$$

$$\{S \mid S \in N \wedge S > 0\} \quad (4)$$

where

P_i is unit net profit of product i
A_i is facing width of product i
S_i is number of displayed items for product i (number of items in front row on the shelf)
α_i is scale parameter of product i
β_i is space elasticity of product i
$\beta_{i,l}$ is cross elasticity between product i and product l, $\beta_{i,l}$ doesn't have to be equal to $\beta_{l,i}$
Y_i is the category of product i (Y = 1, 2, 3, . . ., m)
X_i is the shelf where product i is displayed
T_k is the length of shelf k

The goal is to maximize the objective function while parameters satisfy all of the constraints. Equation number 2 represents category constraint, and equation number 3 denotes that the sum of facing width multiplied with the number of displayed products in the front row for every product must not exceed the length of the shelf those products are displayed at. In other words, the sum of facing widths of products displayed at one shelf must be less than or equal to the length of that shelf. Last constraint, represented with equation 4, denotes that the number of displayed items for every product must be positive integer.

3. ORIGINAL ABC ALGORITHM

The Original Artificial Bee Colony algorithm is relatively new metaheuristic optimization technique inspired by foraging behavior of honey bees introduced by Karaboga (2005). The major difference between ABC and previously described swarm intelligence algorithms is the representation of the solutions. In previous algorithms that are mimic behavior of bees, the potential solutions are represented by individual bees, while ABC represents solutions as food sources. The quality of the potential solution is represented by nectar amount, calculated as the fitness of the objective function. The colony consists of three kinds of bees: employed bees, onlooker bees and scout bees. Employed bees and onlooker bees are conducting the exploitations phase of the algorithm, while scout bees are conducting the exploration phase.

There is an equal number of employed bees and onlooker bees in the colony. The number of bees in the colony is twice as big as the number of food sources. There is one employed bee per each food source. This bee is searching for the nectar around the food source. Employed bees share information about the quality of the food source with onlooker bees through wiggle dance. In this way, onlooker bees intensify search around the good food sources. When the food source is exhausted, employed bee abandons it, becoming a scout bee, which randomly searches for the new food sources.

Original ABC algorithm is presented using pseudo code.

```
initialize the population of solutions
evaluate the population
while maxCycle is not reached:
    produce new solutions for the employed bees
    apply the greedy selection process
    calculate the probability values
    produce the new solutions for the onlookers
    apply the greedy selection process
    send scout bees
    memorize the best solution achieved so far
end while
```

3.1. Original ABC for constrained optimization problems

Karaboga and Basturk (2017) presented an adjustment of original ABC algorithm, so it can be used for constrained optimization problems. This adjustment includes two main steps. Namely, in the original ABC algorithm for optimization of unconstrained functions, one randomly chosen parameter of objective function is modified in the employed bee phase, while the rest of the parameters are copied from the original solution. On the other hand, ABC algorithm for constrained function optimization introduces a new control parameter, called modification rate (MR). For every parameter of objective function, uniformly distributed pseudo random number in range [0, 1] is generated, and if this number is smaller than MR, the parameter is modified. When MR is used, the number of objective functions' parameters that are modified in employed and onlooker phase is in the range [0, all parameters].
The second aspect of the adjustment applies to the selection process. When new solution is produced in the employed or onlooker phase, it is compared to an unmodified solution and better one is kept. The original ABC algorithm for unconstrained function optimization uses greedy selection process so that the solution with higher fitness value is kept. Adjusted ABC however, uses Deb's rule for the selection of better solution.

Deb's rule favors feasible solutions over infeasible ones and pushes the whole population towards the feasible region. Deb's rule compares two solutions at the time, using tournament selection. It is based on three criteria:

1. Any feasible solution is preferred to any infeasible solution
2. If both solutions are feasible, the one with better value of objective function is kept
3. If both solutions are infeasible, the one with smaller constraint violation is kept

4. MULTIPLE SWARM ABC ALGORITHM USED FOR SHELF SPACE ALLOCATION PROBLEM

Population based algorithms are very suitable for parallelization. There are two main questions: granularity of parallelization and communication pattern. There is an implicit parallelization present in all population-based algorithms since each individual inside the colony is performing operations independently from other members of the population. In other words, each individual is independent process. Granularity denotes how many of these processes will be assigned to each physical CPU core. The finest granularity exists if each individual is assigned to one CPU core, while the coarsest granularity exists if the whole colony is divided into two sub colonies and each sub colony is assigned to one CPU core. There are multiple options between these two extremes.

The number of individuals that will be bound to each CPU core is determined by complexity of an evaluation function and speed of an individual core. Avoiding excessive thread creation and synchronization is the main objective when determining granularity level. The following formula explains this in a little more detailed manner.

$$eu = nca / ncm \tag{5}$$

where eu denotes efficiency of CPU utilization, nca CPU cycles used for algorithm calculation and ncm represents cycles used for managing the threads. The objective is to maximize eu. Since cost of creating and monitoring one thread is constant, having fewer number of threads makes denominator smaller. On the other hand, more complex evaluation function makes numerator bigger. This equation shows that finer granularity is more suitable for more complex functions, since greater number of CPU cycles is required for function evaluation, thus the cost of managing threads does not create big overhead. Functions that require smaller

number of CPU cycles are better fit for courser granularity, since that requires fewer threads to be created and managed. Computer systems with greater number of less powerful CPU cores are more suitable for finer grained parallelization. Example of that kind of systems are smartphones and Graphical Processing Units (GPU). Modern multi core CPUs and workstation and server computers with multiple CPUs are more usable for more course grained parallelization. Delévacq, A., et al. (2013), Mussi, Daolio and Cagnoni (2011) and Fabris and Krohling(2012) presented usage of GPU for parallel implementations of bio inspired algorithm where very fine granulation is used. In the study presented herein, very course grained model is used, since the whole population is divided into four subpopulations.

There are different communication patterns among subpopulations in parallelized algorithm. If the main goal of parallelization is to reduce execution time, the parallel run approach is used and there is no communication between threads. Since bio-inspired algorithms are not deterministic, it is useful to run them multiple times, and to compare the results from different runs. Those independent runs could be executed in parallel. This approach scales really well, and speed improvements are almost linear when the number of utilized CPU cores increases. If the aim of parallelization is to achieve better results, there is communication among subpopulations. In the present study, the island-based model is used, which means that the colony is divided into sub colonies called swarms, where by each swarm executes serial version of an algorithm. On every n cycles, the best solutions are exchange among swarms and the worst sw-1 solutions in each swarm is replaced by the best solution from each of the swarms, where sw is the number of swarms. After solution exchange, every swarm continues with execution of an algorithm, but with updated solution set. Although the main objective of island-based parallelization is to improve the quality of the results, there is a tangible side effect of reduction in execution time.

Pseudo code for MSABC algorithm is presented:

```
initialize swarms with different random seeds
for each swarm:
    evaluate population
    while MFEC is not reached:
        send employers
        calculate probabilities
        send onlookers
        send scouts
        reset trial for best bees
excange ();
        memorize bestSolution
    end while
end for
choose best solution from all swarms
```

4.1. Solution representations

While Ozcan and Sakir (2011) used SQL implementations of ABC, in the present study the object-oriented programing paradigm is used. Main classes for the representation of one solution are: Product, Shelf and Solution. Attributes for every of the classes are presented in the following tables:

Table 1: Product class

Attribute name	Attribute type
Net Profit	Real number
Facing Width	Real number
Minimal number of slots	Integer number
Maximal number of slots	Integer number
Scale	Real number
Space elasticity	Real number
Category	Integer number
Cross Elasticity	List of real numbers
Number of slots	Integer number
Shelf	Integer number

Table 2: Shelf class

Attribute name	Attribute type
Length	Real number

Table 3: Solution class

Attribute name	Attribute type
Number of categories	Integer number
Number of products	Integer number
Number of shelves	Integer number
Products	List of Product
Shelves	List of Shelf
Lower limit for net profit	Real number
Upper limit for net profit	Real number
Lower limit for facing width	Real number
Upper limit for facing width	Real number
Lower limit for minimal number of slots	Integer number
Upper limit for minimal number of slots	Integer number
Lower limit for maximal number of slots	Integer number
Upper limit for maximal number of slots	Integer number
Lower limit for scale	Real number
Upper limit for scale	Real number
Lower limit for space elasticity	Real number
Upper limit for space elasticity	Real number
Lower limit for cross elasticity	Real number
Upper limit for cross elasticity	Real number

In the initialization phase, one solution with the list of products and the list of shelves is generated using pseudo random number generator. All attributes are randomly generated. After one solution is completely initialized, it is copied SN-1 number of times, where SN represents the number of food sources. After that, for every copied solution, new randomly generated values for the number of slots and shelf are assigned. Since a lot of CPU resources would be utilized for the creation of feasible solutions, the algorithm starts with randomly created solutions without enforcing feasibility.

5. EXPERIMENTS AND RESULTS

In this study, the original ABC and parallel implementation of ABC algorithm were compared. Three different dimensions of shelf space allocation problem where used for comparison, which are presented in Table 4:

Table 4: Dimensions of benchmark problems

Problem No	Number of products (n)	Number of categories (m)	Number of shelves (o)
1	10	3	5
2	30	5	10
3	100	10	20

The original ABC has very few control parameters: colony size, maximum number of cycles, limit and modification rate. The number of food sources is equal to the number of employed bees and onlooker bees which is half of the colony size. Parallel version of ABC algorithm presented in this study has only one additional parameter - the number of swarms. Table 5 shows the values of control parameters used in this study.

Table 5: Parallel ABC control parameters

Parameter	Value
Colony size	80
Number of cycles	5000
Limit	0.5 * Colony size * n
Modification rate	0.8
Number of swarms	4

Table 6 shows limit values for each of the solution parameter.

Table 6: Limit values

Parameter	Lower limit	Upper limit
Net profit	1	10
Facing width	1	50
Minimal number of slots	1	5
Maximal number of slots	5	10
Scale	1	2
Space elasticity	0.1	0.4
Cross elasticity	-0.2	0.2

Java programming language was used for algorithm implementation. All tests were performed on PC with Intel i7-4930K @ 4.4 Ghz CPU and 32 Gb of RAM. Linux Kubuntu 17.10 was used as the operating system. 30 independent runs with different pseudo random seeds were performed for each of 3different dimension of the test problem. After 30 runs, the best, the worst, and average solution were calculated as well as the standard deviation. Results are presented, in Table 7, as ratio between parallel implementation, Multiple Swarm ABC (MSABC) and the original ABC (ABC).

Table 7: Test results

Problem No	Best MSABC/ABC	Worst MSABC/ABC	Avg. MSABC/ABC	St. Dev. MSABC/ABC
1	1.05	1.03	1.04	1.01
2	1.04	1.06	1.05	1.00
3	1.07	1.06	1.06	0.99

Parallel version of an algorithm obtained better results for all three dimensions of the test problem. For the largest test problem, improvements, in terms of the quality of the results, were the greatest. Parallel ABC managed to find better maximal result for each of the cases demonstrating that MSABC had better exploring capabilities. The worst and average result for all three dimensions were also better when MSABC was used showing greater consistency of MSABC algorithm. Standard deviation was smaller for the first and the second dimension of the test problem when original ABC was used and MSABC produced smaller standard deviation for the largest dimensions of the test problem. This was due to more aggressive exploration process performed by MSABC compared to the original ABC.

Although the main goal of this study was to improve quality of the results, there were additional performance benefits. Time reduction was significant when MSABC was used and it was almost linear with the increase of execution threads. Performance results are presented in the Table 8.

Table 8: Performance results

Problem No	Execution time MSABC/ABC
1	0.31
2	0.28
3	0.26

Performance benefits were more pronounced for larger dimensions of the test problem, which was due to better ratio between CPU load used for calculating objective function and CPU load used for creating and managing threads.

6. CONCLUSION

In this study parallelization of the original ABC algorithm and its application on retail shelf space allocation problem was presented. Island-based model of parallelization was used and total population was divided into four subpopulation, each running original Artificial Bee Colony algorithm with different random seeds. Results were exchanged between swarms periodically. The proposed parallelization model was tested on three different dimensions of shelf space allocation problem, and 30 independent runs were conducted with different random seeds. The best, the worst and average result as well as the standard deviation were compared. The Multiple Swarm Artificial Bee Colony algorithm always performed better in terms of the best, the worst and average result. For larger test problems, differences between MSABC and the original ABC were more pronounced. Due to higher exploration performance of MSABC, standard deviation of the solutions obtained from different runs of the algorithm were slightly worst for two smaller dimensions of the problem set.

Execution times of the algorithm decreased almost linearly with increase of the execution threads. This indicates that Parallel version of the algorithm was almost four times faster, since four swarms were used. Benefits were more apparent for larger dimensions of the problem set.

Taken together, these results show that parallel version of swarm intelligence algorithm, and more specific, parallel version of Artificial Bee Colony algorithm, could provide better quality of the results for shelf space allocation problem, and that the execution times are reduced. Further adjustments of control parameters could, potentially, improve results even more.

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NEUROMARKETING IN ADVERTISING TODAY

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Abstract: *This paper is focused on how modern marketing is being influenced by development of neuromarketing. Human behavior has shaped scientific research and delivered significant influence on new marketing paradigm. Brain and nervous system in the key in understanding most significant part of marketing progress, human itself.*

Keywords*: Neuromarketing, Behavioral economics, Marketing, Research*

1. INTRODUCTION

The process of decision making is a pivotal focus in marketing research. We might say that main goal of study per say is to define what is the consumer decision process. As marketers, we tend to use tools of traditional Marketing such as surveys, interviews and insights to study consumer behavior. People decisions are usually influenced by unconscious processes that are not easily detected or that are not even noticed by consumers themselves. For that reason, the usage of both psychological and Neuroscience techniques is combined so we can be analyzed consumers' responses to stimuli derived from the spectra of the Marketing mix. Neuromarketing was created from these tendencies. Behavioral Economics is heavily based on Neuromarketing research of human behavior, even dough Neuromarketing as such, still gives tangible results according to several scientists. (Lindstrom, 2008 and McClure 2014) Measuring the brain's response to the great number of Marketing stimuli is the crucial part of Neuromarketing.

As we may say, neuroscience and neuromarketing are very similar but their goal is different. Neuroscience focuses on consumer and brain processes of how decisions are made, but Neuromarketing is applying these findings to create optimized advertising campaigns. Technologies that are used in neuroscience can be applied in Neuromarketing. Therefore, are the functional magnetic resonance imaging (fMRI) of the brain, or electroencephalography (EEG) usual tools of modern Neuromarketing studies. Neuromarketing and consumer neuroscience strive to find how the human nervous system processes different stimuli in relation to making economic decisions such as purchasing and brand engagement. Reaction to social media, website and application interface or online shopping are derived from the brain reaction to advertising stimuli that comes from digital surroundings.

2. LITARERY REVIEW

At the beginning of the 1990s, we may see efforts to put neuroscience to commercial use. Coca-Cola and Ford tried to optimize their advertisements to public opinion, but the field was described and developed later, during the first years of the 21st century. Finding ways that person's real behavior can be explained and predicted by human unconscious thoughts better than intentional expressions (Eakin, 2002). Also, Gerald Altman described his patent of marketing research where he tried to learn more about involuntary and announces thoughts.

Term Neuromarketing first appeared in 2002, in an article created by the Bright House marketing firm. This was a year when this company has found a branch office that applies fMRI in marketing research. Read Montague has conducted this kind of research in 2003. And published it very next year. The topic of research was the taste of Coca-Cola and Pepsi. The study monitored their brains using functional magnetic resonance imaging to determine unconscious preferences. Nowadays, a study is considered more significant to be the pioneer in the field of Neuromarketing then due to its result. Next big milestone for Neuromarketing was a research of influence of the sound in an advertisement to consumer decision making. Deppe et al (2005) were focused on finding out how implicit information influence decision making. This study was based on brain imaging. While being monitored on fMRI, users had to imagine the process of purchasing. Persuasion as a process was studied in 2008 when Klucharev measured why are influences boosting sales when appeared in advertising commercials.

3. RESEARCH METHODOLOGY

To explain the relation between neuroscience and marketing, this research is summarizing the most eminent scholarly influences in a field of neuromarketing. The core research deals with the application practices are discussing academic and news sources covering the issue. As said above, this field is new and there is still lack of enough sources to make a conclusion that would answer the question of how the neuroscience contributes to customer research and marketing.

4. DISCUSSION

This work deals with the impact of neuroscience on marketing and its related fields of research, as straight access to human brain provided by medical imaging technologies gets us insights straight from the brain as the hearth of our thoughts – an approach which diminishes fear of expression, possible sensory problems and hesitation to answer in a sincere and honest manner for some of many different reasons. While the ability to read from the deep mind, it is not exactly mind reading. As of today, no technology has been discovered that should be able to scan every brain activity thus reading our thoughts directly. In neuroscience, the focus is on causing and measuring stimuli arising from selected sources that the researchers deem important and useful for his or her work.

Kenning and Plassmann (2008) make an early review of consumer neuroscience. According to the findings of their study, the use of neuroscience in marketing-related projects should be focused on the companies, brands, and products rather than customers. This way the controversial ethical side of the concept is addressed in a manner – if the company uses neuroscientific methods just to measure consumers' perception of their brand and products, rather than trying to “get inside” and try to alter their processes of thinking. There is no evidence that the quest for “holy grail” of marketing deep inside a human's brain, or the “buy button” which can be switched by external stimuli might be fruitful. Plassmann, Venkatraman and Huettel (2015) are praising the neuroscience in academic marketing research and are satisfied with the findings so far. They conclude that consumer neuroscience contributed to a systematic understanding of how consumers value specific goods. They also praise fMRI technique as the most effective thanks to its ability to scan the entire brain and takes images through many local points across this organ. This brings advanced accuracy to results and findings. Also, the growing number of consumer neuroscientists can help or influence authors from other fields of marketing and its related sciences. The perspective from inside the brain was nonexistent few decades ago, and findings from it have a potential to put many commonly accepted statements of business into question.

Pozharliev, Verbeke and Bagozzi (2016) highlight certain limitations of consumer neuroscientific research effectiveness. Their main concern is the laboratory setting where the research – and primarily brain imaging takes place. The solution to this is also proposed – it is the next generation consumer neuroscientific techniques that are multiperson and can be used in social situations. Finally, Karmarkar and Plassmann come into conclusion that combining multiple techniques of neuroscience in a single research is very powerful and suggest less invasive methods than brain imaging, such as eye tracking and comparative research of people with lesions in areas of brain that are important for research, versus those who have these areas healthy and intact. However, this approach can be used only by the academia, whilst for businesses, it may be too complex, expensive and possibly unethical – especially when it comes to using people with brain damage or disabilities to conduct for-profit research.

5.CONCLUSION

The field of applying neuroscience in marketing and business development – independently from more precise notions such as neuromarketing, neuroeconomics and consumer neuroscience, is a very young discipline and still brings about controversies for different reasons. Despite that, it has good prospects of becoming much more significant than is now. It can not only help businesses find more buyers through more effective marketing projects and campaigns targeting our subconscious minds. This field can also contribute to overall development of neuroscience in other fields and can also help us better understand how our brains exactly do work. Universities and research institutions along with businesses may join forces into developing more advanced techniques that unambiguously contribute to creating more effective marketing.

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SEARCH ENGINE OPTIMIZATION STRATEGY IN PERSONAL ONLINE REPUTATION MANAGEMENT[1]

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Abstract: *Search engine optimization (SEO) refers to techniques for achieving better rankings of a website in organic (not paid) search results. Given the increasing usage and importance of digital communication tools for business and personal purposes on one side and decreasing trust in institutions such as media and companies on the other side, SEO is powerful digital communication activity that is necessary for effective personal online reputation management. Therefore, the authors of this paper proposed and elaborated the framework for SEO strategy for personal online reputation management. The key phases of this process are: analysis of search results and online content; identifying and classifying existent online content; defining online reputation strategy; on-site SEO activities; content production and distribution; off-site SEO activities; paid search campaigns and content promotion and monitoring and evaluation of SEO activities.*

Keywords*: Search Engine Optimization, Online Reputation, On-site SEO, Off-site SEO, Paid Search*

1. INTRODUCTION

Internet technologies, social media and mobile technologies led to important changes in the way companies operate and communicate with customers (Maresh-Fuehrer & Smith, 2016; Dong & Wu, 2015; Georgescu & Popescul, 2015). The results of the contemporary academic and practical research emphasize the importance of digital tools and activities and the opportunities they create for business (Veselinovic et al, 2016). Together with the exponentially increasing usage of the digital communication tools in business and personal life, there is an evident trend of decreasing trust in all institutions, especially media and companies (Edelman Trust Barometer, 2018). The same report found that "for Chief Executive Officers (CEOs), building trust is job number one" and "64% of respondents say that CEOs should take the lead on change". Therefore, practitioners' and general academic interest for a profound examination of reputation management has been growing rapidly (Vlastelica et al, 2018). Corporate reputation is "a set of relatively long-term impressions, attitudes and emotions of an individual or a group related to a company, which are formed upon direct experience or received indirect information from credible sources, in the context of personal and social expectations, whereas they influence the intentions or behavior of an individual or a group toward the company" (Vlastelica, 2016). The same author reports that for the majority of people, internet sources and social media present the most often used and highly credible source of information about the object of interest.

According to the Reputation Institute's annual RepTrack report (2018), the corporate reputation is still and even more than before influenced by the CEO's personal reputation. The results of this global longitudinal study indicate that 66 out of the 100 companies with the best reputation in the world have a strong score on leadership, and the authors conclude that "a new kind of leader emerges: a CEO who thinks beyond profit and aligns leadership with societal contributions and highly ethical behavior". Therefore, a strategic corporate reputation management must include well planned strategy and organized activities for CEO's personal online reputation management.

One of the major concerns of web users is to find the most relevant information with less effort and in the shortest time possible (Hariri, 2011). Search engines have become the primary tools used to locate information on the internet (Luh et al, 2016). According to research, 93% of the Internet's traffic is due to search engines (Egri & Bayrak, 2014).

Although there are several search engines present and operating on the search engine market, the analysis of the market share by the Statcounter Global Stats (2018) shows the absolute dominance of Google search engine. Its share worldwide for the period March 2017 – March 2018 is 91.25%, and in Serbia it is even

[1] This article was produced with the support of the research project "Advancing Serbia's Competitiveness in the Process of EU Accession", no. 47028, during the period 2011-2018, supported by the Ministry of Education, Science and Technological Development, Government of Serbia.

higher: 96.57%. Therefore, in the majority of studies search engine optimization or SEO refers to the optimization for Google search engine.

Search engine optimization (SEO) refers to techniques for achieving better rankings of a website in organic (not paid) search results. On-page SEO refers to all the measures that are undertaken on the very website. These measures make it easier for search engines to find a website, index it, understand and classify its content. Off-page SEO refers to measures which are external to a website with a task to ensure an inflow of high-quality inbound links (HubSpot & Ryte, 2017).

The authors of this paper argue that SEO is a powerful digital communication activity that is necessary for successful personal online reputation. For that purpose, the framework for SEO strategy for personal online reputation management is proposed and elaborated in this paper.

2. SEARCH ENGINE OPTIMIZATION – CONCEPT AND PRACTICE

SEO tactics that follow the guidelines set by the search engines are known as "white hat", while those that violate the guidelines are called "black hat" (Ross, 2010). Black hat SEO is the practice of using optimization tactics that cause a website to rank more highly than its content would naturally do, or making changes specifically for search engines that do not improve the user's experience on the website (Moreno & Martinez, 2013). Black hat approach is severely penalized by the search engines, making it very hard after to recover a good page rank.

If done properly, the practice of SEO can significantly increase a website's search rankings (Zhang & Cabage, 2017). A good search ranking is important because most users do not look beyond the first page of search results. The first page of SERP (search engine results page) accounts for 99.3% of all clicks (Internet Marketing Ninjas, 2017).

In order to rank websites Google's ranking algorithm is reported to employ more than 200 factors with most not being disclosed (Luh et al, 2016). Today, each industry, or even each individual search query, has its own ranking factors which are in continuous change and are driven by the dynamic between individual content relevance and user intent (Searchmetrics, 2016). Apart from the technical issues, other important factors for Google search engine are: rank (position in SERP), authority (credibility of the content) and relevance (content relevance for a specific search) of a web page for particular searches (HubSpot & Ryte, 2017). Having that in mind, key areas targeted by the SEO strategy should be: content, keywords, website structure and link optimization (Wang et al, 2011).

Although SEO is obligatory for successful online reputation management, there are several factors restricting its more frequent application. Key challenges for implementation of SEO projects according to Khan and Mahmood (2018) are:

- Relevant back-links generation is a time consuming and challenging activity;
- Web pages currently having high visibility may move downward in the ranking;
- Using SEO approaches and quality content in the web pages will not give results if a website has serious structural or technical issues;
- Duplicate content on several websites is a major technical challenge which requires detailed cleaning up of the websites.

In order to proliferate the SEO usage, the common framework for SEO strategy should be defined. It would demystify some of the areas of SEO and allow marketing practitioners to target the factors known to influence search rankings.

3. FRAMEWORK FOR SEO STRATEGY FOR PERSONAL ONLINE REPUTATION MANAGEMENT

The framework for SEO strategy for personal online reputation management proposed by the authors of this paper is based on: the research of SEO framework by Khan and Mahmood (2018), Google resources – specifically SEO Starter Guide (2018) and Webmaster Guidelines (2018), and digital marketing practice.

The proposed framework consists of the following phases:

- Analysis of search results and online content
- Classifying existent online content
- Defining online reputation strategy

- On-site SEO activities
- Content production and distribution
- Off-site SEO activities
- Paid search campaigns and content promotion
- Monitoring and evaluation of SEO activities
- Activities for maintaining personal online reputation

4. ANALYSIS AND CLASSIFICATION OF SEARCH RESULTS AND ONLINE CONTENT

An analysis of search results and online content about a specific person refers to determining what web users are searching and saying about that person online. The analysis should encompass the research of Google SERPs for relevant keywords, mentions and conversations on the web including the person's name, and analysis of his/her personal web pages.

Google search results
The analysis of Google search results should start by using person's name and surname as keywords. In the next step, additional keywords relevant for the person in question are added.

Although the first page of SERP is usually also the last page examined by the user, with the goal of covering more meticulous users, the first two pages of SERP should be analyzed. Only in the case of existent or possible damaged reputation with high media interest the SEO efforts should be extended to the further pages of search results.

Apart from the results of general search, specific search categories like images, videos, and news should also be analyzed. It is important to define relevant countries and languages for search queries, as searching from different locations or in different languages turns out different search results. The results may vary depending on the searcher's history and socialization as well.

Mentions on relevant web locations
The analysis of mentions of a person online should include examining content and conversations on: media websites (especially the most visited and high authority media); websites, blogs and forums relevant for industry or profession of the person in question; and social media (Facebook, Twitter, LinkedIn, Instagram, YouTube, Wikipedia etc.)

Personal web locations
Personal web locations refer both to the web pages owned by the individual (such as personal website or blog) and the web pages opened and administered by the individual on the third-party web locations (such as social media profiles).

In this phase, apart from the examination of the authorized personal web pages, the possibility of the existence of fake web locations should be considered. It is not uncommon for public figures to have one or multiple fake web pages, especially fake social media profiles. In such a case, a person should undertake actions to report the fake page to the social media platform, prove the proper personal identity, and ultimately demand shutting down the unauthorized profile.

Classification of the existent content
Upon finishing the analysis of the Google search results and the relevant web locations, the existent content about a person subject of the research should be classified using several criteria in order to facilitate defining an adequate SEO strategy. The online content should be classified based on: topics and subtopics; keywords; key web locations; and sentiment (positive, negative or neutral).

5. DEFINING ONLINE REPUTATION STRATEGY

Establishing and maintaining a positive reputation is a proactive approach that includes: analysis of the current online image; defining desired online reputation; identifying the key items (drivers) that affect image and reputation creation with the key stakeholders; defining the key messages; designing content and stories to be told about the person; and finally employing relevant communication channels for storytelling and content placement.

The alternative approach is repairing a damaged reputation, which is a reactive tactic. In the case of negative content or content with false information, there are two possibilities: its suppression or removal.

Suppression consists in pushing negative results down in search results by pushing up the positive content (existing or newly produced) using different SEO tactics. Removal refers to the attempt to remove negative/false content by demonstrating its untruthfulness or based on the legal grounds (copyright issues, right to privacy and other legal arguments).

The removal of the content can also be pursued based on the "right to be forgotten" (Igniyte, 2018). This right exclusively applies to personal issues in EU and UK. Google has an option of removal application concerning irrelevant or outdated information from the search engine results. In practice, it enables removing only local press coverage of a minor incident, outdated magazine articles, and pictures and videos online. It is very hard to remove a content if it is highly relevant for certain searches or published on high-authority media websites, or if there is a public interest to know the information. Public interest is above the privacy rights in the cases such as financial scams, professional malpractices, criminal convictions, public conduct of government officials, etc.

6. ON-SITE SEO ACTIVITIES

In this section, technical requirements and guidelines concerning website's development - architecture and html will be analyzed. The website's content will be examined in the separate section about content strategy and production.

Technical factors remain a prerequisite for good rankings on SERP. Even with the content with high relevance which perfectly meets the searcher's intention, it is extremely difficult to achieve a position at the top of Google's ranking if the page is not easily accessible, easy to consume and optimized from a technical point of view both for humans and search engines (Searchmetrics, 2016).

Below is the list of technical elements mandatory for successful on-page SEO:

- Organized architecture and clear hierarchy of the website – easy to navigate for users and easy to crawl for search engine crawlers;
- Mobile friendliness – responsive web design is recommended by Google;
- User-friendly URLs with keywords used in them;
- Security – implementation of SSL certificate (https protocol);
- Title and description tags – accurate and corresponding with the actual content, unique titles and descriptions for each page;
- Keyword tags and keyword density – publishing content rich in relevant keywords with recommended density of 5-8%;
- H tags and subheads – for emphasizing important text, corresponding with the actual content and title tags;
- Schema markup – improves the way a web page is represented in SERP by providing rich snippets below the page title (for example, for adding star rating or publication date);
- Meta tags – tags that describe a web page's content;
- Alt tags for images – text displaying when the image is not loaded;
- Broken links – all broken links should be removed;
- Site speed – web pages should load quickly;
- File size – all files uploaded to the web pages should be optimized in terms of size in order to ensure high site speed;
- Sitemap – a list of all the URLs on the website allowing easier crawling by search engine;
- Robots.txt – for blocking unwanted crawling (for the content that is not useful for users);
- Duplicate content – elimination of duplicate content or usage of canonical URLs to mark duplicate content;
- Internal links - links to the other pages on the same domain are important for letting crawlers identify the relation between pages and the importance of the topic;
- External links or outbound links –links from other websites with high Google rank, relevance and authority must be included in website's content;
- Anchor text – text in the link that is visible should be descriptive and help understand the content behind;
- Blog implementation - if it was non-existent before, adding a blog to the website should be considered.

7. CONTENT PRODUCTION AND DISTRIBUTION

Content production depends on the web location of its publishing. Its type, form, style, and length usually differ based on whether it will be distributed on personal website or blog, personal social media profiles, media websites, or third party websites relevant for the industry/profession of the individual.

A personal website is a useful channel for publishing content that does not capture the attention of the media or industry's expert websites. Blogging is a great and yet simple way to regularly provide new, up-to-date content on relevant topics. Blogging regularly can have significant implications for search engine optimization, since each new blog entry represents a new web page (HubSpot & Ryte, 2017). The distribution of content on social media, media websites and relevant third party websites will be explained in the section about off-site SEO.

The online content can be produced in various formats depending on its purpose: articles; videos; interviews and video interviews; press releases; comments; photos; and online activations – activities based on interaction (for example: answering visitors' questions on the personal blog).

Some of the guidelines for content production set by Google's resources about SEO include: creating a useful, information-rich content that is easy to read, paying attention to quality, uniqueness and freshness of the content, as well as clear organization of the topics and consistent usage of the keywords.

8. OFF-SITE SEO ACTIVITIES

Off-site SEO activities can be divided in two areas: link building and social sharing. A study conducted by Zhang and Cabage (2017) suggests that both improve website traffic, nevertheless they conclude that social media is an effective method for quickly building traffic, while link building provides a better return on investment in the long run.

8.1. Link building

Link building, also known as back-link generation, refers to building a network of inbound links. Inbound links are the links from third-party websites towards the owned website. The goal of this off-site SEO activity is to strengthen the page rank and the authority of the owned website, but the use of white-hat techniques and natural link building is mandatory.

By building backlinks on high-authority top ranked websites both domain-level and page-level authority of the website or blog is boosted. The quality of links, the number of links, and the anchor text of links are three factors with impact on the SERP positioning. The SEPR positioning is also influenced by so-called "trust" factors which include authority, identity, domain age, and bounce rate of a website.

The lists of top ranked websites and top ranked online media are available on the relevant online traffic audit platforms depending on the country. For example, for the most visited websites in Serbia "Gemius Audience" service can be consulted, so placing links on that locations should be in focus. It is important to notice that links on some domain extensions like ".gov" and ".edu" carry special weight.

Link building is often referred to as "article marketing" because it involves the following activities:

- Guest articles and guest blogging/posting – this is one of the most commonly used tactics of publishing articles or posts on the relevant high-authority websites and blogs with links leading to the personal website or blog
- Appearing in editorial articles of the online media
- Commenting and posting on forums and other blogs with leaving links to the personal website/blog

8.2. Social sharing

The social media are a powerful tool for distributing content due to their global popularity and number of users. Using Facebook, Twitter, LinkedIn, Instagram, Google+, YouTube and other social media platforms is great both for personal branding and traffic generation.

Social media profiles are an important tool in personal online reputation management. They should be used as a support for the content published on a personal website or blog, helping it reach a wider audience. Having in mind that search engines pay special attention to the links from social media, sharing relevant content on the social media channels generates social signals for that content.

9. PAID SEARCH CAMPAIGNS AND CONTENT PROMOTION

Although the SEO strategies mainly focus on the activities other than the paid advertising, it should not be dismissed without considering its possible value and results. Whether there should be an investment in a paid campaign depends on each case and the goals set in the SEO strategy.

Usually, a paid promotion is considered rather a part of search engine marketing (SEM), with it being a wider term than SEO, while SEO is limited to the organic or not paid results.

Paid search ads are the most effective type of advertising for placing web pages on the top of the search results. They are also denominated as search engine advertising (SEA), a part of SEM that involves promoting websites through paid search advertising in order to increase their visibility in SERP.

Google's platform for paid search advertising is Google AdWords. It is based on the pay-per-click (PPC) model.
The ranking of paid ads depends on the metrics called the quality score, and it takes in consideration three elements: landing page experience, expected click-through rate (CTR), and ad relevance. There are several targeting options, with the most important being keywords and location.

The main argument against using paid search ads is that they are marked as such. But, especially in the case of damaged online reputation, the "ad" mark is less important than the need to place a very specific content in front of the eyes of the user.

Additionally, the findings of the study on users' understanding of search engine advertisements (Lewandowski, 2017) show that users generally lack an understanding of search-based advertising model: 42% of users reported that "they either do not know that it is possible to pay Google for preferred listings for one's company on the SERPs or do not know how to distinguish between organic results and ads". In his experiment, Lewandowski also showed that "users who are not able to distinguish between the two results types choose ads around twice as often as users who can recognize the ads".

Even though the paid search campaign can serve its purpose, its impossibility to influence organic search results is a serious limitation. This is confirmed by the results of the Kritzinger and Weideman (2015) comparative case study, indicating that although the pay-per-click campaign produces favourable results, it requires a constant monthly fee in order to guarantee consistent traffic, therefore the investment in search engine optimization activities appears to produce better results at a lower cost, after a given period of time.

When paid campaigns are in question, the sponsored content is another option. An investment can be made in sponsored articles on well-reputed media websites or in sponsored social media posts of high interest and quality. Promoting content is useful since it leads to its faster discovery and increases the number of its consumers.

10. MONITORING OF PERSONAL ONLINE REPUTATION

The final phase of an SEO project is its evaluation. It is important to emphasize that the SEO activities should be undertaken during at least six months in order to be able to measure their effect. It takes time to influence Google's ranking and to get the newly produced content to rank. Tools that can be used to measure the results of an SEO project are Google Analytics and Google Search Console.

Even if the project was successful, for achieving long-term results, continuous monitoring and activities for maintaining good personal online reputation are mandatory. Only by constant efforts in building and maintaining a positive online reputation can a person be adequately prepared for the situations of crisis communication.

11. CONCLUSION

A positive personal online reputation has a positive impact on corporate reputation, while negative online reputation of individuals affects both their personal and professional life. The authors emphasize the importance of planned and organized personal online reputation management by applying search engine optimization process.

SEO is a powerful tool in building a positive online reputation and/or repairing a damaged reputation. Good ranking of positive content in Google SERPs for specific keywords is an important factor for achieving and maintaining strong online reputation. The experimental studies report that implementing SEO tactics improves ranking in Google search. On-page optimization influences a better page rank, while off-page optimization helps better performance in getting top position in SERP for specific keywords.

The authors proposed framework for SEO strategy for personal online reputation management that is based on the analysis of search results and online content, defining online reputation strategy, on-site and off-site

SEO activities, content production and distribution, paid search campaigns and content promotion, monitoring and evaluation of SEO activities and activities for maintaining personal online reputation.

Nevertheless, SEO is a long-lasting process which demands continuous efforts. It evolves and changes together with a change in technology development and the way people "consume" technology, especially digital communication tools. Therefore, it needs continuous updating and repeated research in order to be able to address the issues of the contemporary online reputation management.

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TENDENCIES IN DIGITAL MARKETING COMMUNICATION WITH SPECIAL OVERVIEW OF GENERATION Y MEMBERS IMPACT

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Abstract: *The Internet, as a key factor of digitizing marketing activities, has enabled the establishment and maintenance of continuous and direct communication with customers. The key influence of Internet on creating marketing communication has resulted from the exstensive use of social media, which has shaped communication flows in all spheres of life. Members of generation Y can be defined by their sophistication and promptness in online communication, which is characterized by velocity of information flow in both formal and informal communication. It is therefore essential for marketing experts to realize that members of generation Y are expecting to be provided with personalized communication adapted to their needs, preferences, as well as the platforms they use.*

Keywords*: marketing communication, digital marketing communication, generation Y, social media, user-generated content.*

1. INTRODUCTION

According to Kotler and Keller (2006) marketing communication can be defined as a medium which organizations use for providing information for customers in direct or indirect manner, persuading and reminding them about their products and brands, as well as establishing a dialogue and creating long-term relationship with customers. Nowadays, digital technology transforms marketing communication while marginalizing traditional approaches to activities such as advertising or public relations and leading experts to creating new approaches to marketing communication in contemporary business. Actually, digital technologies development has led to the fact that traditional forms of marketing communications have gained their digital forms. Therefore, direct mail was replaced by e-mail, landline phone was replaced by mobile phone, regular television, radio and press have, to a large extent, been replaced by their digital forms, which resulted in advertising activities being redirected to new media.

The changes regarding preferences, wishes and needs of generation Y which wants to claim its active role in creating their experiences within marketing communications, have caused the adaptation of traditional information exchange models to target audiences. This primarily refers to the introduction of digitally sophisticated marketing communication between companies and their brands with specific target audiences. Traditional media are significantly being replaced with new media that are evolving due to modern information technologies. The development of the Internet has enabled interaction with customers using completely new communication tools such as blogs, forums, chat rooms and social networks. Therefore, traditional communication instruments have undergone transformation in terms of adapting to digital media and have become interactive.

Therefore, the research subject of this paper is the analysis of development and evolution of marketing communications due to the emergence of new technologies, as well as lifestyle changes and manners in which information are collected and processed by target audience members. Considering the specificity of generation Y members which shapes contemporary communication styles in both daily and business life, their sociological characteristics and communication trends which result from their lifestyle habits are examined. Rakić and Rakić (2015) state that technological development and life trends created by members of the Y generation will influence and shape communication among its members, but also between members of this generation and other generations.

Bearing in mind the above mentioned, this paper provides an analysis and display of digital marketing channels specifics as well as the role of customers within this concept, and the effects that digital marketing communications have on the quality of organization business performances. Furthermore, the concept of integrating various types of digital marketing communications and communication channels with the aim of achieving optimal results in causing desired consumer behavior through their synergetic effect was explored. Therefore, authors of this paper suggest that possibilities for integrating different forms and tools of digital

marketing with the aim of achieving optimal communication results with members of the generation Y should be thoroughly researched by other authors.

2. MARKETING COMMUNICATION BASED ON THE APPLICATION OF INTERNET TECHNOLOGY

The concept of Internet marketing implies the implementation of Internet technologies with the aim of marketing activities realization (Chaffey, 2006). Furthermore, Internet marketing represents the process of creating and maintaining customer relationships through online marketing activities, with the aim of achieving more efficient exchange of ideas, products and services between customers and companies. Gašović (2010) states that Internet marketing applies direct marketing approach which is based on development of information technology and telecommunications. This combination of resources allows organizations to establish straightforward communication with target audience members by addressing them directly. Furthermore, interactive component of the Internet ensures that on the basis of customer feedback, organizations can provide products or services which will fulfill their needs with a greater degree. Rakitaand Mitrović (2009) state that Internet marketing is based on contemporary concept of relationship marketing that should provide customers with complete freedom in achieving personal preferences. The Internet enables establishment and maintenance of continuous and direct communication with customers aimed at developing customer loyalty towards brands, or companies' products and services. Given its presentational, informative and educational role, as well as the fact that it can distribute information at a global level in real time, the Internet is observed as a central organizational platform for the creation of marketing communication programs (Aaker, 2002).

Due to the extensive use of digital media by customers, increasing number of organizations are applying digital marketing communication methods in order to establish contact with their target market groups. Digital marketing is a practice of promoting products and services by using digital distribution channels, i.e. using digital or online advertising to deliver marketing messages to customers (Taken Smith, 2011). Chaffey and Ellis-Chadwick (2012) state that "digital marketing involves managing various forms of companies' online presence and the use of techniques such as search engine marketing, digital advertising, online partnerships, online public relations, e-mail marketing and marketing on social media". The use of Internet in implementation of marketing activities has resulted with the occurrence of different terms such as online marketing (Jobber & Fahy, 2006) Internet marketing (Chaffey, 2006), e-marketing (Strauss & Frost, 2009), digital marketing (Chaffey & Ellis-Chadwick, 2012), while some authors equalize the meaning of these terms, stating that digital marketing and electronic marketing concepts are essentially the pursuit of marketing activities using electronic media (Chaffey et al., 2006).

Bearing in mind the fact that development of marketing communication is based on the harmonization of marketing messages content and marketing activities with customer needs and preferences (Ognjanov, 2013), it can be concluded that in this sense, digital marketing communication has reached the highest level of development. Jobber and Fahy (2006) highlight the benefits of online communication, among which are:

- Individualization and customization - that is, creating and distributing specific marketing message for customers based on their needs and previous online activities,
- Multimedia content creation - that is, providing customers with the opportunity to gather more detailed information about products / services through a combination of the latest technologies and thus better understand their needs,
- Interactivity - that is, the possibility for customers to respond to a particular message,
- Real-time information exchange - or the ability to respond to customer questions and issues instantly.

Štavljanin (2014) states that electronic communication channels, unlike traditional ones, have enabled a high degree of interaction, individualization and personalization in marketing communication, which can be initiated by the organization or the customer. The author claims that the benefits of new technologies are reflected in encouraging customers to use the Internet in gathering additional information, evaluating alternatives and making purchasing decisions that are adapted to their needs, conditions and rules. The Internet has empowered customers to increase their knowledge of products and services through access to a large number of information and express their views and preferences regarding them, which has affected companies to deliver unique values and experiences. In order to realize the delivery of such products, companies have established cooperation with customers through the implementation of personalized marketing, which involves the collection of customer data in order to deliver marketing communications which is adjusted to their needs. The characteristics of Internet marketing communication have led to a change in focus from traditional outbound marketing to inbound marketing. Inbound marketing is based on the creation of quality content adjusted to customer preferences, with the aim of encouraging them to

express their interest for particular company's offer, instead of providing customers with promotional content which they haven't requested.

3. INTEGRATION OF DIGITALIZED CUSTOMERS IN THE PROCESS OF CREATING MARKETING COMMUNICATION

O'Reilly и Marx(2011) state that customers are relying on knowledge and competence of other customers, their knowledge and opinion while gathering information about products or services due to the fact that they trust information provided by other customers and enjoy interacting with them. By observing the literature from this field, Holleschovsky(2015) states that there are four categories of motives that encourage customers to seek information through reading other customers recommendation: informational behavior, tendency for reducing risks while choosing a product, search for quality and social acceptance. Campbell (2017) states that the need for obtaining social approval by the community or society in general, affected the popularity and significance of word-of-mouth communication among customers since they want to make correct decisions even during their online activities. To be more precise, positive reviews or ratings that customers provide for specific product or service can serve to other customers as a social approval about the correctness of the decision made when it comes to choosing a product or service.

As a result of this kind of online communication trends, organizations are encouraging mutual customer communication by implementing following activities:

- Engagement of influential individuals / bloggers with the aim of influencing the change of customer behavior or opinion and therefore achieving business aims of the organization;
- Marketing recommendation program through which customers personally share the content they created about products and services with their online group of contacts, with the aim of turning their contacts into new customers. The advantage of this type of marketing communication is reflected in the perception of customers who observe it as confidential and trusted friend's recommendation.
- The activity of commenting and evaluating products or services after purchasing them, which is also perceived by customers as reliable and honest communication based on opinions and impressions of other customers.
- Giveaways which are used to animate customers to share specific content with their group of online contacts for what they are motivated by gaining specific benefits or prizes. (Fanning & Bandlow, 2013).

The importance of such customer activities for the realization of marketing and business aims of companies is testified by numerous studies on customer purchasing habits. Spiegel Research Center (2017) conducted a research about the influence of online reviews on creating purchase habits. The results of the research indicate that 95% of customers read and consult these kind of contents before making decision on which product to choose, since they present not only a form of collecting information, but also a powerful method for encouraging customers to join in the process of co-creating value with companies. The results of the research conducted by Askalidis and Malthouse (2016), indicated that online reviews significantly influence probability of making purchase decision. By observing sales results of luxurious product vendors, the authors made a conclusion that the likelihood of selling products with five reviews is up to 270% bigger in comparison with another product which has no reviews. Furthermore, the results indicated that online reviews are particularly important while purchasing more expensive products which are not being bought on a daily basis, since higher financial expenditures involve greater risk when deciding on a purchase. Based on YouGov research, conducted among customers in USA, 78% of respondents read other customers' comments, reviews and ratings before making purchase decision, 44% actively contribute to creating this type of content by writing reviews on products themselves, while four out of five customers change their attitudes on products under the influence of negative reviews. The most common reason for reading online reviews are search for information about product quality and whether the product provides promised benefits (today.yougov.com).

Based on Influence Centralresearch, 83% of the respondents believe that recommendations of influential individuals, so-called influencers, more authentic than traditional advertising, while 92% of the respondents bought a product based on the recommendation of an influential individual (influence-central.com). The same source provides the results of a research about the impact of online recommendations on purchase decision making among female population, based on which 85% of respondents consult online reviews before purchase and 87% claim that they create this type of content sometimes or often. Furthermore, the research indicates that these trends influence how customers collect product information, since 91% of respondents consider online reviews to be more reliable than the information they obtain from sales staff. Likewise, 88% of respondents consider online reviews to be useful when buying products of unfamiliar brands, while 67% of respondents consult online reviews for familiar brands when they want to find out whether other customers had similar experiences with specific product and whether on the market exists a product which is better than the one they own (business.com). Results of Pew Research Centre as well illustrate the significance that

online reviews and ratings have on purchase decision making process among customers in USA, since 82% of respondents state that they consult online reviews while purchasing a product for the first time, while 46% of respondents consider online reviews helpful in gaining confidence that they made correct purchase decision (pewinternet.org).

4. TENDENCIES IN CONTEMPORARY COMMUNICATION CAUSED BY TECHNOLOGICAL PREFERENCES OF GENERATION Y

The fact that members of the generation Y have grown up with the emergence of ubiquitous networking and the ability to record, process, send and receive information anywhere and at any time through various technological devices (Chelliah & Clarke, 2011), has caused the fact that this generation performs all-day communication but mostly through screens of different mobile devices (Stein, 2013). The emergence of social media platforms resulted with even higher degree of users networking, while research provided by Childs et al. (2009) indicated that 96% members of generation Y uses at least one social network. Among social media users, those who use social media Facebook are the most active, with 1.86 billion monthly users which 22% of world population (statista.com) which collectively every minute via this network sends 30 million messages (weforum.org). Furthermore, 80% of employers from private sector use online business network LinkedIn as a primary mean in searching for appropriate employees, while 43% of social media users aged 19 to 29 uses these platforms to find an employment (icims.com). Based on these statistics, Hershatterand Epstein (2010) state that members of generation Y assume that just by pressing a button all information can be collected at any given moment. Furthermore, authors state that in case member of generation Y would be assigned a research task, they would look for information on web browser Google, than on web site Wikipedia, and in case of searching for current information from the market, they can instantly and without obstacles approach social media and obtain an answer momentarily.

The phenomenon of using online social networks and various Internet platforms has greatly contributed to changes in the consumption of traditional media. As a result of the fact that digital video platform YouTube reaches more people aged 18-49 in the USA than any cable TV network, and that 6 out of 10 people prefer online video platforms compared to television, YouTube channel ratings in 2015 grew by 74% while television ratings fell by 4% among the observed group of respondents (thinkwithgoogle.com). According to the same survey, by 2025, 50% of North American subscribers to YouTube channels under the age of 32 will not be subscribed to TV services. These statistics have led to the fact that brand advertisers seek alternative methods of promoting their products or services. More specifically, as viewers change the platform through which they get information and watch entertainment content, so the advertising campaigns have received their own customized broadcast format on the YouTube platform. According to eMarketer estimation, in 2017 YouTube generated net income from video ads of $ 2.59 billion in the US, which makes up 20% of total revenue from video advertising in the United States in the previous year, while this platform has the largest market share in advertising (emarketer.com).

However, as the aforementioned characteristics of the generation Y members indicate that they do not trust in the advertising activities of companies, eMarketer states that only 29% of them watch commercials entirely without skipping them. As an alternative to classic advertising applied to a new type of media, product placement as a well-known marketing tool that has so far been reserved for movies, TV shows and other popular television programs has become an integral part of the video footage on the YouTube platform. Namely, as this platform gives everyone the opportunity to create and publish their video content, there has been an expansion of personal YouTube accounts of individuals in which they can express their opinions on different topics, including the quality of a particular product or service. The same has caused the emergence of new occupations such as vlogger, or the person who creates a video blog on various topics. With the increasing popularity of these individuals, the number of their followers or groups of people whose opinion can be affected increases, which marketing experts see as an effective method to present a particular product or service to the desired target groups. Through paid advertising, the video author recommends to the group of followers or subscribers on the channel a specific product or service based on personal experience of using it.

5. GENERATION Y INTERACTIVE APPROACH TOWARDS CREATING MARKETING COMMUNICATION

Ernst and Fudge (2009) state that due to the availability of a large amount of information and content on the Internet and online social networks, modern customers feel qualified and empowered to participate in the process of value co-creation with companies. This phenomenon is caused by the fact that customers no longer depend on the information provided by companies, but they themselves collect information from alternative sources that allow them to question the value created by a particular company and find the product that best suits their needs. Van Doorn et al. (2010) state that social networking of modern society

enables customers to interact mutually as well as with organizations representatives through online social networks, which has resulted in the fact that customers create value for companies without making money transactions. More precisely, Hennig-Thurau et al. (2010) state that modern media has enabled customers to create and distribute critical reviews of products and services, and as companies have realized that these types of non-customer activities later result in customer activities, they are directing their marketing efforts to encourage customers to create this kind of content.

Furthermore, Gerdes et al. (2008) indicate that by encouraging customers to evaluate and give qualitative reviews about products or services that company created, useful information about their possible improvement could be generated, while Duan et al. (2008) add that customer reactions to certain products or services in online communities can shape other customers' attitudes towards given products and services and thus affect the sales and financial results of the company. Chenand Xie (2004) observe customer online reviews of products as a new element of marketing communication mix that has a growing importance in making a purchase decision. These statements can be confirmed by the results of the research conducted by Bickart and Schindler (2001) which indicated that the opinion of other customers had far more influence on other customers while creating an opinion on certain product than promotional messages sent by companies. Bearing this in mind, Wind and Rangaswamy (2001) state that one of the biggest advantages of using digital media is their potential to create a personalized relationship with customers, which affects the increase in customer loyalty to specific company or its brand (Srinivasan et al., 2002). Taken Smith (2011) state that members of the Y generation prefer personalized messages, emphasizing online recommendations as a method of creating personalized message for the customer.

These findings can be confirmed by the results of the research conducted by Deloitte, according to which 47% of the generation Y members claim that their customer decisions were brought under the influence of social media. However, this generation does not use social media to listen to brand marketing messages, but to find information from peers about which products and services would best suit their needs. Furthermore, research results indicate that customers who include social media to their purchase activities are four times more likely to spend more money during the process, while the chances of bringing purchase decision the same day when they consulted specific social media are 29% higher (www2.deloitte.com). Allsop et al.(2007) state that online recommendations of other users are more reliable promotional tool than advertising, since in that case customers believe that the product has successfully met the evaluation criteria of "people like me". Furthermore, Lee et al. (2013), emphasize the significance of informative content on social media especially in cases when customers are facing time constraints, lack of product knowledge or lack of interest in making a purchase decision on their own.

These statement can be confirmed by results of a research conducted by PricewaterhouseCoopers, which included 23 respondents who perform online shopping. The results of the survey indicated that almost half of the participants (45%) claim that reviews, comments and feedback from other customers on social networks, alongside respecting their family members attitudes and evaluating the content of promotional messages, influence the creation of their affections and forming opinions on brand authenticity. Likewise, 25% of the respondents stated that their social media platforms allow them to stay up to date with current products and trends, while 22% claimed their active participation in process of writing reviews, comments and feedback on products or services. Also, the results of the survey indicated that 43% of respondents, after interacting with their favorite brands through online social networks, value them more and feel more respect for them (pwc.com).

In accordance with previously stated specificities of generation Y members in terms of their sociological characteristics, communication specifics caused by the extensive use of social media, which shaped the way in which members of this generation make purchasing decisions and create opinion on companies, their brands and products, guidelines to create successful marketing communications with this target group would be:

- It is necessary to build a genuine relationship with members of the generation Y on social media platforms,
- It is necessary to encourage discussions of generation Y members on online social networks about a particular brand, product or service,
- It is necessary to encourage customers to write public reviews on specific brands, products or services on social media platforms,
- It is necessary to emphasize communication about conducting socially responsible activities that are significant for the community that generation Y members belong to,
- Marketing communication should be adapted in order to be available on different technological devices and platforms (Rohampton, 2017).

Furthermore, Friedman (2016) provides companies and brands with recommendations for establishing successful communication with members of generation Y on social media:

- Brands and companies should send messages about their transparency, authenticity and commitment to specific socially responsible community purposes;
- Creating positive brand experience for customers should be an activity of highest priority, since members of generation Y make purchase decisions on the basis of brand perception more than any other generation;
- Since customers trust each other's opinion and actually buy products from them, not from brands, one of the most effective ways for establishing quality communication with members of generation Y is to engage some of them to promote a particular brand or brand product;
- Messages sent to customers should be personalized, adapted to their specificities and preferences, and the platforms they use.

6. CONCLUSION

Based on previously stated advantages of digital media in sense of marketing communication development, it can be concluded that companies are focusing on customers which are the users of social media as key creators of marketing content for their products and services. Considering the decrease of confidence in companies mass advertising activities, nowadays customers have focused their attention on other customers and the content they create about products and services based on personal experience. Therefore, it can be concluded that in the process of generating marketing content, communication between customers is observed with specific interest.

Due to the fact that growing up of the Y generation has been accompanied by rapid development of digital interactive technologies, this has made significant impact on them regarding availability of information and the possibility of their processing. The Internet and social media as well as other interactive technologies have given the opportunity to generation Y members to proactively gather information about products and brands, and to actively participate in the process of product or service creation and improvement. Therefore, members of the generation Y represent the key group for which digital marketing content is being created.

Even though numerous researches regarding digital marketing communication strategies for generation Y have been conducted, preferences and habits of this market segment in Serbia haven't been observed. Although there are several researches regarding the use of Internet and social media by this group of customers, their role in creating online marketing communication hasn't been explored. Since foreign researches indicated that generation Y members are prone to establishing personal, professional and business communication through numerous digital channels, authors of this paper suggest that these specifics should be researched among this market group in Serbia. Furthermore, research should include identification of most commonly used social media by this target group, their attitude towards user generated content and evaluation of its significance in purchase decision making process. This information could make contribution to domestic marketing theory and practice in sense of providing useful data for understanding generation Y preferences towards digital marketing communication and therefore creating more personalized marketing communication adapted to their needs and expectations.

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TECHNOLOGY ENTREPRENEURSHIP AND ECOSYSTEM **657**

Maja Levi Jakšić, Jovana Rakićević, Ondrej Jaško
COMPETITIVE INNOVATION AND ENTREPRENEURSHIP ECOSYSTEM FRAMEWORK **658**

Jovana Rakićević, Maja Levi Jakšić, Nina Ukropina
THE ROLE OF SUPPORT ORGANIZATIONS IN TECHNOLOGY ENTREPRENEURSHIP ECOSYSTEM: CASE OF SERBIA **666**

Aleksandar Vekić, Jelena Borocki, Angela Fajsi
CREATING ENTREPRENEURIAL ECOSYSTEM THROUGH UNIVERSITIES SPIN OFF AND STARTUP COMPANIES - EXAMPLE OF THE UNIVERSITY OF NOVI SAD **675**

Milica Jovanović, Miloš Jevtić, Jasna Petković
THE ROLE OF CULTURE IN ENTREPRENEURIAL ECOSYSTEM: WHAT MATTERS MOST? **683**

Goran Kutnjak, Dejan Miljenović, Ana Obradović
DIMENSIONING THE CONTEXT OF CORPORATE SOCIAL RESPONSIBILITY **692**

Nikola Mehandžić, Sanja Marinković
APPLICATION OF BIOMETRIC TECHNOLOGY IN ELECTRONIC PAYMENT AUTHENTICATION **700**

COMPETITIVE INNOVATION AND ENTREPRENEURSHIP ECOSYSTEM FRAMEWORK

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Abstract: *The research aim is to develop a conceptual framework which is relevant in the process of developing the Innovation and Entrepreneurship Ecosystem (IEE) towards achieving the goals of increasing competitiveness of national economy and regions. The development of competitive IEE is viewed as a process involving changes in all the relevant domains, actors, stakeholders, networks and relationships, and links present in the ecosystem. It is argued that the government, with a smart policy mix of measures and instruments, plays a significant role in the process of creating the ambience of the external environment influencing the crucial domains of the ecosystem. In this paper, it is argued that the "ecosystem approach" is comprehensive, encompassing the firm and the external environment considerations and includes both the micro and macro perspectives of competitiveness. The contemporary research findings point to innovation and entrepreneurship as the relevant pillars of economic growth. The concept of competitive Innovation and Entrepreneurship Ecosystem (IEE) integrates the holistic approach for identifying the main forces leading to feasible and sustainable economic growth. In this respect, global innovation and global entrepreneurship indices are compared for correspondence, coincidence and compatibility as a step towards identifying the crucial domains, determinants and factors of IEE. The IEE framework provides support to policy decision makers involved in national and regional sustainable innovation and entrepreneurship ecosystems development. The relevance of the suggested framework is found in its conceptual and methodological contributions to identifying relevant factors for better understanding the crucial domains of the IEE, their evaluation and monitoring, and ultimately leading to actions that will increase its overall strengths and competitiveness.*

Keywords*: Innovation, Entrepreneurship, Ecosystem Approach, Competitiveness, Framework*

1. INTRODUCTION

The research aim is to develop a conceptual framework as decision support to policy decision makers involved in national and regional sustainable innovation and entrepreneurship ecosystems development. The Innovation and Entrepreneurship Ecosystems (IEE) are recognized as the crucial forces boosting development of nations worldwide. Numerous institutions, experts, and teams have engaged in developing methodology, models and tools for measuring, monitoring, and continuously improving the innovation and entrepreneurship environments. Contemporary research results, both in theory and in practice, as reported in relevant literature, indicate a convergence between innovation, entrepreneurship and competitiveness. These results also indicate a convergence between the macro and micro research perspectives resulting in integrating the relevant factors of both. It is widely ascertained that in order to achieve competitiveness and economic growth it is necessary to focus efforts at strengthening the three crucial domains of innovation, entrepreneurship, and competitiveness and this implies integrating the relevant actors, resources, relationships, networks, and linkages in the analysis.

The rising interest in this field has resulted in multiple approaches, concepts and models found in relevant literature, e.g. National innovation Systems, Ecosystems, Triple (Quadruple) Helix, Sustainable Development, PESTLE (Political, Economic, Social, Technology, Legal, and Environmental) analysis, Key Enabling Technology- KET, Global Indices and Models. There is a wide range of institutions, organizations and individuals that contribute to these efforts: universities, research institutions, European and World Organizations, academics, researchers. With no intention to give the complete list, we name some of them as follows: European Institute for Innovation and Technology (EIT), World Economic Forum (WEF), European Commission Joint Research Centre, (EC JRC), EC High Expert Group (EC HEG), World Intellectual Property Organization (WIPO), OECD, World Bank, EBRD, INSEAD, Cornell University, Aspen Group, Global Entrepreneurship and Development Institute (GEDI).

The different approaches are in accordance and based on the assent that external environment and the overall ambiance for innovation and entrepreneurship is crucial in enhancing competitiveness of national economies, regions, and firms.

The Ecosystem Approach (EA), essential in the framework developed in this paper, is represented by the dimensions, factors and indicators found in integrated, complex, composite indices for ranking countries and regions in respect to their innovative, entrepreneurial, and competitiveness performance. The comprehensiveness of the EA is based on both the external environment and the firms included in the ecosystems disclosure. The EA is viewed as playing a crucial role in the development of models and tools, indices and indicators that can be used, and are relevant in the process of efficient and effective achievement of feasible and sustainable development goals. The EA emphasizes the development of a dynamic, evolving systems framework for management based on data, evidence, and performance.

The global indices, focused mainly at measuring and monitoring performance annually, are introduced in the framework and complemented by policy measures and instruments related to the crucial indicators, presenting a valuable decision support for improving the competitive IEE. Thus, the framework, apart from measurement and monitoring, adds new dimensions of evaluation, assessment, control and intervention, contributing to the overall management of the ecosystem. The research aim is to develop a framework for policy decision making, as support to creating a policy mix best suited and adapted to concrete situations and conditions of a certain country. It is in accordance with the present efforts in the global economy at focusing on priorities taking into account the differences and specific features of national and regional economies.

The paper is organized in the following manner. After Introduction, the second section presents the concepts and definitions of the IEE. The third section presents a comparative analysis of the global indices that are used for measuring and monitoring the IEE domains at country and regional levels. The Framework for competitive IEE is presented in a separate section with smart policy considerations. In the end, Conclusion and References are presented.

2. INNOVATION AND ENTREPRENEURSHIP ECOSYSTEMS (IEE) – CONCEPTUAL APPROACH

The rising interest of academia and practitioners in IEE, as the strong force boosting competitiveness and economic growth, has resulted in multiple studies, reports, and global indices indicating multiple approaches, definitions and interpretations. The development of the concepts is strongly related to the rising awareness of the significance of the external environment characteristics in creating the overall ambience that supports innovations and entrepreneurship. The Ecosystem Approach (EA) brings new insights for better understanding the forces that push competitiveness and enable economies to develop at an intensive, high rising rate.

The EA is strongly connected with the research in the field of Technology and Innovation Management and Entrepreneurship – TIME, comprising information management, innovation management, technology entrepreneurship, new product development, Research and Development (R&D) management, intellectual property, as being “increasingly recognized as essential for continued corporate and societal well-being” (Atkinson & Correa, 2007, cited in Jovanovic et al, 2017, pp. 40).

Technology entrepreneurship as a holistic concept and approach is defined by the three main contingencies/pillars of the technology entrepreneurship process: Technology and Business Innovation; Identifying opportunity for new products, goods and services; Organizing for exploiting the opportunity and innovation by creating and capturing value on the markets (Levi Jaksic et al., 2018, pp. 91). The three contingencies/pillars represent also the forces of entrepreneurship in creating value by organizing resources (firm) for developing new products and services (innovation) for the market and society (opportunity), ultimately leading to the achievement of sustainable development goals. The three pillars are influenced by the overall conditions in the environment and the internal firm potentials. The focus is on technology and innovation essential to entrepreneurship and firm growth that generates economic and social benefits.

The EA is based on the integral set of factors driving innovation, entrepreneurship and competitiveness in a closed loop relationship as presented in Figure 1 (EBRD Transition Report 2014). The EA captures the forces of both the firm and the environment integrating the micro and macro research perspectives. Figure 1 presents the integral set of factors in the EA.

Figure 1: Ecosystem Approach based on integral set of factors driving innovation, entrepreneurship and competitiveness (Source: EBRD Transition Report 2014)

Focus on the firms (industry and business) in the IEE is related to their central role in improving productivity and competitiveness of the economy. It is the individual firm that harnesses innovation to create new value. At the same time the firms are not "isolated islands" and the EA emphasizes the environment factors and conditions (external and internal) in boosting the overall competitiveness and growth. The competitive ecosystem is created by nourishing high growth competitive firms as the motor force of the development of the economy.

As stated in the Report "Regardless of a country's level of economic development or its progress along the transition path, individual firms can make a difference" (EBRD Transition Report 2014, pp.4). It is ascertained that the competitiveness of the economy is positively related to the ecosystem dynamics. All the domains of the ecosystem are engaged in fostering the dynamics of new firms entering the markets, developing and growing at a high rate and incumbents ceasing to operate. The fast growing firms (Mason & Brown, 2014) are the key, competitive firms whose market share growth effects the growth of the economy. It is the ecosystem that creates the fertile grounds for the firms with the high growth potential to flourish and in the dynamic ecosystem there is more opportunity for firms to emerge, grow and create employment (Rosted, 2012). The central role of the firm within the ecosystem is presented in Figure 2 indicating six relevant dimensions of the ecosystem: The Firm, Infrastructure and Institutions, Education and Public research System, Innovation Policies, Market Demand, and Other Firms (Hao et al., 2017).

Figure 2: The six Ecosystem dimensions (Hao et al., 2017, pp. 8)

The term ecosystem has emerged for the first time in the 1990s (Moore, 1993). Multiple models of innovation and entrepreneurial ecosystems have emerged in the recent years. According to Mason and Brown (2014, pp. 5), the entrepreneurial ecosystem represents a holistic approach focusing on: actors, resource providers, entrepreneurial connectors, and entrepreneurial environment.

It is noted that an influential approach has been developed by Daniel Isenberg, leader of the Babson College Project with reference to the "entrepreneurship ecosystem strategy for economic development" (Isenberg, 2011). It is postulated that this is a novel and cost-effective strategy for stimulating economic prosperity. This approach potentially "replaces" or becomes a "pre-condition" for the successful deployment of cluster strategies, innovation systems, knowledge economy or national competitiveness policies (Isenberg, 2011). The ecosystem includes six domains: a conducive culture, enabling policies and leadership, availability of appropriate finance, quality human capital, venture friendly markets for products, and a range

of institutional supports (Mason & Brown, 2014, pp. 5). Figure 3 provides a graphic representation of the Isenberg's Entrepreneurial Ecosystem.

Figure 3: Isenberg's Entrepreneurship Ecosystem (modified source: based on Isenberg, 2011)

Based on the analysis of definitions found in the relevant literature, we propose a synthesized definition of the Innovation and Entrepreneurship Ecosystem as a set of interconnected entrepreneurial actors (organizations, institutions) and entrepreneurial processes playing relevant roles in the three essential domains (pillars) of entrepreneurship: creating opportunity, innovation and organizations, and bearing responsibilities in developing policies, measures, instruments for connecting, mediating and governing the performance within the local innovation and entrepreneurial environment.

3. IEE METRICS: GLOBAL INNOVATION AND ENTREPRENEURSHIP INDICES - COMPARATIVE ANALYSIS

Mapping and measuring the existing innovation and entrepreneurship ecosystem is the first step in the efforts aimed at enhancing its competitiveness. Managing ecosystem performance is based on comprehensive performance measurement. Global indices are recognized as valuable tools serving the purpose of measuring and monitoring the ecosystem.

We have reviewed six relevant ecosystem measurement approaches, reported as global indices, for comparative analysis: European Innovation Scoreboard (EIS), Global Innovation Index (GII), Babson, OECD - Entrepreneurship Measurement Framework, Doing Business (DB) and Global Competitiveness Index (GCI). Brief summary of the selected indices is presented.

1. The European Innovation Scoreboard (EIS), created by European Commission, postulates the main domains grouped as Enablers, comprising Human resources, Finance and Support; Firm Activities comprising Firm investments, Linkages and Entrepreneurship; and Output comprising Innovators and Economic Effects. It was first published in 2001 and in 2017 performance is measured by 27 indicators structured around 4 main types: Framework conditions, Investments, Innovation Activities, and Impacts which are further developed into 10 Innovation Dimensions. Within the Framework conditions the dimensions are: Human Resources, Attractive Research Systems, and Innovation friendly. The dimensions of Investments are: Finance and Support, Firm Investment; Innovation activities are represented by the dimensions: Innovators, Linkages, Intellectual Assets; and Impacts have the dimensions: Employment, Sales. Each of the dimensions is represented by 2-3 indicators.
2. The Global Innovation Index (GII), co-published by INSEAD, World Intellectual Property Organization (WIPO) and Cornell University, GII has two sub-indices: input and output (Cornell University, INSEAD, and WIPO, 2017). The Input Sub-index covers the following domains: Institutions, Human Capital, Research Infrastructure, Market sophistication, and Business Sophistication. The Output Sub-index covers Knowledge, Technology and Creative Outputs. It comprises 83 indicators, referenced in the Report for 2017. The first version was created in 2008, and since then published annually.
3. Babson College - Babson Entrepreneurship Ecosystem Project, with Daniel Isenberg as the Project Leader defines an entrepreneurship ecosystem as "a set of networked institutions with the objective of aiding the entrepreneur to go through all the stages of the process of new venture development". It consists of 6 domains: policy, finance, culture, supports, human capital, and markets (Isenberg, 2011).
4. The OECD framework is extensive, listing 57 key indicators to measure the determinants of entrepreneurship in a country (Organization for Economic Co-operation and Development (OECD) -

Entrepreneurship Measurement Framework). The OECD framework seeks to inform policy makers and help to create a sound base for internationally comparable indicators of entrepreneurship. Entrepreneurial activities, as defined in the Framework, represent "the pursuit of the generation of value through the creation or expansion of economic activity, by identifying and exploiting new products, processes or markets". The OECD conceptualizes the ecosystem of entrepreneurship as the combination of three factors: opportunities, skilled people, and resources, represented by 6 key determinants: regulatory framework, market conditions, access to finance, R&D and technology, entrepreneurial capabilities, and culture. The OECD Framework also specifies the variety of indicators for measuring each of these determinants.

5. The World Bank's Doing Business framework specifically focuses on policy and the enabling environment. The Report for 2018 (Doing Business, 2018) is the 15th annual report based on quantitative indicators on regulations and intellectual property rights protection that influences business activity. It covers 11 areas related to the ease of doing business: starting a new business, dealing with construction permits, getting electricity, registering property, getting credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts, and resolving insolvency. The eleventh area is labor market regulation and it has not been included in this year's Report.
6. Global Competitiveness Index (GCI) has been published by World Economic Forum (WEF). WEF has published for more than three decades Global Competitiveness Reports, and since 2005 WEF has based its competitiveness analysis on the GCI that "measures the microeconomic and macroeconomic foundations of national competitiveness" (WEF 2012-2013, pp 4). It comprises 12 pillars of competitiveness: Institutions, Infrastructure, Macroeconomic environment, Health and Primary education, Higher Education and training, Goods market efficiency, Labor market efficiency, Financial market development, Technological readiness, Market size, Business sophistication, and Innovation. Within the pillars there are multiple indicators organized according to some characteristics, adding up to the total of 115 indicators.

The different approaches can be classified based on the geographic unit of analysis, their level of detail, and their sector or domain focus. The comparative analysis based on their domain focus is conducted and the research results presented as the synthesis in Table 1. The Table presents the relevant domains found in 6 selected Global Indices, and the presence of a certain domain is designated in the concrete measurement index. The Table is constructed with the aim of comparing the degree of comprehensiveness of the domains and indicators in the selected six global indices.

Table 1: Comparison of 6 Global Indices in relation to the relevant Domains

Domains	GII	EIS	Babson	OECD	Doing Business	WEF- GCI
Policy			x	x	x	
Finance		x	x	x		x
Infrastructure	x		x	x	x	x
Markets	x		x	x		x
Human Capital	x	x	x	x		x
Support/Services/Connections			x	x		
R&D/Innovation	x	x	x	x		x
Quality of Life			x			
Macroeconomic Conditions	x	x		x		x
Institutions	x					x
Firms/Business	x	x				x
Health and Education	x					x

The comparative analysis synthesized in Table 1 shows that there is high correspondence between the indices in treating certain domains, i.e. Infrastructure, R&D/Innovation and Human Capital are considered in 5 Indices; Finance, Markets, and Macroeconomic Conditions in 4; Policy and Firms/ Business are considered in 3 indices. Support/Services/Connections, and Health and Education are treated by 2 indices, while only 1 Index treats the Quality of Life domain. It should be noted also that the most (9) of the 12 domains are measured by the WEF GCI, 8 domains are measured by GII, Babson and OECD, 5 by EIS, and DB reports on 2 domains. This leads to the conclusion that the selected indices under inspection cover a wide range of the domains and are comprehensive in treating the ecosystems. There is also a high degree of coincidence among them, indicating the tendency of covering multiple areas regardless of their main designation as being global innovation, entrepreneurship or competitiveness indices.

4. THE COMPETITIVE IEE FRAMEWORK: DEVELOPING A SMART POLICY MIX

Relevant literature review points to the general agreement that "it is important that policy makers develop metrics in order to determine the strengths and weaknesses of individual ecosystems so that their strengths and weaknesses can be assessed, to identify whether and how to intervene, and monitoring over time the effectiveness of such interventions" (Mason & Brown, 2014, pp.1). Policy makers are relying more on a systems based support in developing more focused and effective policy measures and instruments that will bring effects in a short time span (European Commission, 2010). They are oriented at developing networks, aligning priorities, building new institutional capabilities and fostering synergies between different stakeholders (Rodriguez-Pose, 2013; Warwick, 2013). In this network the actors and their interconnections are important, and the state as an entrepreneurial agent has a special role in developing smart policies to enhance competitiveness and economic growth (Fuerlinger et al., 2015).

Policy mix, a set of measures and instruments developed and used to achieve the goals of sustainable development of the economy and society, also refers to "the balance of and interactions among policies" (OECD, 2014; OECD, 2016). Policy mix represents complementary, synergistic constructions rather than alternatives. The smart policy mix encompasses policy measures and instruments addressing issues of the highest priority with the ultimate purpose of creating the appropriate balance for most effective results. The greatest challenge of the successful Policy mix is to reflect the priorities of the concrete IEE. A specific IEE is characterized by its main domains and dimensions, and in this paper global indices and indicators are used as the relevant reference base for IEE measurement and monitoring while the suggested Framework adds the smart policy mix considerations for creating and enhancing competitive IEE. The Framework indicates the relevant phases necessary in the process and supported by research steps and results, as represented in the Figure 4.

Policy measures and instruments are grouped in several ways (OECD, 2014, pp. 152):

- Target groups refer to policy instruments specially targeting specific types of firms sectors and technology. Sector and technology targeting would involve a policy instruments mix focusing support to special fields of R&D and innovation or specific industry sectors;
- The difference between supply-side and demand-side policy instruments are reflected in the push of knowledge production and R&D related to the supply side, e.g. accelerating knowledge spillovers and externalities. The Market pull focus is explicated in the Demand side instruments aimed at boosting market opportunities and demand for innovation (e.g. public procurement for R&D and innovation);
- Desired outcomes, as the expected results and relevance, are another way of grouping and creating priorities among the policy instruments. It is noted that policy instruments affecting competitiveness as the desired outcome is to be differentiated from the non-competitive instruments that are not creating a competitive difference;
- Mode of intervention is looking at the following categories of instruments: financial, law and regulations, and non-financial instruments.

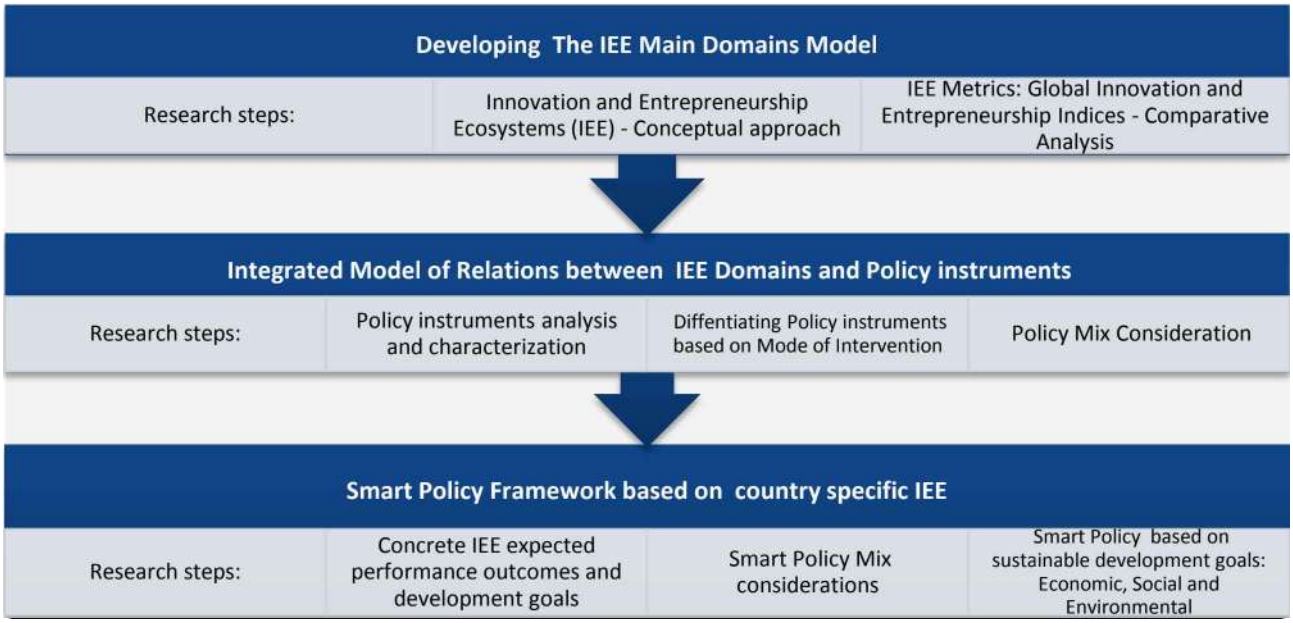

Figure 4: Framework for competitive IEE

The Framework indicates the three main phases in the smart policy creation process. These phases are supported by research steps and results that represent methodological support for effective policy decisions.

5. CONCLUSION

The ecosystems approach enables capturing the main forces driving social development and economic growth. In the last decade, multiple global indices and indicators have been created for measuring innovation, entrepreneurship, and competitiveness thus leading to country ranking reports and indicating different positioning of countries based on these indices. Global innovation, entrepreneurship, and competitiveness indices are compared; it is found that there is a high degree of their correspondence, coincidence, and compatibility. They represent one of research steps in the suggested Framework related to the first phase: Developing the IEE Main Domains Model. It is argued that only with an integrated approach within a comprehensive Framework, consistent rankings between countries are made possible serving simultaneously as a valuable tool for policy makers to trace paths for improving the country's position in respect to the potentials, capacities, and results in the domains of innovation, entrepreneurship, and competitiveness.

The relevance of the suggested framework presented in the paper is found in its conceptual and methodological contributions to identifying relevant factors for better understanding of the crucial domains of the IEE. The focus is on policy decision making support in relation to recognizing opportunities, priorities and developing smart strategic solutions that fulfil economic, environmental, and social development goals.

In the research, the bibliographical method and relevant literature review is mainly used for both theoretical considerations and empirical data found in the up-to-date reports and activities of relevant international bodies and organizations. Secondary data sources are used to argument and demonstrate the rationale of the comprehensive framework. It is viewed as a contribution to the ongoing, continuous efforts of research and development of the methodology for identifying, measuring the factors and forces that influence the upgrading of Innovation and Entrepreneurship Ecosystems on the scales of competitiveness and growth.

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THE ROLE OF SUPPORT ORGANIZATIONS IN TECHNOLOGY ENTREPRENEURSHIP ECOSYSTEM: CASE OF SERBIA

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Abstract: *Both academia and policy makers observe technology entrepreneurship as one of the most important forces influencing economic growth and development of countries. To flourish and grow, technology entrepreneurship needs special supportive environment. In this sense, competitive entrepreneurial ecosystems are seen as necessary complex "mechanisms" enabling firms with high growth potential to advance and expand. In this paper we focus on "support" as one domain of the ecosystem. Science parks, incubators, accelerators and other supporting organizations are recognized as important policy tools for supporting innovation and technology-oriented entrepreneurial growth by providing critical value-added inputs. In this paper we examine the role of support in an entrepreneurial ecosystem, systematizing different forms of institutional support, and classifying the services they provide; and further conduct a secondary research on support provided in Serbia, on a sample of eight organizations oriented towards technology entrepreneurship development and promotion in Serbia. This analysis could serve the needs of different actors in the technology entrepreneurship ecosystem in the following manner: (1) entrepreneurs – to better understand the help supporting organizations could offer, and recognize the possibility and necessity to interact, (2) policy makers – to identify the level of development of support to techno-entrepreneurship development as a domain of Serbian entrepreneurship ecosystem, (3) support organizations – to benchmark in the ecosystem, trying to further develop and grow, and (4) researchers – to identify future research directions in the rich field of support to technology entrepreneurship development.*

Keywords*: technology entrepreneurship, technology start-up, ecosystem, support, forms of support.*

1. INTRODUCTION

Entrepreneurship, especially technology (technological, hi-tech or techno-) entrepreneurship has significant importance in today's business. Over the last two decades it attracts high interest of both academicians and policy makers due to its high impact on economic growth, innovation, job creation and well-being of countries, changing the overall living standards and work conditions (Kirchhoff, Linton & Walsh, 2013; Mosey, Guerrero, & Greenman, 2017; Ratinho, Harms, & Walsh, 2015). However, although technology entrepreneurship has been recognized as a driver of prosperity in individuals, firms, regions, and nations (Bailetti, 2012), a unified framework for understanding technology entrepreneurship and assessing its value does not exist (Sobel and Clark, 2017).

The definition of Technology entrepreneurship has been emerging in time with the need to focus on technology and innovation as a necessary constituent of entrepreneurship, thus making a difference in comparison to the widespread understanding of entrepreneurship being any new business in the early stages of development. The discussions are still open on what the real entrepreneur does, but the "technology" in the new entrepreneurship concept emphasizes the difference to the entrepreneurship of a person who opened a candy shop last week and is considered as an entrepreneur. Technology entrepreneurs create new values and boost the economic growth of a country. Steve Blank, one of the most important entrepreneurs of today, defines technology start-up as "*a temporary organization formed to search for a repeatable and scalable business model*". Paul Graham, founder of the *Y-Combinator*, the most famous accelerator in the world, defines a technology start-up with only one word "*growth*" (Vukanovic, Andric, & Nesic, 2016). Academicians offer different definitions. Beckman et al. (2012) define technology entrepreneurship as the interface of two well-established, but related fields – entrepreneurship and technological innovation. Bailetti (2012) defines it 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"*. Byers, Dorf and Nelson (2011) highlight the task technology entrepreneurs have in bringing together the technical world and the business world in a profitable way. Eric Ries (2011), author of the bestseller "*The Lean startup"*, defines a start-up as *"a human institution designed to deliver a new product or service under conditions of extreme uncertainty".* It is obvious that technology entrepreneurship lacks a unique definition. According to Bailetti (2012), unless a generally accepted definition is established, the debates on technology entrepreneurship lose their focus.

However, one thing is certain, technology entrepreneurship, whether academic or technical, requires a special supportive environment (Runge, 2014). It is the ecosystem that creates the fertile grounds for the firms with the high growth potential to develop and flourish. In the dynamic ecosystem there is more opportunity for firms to emerge, grow and create employment (Ben Letaifa, Gratacap, & Isckia, 2013). The concept of entrepreneurship ecosystem puts the firm in the heart of the ecosystem, "surrounding" it by various elements. Technology entrepreneurship ecosystem comprises of a dozen or so elements which interact in very complex ways. They are always present if entrepreneurship is self-sustaining. Hao, Van Ark and Ozyildirim (2017) identify external innovation ecosystem as one of six major signposts of innovation. Based on the *Oslo Manual* (OECD, 2005), they identify six elements of the ecosystem – The firm, Education and public research system, Innovation policies, Market demand, customers, and buyers, Other firms (suppliers, contractors, partners, and joint ventures), and Infrastructure and institutions. As defined by Isenberg (2011) technology entrepreneurship ecosystem includes six domains: a conducive policy, markets, capital, human skills, culture, and supports.

In this paper we focus on "support" as a domain of technology entrepreneurship ecosystem. We concentrate on centers, organizations that provide support for technology entrepreneurship development. They are usually identified as providers of infrastructural support, but have developed and overcame that basic role over time. In this paper we identify the role they have in an entrepreneurial ecosystem and classify the services they provide to enable firms to develop and grow. A special emphasis is put on a comparative analysis of organizations working in Serbia. A secondary research is performed on a sample of eight organizations oriented towards technology entrepreneurship development and promotion is Serbia. For the purpose of identifying and classifying the services they offer, we adapt the model provided by Fomiene (2010) and analyze the observed institutions in accordance with the proposed adapted model.

The paper is organized as follows. Section 2 briefly defines different forms of support centers for technology entrepreneurship development, and emphasizes the importance of the incubation and acceleration process in developing technology start-ups. Section 3 presents a comparative analysis of support centers in Serbia and discusses the results. Section 4 concludes and presents the limitations, as well as future work directions.

2. SUPPORT CENTERS FOR TECHNOLOGY ENTREPRENEURSHIP DEVELOPMENT – DEFINITION AND CLASSIFICATION

Entrepreneurs need support, especially in overcoming problems in the start-up phase (Karlan & Valdivia, 2011). They need an environment that offers different mechanisms of support aimed at boosting innovation activity of firms – from infrastructural support to financing and different intangible services like mentorship, training, education, networking etc. Various organizations offer different mechanisms of support by providing critical value-added inputs essential for the creation and development of innovative technology-based firms. Mian, Lamine, and Fayolle (2016) introduce Technology Business Incubation as a significant field of study and practice. A variety of incubation mechanisms have evolved (Bruneel et al., 2012) over the past decades. They were introduced by universities, policy makers, corporations, research institutes, private investors, etc., contributing to nurturing and boosting new venture creation. Barbero et al. (2012) highlight the importance of examining the impact these organizations have on incubated ventures, taking into account different models of incubation (Barbero et al., 2014). Still, determining what type of mechanisms are most helpful in achieving the desired results is very much mission-driven and context-specific (Mian, Lamine, & Fayolle, 2016).

The most usual forms of support to techno-entrepreneurship development are business incubators, science and technology parks, technology transfer offices, business accelerators, angel investors, venture capital funds etc. This is not a closed list.

Business incubators are generally defined as organizations that support and help the growth and survival of new companies. They are often seen as places where recently established companies are concentrated in a limited space (Aranha, 2003). There is no one classification of business incubators, but it depends on the criteria used for classification. Secondly, it depends on the definition of incubator an author follows. In Table 1 we systematize several existing approaches to business incubators classification. This is certainly not the final, nor the closed list. Observing this limited literature review presented in the table we capture an evident call for systematic classification of incubators with the aim to better understand their position and potential in the ecosystem, and also to better define and clarify their role in providing help for developing new entrepreneurial ventures based on new technologies. De Bem Machado, Catapan and Sousa (2018) stress that among wide literature on business incubators models, observed as transformation mechanisms, there is a lack of detailed explanation of the incubation process and best management practices for the continuous improvement of incubated business. Fomiene (2010) explains how business incubator services and support vary depending on a certain business incubator lifecycle (establishment phase, growing/business development phase, or final maturity phase).

Table 1: Classification of business incubators by authors

Source	Classification criteria	Business incubator forms
Allen and McCluskey (1991)	Source of value added	For-profit property development, Not-for-profit development corporation, Academic, For- profit seed capital, Hybrid, Corporate.
Aranha (2003)	Leading institution	Incubators linked to the "leader sponsor": university/academic, community, industrial, government, venture capital, consortiums, corporate, franchises, NGOs, cooperatives, unions.
	Strategic aim	Incentives to the enterprise culture, Support for minorities, Research and development, Economic development, The creation of jobs and the generation of employment, University – company relations, Opportunity for risk capital, Exports / internationalization, Development of non-profit making companies (third sector), The formation of productive clusters/arrangements, Induction by demand.
	Localization	Urban, Suburban, Rural, Industrial.
	Operational model	Bricks and Mortar (BAM), Virtual/portal/"without walls", Hub/venture incubator, "Eggubator".
	Purpose of enterprise	For-profit – Real Estate Development and Cooperatives, Non-profit – Academic Related or Technology Commercialization
	Focus	Traditional, Mixed, Cultural, Technological, Social, Agro industrial, Services/consultancy, Target.
Becker and Gassmann (2006)	Source and type of technology	Fast-profit incubators, Market incubators, Leveraging incubators, In-sourcing incubators.
Clarysse et al. (2005)	Level and complexity of activities performed and heterogeneity of resources deployed	Low selective model, Supportive model, Incubator model.
European Commission and CSES (2002)	Technology level and management support	Industrial estate, Business park, Science park, Managed Workshop, Enterprise centre, Innovation centre, Multipurpose business incubator, Business and innovation centre, Technology centre.
Grimaldi and Grandi (2005)	Needs and requirements of new ventures	Business innovation centre, University business incubator, Corporate business incubator, Independent business incubator.
Von Zedtwitz (2003)	Degrees of competitive focus (segment, industry, geography)	Independent commercial incubators, Regional business incubators, University incubators, Company-internal incubators, Virtual incubators.

Contemporary theory and practice identify business accelerators as a new-generation form of support for technology entrepreneurship development. Accelerators are organizations that provide specific incubation services, focussed on education and mentoring, during an intensive program of limited duration with the aim to accelerate successful venture creation (Cohen and Hochberg, 2014; Miller and Bound, 2011; cited in Pauwels, 2016), helping them to "*define and build their initial products, identify promising customer segments, and secure resources, including capital and employees"* (Cohen, 2013). "Business accelerator" cannot be used interchangeably with "business incubator". As Fernando Sapulveda, managing director of *Impulsa Business Accelerator* notes *"business incubators mentor companies through childhood while*

business accelerators guide them through adolescence into adulthood". Miller and Bound (2011) stress that accelerators have a greater impact on the success of entrepreneurial ventures in relation to incubators. Business accelerators usually offer three-months programmes of support. Programmes include initial funding, work space, networking, education and training by mentors. Corporate accelerators stand out as novel models of nurturing innovations from entrepreneurial ventures. However, large differences between corporations and start-ups make collaboration challenging, since these accelerators need to be designed in a two-fold way – to add value for the entrepreneurs, but also to make company benefit from this business model innovation (Kohler, 2016).

Science and technology parks are observed as locations fostering local knowledge exchange and promoting innovation. In recent years they have attracted significant attention and public funds (Vásquez-Urriago et al., 2014). Díez-Vial and Fernández-Olmos (2015) evaluate the role of science and technology parks as locations fostering local knowledge exchange and promoting innovation, considering that knowledge transfer depends on firms' internal capacity to understand and exploit others' knowledge, which depends on their own knowledge base. Albahari et. al (2017) explore the role of University in both Technology Parks and Science Parks and report the differences.

Another important form of support are business angels or angel investors – "*individual investors, or groups of individual investors, who provide seed capital and varying amounts of advice to young firms*" (Cohen, 2013). Those are individuals who provide capital for a start-up business, usually in exchange for convertible debt or ownership equity. Cohen (2013) provides a comparative analysis of business incubators, angel investors and accelerators based on: process duration, cohorts, business model, selection, venture stage, education, mentorship, and venture location, and highlights the difference among them. Teker and Teker (2016) explore the differences between business angels and venture capital funds regarding the way of doing business. Venture capital firms are seen to play a different and more proactive role in emerging markets as an "ecosystem engineer", turning a weak innovation ecosystem into a productive and robust one (Sun et al., 2018). Venture capital funds are able to build companies from the simplest form to mature organizations. Further definition, classification, differentiation and in-depth analysis of various forms of support are omitted for the reason of space limitation per paper.

3. RESEARCH – COMPARATIVE ANALYSIS OF SERBIAN SUPPORT CENTRES

Serbia proves to be a fertile ground for technology entrepreneurship development (Rakicevic, Levi Jaksic, & Jovanovic, 2016). *Strawberry energy, Nordeus, FishingBooker* or *ActiveColab* are just some of the examples that confirm it is possible to start and develop a globally successful company, starting as a technology start-up in Sebia.

Law on innovation activity of the Republic of Serbia ("Official Gazette of the RS", No. 110/2005, No.18/2010 and No. 55/2013) defines organizations for rendering infrastructural support to innovation activity in the following manner: 1) business and technology incubator; 2) science and technology park; 3) organization for stimulation of innovation activities in the priority field of science and technology; and 4) centre for transfer of technologies.

In the *Analysis of Business Support Infrastructure in the Republic of Serbia* conducted by the National agency for regional development of Serbia (Mijacic, 2011) it is reported that since 2005, the number of business support infrastructure entities has been constantly growing and their capacities have become more significant. However, Mijacic (2011) compares incubators in Serbia to an owner of luxury car who cannot afford to buy fuel, since most incubators are placed in new or completely renovated premises, equipped with the latest technical equipment, modern office furniture, and fast internet connection, but are financially unsustainable. Funds they receive from services are not sufficient to cover even basic operational costs. Still, it is encouraging to note that *Strategy for the support to development of SME, entrepreneurship and competitiveness 2015-2020* and the Action plan for the implementation defines "*Optimisation and improvement in the level of utilization of current business infrastructure and the development of a new one"* as a specific goal of the defined strategic goal "*Enhancing sustainability and competitiveness of SMEs"*, showing that the government recognizes the relevance of this issue to entrepreneurship development.

3.1. The sample and data collection

The research sample comprises of eight support organizations oriented towards technology entrepreneurship development and promotion in Serbia: *SEE ICT – StartIT, ICT Hub, StartLabs, Serbian Venture Network – SeVeN, Business-Technology Incubator of Technical Faculties – BITF, Science-Technology Park Belgrade, Nova Iskra*, and *Impact Hub*. All data used in the research are collected from the secondary sources – websites of the observed organizations over the period April – May 2018.

StartIT (https://startit.rs/) is a project of non-profit organization SEE ICT which is a pioneer in developing technology entrepreneurship scene in Serbia. Its main goal is to encourage Serbian technological progress, focusing primarily on domestic IT scene. It operates in several Serbian cities, developing strong network of tech-professionals throughout the whole country. It offers educative and informative programmes, space and mentorship, both external and internal. Major projects are the startit.rs portal, Startup academy, StartIt centre, "Potkrovlje Hub", Social change hackathon and others. *ICT Hub* (http://startup.icthub.rs/) is one of the leading organizations in Serbia oriented towards techno-entrepreneurship development. It is located in Science and Technology Park Belgrade. Besides the co-working space, it offers various forms of support to ICT professionals and tech-entrepreneurs through programmes of education, mentorship, networking, and by connecting Serbian startup ecosystem with the leading ecosystems worldwide. ICT Hub ecosystem comprises of ICT Hub start-up, ICT Hub Playground, ICT Hub Corpo Lab, and ICT Hub Venture. *Serbian Venture Network – SeVeN* (https://www.seven.rs/) is an association committed to development of start-up and entrepreneurship ecosystem in Serbia and South-East Europe. It promotes equity-based investment models and support startups, innovative entrepreneurs and fast growing companies in acquiring investments for their development. Major project is Belgrade Venture Forum (BgVF) – largest investment forum in the region, dedicated to promotion of entrepreneurship and investments in innovative companies and ideas. StartLabs (http://startlabs.co/) is a US based fund investing in startups from South-East Europe. They provide funding, mentorship, office space, technical infrastructure, business services and networking channels to exceptional entrepreneurs and their teams helping them turn ideas into sustainable business. *Business Technology Incubator of Technical Faculties - BITF* (http://bitf.rs/) has been established as a partnership between the four technical faculties of the University of Belgrade (Civil Engineering, Mechanical, Electrical and Technological/Metallurgical), the Municipality of Palilula and the Democratic Transition Initiative. The establishment has also received support from the Organization for Security and Cooperation in Europe (OSCE). Main goal is to provide various forms of support to entrepreneurs in the early stage of business development in the form of subsidized overhead, administrative assistance, as well as business counseling. *Science-technology park Belgrade* (https://www.ntpark.rs/) is established by the RS Government (represented by the Ministry of Education, Science and Technological Development), the City of Belgrade and the University of Belgrade, "*with the aim to create a favorable environment for developing links between industry and science and research organizations and universities, knowledge transfer, new technology development, innovation commercialization, networking and stimulating growth in the knowledge-based economy*". It is becoming a new technology core of the Belgrade city that brings together domestic and foreign high-tech development companies and promotes start-ups by creating a favorable environment to innovation, technology development and competitiveness. *Impact Hub* (https://belgrade.impacthub.net/) is a global network of individual hubs all over the world. It operates with a goal to develop a strong network of startups, and has its office space in Belgrade. It offers services of renting the space, co-working and launch pad program, consisting of mentorship and investment in startups. This hub's primary focus is on startups that are dealing with social challenges in fields of agro-tech, clean energy, local production, health, culture and education, but it also welcomes startups that come from IT and tech industries. *Nova Iskra* (http://novaiskra.com/) is the first creative hub in the Balkans, which represents the community of freelancers, startups and creative entrepreneurs. It enables space, initiates collaboration and organizes education programs for innovators, entrepreneurs, students, professionals and organizations. Its goal is to provide network between creative industries, technology and people.

3.2. Comparative analysis – results and discussion

Fominienė (2010) synthesizes and differentiates three types of support services provided by incubators: tangible services, intangible services, and financial support. Tangible services refer to office rent (office space, common use premises, incubator postal address, and equipment) and office space (secretarial services, internet, fax, and copying services); Intangible to process services (consulting, training, and maintenance) and network services (internal and external); and financial support to internal and external funding. We expand this model by differentiating various extra services classified by the given categories (Table 2, column 3). Also, we add the fourth category named "additional support" which refers to services oriented towards creation of positive and attractive work environment in which entrepreneurs are supposed to be more motivated, inspired and satisfied. Thus, we adjust the model for systematization of services provided by different support organizations. Afterwards, we map the supporting organizations in Serbia to the mentioned categories. All with the aim to identify the development level and role these organizations have in boosting new tech-firms development and growth in Serbia. Table 2 presents the comparative analysis.

Table 2: Comparative analysis of eight organizations that support technology entrepreneurship development in Serbia – classificaton of provided services

Services provided			StartIT	ICT Hub	SeVeN	Start Labs	BITF	STP Belgrade	Impact Hub	Nova Iskra
Tangible	Office rent	Office space	x	x		x	x	x	x	x
		Common use premises	x	x		x	x	x	x	x
		Incubator postal address	x	x		x	x	x	x	x
		Equipment – hardware and software		x		x				x
		Office equipment	x	x		x	x		x	x
	Office services	Logistical and technical support		x		x	x	x		x
		Legal		x	x	x	x	x		
		Accounting		x		x	x	x	x	
		Marketing, promotion	x	x		x	x	x	x	x
		Product design	x				x	x	x	
		Assistance with business, strategic and marketing plan	x	x		x	x	x	x	x
		Easier access to market		x			x	x	x	x
		Internet	x	x		x	x	x	x	x
		Telephone, Fax	x	x		x	x	x	x	x
Intangible	Process services	Consulting	x	x	x	x	x	x	x	x
		Training	x	x	x	x	x		x	x
		Education – programme of lectures and workshops	x	x	x			x	x	x
		Mentoring – “one on one” sessions	x	x	x	x	x	x	x	x
		Mentoring – mentorship programme	x	x		x	x	x		x
		International mentoring	x	x	x	x		x	x	x
		Maintenance						x		
		Certification						x		
		Acceleration programme	x						x	
	Network services	Internal network	x	x	x	x	x	x	x	x
		External network	x	x	x	x	x	x	x	x
Financial support		Business incubator funds		x		x			x	
		Grants by outside investors	x		x	x		x	x	
Additional support		Relaxing, playground area	x	x					x	x
		Free parking space		x				x		
		Refreshment for free	x	x					x	x
		Free library	x	x					x	x
		Pet friendly	x	x					x	x
		24/7	x							
		Shower	x							
		Community bar or kitchen	x						x	x
		Photo equipment								x
		Locker		x					x	x
		Yoga and workout		x						x
		Socializing events/parties		x					x	x

The analysis shows the highest correspondence between the observed institutions regarding: (1) the first group of tangible services – office rent (only equipment reflected in hardware and software is present in three out of eight organizations); (2) office services: business counseling observed as legal support, accounting, marketing, promotion, product design, etc. is present in all organizations, in different forms. This is not the closed list of counseling services they provide, since it depends on the needs of each start-up. As stated on *STP* website, they offer "*access to business counseling in a wide range of areas affecting successful business results, including: business development and planning, intellectual property protection, marketing, management and other areas depending on their needs*". Basic technology infrastructure (internet, telephone) shows to be usual form of support in all centres; and (3) network services – all of them offer networking both internal and external.

The largest discrepancy is captured in the following process services: acceleration, certification, and maintenance. Only the STP offers support in the process of certifying products, processes and services in compliance with national and international standards. Observing the fourth dimension, there are organizations that do not provide this Additional support. It seems to be the trend of modern hubs opened from 2010 onwards. Regarding financial support, it is interesting to notice that a few of them have internal funding. *ICT hub*, for example, has its own VC fund, initially offering up to 50.000 Euros in exchange for 5 - 15% equity with a possibility for follow-on investment. *Impact Hub* has its group of angel investors who offer 20.000 Euros for 7% ownership.

Observing the results in general, *SeVeN* mostly differs from other organizations. Still, we should highlight that we were not able to identify the business counseling services they offer since on the website it is stated that they offer "*advocacy efforts, providing business advisory and consultancy services to companies seeking investment*". Results indicate that *ICT Hub* and *Impact Hub* offer the widest range of services, while *STP* offers some unique services. The range of services depends on the purpose and mission of each organization. Therefore, the future work should address the type of support organizations for better classification and analysis.

Throughout the analysis, we identified another important business aspect which could be named "openness towards community" which refers to the programmes of support like young talent pool creation, open workshops and trainings, and different events which are not oriented directly towards development of a specific start-up, but towards promotion and rising awareness of technology entrepreneurship concept among population. They highly recognize the importance of future generations and their education in the process of strengthening the national economy and the domestic entrepreneurial ecosystem. Additionally, it is noticed that these organizations are being oriented towards achieving sustainable development goals, dealing with different social and environmental issues.

4. CONCLUSION AND FUTURE WORK

Technology entrepreneurship needs supportive environment to flourish and grow. In this paper we identify the role of different supporting organizations in an entrepreneurial ecosystem, and base our study on classification of support services provided by Fominienė (2010). We expand the proposed model firstly by differentiating various additional services, classified in the proposed categories: tangible services, intangible or "value-added" services, and financial support. Secondly, we add the fourth category "Additional services" which refer to positive and attractive work environment in which entrepreneurs are supposed to be more motivated, inspired, and satisfied. This includes e.g. relaxing, playground area, free parking space, refreshment for free, free library, pet friendly space, 24/7 working hours, shower, community bar and others.

Using this expanded model, we perform a comparative analysis of eight support organizations for technology entrepreneurship development operating in Serbia. The results show that Serbian supporting organizations offer a wide range of support services – from infrastructure to financing, mentoring, providing acceleration programmes, education programmes, networking etc. The results are discussed in section 3. Additionally, they overcome their basic role in an entrepreneurial ecosystem where they are oriented at development of specific start-ups (tenants), operating as technology entrepreneurship "enlighteners" of the community. Common values and goals are increasingly becoming an added value that holds the connection between the support organizations and their startups.

This research should be considered as a pilot research since it relies on the secondary data collected from the web sites of the observed organizations. To provide a more comprehensive insight and preciseness into the state of support organizations for technology entrepreneurship development in Serbia, a primary research should be conducted through the interviews with the organizations' management. This way we could provide a fine tuned service classification and better understanding of the level of development of supporting organizations in Serbia. Authors recognize this issue as the future work direction.

ACKNOWLEDGEMENT

This paper is a result of Strategic Project founded by the Ministry of Education, Science and Technological Development of the Republic of Serbia: Exploring modern trends of strategic management by application of specialized management disciplines in the function of the competitiveness of Serbian economy, No 179081.

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CREATING ENTREPRENEURIAL ECOSYSTEM THROUGH UNIVERSITIES SPIN OFF AND STARTUP COMPANIES - EXAMPLE OF THE UNIVERSITY OF NOVI SAD

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Abstract: *An entrepreneurial idea carries great challenges and opportunities with it, and as such is the research subject in many fields. Creation of innovative entrepreneurial ideas and development of a real business based on them is a mission of all modern societies. Universities play important role in this process, as well as facilitating connection between entrepreneurs, and connecting them with other relevant subjects. In this way, the development of entrepreneurial ecosystems is emerging, as unique leverage of development of contemporary society. Promotion of establishment and sustainability of startup and spin off companies is crucial to the success of this venture. University of Novi Sad can be shown as exceptional example in this field, since it recognized the importance of participating in entrepreneurial ecosystem development, both for own development and for the society as a whole. In this paper, we will show the most important effects of this approach and implications for basic economic indicators which reflect the state of functioning of the entrepreneurial ventures developed and supported by the University of Novi Sad.*

Keywords*: entrepreneurial ecosystem, innovation, startup, spin off, development, University of Novi Sad*

1. INTRODUCTION

Success of entrepreneurial ventures depends on the quality of entrepreneurial idea, and ability of entrepreneurs to realize it. Nowadays, entrepreneurs are challenged to continuously promote innovativeness and entrepreneurial behavior of employees. Universities, on the other hand, are facing the problems of commercialization of new knowledge, technologies and scientific and research results. Establishment and development of an effective environment, that will promote entrepreneurial behavior and provide knowledge and technologies transfer on the market, is a significant challenge for organizations that operate in dynamic business environments. This type of environment is recognized as an "*entrepreneurial ecosystem*".

The purpose of this paper is to show the most important effects of establishment and promotion of entrepreneurial ecosystem through universities spin off and startup companies. Implications of basic economic indicators which are connected with entrepreneurial environment of University of Novi Sad will be shown.

Spin-offs can be defined as a "*range of important functions, including a vehicle for technology transfer and technology commercialization, a way to produce direct income for universities, a source of employment, a way to strengthen the relationships with the local business community and a way to contribute to restructuring regional economies*" (Pérez & Sánchez, 2003; van Geenhuizen & Soetanto, 2009).

According to Reis startup is "*a human institution designed to deliver a new product or service under conditions of extreme uncertainty*" (Reis, 2014). Startup can be defined as a "*temporary organization designed to search for a repeatable and scalable business model*" (Steve, 2013).

This paper was organized in three chapters. In the second chapter, literature review on the topic of university role within entrepreneurial ecosystem is done. This chapter also covers university spin-offs and startups, their role and importance in the process of creation of entrepreneurial ecosystem. Following this, in the third chapter, example of University of Novi Sad was shown as very development in terms of founding and developing startup and spin off companies. Considering this, authors reviewed effects of entrepreneurial environment to economic development of one country and/or region and made implications for further research relevant to this topic.

2. LITERATURE REVIEW

2.1. Entrepreneurial ecosystem

Fostering entrepreneurship has become one of the most important elements of economic development in countries and regions around the world. Social-economic environment needs to be created or adapted to foster and affect entrepreneurship and promote creation of effective entrepreneurial ecosystem. Entrepreneurial ecosystem can be defined as "*set of various actors within geographic region that influence creation and development of group of stakeholders with aim to generate new venture creation over time".* (Cohen, 2006).

According to Isenberg entrepreneurial ecosystem can be seen as "*collective vision of a group of stakeholders committed to the promotion of entrepreneurship, creating an ecosystem to actualize their vision"*. Isenberg defined a model for ecosystem that consists of thirteen factors, which are shown in the figure below.

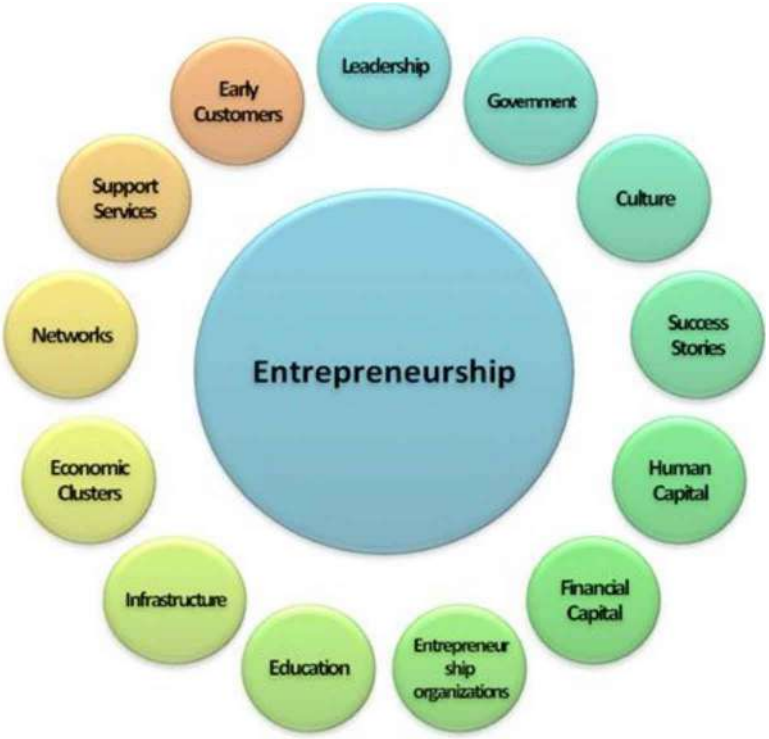

Figure 1. Thirteen factors of entrepreneurial ecosystem model (Isenberg, 2010)

Figure 1 shows factors that promote and foster entrepreneurship in particular region or country. Each factor has its own role and importance, depending on the level of ecosystem development. Mason (2014) defines three main ecosystem groups as following:

- Entrepreneurial organizations - firms, venture capitalists, business angels, banks;
- Institutions - universities, public sector agencies, financial bodies; and
- Entrepreneurial processes- the business birth rate, numbers of high growth firms, number of serial entrepreneurs, levels of entrepreneurial ambition.

Isenberg (2010) states four main groups of stakeholders in entrepreneurial ecosystem: Government, Educational Institutions, Financial Institutions, Media and Network.

Educational institutions have realized the strategic role of their research potentials and their ability to create and diffuse knowledge and skills. For that reason, universities are identified as main stakeholders in the process of fostering and promoting entrepreneurship.

Nowadays, educational institutions, especially universities are encouraged to become more entrepreneurial through greater commercialization of knowledge and innovations. Development and maintenance of effective entrepreneurial environment lead to better economic performances and more productive society as well. In that respect, in the following sub-chapter role of academic spin offs and startups in the development and promotion of entrepreneurial environment will be shown.

2.2. Role of University in the entrepreneurial ecosystem: spin off and startup companies

Universities and public authorities would be advised to intensify their activities to foster and promote entrepreneurship, especially among young people. Such kind of activities leads directly to creation of culture of academic entrepreneurship (Lüthje & Franke, 2003). The most important entities of academic entrepreneurship are spin off and startup companies.

University spin offs transfer technology from their parent organization in the first phase and later, they transfer technology to their clients. Developing an effective network of various stakeholders is a key challenge for successful functioning of spin offs (Todorovic et al., 2011). This network brings together not only academically-oriented stakeholders, but also ones who are primarily market-oriented. (Pérez & Sánchez, 2003). Creation of successful spin offs requires various types of resources such as knowledge, finances, organizational assets, social capital and intellectual property (Landry et al., 2006), (Steffensen et al., 2000) highlighted critical success factors for academic spin offs, such as risk taking, opportunity identification and risk mobilization.

Technology transfer is based on network capability that enables companies and other participants to build strong relationships. On the participant's side, relationships are important means of sharing resources, knowledge, expertise, software, equipment, etc. (Pérez & Sánchez, 2003). However, these relations are also important from the side of economic development of some region and/or country. Existence of spin offs with important and purposeful connections increase productivity of their actors (eg. research institutions, customers, legal authorities) (Walter et al., 2006). Spin offs continuously seek to contribute to region's and country's economic development (Mian, 1997), and for that reason, they are recognized as important business support mechanism.

When it comes to startup companies, it can be said that they are unpredictable organizations that are primarily oriented towards research of business opportunities. In the early stage of startups development, educational and research institutions have an important role to strengths their capacities and foster their further development. Likewise, government and public authorities have a significant role in startup development through defining policies and strategies that foster their growth and enable their transformation from startups to SMEs (Laso, 2016).

Increase in number of startups directly leads to the strengthening of economy in one country or particular region. Startups are designed to grow fast (Mata et al., 1995), thus they could have significant impact on economy development in short term.

Spin offs and startups are related to economic growth and increasing number of employees. The promotion of the entrepreneurial vision via spin off and startup companies could motivate researchers and scientists for a higher level of commercialization of research knowledge.

3. RESEARCH RESULTS

Entrepreneurial ecosystem is an unique entity, in which enterprises and their entrepreneurial activity play a crucial role. Understanding and interpreting entrepreneurial activity and the number of enterprises is of great importance for definition of the further development strategies. Entrepreneurial activity is the enterprising human action in pursuit of the generation of value, through the creation or expansion of economic activity, by identifying and exploiting new products, processes or markets. (Ahmad & Seymour, 2008). The definitions recognise that many business entities can attempt to instil an entrepreneurial spirit in their employees and encourage them to be creative and innovative.

Governments around the world seek to encourage entrepreneurial activity as the main generator of society's development and influence the improvement of all economic indicators, in particular employment rates and GDP. The Government of the Republic of Serbia also established clear strategies for short-term and long-term development. In this context, establishment of entrepreneurial activities across the country is one of its most important priorities. In documents published by Government of the Republic of Serbia **"Strategy for the support to development of small and medium-sized enterprises, entrepreneurship and competitiveness for the period from 2015 to 2020"** and **"Action plan for the implementation of the strategy for the support to development of small and medium-sized enterprises, entrepreneurship and competitiveness",** priorities about development of entrepreneurial activity are listed and defined. Within them, it is stated that the precondition for achieving sustainable socio-economic development and successful completion of the process of European integration of the Republic of Serbia is the development of economy, which builds its long-term competitiveness on a private entrepreneurial initiative, knowledge, application of new technologies and innovation (Government of the Republic of Serbia, 2015).

The table below shows the comparison of data on business subjects at the level of the Republic of Serbia, the region of Vojvodina, and the City of Novi Sad.

Table 1: An overview of the number of companies and employees on the territory of the Republic of Serbia, the region of Vojvodina and the City of Novi Sad in 2014

Enterprises by size	Republic of Serbia	Vojvodina region	City of Novi Sad
Entrepreneurs	231.616	60.968	14.529
Micro, Small and Medium Enterprises	92.656	85.117	10.031
Large enterprises	494	130	-
Total number of business subjects	324.766	148.215	24.560
Total number of employees	1.174.947	213.151	127.078

Source: Statistical Office of the Republic of Serbia, 2018

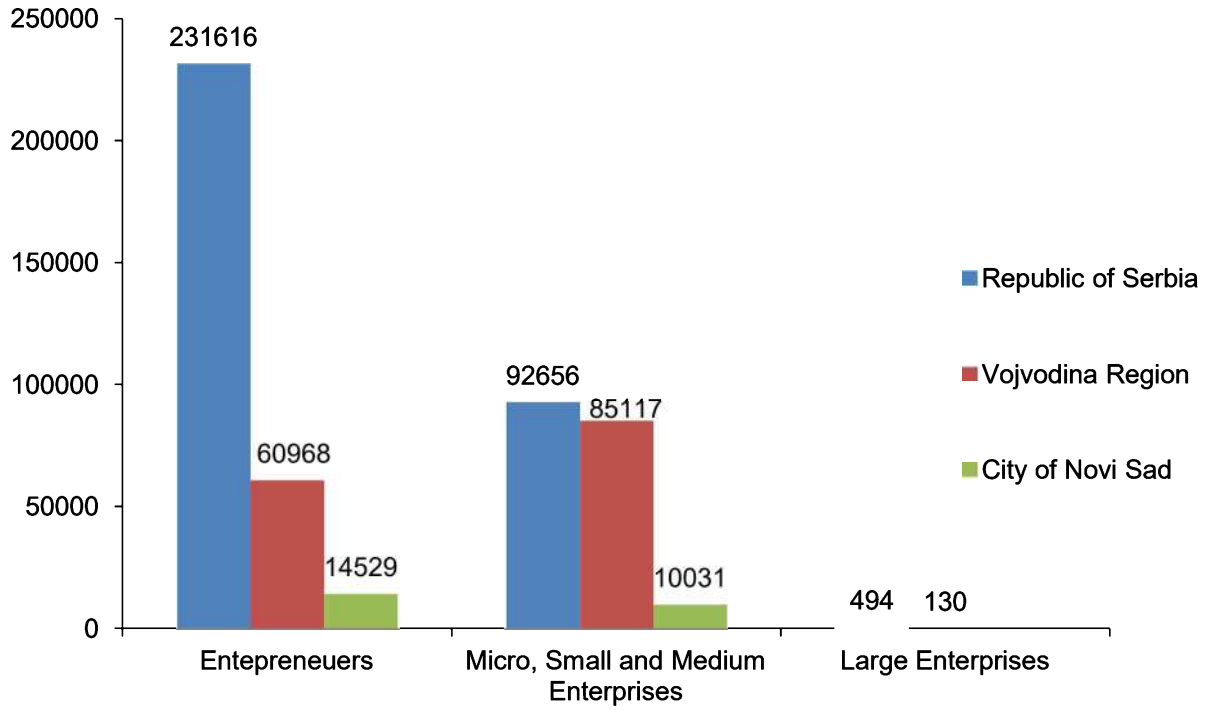

Figure 2: Number of enterprises by size in Republic of Serbia, Vojvodina Region, and City of Novi Sad in 2014

This data shows that 99.84 % of total enterprises in the Republic of Serbia, are entrepreneurs and micro, small and medium enterprises. Such a picture and result does not deviate very much from the European average. If we look at the region of Vojvodina, that percentage is 99.9 % of the total number of business subjects. The used database did not find the exact number of large companies in the City of Novi Sad. Business entities from the City of Novi Sad make 7.56 % of the total number of business subject in Republic of Serbia, and 16.57 % of the total business subject in Vojvodina region.

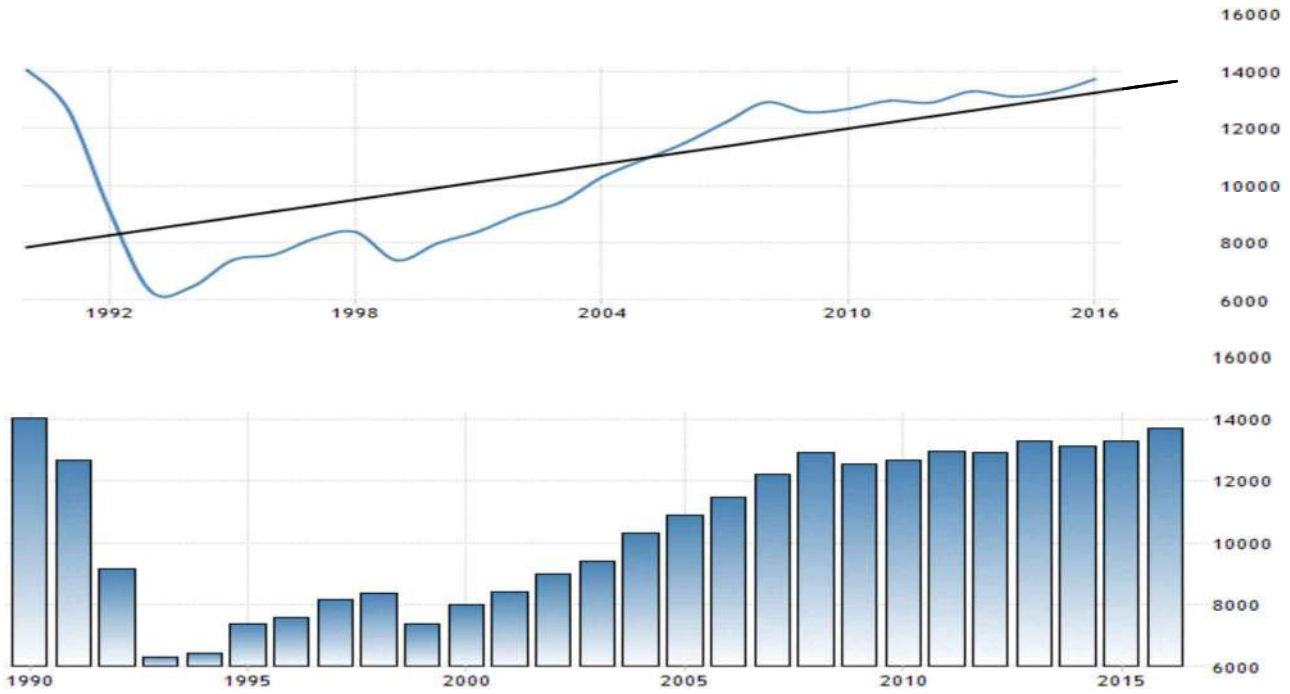

Figure 3: GDP growth in the Republic of Serbia in the period 1990 - 2016 in USD (Tradingeconomics.com; ivanstat.com, 2018)

The observed phenomenon can also be related to the movement of gross domestic product, as a basic indicator of economic activity in one country. With economic growth, there is also increased allocation of funds in all areas of the economy and society, as well as in the allocation of funds for launching and supporting new business entities, where the startup and spin off companies certainly play important role. The trend line in the GDP of the Republic of Serbia is on an upward path, which coincides with the growing number of companies that have been established as a startup and spin off company. All this leads to strong development of the entrepreneurial ecosystem, which should be the leverage of the development of the economy and all business entities. There is also a positive impact on other economic indicators such as employment growth, taxation, per capita income, etc. The unemployment rate has decreased by about 10 years since the last 5 years (Statista.com, 2018), and a significant contribution was made by a large number of new established companies. Also, entrepreneurial ecosystems could enable a faster pace of technological progress and the introduction of new technologies, development of human resources and their mobility.

Development of entrepreneurial ecosystem is the mission of all modern universities. Establishing entrepreneurial ecosystems with the support of the university should create basis for the further development of the university, and its research activities. In this way, sustainability and development are established according to modern trends, and the University of Novi Sad follows this direction.

Table 2: Basic indicators of University of Novi Sad

University of Novi Sad – Review	
Number of faculties	14
Number of accredited study programs	around 400
Number of students	more than 50.000
Number of employees	more than 5.000
Number of Scientific Institutes	3
Number of University Centers	17
Number of Scientific Laboratories	250
Number of projects (up to 2016)	126
Number of partner and coordinating international projects	127

Source: University of Novi Sad, 2018

Orientation of universities to support creation of entrepreneurial ventures and creation of entrepreneurial ecosystem is certainly significant character. This requires a high level of engagement of all available resources which one university has, as well as a longer period of time for the establishment of stable bases, which should lead to the sustainability of enterpreneurial ecosystem. By strengthening its own capacities, but also by developing the economy as a whole, the University is able to create entrepreneurial environment,

and leads to an intensive transfer of academic ideas into market-oriented ventures. In this case, a 25-year period was taken, in which there were very large changes in society, but also on the global level. The transition to the market economy, higher usage of the Internet in business, the strengthening of academic potentials and the development of a democratic society, and the orientation towards wider domestic, regional, European and world market has led to a change in the way of thinking in the entrepreneurial sense. The occurrence of startup and spin off companies is indispensable part of every developed society, if we take into account the macro level, but also every individual participant in the entrepreneurial ecosystem, if we observe the micro level. On the example of University of Novi Sad, we can notice that 123 startup and spin off companies were established in the observed period 1990-2015, faced with all market challenges and opportunities (University of Novi Sad, 2015). However, from these 123, about 78 companies are still active, which indicates that success rate of such ventures at the observed University is around 63%.

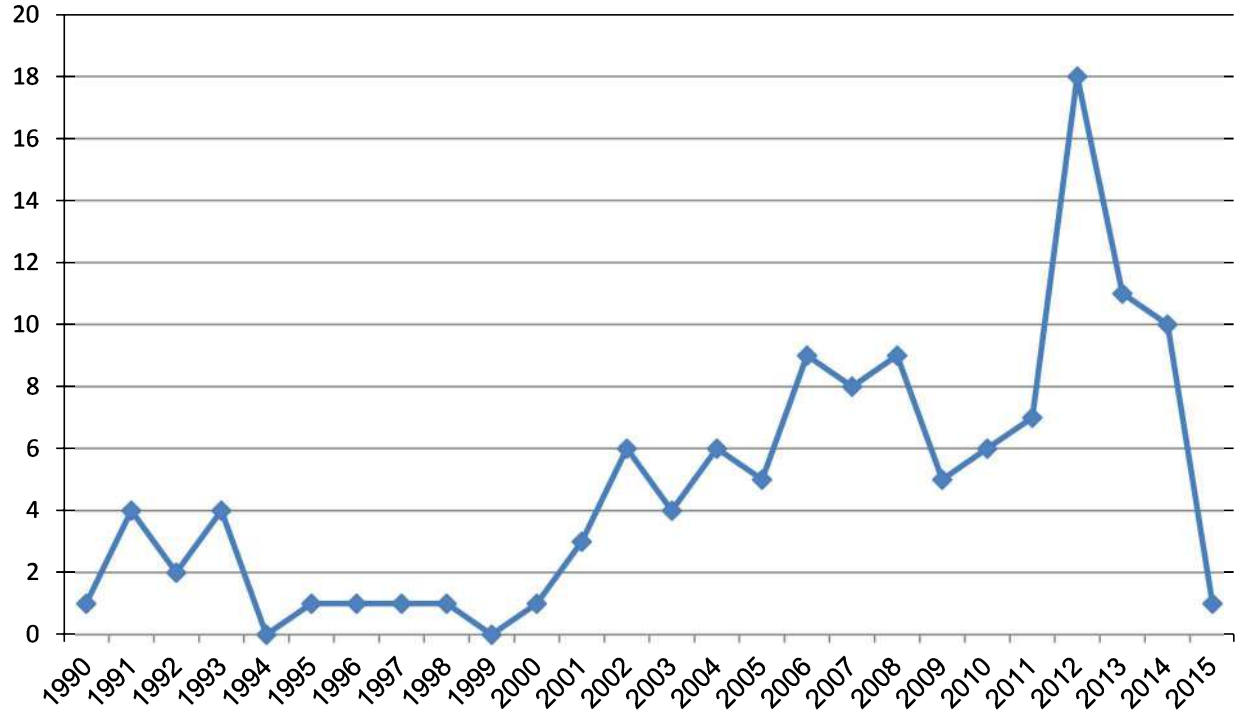

Figure 4: The number of founded startups and spin off companies in the period 1990-2014 at the University of Novi Sad (University of Novi Sad, 2015)

The largest number of startup and spin off companies at the observed University was founded in the last 10 years. This has certainly contributed to the current trends, the increasing openness of universities to launch such ventures, and supporting the building of unique entrepreneurial ecosystem. The largest number of these companies was established in 2012, more than 18, while smaller number of companies was established at the beginning of observed period. The causes for small number of founders should be sought in a very poor economic environment, the lack of market economy as well as the consequences of wars and period of sanctions. Possible explanation of this phenomenon may also be insufficient understanding the importance of establishing such types of business entity in the economy. A smaller activity in triggering this type of venture was observed in the period of major economic crisis from 2008. Need for rapid development can be one of the reasons for increase in the number of newly established companies, through raising awareness about the importance of starting one's own business and the opportunities that this kind of activity brings. There is also growing support from relevant stakeholders in the economy and entrepreneurial ecosystem, among which are certain universities. Possibilities for applying for new sources of financing, both in the country, or abroad, especially within European funds, have been increased.

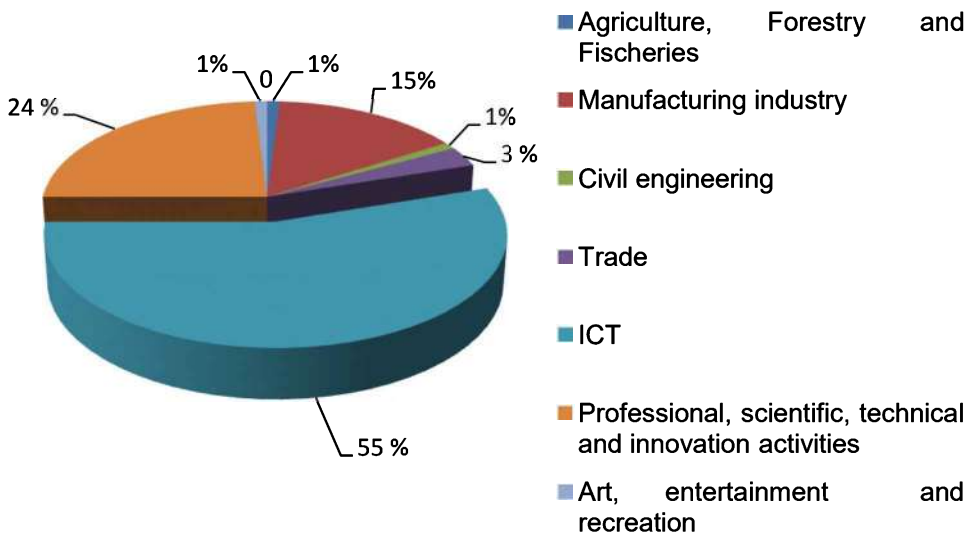

Figure 5: Startup and spin off companies at the University of Novi Sad by industry division (University of Novi Sad, 2015)

The largest number of observed companies belongs to the field of information and communication technologies, on the second place are professional, scientific, innovative and technical activities, and on the third place are companies in the field of manufacturing industry. The total number of employees within these companies in 2015 was 2201, which represents 1.75 % of the total number of employees in the City of Novi Sad. Nowadays, some of startup and spin off companies are large enterprises, with more than 250 employees. It has a very beneficial effect as on the local, as much as on national, economy level.

Significant development of entrepreneurial activity and number of different types of entities involving start up and spin off companies, based on the foundations established at the university, enabled the participation of other participants in the creation of entrepreneurial ecosystems. Their contribution to the development of this system is with great importance and by their active participation in system constructing, they influence its quality and strengthening. Among these institutions and companies, which are the part of entrepreneurial ecosystem, exist a high level of interdependence. Some of the most important institutions in the functioning of entrepreneurial ecosystems at the city and province level are: Business incubators (in Novi Sad, Subotica, Senta, Zrenjanin), Startit Centar Novi Sad, iDEA Lab, Vojvodina Chamber of Commerce, The Regional Development Agency Backa, different clusters, Provincial government and a large number of other provincial and city institutions. Science technology park Novi Sad is currently under construction and that will certainly contribute to the further development of the presented entrepreneurial ecosystem.

4. CONCLUSION

Development of entrepreneurial ecosystem has great importance at all levels: local, provincial and national. Entrepreneurial vision should be promoted and fostered on both market-oriented and academic-oriented environment. Observing the startup and spin off companies at the University of Novi Sad, and the basic indicators of their economic activity, we can notice the upward trend line in terms of the number of employees and total income. This points to the possibility of allocating a higher level of funds for new investment cycles and raising the innovation and competitiveness of these companies. Considering the constant growth of the number of employees, it can be said that the largest investments are also realized in human resources in order to attract, develop and retain them. Certainly, in this process, the university has a very important role, especially in the support it provides. Therefore, importance of university can be measured by its ability to stimulate and support entrepreneurial activity. It is necessary to create a stable environment and conditions that will lead to the development of entrepreneurial ecosystem in all its aspects. This requires a high level of readiness for engagement and cooperation among all participants at entrepreneurial ecosystem, in order to achieve set of goals. According to the previous results, University of Novi Sad is making tremendous efforts to permanently encourage the building of a strong and stable entrepreneurial ecosystem, which will play a major role in the economy of the whole country and beyond. This feature of the university leads to the strengthening of innovative potential and implementation of important projects from different fields. In the future, it's expected that the results of entrepreneurial activity within the University of Novi Sad will be more accessible, more measurable, and in that way more suitable for research, which will be another indicator of the strength and development which this entrepreneurial ecosystem has.

ACKNOWLEDGEMENTS

The authors acknowledge the financial support of the Ministry of Education and Science of the Republic of Serbia, within the Project No. 47005.

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THE ROLE OF CULTURE IN ENTREPRENEURIAL ECOSYSTEM: WHAT MATTERS MOST?

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Abstract: *This paper examines the role of cultural characteristics in entrepreneurial ecosystem. We investigated whether and how much cultural differences affect entrepreneurial orientation and performance. Measuring culture is a challenging task, and through years there have been developed several methodologies to solve this issue. In this paper, we used Hofstede's model of cultural dimensions to compare the results with appropriate metrics of entrepreneurial ecosystem performance. On a set of OECD and EU countries, this paper examines the relationship between cultural aspects and entrepreneurial performance based on the Global Entrepreneurship Development Institute methodology. The conclusions are derived from the calculated correlations between Hofstede's cultural dimensions and values of Global Entrepreneurship Index and its main components that represent the pillars of entrepreneurial ecosystem. The results indicate the significance and the direction of importance that cultural determinants have on the entrepreneurial environment of a country.*

Keywords*: Culture, Entrepreneurship, Ecosystem, Hofstede, Performance indicators*

1. INTRODUCTION

Entrepreneurial activities have been identified as the catalysts of economic development and prosperity (Ács, Autio, & Szerb, 2014). These activities have been intensified by the rapid technological growth, and the development of the technology entrepreneurship (Levi Jakšić, Jovanović, & Petković, 2015). Increasing entrepreneurial activities are not solely reserved for the technology, but also social, sustainable, strategic, and knowledge entrepreneurship. Even large, international, and global firms are recognizing entrepreneurship as a primary source of innovation and competitiveness, and thus engage in so-called corporate entrepreneurship (Levi Jakšić, Marinković, Petković, Rakićević, & Jovanović, 2018, p. 47-55). Although an individual initiates entrepreneurial activities, the success of an entrepreneurial venture highly depends on institutional factors and its environment - entrepreneurial ecosystem (Aparicio, Urbano, & Audretsch, 2016). Culture is one of the essential parts of entrepreneurial ecosystem (Isenberg, 2011). The values, norms, attitudes, risk tolerance of a society can be crucial determinants of entrepreneurial activity within a country. Some research discuss and highlight the importance of cultural determinants on entrepreneurial activities (Castaño, Méndez, & Galindo, 2015; Dubina & Ramos, 2016). Still, no research examines specific metrics and concrete measures of this impact. Thus, in this paper, we will discuss the relationship between the results of entrepreneurial performance measured by the Global Entrepreneurship Index (GEI), and cultural determinants values of Hofstede's cultural dimension model. To evaluate the relationship between these components we calculated the correlation coefficients at the set of 38 OECD and EU countries.

Next section discusses the central concepts examined in this paper: entrepreneurship, entrepreneurial ecosystem, culture, and relationship between entrepreneurship and culture. The third section presents the conducted research and has two parts: the first explains the data and methods, while the second presents the results of the research, discussion, and implications. Finally, the last section gives the research conclusions.

2. ENTREPRENEURSHIP AND CULTURE IN THEORY

Entrepreneurial activities are important determinants of economic growth (Noseleit, 2013). They are essential for creating the linkage between scientific activities and new values for customers, which improves the quality of life and contributes to the overall wealth of an economy and society (Levi Jakšić et al., 2018, p. 58). Entrepreneurship has global effect since it affects (GEDI, 2017):

- Individuals: by creating new solutions that improve lives, and by creating new employment opportunities;
- Governments: by creating new solutions that improve economic efficiency and by solving environmental and socioeconomic problems;
- World: by presenting new ideas with new markets, and by introducing new ideas from abroad.

Having in mind the importance on entrepreneurial activity for a national economy and national differences driven by the cultural influence, we proposed two research questions:

Whether and to what extent is entrepreneurial ecosystem performance affected by the cultural characteristics of a society?
Whether and how are entrepreneurial ecosystem pillars affected by the cultural characteristics of a society?

Thus, in this research, we measure the relationship between entrepreneurial ecosystem (and its components) and the cultural dimensions of a nation. We based our conclusions on a set of 38 EU and OECD countries. As a measure of entrepreneurship, we observed The Global Entrepreneurship Index and compared with the scores with Hofstede's cultural dimensions model.

2.1. Entrepreneurship ecosystem

Entrepreneurial activities are driven by the initiative of an individual: his motivation, ambition, ability, capacity. However, "no man is an island", isolated and focused on its performance, especially in the case of entrepreneurial ventures that are demanding devotion, hard work, a lot of resources and patience to succeed. In these kind of projects, mutual effort of all environmental participants plays a vital role of (Ács, Autio, & Szerb, 2014). Sometimes, the supporting activities of the entrepreneurial actors are crucial for a success of venture. A well-organized community of entrepreneurial ecosystem is an important factor in the entrepreneurial equation of success. It represents a system of interconnected actors: entrepreneurs, other individuals, organizations, and institutions at a national level (Levi Jakšić et al., 2018, p. 70). The main role of this system is to support and foster entrepreneurial activities. Daniel Isenberg (2011) summarizes entrepreneurial domain on the following elements: politics, finance, culture, support, human capital, and market. While some actors are directly involved in entrepreneurial activities (market, humans, individuals), the others foster and enable further development of ventures. In this kind of ecosystem, culture has the supportive role with its norms, values, and events organized to raise the entrepreneurial spirit within the ecosystem. In this term, culture also encompasses risk tolerance, ambition, orientation to innovativeness, creativity, and experiments.

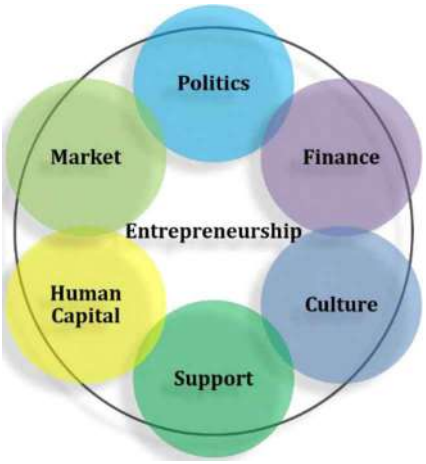

Figure 1: Entrepreneurship Ecosystem (adapted from Isenberg (2011))

Measuring entrepreneurship

There are numerous indicators for measuring and comparison entrepreneurial performance of a nation. They aim to improve the entrepreneurial ecosystem and identify weak links in the chain of actors. Institutions such as World Bank, Eurostat, OECD, and others annually publish different indicators that measure the performance and success of national entrepreneurial activities. However, to use the holistic approach, and evaluate the overall performance of the ecosystem, it is necessary to use composite indices approach that is very suitable for measuring complex issues such as national performance (Zhou, Fan, & Zhou, 2010).

There are several methodologies that measure not only the success of the ventures but also the health of the ecosystem and its parts. These methodologies follow the performance of the actors that foster and support entrepreneurial activities. Global Entrepreneurship Monitor (GEM) is the world's leading study of entrepreneurship, which started publishing different entrepreneurial data in 1999 (GEM, 2018). Their approach observes two perspectives of an economy:

- The entrepreneurial behavior and attitudes of individuals, and
- The national framework and how that impacts entrepreneurship.

GEM annually publishes summarized global report of profiles of 62 countries, with various data related to different aspects of the ecosystem (GEM, 2018). However, this methodology does not provide an aggregated

value of the overall entrepreneurial performance of the observed countries. Therefore, for this paper, we selected another methodology that measures the health and intensity of entrepreneurial activities – Global Entrepreneurship Index.

Since 2009, the Global Entrepreneurship and Development Institute has annually published the Global Entrepreneurship Index. This composite indicator combines 28 indicators that compare entrepreneurial activities of 137 ecosystems (in 2017), and provides a deep understanding of the environment by measuring entrepreneurial attitudes, abilities and aspirations (GEDI, 2017). Figure 2 illustrates the structure of the index for better understanding of its scope. In this paper, we are not examining the methodological issues of the index, since some previous research identifies it (Jovanović, Rakićević, Levi Jakšić, Petković, & Marinković, 2017). Instead, we will focus on the comparison of the results with the cultural characteristics of the observed countries. This index consists of three subindices (Attitude, Ability, and Aspiration) that are derived from the values of 14 pillars. Each pillar is calculated from the value of 2 indicators, and represent a particular component of the ecosystem.

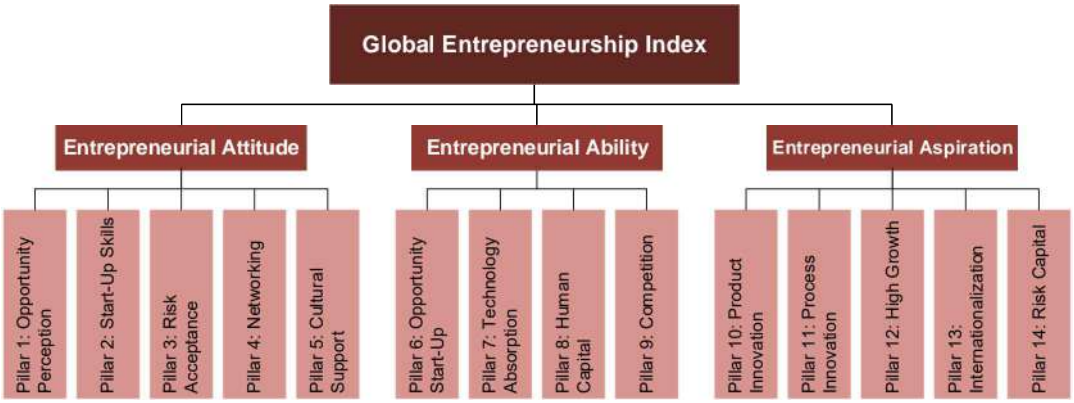

Figure 2: The Global Entrepreneurship Index structure (adapted from GEDI (2017))

Table 1 explains the pillars in accordance with the official GEDI report (GEDI, 2017). We used the values of the pillars in the research to determine their relationship with the values of cultural dimensions.

Table 1: 14 Pillars of Global Entrepreneurship Index (GEDI, 2017, p. 3-4)

Pillar	What does it measure?
Opportunity Perception	Can the population identify opportunities to start a business and does the institutional environment make it possible to act on those opportunities?
Start-up Skills	Does the population have the skills necessary to start a business based on their own perceptions and the availability of tertiary education?
Risk Acceptance	Are individuals willing to take the risk of starting a business? Is the environment relatively low risk or do unstable institutions add additional risk to starting a business?
Networking	Do entrepreneurs know each other and how geographically concentrated are their networks?
Cultural Support	How does the country view entrepreneurship? Is it easy to choose entrepreneurship or does corruption make entrepreneurship difficult relative to other career paths?
Opportunity Start-up	Are entrepreneurs motivated by opportunity rather than necessity and does governance make the choice to be an entrepreneur easy?
Technology Absorption	Is the technology sector large and can businesses rapidly absorb new technology?
Human Capital	Are entrepreneurs highly educated, well trained in business and able to move freely in the labour market?
Competition	Are entrepreneurs creating unique products and services and able to enter the market with them?
Product Innovation	Is the country able to develop new products and integrate new technology?
Process Innovation	Do businesses use new technology and are they able access high quality human capital in STEM fields?
High Growth	Do businesses intend to grow and have the strategic capacity to achieve this growth?
Internationalization	Do entrepreneurs want to enter global markets and is the economy complex enough to produce ideas that are valuable globally?
Risk Capital	Is capital available from both individual and institutional investors?

2.2. Cultural dimensions

Isenberg (2011) identified culture as an important part of the entrepreneurship ecosystem (Figure 1). It determines the level of risk acceptance, willingness to use and recognize the opportunities, creativity, collectivistic orientation, etc. (Dubina, Ramos, & Ramos, 2016). Culture can enforce one type of activities or obstruct another. Professor Geert Hofstede defined national culture as a collective programming of human mind which differs one group or category from another. Culture is learned, not inherited, and it comes from social environment, not genes (Hofstede, Hofstede, & Minkov, 2010). In other words, culture represents the common characteristics of members of a group, the differences that distinguish them from another groups. These similarities are passed from generation to generation, particularly from parents to children.

Hofstede's research shows that cultural differences among nations are at the deepest level, level of values. These values determine which behaviour is appropriate and respectful. Those are tendencies to prefer a certain state of things in comparison to others. This behaviour which is considered as "appropriate", shapes an individual's actions, motivation, and orientation. For example, Japanese culture is highly intolerable towards risk. Thus, one can assume that the entrepreneurial activities with a high probability of failure are not representing a preferable type of business action in Japan.

Cultural dimensions

There are several tools developed for measuring the dimensions of national culture. In addition to the mostly used Hofstede's cultural dimension model, there are other methodologies used for this purpose. Fons Trompenaars and Shalom Schwartz developed their own models of cultural dimensions (Trompenaars & Hampden-Turner, 2000; Schwartz, 2006), so the research could also be based on those methodologies. However, in this paper, we based our conclusions on the values of Hofstede's model.

Initial Hofstede's analysis identified systematic differences in national cultures on four primary dimensions: power distance, individualism, uncertainty avoidance, and masculinity. Later research of Michael Minkov motivated Hofstede to add two new dimensions: long term orientation, and Indulgence vs. restraint. In this section, we will briefly describe each dimension based on the explanation provided on the official webpage of Hofstede Institute (Hofstede Insights, n.d.). We will interpret the characteristics of the dimension in terms of entrepreneurial orientation and activities.

Power distance is the first dimension of national culture. It can be defined as the amount to which less powerful members of an institution of organization expect and accept unequally distributed power. In societies with high power distance, superiors and subordinates consider each other existentially unequal. Subordinates expect to be told what to do, and there is a high amount of supervision and reporting. It the context of entrepreneurial activities, high power distance societies are not expected to be entrepreneurially oriented, due to the high hierarchy which is not a feature of entrepreneurial ventures.

Individualism vs. Collectivism are two opposites of the second dimension of national culture. Individualism is related to the societies where the relations between individuals are week. It is expected of them to take care solely of themselves and close family members. On the other side, in collectivistic societies people are integrated in strong, solid groups, to which they are endlessly loyal. Employees in individualistic culture are expected to behave in accordance with their interests. In such societies work should be organized in a way that individual interests of employee and employer are matching. Having that in mind, entrepreneurial orientation comes more naturally for individualistic societies.

Masculinity vs. Femininity differs male and woman role in the society. Society is described as masculine when the emotional roles of the genders are strictly distinguished: males are expected to be confident and focused on material success, while women should be modest, gentle, and focused on quality of life. On the contrary, feminine societies are characterized with overlapping roles of men and women: both gender are modest and oriented on the higher quality of life. It is not clear in terms of entrepreneurial activities which scores are expected to be achieved on this dimension. Masculine societies are related to the entrepreneurial activities in terms of achievements and motivation, but the feminine societies nourish the importance of life quality, which is also characteristic of entrepreneurially oriented individuals. The empirical research will solve this dilemma in the following section.

Uncertainty avoidance is the fourth dimension. It is defined as the degree to which the members of a culture are feeling threatened due to uncertain and unfamiliar situations. This dimension should not be replaced with risk avoidance. While risk is defined as the probability that a certain event will occur, uncertainty is a situation where the outcome is unknown. Entrepreneurship is characterized with high uncertainty, so the nations with low scores on this dimension are more likely to cope with entrepreneurial activities.

The fifth dimension of national culture, long-term orientation, measures how much a certain nation is oriented to the past and tradition. Lower values of this dimension (short-term orientation) imply that a culture worships the tradition and societal norms. On the other hand, long-term orientation considers changes, adaptation and pragmatic problem solving as a necessity. From the perspective of entrepreneurial orientation, it is expected that long-term orientation is a characteristic of nations with higher entrepreneurial performance.

Indulgence vs. restraint is the last Hofstede's cultural dimension. Indulgence is a tendency of fulfilling the basic and natural human desires related to hedonism and enjoying life. Its opposite, restraint, is related to the beliefs that those needs have to be limited and regulated by strict societal norms. Indulgent societies believe that they have control on their own life and emotions. They are more optimistic and oriented towards quality of life, while restrained ones are pessimistic and driven by the strong norms. It is expected that indulgent societies have more entrepreneurial orientation than the restraint ones.

In this section, we interpreted the implications of cultural characteristics on entrepreneurial performance based on the theoretical suggestions. In the next section, we present the results of empirical research based on the values of two presented methodologies: Global Entrepreneurship Index, and Hofstede's cultural dimensions model.

3. RESEARCH

To answer the research questions we compared the values of Global Entrepreneurship Index with the values of Hofstede's cultural dimensions. For the first research question, we determined the correlation of GEI score with the cultural dimensions. To get more insight, and answer the second question, we calculated the correlations of cultural dimensions and values of GEI pillars to determine the cultural influence on the components of entrepreneurial ecosystem. In this section, we will explain sample structure, present and discuss the results, and provide the implications of the research.

3.1. Sample structure, data, and methods

The research was based on GEI data from 2014 to 2017. In the first iteration of the research, we examined the relationship on the set of the 28 EU countries. But, since the paper highlights the importance of cultural differences, it was necessary to include another set of countries to get a multicultural set of nations. For more relevant results, we expanded the 28 EU set with the OECD countries which are not part of the 28 EU: Australia, Canada, Chile, Iceland, Israel, Japan, Korea, Mexico, Norway, Switzerland, Turkey, and United States. The total number of countries was 38 (due to lack of data, we excluded Cyprus, Malta, and New Zealand). GEI data was collected from the official Global Entrepreneurship and Development Institute reports from 2015 to 2018. The values of the cultural dimensions were collected from the official website of The Hofstede Centre. Data sources are given in Table 2.

Table 2: Data source for GEI 2014-2017 and Hofstede's Cultural dimensions

Measure	Data source
GEI 2015	Retrieved March 28, 2018, from http://thegedi.org/2015-global-entrepreneurship-index/
GEI 2016	Retrieved March 28, 2018, from http://thegedi.org/2016-global-entrepreneurship-index/
GEI 2017	Retrieved March 28, 2018, from http://thegedi.org/2017-global-entrepreneurship-index-data/
GEI 2018	Retrieved March 28, 2018, from http://thegedi.org/2018-global-entrepreneurship-index/
Hofstede's Cultural Dimensions	Retrieved March 29, 2018, from http://www.hofstede-insights.com/product/compare-countries/

Source: Authors

For the calculation of correlation, we used StatSoft's software *Statistica* (StatSoft, 2018). We measured the Pearson's correlation coefficient to compare the Global Entrepreneurship Index and the cultural dimensions' values since the data from both methodologies is interval (Kovačić, 1994). The values of correlations are presented in Tables 3 and 4.

3.2. Results, discussion, and implications

In the first part of the research, we compared the GEI score from 2014 to 2017 with the values of Hofstede's cultural dimensions. This analysis was performed to determine if there is a significant difference among the annual correlation values. The results were stable, and there were negligible changes in the provided results.

Table 3: Correlation of Hofstede's cultural dimensions and Global Entrepreneurship Index (2014-2017)

Cultural dimension	GEI 2014	GEI 2015	GEI 2016	GEI 2017
Power distance	-0.6732*	-0.6688*	-0.6810*	-0.6635*
Individualism	0.6331*	0.6449*	0.6253*	0.6356*
Masculinity	-0.2392	-0.2200	-0.1458	-0.0961
Uncertainty avoidance	-0.6656*	-0.6820*	-0.6764*	-0.6606*
Long-term orientation	-0.2189	-0.2357	-0.1996	-0.2256
Indulgence	0.5071*	0.4989*	0.5791*	0.5786*

*significant at p< 0.05; *Source: Authors*

Table 3 shows the values of correlation for the final GEI score. According to the Pearson's correlation coefficient, power distance has strong negative impact on the entrepreneurial performance of the country. This signifies that the countries with less hierarchy are more entrepreneurially oriented. On the other hand, Individualism has strong positive correlation with the entrepreneurial performance, which is in accordance with the conclusion from the previous section that the individualistic societies have better entrepreneurial activities. Masculinity component does not detect any relationship with the GEI. The result may imply that the society's gender orientation does not play a vital role for entrepreneurship. This can be explained by the fact that the entrepreneurship has a wide range of areas and is oriented on both economic wealth (i.e. technology, corporate entrepreneurship) and social responsibility (i.e. social entrepreneurship). As predicted, uncertainty avoidance has a strong negative relationship with the entrepreneurial orientation – societies that are not afraid of uncertainty are more likely to achieve a higher score on GEI. Yet, long-term orientation has a weak negative correlation with GEI score, which is not statistically significant. This comes as a surprise, since it was expected, by the interpretation of this cultural dimension, that long-term oriented societies score higher on the GEI, that is, that there exists strong positive correlation. Not only that the correlation is not strong, it even has negative value, which is the opposite of expected. In the end, indulgence has the moderate positive impact on the entrepreneurial activity, which is in accordance with the expectations, signifying that societies oriented towards quality of life score higher in terms of entrepreneurial performance.

To have the better insight of cultural impact on the elements of entrepreneurial ecosystem, we calculated the correlation coefficients of the cultural dimensions and scores of 14 GEI pillars for 2017 (Table 4).

Table 4: Correlation of Hofstede's cultural dimensions and GEI pillars for 2017

GEI pillar	Power distance	Individualism	Masculinity	Uncertainty avoidance	Long term orientation	Indulgence
Opportunity perception	-0.7149*	0.5367*	-0.3585*	-0.7205*	-0.3367*	0.6113*
Start-up skills	-0.2640	0.0687	-0.2806	-0.1364	-0.3490*	0.1474
Risk acceptance	-0.3892*	0.2254	-0.1675	-0.4542*	-0.1846	0.5279*
Networking	-0.4483*	0.2124	-0.3585*	-0.3975*	-0.2631	0.5992*
Cultural support	-0.6644*	0.5904*	-0.3173	-0.6826*	-0.3034	0.5086*
Opportunity start-up	-0.7837*	0.5481*	-0.2981	-0.7209*	-0.2700	0.5442*
Technology absorption	-0.6285*	0.5518*	-0.0389	-0.5851*	0.0566	0.4516*
Human capital	-0.4033*	0.4742*	0.0939	-0.4386*	-0.0890	0.3320*
Competition	-0.6471*	0.6063*	-0.0186	-0.6044*	-0.0603	0.5535*
Product innovation	-0.1733	0.2120	0.1895	-0.2430	0.1233	0.2171
Process innovation	-0.3875*	0.3525*	0.1378	-0.2820	0.2723	0.2531
High growth	-0.3365*	0.4414*	0.1299	-0.4344*	0.0289	0.1800
Internationalization	-0.2947	0.4559*	0.2691	-0.3017	0.0980	0.0989
Risk capital	-0.4300*	0.4127*	-0.0341	-0.3608*	-0.1838	0.4318*

*significant at p< 0.05. *Source: Authors*

The ability of a population to perceive the opportunity is influenced by all cultural dimensions. The strongest impact have power distance, uncertainty avoidance and indulgence. Societies with less hierarchy, which are not afraid of uncertainty, and are aiming better quality of life are more likely to be entrepreneurially oriented. On the other hand, start-up skills are not significantly dependent on the culture. The only identified impact is long-term orientation, which is again surprising, having in mind that this element of ecosystem is related to the availability of the education. This means that start-up skills are better in societies that follow strict norms. Risk acceptance has a moderate relationship with power distance, uncertainty avoidance (negatively) and

indulgence (positively). Cultural support of a society and readiness to become the entrepreneur is significantly higher in less hierarchical societies that are open towards uncertainty. Regarding technology absorption, it is also strongly influenced by the hierarchy in society. The entrepreneurial competition is significantly stronger in societies that are more equal, individual, and are not afraid of uncertainty, but the product innovation is not related to any cultural determinant. We summarized the intensity and direction of the examined impacts in Table 5.

Table 5: Summarized impact of cultural dimensions on entrepeneurial ecosystem

Ecosystem component	Cultural dimension	Impact	Ecosystem component	Cultural dimension	Impact
Opportunity perception	Power distance	Strong negative	**Human capital**	Power Distance	Moderate negative
	Individualism	Moderate positive		Individualism	Moderate positive
	Masculinity	Moderate negative		Uncertainty avoidance	Moderate negative
	Uncertainty avoidance	Strong negative		Indulgence	Moderate positive
	Long-term orientation	Moderate negative			
	Indulgence	Strong positive			
Start-up skills	Long-term orientation	Moderate negative	**Competition**	Power Distance	Strong negative
				Individualism	Strong positive
				Uncertainty avoidance	Strong negative
				Indulgence	Moderate positive
Risk acceptance	Power distance	Moderate negative	**Product innovation**		
	Uncertainty avoidance	Moderate negative			
	Indulgence	Moderate positive			
Networking	Power distance	Moderate negative	**Process innovation**	Power distance	Moderate negative
	Masculinity	Moderate negative		Individualism	Moderate positive
	Uncertainty avoidance	Moderate negative			
	Indulgence	Moderate positive			
Cultural support	Power distance	Strong negative	**High growth**	Power distance	Moderate negative
	Individualism	Moderate positive		Individualism	Moderate positive
	Uncertainty avoidance	Strong negative		Uncertainty avoidance	Moderate negative
	Indulgence	Moderate positive			
Opportunity start-up	Power distance	Strong negative	**Internationa-lization**	Individualism	Moderate positive
	Individualism	Moderate positive			
	Uncertainty avoidance	Strong negative			
	Indulgence	Moderate positive			
Technology absorption	Power distance	Strong negative	**Risk capital**	Power distance	Moderate negative
	Individualism	Moderate positive		Individualism	Moderate positive
	Uncertainty avoidance	Moderate negative		Uncertainty avoidance	Moderate negative
	Indulgence	Moderate positive		Indulgence	Moderate positive

Source: Authors

Table 5 could be a useful tool for policymakers to determine the strategies for creating more successful entrepreneurial ecosystem. The presented table summarizes the impact of cultural determinants on the entrepreneurial performance. Having in mind the characteristics of the specific culture, government or other interested parties could define more effective policies, measures, and strategies for achieving higher performance of the ecosystem. For example, in the societies with high power distance component, to foster entrepreneurial activities, policymakers must make the effort on motivating the citizens on ventures due to their lack of readiness to be the entrepreneurs (Opportunity Start-up component).

3.3. Limitations and future research directions

Although we have derived important implications, this research has certain limitations. Firstly, the set of countries is limited to 38 OECD and EU countries. This issue is important because cultural differences may be even stronger, and conclusions may significantly differ when the rest of the world countries are included (especially other Asian and African countries). The issue can be addressed in the future research of the authors by expanding the data sample with (at least) BRICS countries. In case of different results Table 5 should be updated. Another direction of the future research is to compare the results with the Global Entrepreneurship Monitor methodology. Even though there is no composite index calculated by this methodology, research could be conducted for the components that are related to the elements of entrepreneurial ecosystem. On the subject of tools for measuring cultural dimensions, the two above mentioned tools by Trompenaars and Schwartz could also be compared with the values of the entrepreneurial performance to examine the impact of cultural differences according to these two models.

4. CONCLUSION

Entrepreneurial activities have numerous positive impacts on all global aspects: individuals, governments, world (GEDI, 2017). These activities are highly dependent on a motivation of an individual. But, for a successful venture, it is necessary to have the support of all the relevant actors in the entrepreneurial process – entrepreneurial ecosystem. One of the major elements of the ecosystem is its culture: norms, values, supporting events, and other. To determine the role of culture in the ecosystem we proposed two research questions: Whether and to what extent is entrepreneurial ecosystem performance affected by the cultural characteristics of a society? and Whether and how are entrepreneurial ecosystem pillars affected by the cultural characteristics of a society?

The research, based on the set of OECD and EU countries was conducted to answer the questions was based on the Hofstede's cultural dimensions model and Global Entrepreneurship Institute composite index – Global Entrepreneurship Index. The results from Table 3 answer the first research question, and show that certain dimensions (Power distance, Individualism, and Uncertainty avoidance) have strong relationship with entrepreneurial performance of the countries. Societies with low hierarchy, which are individualistic, and not afraid of uncertainty are achieving higher scores on GEI methodology.

The research results presented in Table 4 are answering the second research question, where we examined the impact of the culture on components of entrepreneurial ecosystem to answer the second research question. It also resulted with Table 5 that could be a tool for policymakers, used to create better strategies to foster and enhance entrepreneurial activities.

It has been noted during the research that the scope could be improved with expanded set of countries. Also, conclusions could be compared with Global Entrepreneurship Monitor methodology and Trompenaars and Schwartz cultural tools for another insight and comparison of the results. However, this research confirms that the culture has an important role in the entrepreneurial performance of a country. The paper provides first concrete measures of the relationship between culture and entrepreneurship, and represents a good foundation for future research.

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DIMENSIONING THE CONTEXT OF CORPORATE SOCIAL RESPONSIBILITY

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Abstract: *Corporate Social Responsibility (CSR) has change the role of business in society by transforming companies dedicated exclusively to shareholder's value to companies that embrace environmental and social commitments. CSR has become the subject of global scientific and institutional research regarding multiple aspects of finances, environment and society. CSR concept is applicable to companies of different sizes, although it is most discussed within large companies due to their significant impacts and market strengths. However, this doesn't exclude CSR in small and medium companies. Global empowerment of CSR policies and strategies brings their dimensioning to a focus. Many national laws and policies within EU and countries of the Southeast Europe include principles of transparency, social and gender equality along with long-term environmental sustainability. Effective managing of sustainability issues related to community and stakeholders becomes important indicator of business performance. Aim of this paper is to extract implementation levels of CSR in business strategies with reflection on contemporary management.*

Keywords*: company, sustainability, corporate social responsibility, management, stakeholders*

1. INTRODUCTION

CSR has developed from pure selective philanthropy business engagement to nationally implemented laws that explicitly regulate sustainability management in organizational environment. There are three basic dimensions or pillars of CSR: financial, social issues and ecology. The main question is not only being the profit used sustainably but also was it generated sustainably. Next issue is focusing on general company contributions to social innovations and prosperity. It is a matter of strategic positioning of business within society to simultaneously encourage generation of social and business value added. Because of that companies giving more to society than to the shareholders are not a problem anymore, they become a tool for creating solutions for urgent social problems and challenges. According to Schmidpeter, (2013, p.171) this redirection (in the sense of sustainable entrepreneurship) is a real and fundamental contribution to business performance in the sustainable development of our society. It is an investment in the competitive ability of the company and in the future of new generations.

There are differ opinions regarding the role of social responsibility in society. Classical approach claims that business has only the financial responsibility of achieving profit by respecting the law (pure profit - an economic view of social responsibility). This is advocated by monetarists and economists on the supply side. In the middle are people who simply want corporate governance to be more sensitive to the social impact of their decisions, especially in terms of potential harm to the stakeholders (social awareness or ethical social responsibility). These are economic liberals and neo-Keynesian interventionists. On the other end stand those who want to see businesses actively involved in programs that cure various social "illnesses"; such as providing employment opportunities for everyone, environmental protection and justice promotion around the world, even though it means cost to the shareholders (altruistic social responsibility or service to the community).

Business ethics and corporate governance are combined to create conditions for achieving organizational excellence. Social responsibility is nothing more than a characteristic of organizational excellence and shows the wealth of corporate beliefs, values and cultures to the extent that they affect the larger civil society they are part of. Therefore, companies take into account social responsibility, and indirectly state that social responsibility is essentially voluntary, yet it can be used strategically to influence the corporate brand image (Mohanty, 2007).

Over the last three decades' numerous companies have adopted and implemented the concept of socially responsible business. However, a limited consensus has emerged about what socially responsible business really means. Agreeing around one definition would be very difficult, because each of them represents a different standpoint and somehow tries to explain the relationship between business and its environment. This is acceptable because each organization or company is specific in its operations, shareholders, stakeholders and environment. As a modern concept of management CSR enters the era of its dimensioning in 21st century and adapting to a new role of sole sustainability business model. In this paper context for dimensioning CSR will be elaborated regarding its historical content, organizational participants and business sustainability processes.

2. HISTORICAL CONTEXT OF THE CSR

Dimensions of social responsibility have changed the way business and society cooperate, ranging from companies with low social community interactions to companies highly involved in social activities. The notion of socially responsible business supports the idea that businesses cannot act as isolated economic entities that dissociate themselves from a wider society. In simple terms, socially responsible business can be understood from the three words that the phrase contains: "socially" refers to the local communities with which they interact, the "responsibility" on both sides of these relationships and "business" that encompasses a large spectrum of companies (Bhaduri, Selarka, 2016, p.13). It is a fact that CSR is not fully regulated by any official law. In practice company decides on models of CSR implementation and fulfillment. As such CSR has become an unconsciously legitimate practice.

The evolution CSR concept had six phases, from 1950 to 2000 onwards. These phases are (Bhaduri, Selarka, 2016):

1) 1950s – 1960s - period of defining and introducing social responsibility into the academic field and corporate philanthropy;
2) 1970s - period of rapid spreading of business concept of the social responsibility;
3) 1980s - period of stakeholder theory and business ethics;
4) 1990s - period of introduction of corporate social responsibility - CSR;
5) 2000s and beyond - period of empirical research intended to determine the CSR effects to business strategy.

Sixty years marked the period of significant growth in the formalization of corporate social responsibility (CSR) definition. However, philanthropy manifested itself as the most important determinant of social responsibility in THE 1960s. The next decade of 1970s was characterized by concepts of socially responsible business and corporate social performance. The development of new definitions of social responsibility dominates in the 1980s. Themes as public policy, business ethics, stakeholder theory and management became a part of social responsibility. During the late 1980s and early 1990s, the concept was further expanded by the introduction of the Triple Bottom Line (TBL) representing the balance between company financial, social an environmental business results.

The concept of business ethics or corporate philanthropy has a longer development base from 1920 to 1980s. In the 1950s, the primary focus was on corporate responsibility toward society and for society. In key events of the 1960s of the last century, people and ideas were instrumental in marking the social changes that have emerged during that decade. Although managers tried to apply traditional management functions to the problems of social responsibility even before, it was not until 1980s that business and social interests became closer to each other and when companies became more sensitive to their stakeholders. During the 1990s, the idea of socially responsible business became virtually and universally approved and became an important strategic issue during the 2000s (Moura-Leite, Padgett, 2011). In the 21st century there is a shift from theory to empirical research on topics such as stakeholder theory, business ethics and sustainability.

In current global economic conditions CSR relates to different types of market crisis. Financial crisis from 2007 indicated that there was no responsibility among financial institutions. However, 2007 crisis was not only financial one, because it also involved difficult environmental, social and energetic moments of the crisis. Crisis issues of energy supply demands and high consumption of natural resources brought sustainability of energetic sector to multiple question. Social sustainability is still aggravated by the social issues of high unemployment rates among young people, equality and working rights of women, child labor and corruption. Environmental issues nowadays form important part of financial risks due to ecological scandals of multinational corporations. To pursue environmental protection and sustainable development became mainstream CSR paradigm of management. All of the mentioned represent dimensions within which CSR develops today and according to them it will outline its future path that will always depend on society needs, which form contemporary market trends.

3. CSR RELATIONS IN A MODERN COMPANY

CSR is a part of a new management paradigm, strongly advocating sustainability issues being solved in cooperation with community and the stakeholders. Omazić and Baljkas (2005) state it as a concept of company management in order to realize profits but also to meet social and environmental protection criteria, with the ultimate goal of sustainability and satisfaction for all involved stakeholders. The European Commission defines CSR as a "*concept by which a company voluntarily integrates environmental issues in its business activities and relations with interest-influencing groups (owners, shareholders, employees, consumers, suppliers, government, the media and general public)*". These groups are called stakeholders

and they are divided on internal and external stakeholders. Some authors understood social initiatives as the most important activities that corporation undertakes to support the company value and make a commitment to socially responsible business. Socially responsible business represents the commitment of the company to improve community well-being through discretionary, voluntary business practices and contributions to the account of its own resources. The most important element of this definition is volunteerism. Kotler and Lee (2009, p.14-15) here do not include mandatory business activities demanded by law, nor activities that can be expected due to their ethical nature. According to them it is a matter of voluntary commitment of the company to go beyond the usual level of business practice when giving various socio-economic contributions. CSR is always preconditioned to give balance between profits, environmental protection and social equity. It is what is called ˝3P˝ - *people, planet and profit.* There are two basic dimensions of CSR:

1) The internal dimension - includes everything in the organization and relates to areas such as: a) human capital management, b) health and safety at work, c) adaptation to changes, and d) management of environmental and natural resources impacts. Responsible practices in the field of environmental protection mainly concern the management of natural resources that are used in production.
2) The external dimension - refers to a) local community, b) various stakeholders (alongside employees and stockholders): business partners, suppliers and consumers, c) respect for human rights, d) global environmental care,

One area of CSR gains a special momentum in the given circumstances. – the area of CSR reporting. CSR reporting enables efficiency analysis of implemented CSR policies as it provides insight into the company Triple Bottom Line (TBL). TBL includes the aspects of business responsibility in the area of financial, environmental and social impacts of one organization (Miljenović, 2016, p.57-58). TBL concept in his basic form is used as a framework for measuring and reporting sustainability goals related to environment and social aspects who interact simultaneously. Measuring business performance in terms of sustainability includes three levels of measurement and evaluation of business operations (Bodiroga Vukobrat, Barić, 2008, p.20-21):

1) economic results that include measurements of financial and operational aspects;
2) the environmental aspect focusing on the emission of harmful substances, consumption of energy, water, air and generating other various impurities and their impacts on nature;
3) a social aspect that attracts attention to health and education of employees, social justice and the protection of employees.

The social dimension measures the benefits in terms of human capital, including the position of a company in a local community. This dimension increases with righteous and contributing work practices and by engaging business in the community. Environmental dimension control is about managing, monitoring and reporting on energy and material consumption, generating waste and emissions. Corporate sustainability measurement is always based on environmental impact, community relationships and company contributions to the stakeholders.

During the 1990s business entities and their leaderships exclusively sought responsibility for financial success, while today there is an increasing demand on business organizations (from governments, consumer associations, and communities) to operate in a way that benefits society as a whole. The question of social responsibility usually emerged in those areas of business activity that were not legally regulated and where there was no certainty regarding ethically correct approach (Črnjar, Črnjar, 2009, 182 - 183). Business ethics also depends on the company culture. The decision to conduct an ethical activity is always a basic expression of moral behavior. Companies in this case have to determine their ethical values and promote them internally and, most of all, externally i.e. towards its stakeholders. To bring an ethically right decision management has to detect and engage stakeholder ethical values into decision making process. There are many positive impacts of ethical elements within the CSR like attracting customers and better employees (related to increased productivity) and avoiding possible environmental and social risks. There is also one more important part of business success based on ethical behavior. This part is about attracting investors who recognize organizational inputs in the CSR and the additional value it creates. Ethical behavior is one of the CSR basics and crucial to gain stakeholder or public confidence and cooperation.

The American CSR model differs slightly from European one. For example, in the USA business responsibility program is "sold" through charitable foundations or philanthropy, while in Europe, focus is held on targeted social programs and sustainable business projects. Furthermore, in the USA workplace is based on the principle of individualism, while in Europe the principle of collective solidarity prevails (Madrakhimova, 2013, p.511).

CSR as a concept with many definitions and practices can be implemented and understood differently for each company and country. Moreover, CSR is a very broad concept that addresses many different topics such as human rights, corporate governance, health and safety, environmental impacts, working conditions and contributions to economic development. Regardless of the definition, the purpose of social responsibility

is to encourage changes to sustainability, especially within conformed business community. Definitions of business sustainability can be presented by the pyramid of social responsibility. The pyramid is comprised of four types of responsibilities (Figure 1).

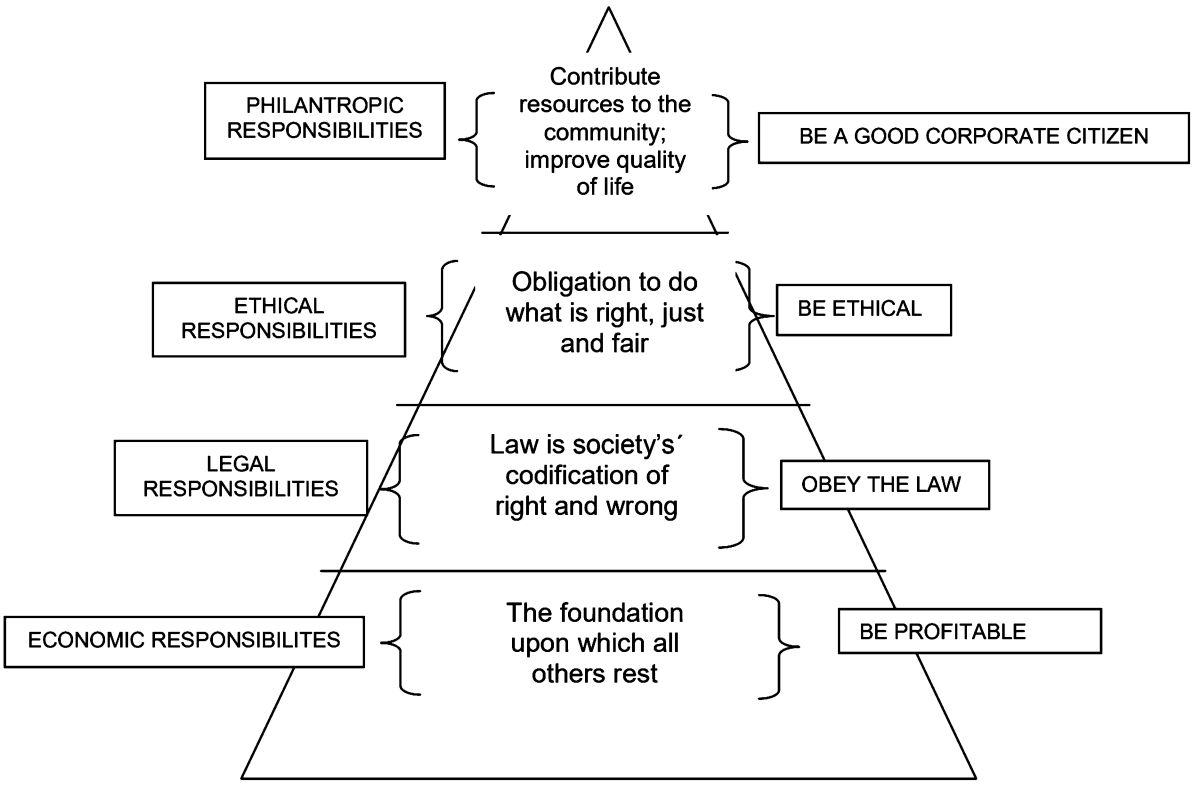

Figure 1: Pyramid of the social responsibility
Source: Carrol (1991)

This original pyramid emerges economic responsibility as the most basic one. However, this can be a theoretical or practical illusion. Economic responsibility doesn't necessarily correlate to financial performance. Economizing relates also to management of natural and human resources. To manage this resource in a sustainable manner reflects company financial performance. Also, investors prefer investments of low environmental or social risk as adequate and with attractive returns. Legal responsibility implies compliance with all laws, in accordance with all regulations. These include environmental protection and consumer laws, safety at work regulations, meeting all contractual obligations, and guarantees. Ethical responsibility is a part of individual character, although defined as obligation to do what is right and fair and to avoid damage to stakeholders (employees, consumers, the environment and others). It is preferable to avoid questionable practices and operate beyond the required minimum of social or ecological standards. Managers need to do what is right, fair and just and establish ethical leadership. However, this again, depends, exclusively on their behavior, cultural and educational development. Philanthropic responsibility i.e. to contribute to the financial and human resources of the community and to improve the quality of life has an aim to provide programs that support communities - education, health / human services, culture and art. It is also necessary to promote and participate in volunteering. All of these responsibilities make company a ˝good citizen˝. Objective is to go far more than basic moral principles, the conviction that this is the "right thing" and concern for the benefit of current and future generations and to encourage the company to consider its responsibility.

The motive for socially responsible business is often the pressure of the public (e.g. clients, consumer protection associations, non-governmental organizations involved in environmental protection, human rights organizations, etc.). CSR is a crucial generator of company reputation and brand value. In addition, it is clear that company reputation affects stock price, shareholder value and customer loyalty, which is a very valuable motive that should not be forgotten (Krkač, 2007, p.380). The company can grow with or without social responsibility, but doing good to others allows the company to benefit in different forms of capital than only financial one. CSR enables company to develop stakeholder capital (i.e. stakeholder relations), better human capital and conserve different forms of natural capital/resources in terms of ecological efficiency.

4. DIMENSIONS OF THE CSR IN THE EUROPEAN UNION AND CROATIA

In the world of multinational investments and global supply chains, CSR must also be taken beyond national limits. Rapid globalization has prompted debate on the role and development of global governance. Social responsibility is an important business sector policy for the EU in terms of promoting sustainable development, innovation and competitiveness in the EU's market economy. In this context, the European Commission strongly promotes the sustainability and accountability of European companies, regardless the seize. Moreover, socially responsible business is used to enhance the development basis and opportunities for market growth and innovation. This requires careful monitoring of social changes and expectations from the stakeholders to the companies. Important part of the EU CSR policy is the adoption of new sustainable business models. These models aim to improve consumer confidence and give sustainable quality at a high level of assurance.

European Commission in its Green Paper of 2001 strongly promotes the importance of socially responsible business, as a path to sustainable development embedded in relevant European policies and activities. The Commission states that "*socially responsible business can contribute to sustainable development, boosting Europe's innovative potential and competitiveness, thereby contributing to employment and job creation through the development of sustainable technologies*" (Yildiz, Ozerim, 2014). The European Program for Supporting Corporate Social Responsibility includes (European Commission, retrieved from: http://ec.europa.eu/growth/industry/corporate-social-responsibility_hr):

- spreading good practice;
- improving and monitoring the level of trust in business;
- increasing market benefits for socially responsible business;
- improving the release of general information and especially environmental information;
- a more comprehensive integration of CSR into education, training and research;
- better alignment of the European and national CSR approaches.

The Commission expects European companies and businesses to show their constant commitment to socially responsible business through responsible, transparent and sustainable business behavior.

4.1. Public CSR policies in the EU

In response to the urgent needs to tackle unemployment, climate and demographic change in Europe, the "Enterprise 2020 Manifesto for Action" (CSR Europe, 2015) should emerge by 2020 social responsibility associations across Europe, involving over 40 national partner organizations and over 10,000 companies across in European Business Network for Corporate Social Responsibility. Parts of this network are also Responsible Business Forum Serbia and Croatian Business Council for Sustainable Development (HR PSOR). "Enterprise 2020 Manifesto for Action" invites companies and governments to work together through three strategic priorities over five years, from 2015 to 2019 including:

1) enabling employment and community engagement, value chain management,
2) engage as committed partners with communities, cities and regions to develop and implement new sustainable methods of production, consumption and life,
3) promote transparency and respect for human rights as the focus of business behavior.

These actions frame the social responsibility movement set by the European Commission in its "Europe 2020" strategy, which requires smart, sustainable and inclusive growth. The European Commission sets out socially responsible activities for business in the EU countries that can be summarized in following (Mullerat, 2013):

a) adopting CSR action plans and strategies;
b) responsible supply chain management;
c) CSR reporting;
d) addressing climate changes;
e) small and medium-sized enterprises;
f) socially responsible investment;
g) education and socially responsible business;
h) public procurement relied on social responsibility.

All of the noted are important, however, some points can be especially emphasized. For instance, according to Mullerat (2013, p.17-18) the number of companies reporting on CSR has increased considerably over the last few years. At a global level, annual global reporting increased from almost zero in 1992 to a total of 4,000 reports in 2010. Despite the crisis, the growth rate of reporting declined slightly in 2009. Although this trend is growing, companies reporting on CSR make up only a small share of global business, with some 82,000 multinational companies and more than 23 million of small and medium-sized businesses. EU is intensively addressing climate changes in sectors such as electricity, industry and manufacturing, transport,

retail, investment in clean technology, products, services, production processes related to energy efficiency, renewable energy or sustainable mobility. New technologies represent a way to appropriately channel these changes. This is where small and medium-sized enterprises play a significant role, bringing startups even to small local communities. Socially responsible investments are essentials to meet financial, social and environmental needs representing a bridge between organizations and its stakeholders. Green and technologically sustainable investments are in focus, especially in small and medium companies that provide more than 80 million jobs with a tendency to spread.

United in its diversity EU contains different national policies regarding the CSR and different rate of sustainability awareness. In each country of the European Union, the development of socially responsible business initiatives depends on a set of cultural, economic, institutional and political factors that can help to provide insight into CSR priority settings. The national approach is influenced by a number of interrelated factors: economic and sectoral structure (e.g. overcoming small and medium-sized enterprises or micro-companies, prevalence of the above-mentioned enterprises in the ownership, exposure to international trade, etc.), economic development/impact of the crisis, level of institutionalization of stakeholder engagement, awareness of social responsibility, definition of social responsibility, existing policy and regulatory framework and structure of policy making (central, regional and local responsibility).

4.2. CSR in the Republic of Croatia

The importance of developing CSR practices in the Republic of Croatia is promoted by the foundation of the Croatian Business Council for Sustainable Development (hereinafter referred to as HR PSOR), based on the signed Memorandum of Understanding with the World Business Council for Sustainable Development (WBCSD), which was established in 1997. The organization was founded by 18 Croatian companies that have committed themselves to promoting sustainable business practices in order to protect the environment and contribute to all aspects of the sustainable development. With the launch of the European integration process in 2001 and the signing of the Stabilization and Association Agreement, when Croatia gained its candidate status in June 2004, it also began to strengthen its practices such as the European political and market - economic model. At the end of 2004, the 1st National Conference on Social Responsibility, "Agenda 2005", was held. The conference has gathered more than 120 researchers and entrepreneurs and has enabled the formulation of common priorities for developing socially responsibility of national business sector. The first intention of CSR in Croatia is largely based on environmental practice (primarily among industry manufacturers). In the second phase, the interest of the companies expanded to human resources, cooperation and care for the local community. An important export incentive was to apply new, green technologies advocated by the CSR. The best example is the Croatian electric automobile manufacturer Mate Rimac. Another important stakeholder in the development of Croatian socially responsible business is surely the Community for CSR that operates within the Croatian Chamber of Commerce since 2006. Community objectives are to raise awareness for CSR in all sectors of society, to promote business ethics codes within business entities, and to organize systematic education and counseling with the aim of improving and exchanging good practices from the Republic of Croatia, the rest of the EU and the world.

Important initiative in Croatia and other EU countries concerns the matter of the CSR reporting. By European legislative member countries have a commitment to represent CSR reporting as a part of a broad CSR incentives, even by law. For instance, law regulating accountancy contents in Croatia describes the need to publish environmental and social data on a regular basis (along with financial data). Another important step in CSR implementation is measuring the CSR Index of Croatian firms. This index is a methodology for assessing responsible practices in business of Croatian companies'. Index was modeled according to similar world methodologies, primarily based on the Business in the Community CR Index, which follows a systematic approach to managing, measuring and reporting on CSR business-related practices.

The index of the CSR also represents a reward, with companies competing in different categories, given the size and type of ownership. CSR Index is jointly awarded annually to the category of small, medium, large and public enterprises by the Croatian Chamber of Commerce and Croatian Business Council for Sustainable Development - HR PSOR. Index methodology evaluates activities in six areas: 1) company focus on economic viability, 2) involvement of CSR and sustainable development in business strategy, 3) responsible policies and practices at work, 4) policies of environmental management, 5) CSR in market relations and 6) socially responsible community relations (Croatian Business Council for Sustainable Development - HRPSOR, http://hrpsor.hr/indeks-CSR-2-452.html). The presence of the CSR index in Croatian public, small, medium and large enterprises is presented by the following figure (data from Croatian Business Council for Sustainable Development – HRPSOR).

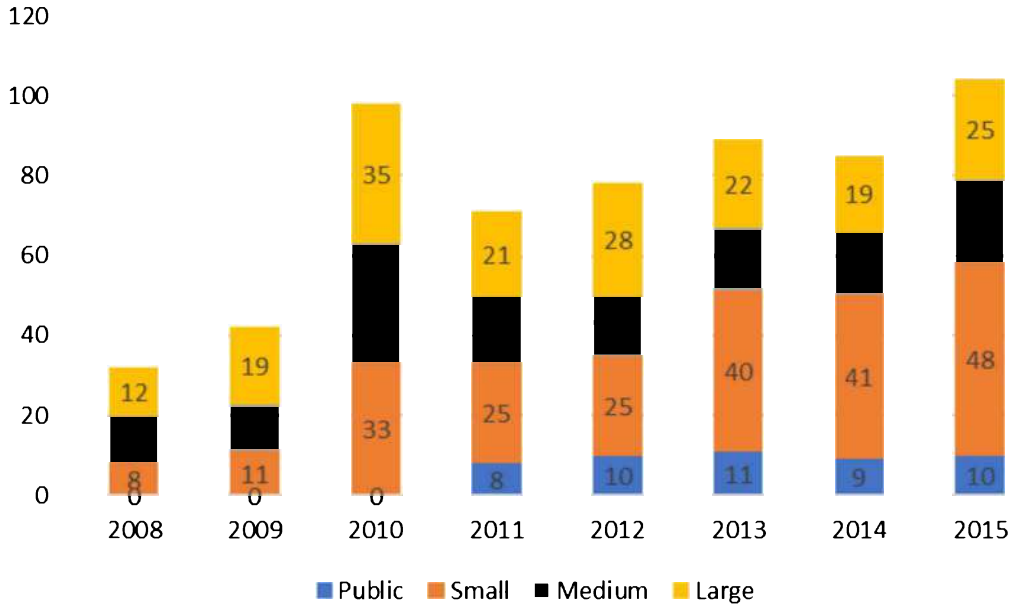

Figure 2. Number of Croatian companies included in the CSR Index

Sample size of the CSR Index for Croatian companies changed over the years. In Figure 2 it was ranked by company size. The observed period from 2008 to 2015 provides an insight into growing number and structure of companies included in the CSR Index, proving a growing number of companies dedicated to deliver business operations in a sustainable manner. According to this data, small enterprises have a developing trend within the observed period, while in 2011 and 2012 they recorded stagnation regarding the indexing of their CSR performance. In 2015, most of the CSR Index is comprised of small businesses. Public companies, compared to others, are negligible, while in 2008 they were not included at all. This relevantly imposes issues of transparency within the companies of the public sector. Data shows that CSR is no longer reserved exclusively for large companies because it is being increasingly integrated with small and medium-sized businesses as a prerequisite of their business expansion.

5. CONCLUSION

CSR is about companies balancing on the line of sustainable development and growing global consumption. Balancing economic issues and ecological responsibilities is not an easy task, however it became a management paradigm of 21st century. Innovations contributing to sustainable development require innovative business models. CSR is not only about leaving good impression on general public or improving public relations, just the contrary, CSR has to be a core value of any business leaders. Stewardship in the area of the Triple Bottom Line requires managers balancing between financial and non-financial issues. Decisions on business ethics and social responsibility have a huge impact on local consumers, communities, and even global consequences. Making positive decisions and choices regarding stakeholders can create a positive impact on business in the area of product quality and employee rights. The EU CSR strategy shows that the positive development of the European economy is closely linked to European companies that practice sustainability and corporate responsibility.

In order to facilitate the CSR implementation, the European Union creates a common political framework and promotes a debate on socially responsible business. CSR strategies of the European Union seeks to introduce sustainable development at the heart of its corporate responsibility policy and member's business strategies. The key motivation of a socially responsible business strategy in the European Union is the belief that social responsibility is good for businesses. But social responsibility is also a tool for the European economy and society as it represents more stability, sustainability and innovation.

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APPLICATION OF BIOMETRIC TECHNOLOGY IN ELECTRONIC PAYMENT AUTHENTICATION

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Abstract: *The banking industry has been experiencing pressures to increase its profitability and growth rate as a consequence of the 2008 economic crisis. One of the responses was the introduction of new technological solutions in order to attract and retain new and existing customers. Biometrics, which involves using measurable physical or behavioral characteristics, as a way of establishing or verifying identity, is among those technological solutions. This paper reviews the topic of biometrics as payment authentication method. Delphi method was implemented in order to forecast application of biometric technology where the questionnaire was sent out to experts in electronic payment and biometrics. Delphi was chosen as preferred method as usage of biometric technology in electronic payments industry is still in pioneer phase and experts had to intuitively answer the questionnaire covering three main topics: convenience of use versus security, implementation on the global level, implementation in Serbia (each of the topics is represented with a cluster of five statements). 5-degree Likert scale was used to assess to what extent experts agree or disagree with the statements offered in the questionnaire. Data obtained from the questionnaire was analyzed using SPSS. Two rounds of Delphi research were conducted. Paper presents the interpretation of results obtained through primary research and conclusions and recommendations were drawn based on both literature review and research results.*

Keywords*: technology, biometrics, electronic payment, Delphi method*

1. INTRODUCTION

Contemporary banking industry is generally characterized by low growth and excessive regulatory changes (Ernst & Young, 2016). The industry has been experiencing pressures to increase its profitability and growth rate as a consequence of the 2008 economic crisis. One of the responses was the introduction of new technological solutions in order to attract and retain new and existing customers. Main activities in banking industry are recognized as following: risk management, streaming, process/automation/technology investments, capital, liquidity and the leverage ratio, compliance with capital market regulations, reputational risk, cyber security/data security, investing in customer-facing technology, minimizing all non-essential expenditure/cutting costs (Ernst & Young, 2016). According to the report, there is a strong focus on technology-related activities, which account for 3 out of 8 essential tasks for banks, as 53% banks included in their survey answered placed customer-facing technology as a priority investment

A very strong technological disruptor for the banking industry is the ever-growing popularity of smart phones as they inherently changed the way people complete many different activities, as now almost everything can be completed on the run, while doing something else. This change in the end-consumer lifestyle did not create just a need for new services and products, but it changed the core model banking industry used. One may witness a transition from multi-channel banking to omni-channel banking, which is the latest trend (IBM, 2014). While in multi-channel banking financial institutions were primarily focused on execution and transactions, the core activity of omni-channel banking is interacting with consumer. Some of the main characteristics of omni-channel banking are its client-centric approach to business, focus on interaction with customers using different channels, its baseline is system of engagements, and it heavily relies on big data (IBM, 2014).

2. BIOMETRIC TECHNOLOGY

For quite some time, various forms of passwords and security codes were thought to be the best way to protect computers, phones, and any type of relevant and important pieces of information (O'Gorman, 2003). However, as the technology developed over the time, a number of new possibilities emerged. One of them is biometrics as a method of user authentication. Biometrics includes several different indicators that can be used separately or combined in order to identify the user. The most popular indicators include a signature, a fingerprint, voice recognition, or face recognition (either through scanning the whole face or just the iris) (Everis Digital, 2016). Other modalities include keystroke dynamics, gait, palm print, finger veins, ear recognition, etc. (Rosenberger, 2016).

The importance of biometrics has been increasing mostly because consumer preferences have been changing over the time and the popularity of computers decreased in comparison with mobile phones. One of the strongest drivers of change in the financial sector is the constant increase in the number of smart phone users (Tsys.com, 2016). Hence, it does not come as a surprise that companies which customers predominantly use mobile phones for payment services have already implemented a number of new options, including biometrics as a payment authentication method. Some of the pioneers in this area are Apple, Samsung, and PayPal. Access to mobile platforms of the previously listed companies is granted or denied based on touch ID or fingerprint scans. It has been recognized that biometrics is a quick and easy solution and in most cases it contributes to a more positive customer experience (Garg & Garg, 2015).

While it is undeniable that using biometric indicators has significant advantages, it also carries some significant security risks, which is the main reason why the financial sector hasn't been so quick to adopt this option. According to a survey conducted in the first half of 2015, 22% of financial institutions included in the survey offered biometric authentication for mobile services (Mobey Forum, 2015a). The most commonly found areas of application of biometrics in the financial sector are authenticating user, payment or transaction confirmation, digital signing of documents, on-boarding of new customer, additional verification of high-risk transaction, and account management. When the rest of the participants was asked to predict when that option would be offered by companies they work for, majority of them responded that they expect that to happen in more than 12 months (Mobey Forum, 2015a).

In general, biometrics "involves using measurable physical or behavioral characteristics as a way of establishing or verifying identity" and it has been recognized for the past two decades as a potentially dominant payment authentication mode in the future (Mobey Forum, 2015). Although biometric payment authentication is usually associated with fingerprints, it can also utilize palm-prints, facial and voice recognition, eye scans, and heart-rate (Edgar, Dunn & Company, 2016). Development of biometric payment authentication and its adoption have been relatively slow, but the expectations are that due to enormous popularity of smartphones, many of which already support biometrics, it will be possible to push this technology.

2.1. Research question

Previously presented information clearly shows that there is a strong focus on biometrics and its potential applications in the financial sector. One of the crucial issues is the exact point in time when this technology will be fully employed. This issue will be explored in this study, but instead of adopting global stance, the focus will be placed on Serbia as the main financial market of the interest. For now, there are no serious studies conducted in our region which would explore use of biometrics as a payment authentication method. As the research gap was identified, following research questions were formulated:

1. What are the advantages and disadvantages of the biometric payment authentication method?
2. Are there any challenges related to this method?
3. When will this method be globally applied on a large scale?
4. When will this method be available in Serbia?

3. RESEARCH DESIGN

Delphi method is used for collecting opinions from experts on a very specific topic. The method is often implemented when the subject of discussion is relatively poorly researched or developed and barely no other sources of relevant information are currently available (Okoli&Pawlowski, 2004). Experts relevant for this study were high-positioned individuals working in the financial sectors across Europe. As they are geographically dispersed, online questionnaire was chosen as the most acceptable research tool.

3.1. Delphi method design

The questionnaire consisted of three clusters of questions: convenience of use versus security, implementation on the global level, and implementation in Serbia. Each of these clusters was represented with 5 statements followed by a 5-degree Likert scale. Likert scale values varied from strongly disagree to strongly agree. Each question was formulated based on the information found in the existing literature and reports on similar surveys were consulted in order to cover all the relevant elements. The online platform Qualtricswas used to create the questionnaire and experts received an email with a link to the survey. All questions both in Questionnaire 1 and Questionnaire 2 were in a forced-choice format, meaning that a participant cannot move to the next question until the current one is answered. Overall procedure of the Phase 1 research is provided in the Table 1. Questionnaire 1 structure is presented in Table 2 and Questionnaire 2 structure is presented in Table 3.

Table 1: Delphi Method Procedure

	Round 1	Round 2
Instrument	Online questionnaire 1	Online questionnaire 2
Data source for the questionnaire	Literature review	Literature review + responses from the round 1
Duration	10 days	10 days
Number of experts selected	38	23
Data analysis	Descriptive statistics necessary for the feedback	Mean, Mode, Median, SD; Pearson correlation

Table 2: Questionnaire 1 Structure

Section	Statements
Convenience of use versus security in case of biometrics payment authentication	1. Payment authentication using biometrics technology is cost-efficient. 2. Payment authentication using biometrics technology is time-efficient. 3. Payment authentication using biometrics is more convenient for users than traditional authentication methods (PIN, password, signature, etc.) 4. Payment authentication using biometrics increases the security of authentication process. 5. Payment authentication using biometrics is a completely reliable identification method.
Implementation of biometrics payment authentication on the global level	1. The adoption rate for payment authentication using biometrics systems depends on customers' perception of data privacy issues. 2. The majority of payment providers (financial institutions, merchants, and fintech companies) already offers product/service which supports payment authentication using biometrics. 3. By 2020 majority of payment providers (financial institutions, merchants and fintech companies) at the global level will offer product/service which supports payment authentication using biometrics. 4. Payment authentication using biometrics will become a pre-requisite for acquiring and retaining customers in the payment industry. 5. Payment authentication with fingerprint (set of features from a cardholder's finger stored securely on a smartphone) will be the dominant method for payment authentication using biometrics.
Implementation of biometrics payment authentication in Serbia	1. The biggest challenge for payment providers (financial institutions, merchants and fintech companies) in Serbia will be technology providers and their ability to support payment authentication using biometrics. 2. The biggest challenge for payment providers (financial institutions, merchants, and fintech companies) in Serbia will be end users education in adopting and using payment authentication with biometrics. 3. Payments authentication using biometric will be quickly (1-3 years) adopted by majority of users in Serbia. 4. IT infrastructure in Serbia is CURRENTLY sufficiently developed to support technology required for payments authentication using biometrics. 5. Payment authenticated with fingerprint (set of features from a cardholder's finger stored securely on a smartphone) will be the dominant method in Serbia for payment authentication using biometrics.
Prediction	In how many years payment providers (financial institutions, merchants, and fintech companies) in Serbia will implement payment authentication using biometrics?

Table 3: Questionnaire 2 Structure

Question	Options
Payment authentication using biometrics technology is cost-efficient for the end consumer.	5-degree Likert scale
Payment authentication using biometrics technology is cost-efficient for the payment provider (financial institutions, merchants, and fintech companies).	5-degree Likert scale
One of the most significant challenges for payment providers (financial institutions, merchants and fintech companies) in high-growing and emerging markets will be technology providers and their ability to support payment authentication using biometrics.	5-degree Likert scale
Among the following options, which one is, in your opinion, the biggest challenge for payment providers (financial institutions, merchants, and fintech companies) in high-growing and emerging markets?	▪ technological readiness for payment authentication using biometrics, ▪ users education in adopting and using payment authentication using biometrics, ▪ regulation regarding payment authentication using biometrics
Which of the following two represents a greater obstacle for adopting payment authentication using biometrics (from the perspective of end users)?	▪ data privacy risk (personal information, stored biometric data) ▪ sensitive payment data theft (account number, expiry date, CVC2, etc.)
In your opinion, what is the expected adoption rate of payment authentication using biometrics once this service is widely available in high-growing and emerging markets?	▪ fast (1 - 2 years) ▪ moderate (3-4 years) ▪ slow (5+ years)
Under assumption that payment authentication using biometrics becomes widely available in high-growing and emerging markets which of the following modalities will be predominantly used	▪ Fingerprint ▪ Face recognition ▪ Iris recognition ▪ Voice recognition

4. RESULTS

Statistical analysis was conducted using SPSS. Due to choice of the research method and type of the instrument, the choice of statistical analyses was restricted. Descriptive statistics was performed (arithmetic mean M, standard deviation SD, mode, median) as well as Pearson correlation for researching the potential relationship between three sections of questions from Questionnaire 1. ICC Two-way random coefficient was calculated to estimate reliability of the constructed scales.

4.1. Phase One

Thirty eight experts were contacted with a request to complete the questionnaire in Phase 1, but only 23 of them completed the questionnaire, meaning that the response rate for Phase 1 was 61%. Response rate for each question in the questionnaire was 100%. The Likert scale used in the survey followed a usually pattern of assigning values to numbers: 1 – strongly disagree, 2 – somewhat disagree, 3- nether agree nor disagree, 4 – somewhat agree, 5 – strongly agree.

4.1.1. Convenience of use versus security in case of biometrics payment authentication

In this section of the questionnaire, the statement which was most approved by the experts was regarding superior convenience of biometrics over traditional authentication methods such as PIN, password, signature, etc. additionally, none of the experts disagreed with this statement, which wasn't the case with others. Statement about payment authentication biometrics being cost efficient received most disagreements. Although the number of negative responses was relatively low (3 in total), the interest in this statement was also sparked because of relatively high number of participants who chose the neutral option (N = 8).

Results also show that there is a general consensus that payment authentication using biometrics increases the security of authentication (16 positive answers) and that it is time-efficient (18 positive answers). Finally, the statement about biometrics as a completely reliable identification method also received relatively high number of neutral answers (N = 7) paired with high number of positive answers (N = 14). The reason for this detected once the feedback for Questionnaire 1 was received and some of the respondents draw attention

to the fact that the construction "completely reliable" was either unclear or unacceptable to them since no technological solution is completely reliable, but reliability is a continuum and, in their opinion, none of the existing solutions reached its highest value. For that reason, the conclusion was that, despite high number of neutral answers, experts believe that payment authentication using biometrics is a reliable method.

In order to make results in section 1 more comparable, descriptive statistics was done for each of the statements including arithmetic mean (M), standard deviation (SD), mode, and median. ICC coefficient was calculated in order to determine reliability of the scale used. Based on these values, decision was made which of these statements remained unclear and need to be repeated in the second phase of the research.

Table 4: Questionnaire 1 Section 1 Descriptive Statistics

Statement	M	SD	Mode	Median	ICC
Statement 1	3.39	.891	4	4	
Statement 2	4.17	.887	4	5	Cronbach's
Statement 3	4.43	.662	5	5	Alpha = .766
Statement 4	4	1	5	4	p = .000
Statement 5	3.65	.935	4	4	

Descriptive statistics showed that dispersion of answers for each of the statements (based on the value of SD) was acceptable as SD values were in a range considered to be acceptable (they do not distort Mean value). ICC coefficient showed that the scale consisting of five items had good internal reliability, meaning that all the statements used are relevant for assessment of convenience of biometrics payment authentication. In order to determine which questions should be further clarified, information from both tables was combined. Only statement 1 was chosen to be further explored as it is the only one with relatively high SD (in comparison with other values observed) and dispersion of answers was present across the whole continuum of the Likert scale, which was not the case with other variables.

Data distribution is in accordance with previous conclusions made about generally positive attitude of experts towards the convenience of biometrics payment authentication. In order to see whether this positive attitude towards biometrics payment authentication influences the prediction regarding the moment when it will be implemented in Serbia by financial institutions, merchants, and fintech companies, Pearson correlation was calculated between total score on the Section 1 Scale and number of years experts estimated as the period in which this method will be available. However, the results showed that correlation was not statistically significant (p = .406). This can be probably explained by the fact that other factors may be equally or even more relevant in determining when this authentication method will become widely available in Serbia.

4.1.2. Implementation of biometrics payment authentication on the global level

Majority of answers grouped around higher values, except for the statement regarding the current offer of biometrics payment authentication where almost 70% respondents did not support the statement. Although currently biometrics is not widely adopted, in experts' opinion, majority of payment providers will include biometrics in their offer by 2020 (69% respondents agrees with this statement to a different degree). A slightly greater dispersion of answers was noted for the statement about biometrics being the cornerstone of retaining and acquiring new customers. Based on the answers, 21% respondents somewhat disagree with this claim and 26% of them were neither disagreeing nor agreeing. Although more than half of the sample (52%) agreed with the statement, this was in a slight disproportion with reports on biometrics and the expected significance of this payment authentication. It was also contrary to expectations to observe that 26% respondents choose neutral position regarding the dominant use of fingerprint recognition, although 70% of the sample agreed that this will be the dominant modality.

Table 5: Questionnaire 1 Section 2 Descriptive Statistics

Statement	M	SD	Mode	Median	ICC
Statement 1	3.91	.97	4	4	
Statement 2	2.26	1.14	2	2	Cronbach's
Statement 3	3.57	.99	4	4	Alpha = .589
Statement 4	3.30	.82	4	4	p = .002
Statement 5	3.83	.94	4	4	

Descriptive statistics also confirmed that the statement with the lowest score was statement number 2, which also had the highest variation in answers (higher SD in comparison to other questions due to higher number of negative answers as well). Information about mode and median values shows that majority of respondents chose moderate agreement with statements as their answer (apart from the Statement 2).

Value of Cronbach's Alpha suggests that this scale has lower internal consistency in comparison with Section 1, which was expected as this scale covered several different aspects of biometrics implementation on a global level (security, prevalence, adoption rate, modality).

4.1.3. Implementation of biometrics payment authentication in Serbia

The most notable characteristic of answers in the third section of the Questionnaire 1 is a general increase in the number of neutral answers. This is a consequence of the fact that experts included in the research are coming from different countries across Europe and some of them were not familiar enough with the Serbian market so they did not feel competent enough to discuss specific questions relating to Serbian market. For that reason, in the Questionnaire 2 a phrase high-growing and emerging markets was used as a broader term, but one that is directly applicable to the domestic market.

Majority of respondents (56%) agreed that technology providers and their capabilities will be the main challenge for payment providers, while slightly higher portion of respondents agreed that the same role will be reserved for end users education regarding biometrics payment authentication. However, there is a significant difference between these two statements, as in the case of Statement 1 only two respondents disagreed, while five respondents disagreed with Statement 2, showing more unified confirmation for that challenges for payment providers will emerge from technological readiness of the market. Furthermore, experts did not agree on the adoption rate of biometrics payment authentication in Serbia (30% did not agree that it will happen over the course of next three years, while 34% agreed).

The highest number of neutral responses was recorded for the Statement 4 regarding IT infrastructure in Serbia with more than half respondents choosing the option of neither disagreeing or agreeing, which was taken as an indicator that experts have very little knowledge about this specific topic. Relatively high number of neutral responses was recorded for Statement 5 as well (43%), although it was noted that 43% respondents agreed that fingerprint recognition will be dominant in Serbian market, compared with only 13% of respondents who disagreed with this statement.

Descriptive statistics confirmed previous observations that neutral answer was the most commonly chosen one (based on mode and median values). It should be also noted that while average values are lower compared to previous scales, values of SD remain similar, meaning that participants in general agreed less with the statement. Additionally, ICC coefficient is not significant for this scale (p = .513) and Cronbach's Alpha has a negative value (-.035), meaning that this scale does not measure consistently implementation of biometrics payment in Serbia. Since this is an exploratory study, this kind of issue does not impose any restrictions on later data conclusions. However, it implies that in any potential further research special attention should be paid to scales that assess more specific characteristics of the researched topic.

Table 6: Descriptive Statistics for Questionnaire 1 Section 3

Statement	M	SD	Mode	Median	ICC
Statement 1	3.70	.93	3	4	
Statement 2	3.57	1.17	4	4	Cronbach's
Statement 3	2.96	.98	3	3	Alpha = -.035
Statement 4	2.91	.79	3	3	p = .513
Statement 5	3.35	.935	3	3	

The distribution of cumulative scores for Section 3 follows the normal distribution (skewness = -.478, kurtosis = -.422). Theoretical range starts at 0 as the lowest value and ends at 25 as the highest value. The observed range starts at 12 and ends at 20.

4.1.4. Prediction

In the final stage of the Questionnaire 1 respondents were asked about the amount of time needed for biometrics payment authentication to be implemented in Serbia. Based on the average value, this can be expected to happen in 4.42 years. The most commonly stated answer (Mode) was period of 4 years. It should be taken into account that standard deviation for this question is higher in comparison with all of the statements from previous sections (SD = 1.78). This is due to the fact that distribution of answers included a range of 8 years, with 2 years period being the shortest period quoted and 10 years being the longest period quoted by experts.

4.2. Phase Two

Statements regarding biometrics payment authentication and its cost-efficiency were only slightly differently perceived from the perspective of end-consumer and providers of financial payments. Experts showed a bit

positive attitude towards biometrics payment authentication cost efficiency from the perspective of payment providers (56.5%) in comparison with 52% for end consumers. Furthermore, number of experts who provided a neutral answer was higher for the statement regarding cost efficiency for end consumers (21.74% compared to 13.04%). In general, it can be said that experts believe that biometrics payment authentication is cost efficient both for end consumers and payment providers. In the context of high-growing and emerging markets, capabilities of technology providers is by majority of experts seen as one of the most significant challenges (61%), although 26% of respondents does not share that opinion.

Descriptive statistics confirmed that majority of experts agreed with the statements provided in the Questionnaire 2. It is observable that standard deviations are slightly higher in comparison with those obtained in the Questionnaire 1, implicating that there was a higher variability among answers. No ICC coefficient was computed as questions were grouped based on type and not topic.

Table 7: Questionnaire 2 Descriptive Statistics

Statement	M	SD	Mode	Median
Statement 1	3.43	1.20	4	4
Statement 2	3.26	1.05	4	4
Statement 3	3.43	1.24	4	4

The following question about challenges payment providers are facing showed that opinions on experts are divided when it comes to choosing the biggest challenge: 39.13% chose technological readiness for payment authentication using biometrics, 34.78% selected regulation regarding payment authentication using biometrics, while 26.09% chose users education in adopting and using payment authentication using biometrics. Apparently, there is no consensus about the biggest challenge in biometrics payment authentication.

The level of agreement among experts was higher regarding the obstacles for adopting payment authentication using biometrics. Among the two options, vast majority (78%) chose data privacy risk (personal information, stored biometric data), while significantly smaller portion (22%) selected sensitive payment data theft (account number, expiry date, CVC2, etc.). Relatively high level of agreement among experts was also observed for the question regarding the speed of adoption rate of biometrics payment authentication in high-growing and emerging markets. Majority of respondents (56.5%) predicted moderate adoption rate (3 to 4 years), while 26.09% predicted fast adoption rate (1 to 2 years) and 17% chose slow adoption rate as an option (5+ years). It should be taken into account that these values were in the context when biometrics becomes widely available, meaning that majority of payment providers offers this type of service and the penetration of mobile devices supporting all biometric authentication exceeds 50%).

While in the Questionnaire 1 obtained results were not always in accordance with existing literature, Questionnaire 2 is compatible with existing reports about popularity of different biometrics modalities. Results of the research showed that 91% of respondents believe that fingerprint recognition will be the dominant biometrics modality, while face recognition and iris recognition both received one vote each. Voice recognition was not selected by any of the participants.

5. CONCLUSION AND RECOMMENDATIONS

Based on information found in various reports, articles, researches and results from the primary research, a definite conclusion is that biometrics payment authentication will be widely used in the future. Studies on consumer preferences quoted in this paper show that the extent to which people are ready to accept this technological solution varies. While some authors claim that the there is low readiness in the market for such innovation due to security concerns, some reports offer contradictory results showing that consumers are more than willing to give a chance to biometrics payment authentication. What all sources confirm is that attitude towards biometrics in general heavily depends on the modality it is associated with. There is still a strong preference for fingerprint authentication over other modalities, especially face recognition and DNA matching. A very important factor that actually influences the adoption rates is the biometric modality. Results of the primary research show that experts see fingerprint recognition as future dominant biometric modality in Serbia as well. However, before implementing such technological solution, it is highly recommended to conduct a consumer research in order to determine which biometric modality is preferred in the Serbian market. There is a great probability that results from previous studies will be confirmed, however, it is necessary to discover which other modalities are acceptable to Serbian users. Both regulations and security issues influence the decision to implement multimodal biometric payment authentication.

The biggest problem for financial institutions, banks, and fintech companies in Serbia lies in the fact that Serbian market still hasn't achieved the necessary pre-requirements for popularization of biometrics technology - high presence of smartphones and biometric payment authentication as part of companies' service portfolio. This means that any marketing efforts and additional investments probably would not lead to the desired results. One of the approaches that can be taken is further popularization of mobile banking, which is already booming across the world. This may be a transitional phase for users in the Serbian market as it is a step further from traditional banking services and it would make it easier for them to accept biometric payment authentication as another way of further improving customer experience. Reports coming from developed markets showed that users appreciate simplifications of different processes related to mobile banking, especially when it comes to log-in process that was in the past quite redundant (log-in was required before completing any command) (Javelin, 2016). It is reasonable to assume that Serbian consumers will follow the similar path as well, where after remote control over card activation, PIN change, ordering a replacement card, turning card payment on or off, etc. biometric payment authentication represents a natural progression.

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ENTREPRENEURSHIP AND SME IN THE DIGITAL AGE 719

Bojana Jeremić, Jasmina Omerbegović-Bijelović

MODEL OF FUNCTIONING OF INTERNAL ENTREPRENEURSHIP INPUBLIC ENTERPRISES OF THE REPUBLIC OF SERBIA 710

Marina Jeremić, Jasmina Omerbegović-Bijelović

AN APPROACH FOR MANAGING SMEs BASED ON KPIs IN STARTING PHASE OF COMPANY'S LIFE CYCLE 720

Nikola Atanasov, Predrag Mirković, Vladimir Marinković

PLANNING OF THE ACTIVITIES OF THE FAMILY FIRM SUCCESSOR PREPARING IN SERBIA 731

Mirjana Jeremić, Zoran Rakićević

RESOURCE MANAGEMENT QUALITY OF SME IN THE FIELD OF FASHION AND DECORATIVE FABRICS RETAIL 743

Bojan Živadinović, Nikola Atanasov

PROBLEMS WITH RESOURCES MANAGEMENT IN CATERER-SME IN THE DIGITAL AGE 751

Ivana Zdravković, Vesna Cakeljić, Jelena Krstić

EDUCATION PERFORMANCE INDICATORS FOR ENTREPRENEURSHIP IN THE SECONDARY SCHOOLS OF SERBIA AND IN THE WORLD 762

Nemanja Backović, Bojan Ilić, Vesna Milićević

BUSINESS ASPECTS OF PUBLIC-PRIVATE PARTNERSHIP IN DIGITAL ECONOMY ENVIRONMENT 771

Marko Miletić

INTRODUCTION OF THE NEW SERVICE ON SERBIAN TELECOMMUNICATION MARKET: VIRTUAL PHONE NUMBER 778

MODEL OF FUNCTIONING OF INTERNAL ENTREPRENEURSHIP IN PUBLIC ENTERPRISES OF THE REPUBLIC OF SERBIA

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***Abstract**: This work presents the study of internal entrepreneurship (IE) in public enterprises (PE,) in Serbia. The idea of an author is to check the existence and, if necessary, generating and presentation of the model (objectives and limitations) for the functioning/operation/IE manifestation in PE Republic of Serbia. It is expected to show whether Serbia has been operational in IE PE, and that, as in the developed world, and PE in the Republic of Serbia, which applied IE, be more competitive, successful and socially-useful than PE, which do not apply this concept. This topic provides a motive to provide guidance, as well as the necessary support, to launch IE in the PE of Republic of Serbia. The research in this paper, based on a survey is conducted in PE that operates in our country, founded by the Republic of Serbia or local government. As the basic research tool was the questionnaire about defining models of the functioning of IE in PE. This work shows the IE stakeholders in PE, models of this concept, the way the research was conducted and what are its results. Practical aspects of the research refer to the usefulness of the data, information and ideas on IE models in PE, with the hope that PE Serbia will show interest to learn more about them and use it to improve their own management, and business.*

***Keywords:** Internal Entrepreneurship (IE), Public enterprises (PE), Stakeholders in PE, Operation of IE in PE, Model of IE in PE Serbia*

1. INTRODUCTION

The concept of internal entrepreneurship (hereinafter: IE) is seen as a process of discovery and development of opportunities to create value - through innovation and to take advantage of an opportunity, regardless of the resources (human or material), or the location of Entrepreneurs (Churchill, 1992). Internal or corporate entrepreneurship is essential for survival, profitability and growth of any company. This is due to the fact that IE stimulates creativity and innovation, and to encourage risk-taking organization - through business operations that can strengthen the company position in existing markets and entry into new profitable fields of operations (Zahra et al., 2009). IE is of great importance for the social, the economic development of enterprises in the Republic of Serbia (hereinafter: RS), because it allows the inflow of new goods and technologies to the market, opening new markets, introduction of new processes and technologies. It enhances economic and financial indicators of enterprises – by more efficient use of resources and the application of appropriate motivation system for its employees (Istocescu, 2006). Facilitates the allocation of resources from less productive to more productive activities, filling capacities that are missing and supporting structural changes in the economy and the economy. The importance is also reflected in terms of innovation, because the internal entrepreneurs bring new ideas, create new products and create new markets. It is clear that without the entrepreneurial innovation and new ideas, the world would not be as it is today, not culturally not in terms of technology.

The term "public sector" is widely used, both in the world and in our country, primarily for labeling of all activities which are opposite to business, including: the civil service/administration (eg. justice), institutions/establishments (education, health) (Zekić, 2011) and public enterprises. Under the public sector include the various forms of organization of individual businesses, through which the state or its local authorities, ensure the realization of certain interests in certain areas of the economy. The public sector includes the part of the national economy for which the state has a certain responsibility (ibidem). The public sector, as well as the institutions and organizations that make it operates on the basis of the constitution, laws, regulations, internal decisions, and partly based on economic principles. The public sector consists of two subsystems: the executive power sector- which has a decisive role bureaucracy under direct political control, as well as Public Enterprises (PE) and commercial associations owned by the state or local governments. According to the Law on Public Enterprises RS, PE is a company that carries out activities of general interest, founded by the Republic, autonomous province or local self-government (Law on Public Enterprises and Activities of general interest, Article 1, no. 116/2013). The RS has a total of 727 public and public utility companies. Public enterprises founded by the Republic of Serbia has a total of 36. Public enterprises founded by local governments or autonomous province has 691. These enterprises are divided by districts represented in Serbia, and in the cities that are located in a given district. Public enterprises are

established in the field of infrastructure, public utilities, management of goods of common interest, as well as in areas that are of strategic or special importance for the Republic. Business of PE is crucial for the Serbian economy, because these companies at the national, provincial and local levels make up a significant part of the economy- by its number, the number of employees and money at their disposal. Public companies in the RS increasingly gaining in importance, and citizens, with right, expect that those who have received from the state a monopoly position in the field of the use of funds, resources and markets, and their results, justify the same.

Internal Entrepreneurship (IE) is necessary for the transformation of existing enterprises into viable market units, which are able to compete with its competitors. The development of IE could lead to the development of a systematic exploration of new opportunities for production/service delivery, innovation in technology, marketing and similar. These studies and the organizational schemes that perform them should be led by professionals at a given activity and those employed in PE (Prokopenko, Pavlin, 1991). IE has become more important than before. The reason is that the world today is changing much faster - under the influence of new technologies, and the growing competition makes the work harder- because they must constantly innovate in the market.

Based on the research of IE in all three categories of organizational systems of the public sector (public enterprise, institution/organization and administration), it was determined that the greatest propensity to IE showed respondents from public institutions (education, health, etc.), followed by respondents from the public administration, and the lowest propensity to IE was found in respondents from PE (Balaž, 2015). Unlike private sector enterprises, entrepreneurship and innovation as means to improve organizational performance, do not occur naturally in PE. Public enterprises are under the direct influence of the political philosophy of those political forces that are in power, where it is very difficult to protect workers in PE from undue political influence. In addition to political influence (which are an obstacle to the development of entrepreneurship in PE and the whole public sector), significant obstacles arise in terms of organizational culture and management. Operation of PE is regulated by the system of civil service, which is usually complex, formalized and risk-averse. PE is characterized by certain specifics - which represent the limits of efficiency and barriers to the development of these enterprises and make development and IE practice harder. These obstacles relate to: Government control of public enterprises; Budgetary constraints - PE financed from the state budget; Legislative and regulatory constraints; Political influences; Inadequate resources; Bureaucratic organizational structure; Focus on how the realization of profit, and non-profit objectives (Sadler, 2000). PE should work on education and training of staff - from areas: entrepreneurship, and the bureaucratic decision making (which is typical for PE), should be kept to a minimum. Stimulating ideas and active participation should be encouraged at all hierarchical levels; teamwork and cooperation must become part of the way of doing business, and the old strategy of continuity and predictability must be replaced by a strategy of continuous change / improve the management of the business.

2. STAKEHOLDERS INTERNAL ENTREPRENEURSHIP IN PUBLIC ENTERPRISES

Internal/corporate enterprise (IE) can be regarded as a phenomenon which takes place at the level of the organization or organization parts, but also on the micro level, comprising entrepreneurial projects, and each entrepreneurship individually. To make the organization fully effective, every part must make a contribution in fostering entrepreneurial initiatives. Each organizational function has a role in encouraging corporate entrepreneurship (Goffin & Mitchell, 2010).

Stakeholders in the modern enterprise consist of all the stakeholders that are, in any way, affiliated with and that have a certain interest - in relation to its existence and operation. Company's stakeholders can be classified into two main groups: internal and external stakeholders. External stakeholders are external partners with whom the company does business in various ways (customers, suppliers, banks and others), then state authorities, business associations, media and other entities, more or less direct way, expressing the interests of the community.

Since big obstacles IE in PE represents bureaucratic organization, inadequate funding, political opposition, legislative and regulatory constraints, this is where the state has an important role (to ensure macroeconomic and legal framework for the functioning of IE in these companies). Hard budget constraints, the introduction of positive real interest rates and a balanced exchange rate should ensure the efficient functioning of the market, which is a necessary condition for entrepreneurial development.

Cooperation with companies of the private sector is one of the important factors in the functioning of the IE in PE. Networking is a concept with which PE uses ability of certain entrepreneurial experts and establishes cooperation - as with other sectors within their enterprises, as well as with the private sector and their companies (in order to be able to take the ideas that they can use in their practice). When it comes to PE, as

an example of business networking and encouraging IE, the most common is the concept of public-private partnerships. This concept works attractive to all decision makers in PE, as it enables the implementation of infrastructure projects and troubleshooting of individual services. Business networking is useful not only for PE indirectly, due to increased entrepreneurial activity, but also because it helps to reduce costs and increase the flexibility of the workforce within the company (Bailey, 1994). Also, it allows a PE to be up to date with current issues and solutions that are offered, as well as developments in the field of science (therefore the industry) in the future period. Significant external knowledge source as the key input of entrepreneurial activities and the development of core competence are universities and research centers. Banks and media are also important stakeholders of PE.

Employees of PE are internal stakeholders without which the IE could not work in these companies. Employees should be motivated to be entrepreneurial. Training employees for IE must create the conditions and environment that will enable the application of new knowledge to work and change. Special attention must be paid to the implementation of new management approaches, both conceptually and in terms of organization. They should provide and officially regulate the time required for the IE. It should also regulate and enforce certain events, fairs IE, in which the employees of PE are able to present their ideas, results, share experiences and compete. Investments in human resources are a potential source of competitive advantage for increasing the overall effectiveness of the PE, which leads to improving the performance of these institutions.

As internal stakeholders, owners and management of PE are one of the most important factors. Managers need to encourage the entrepreneurial culture that supports the changes/improvements/innovations that accepts mistakes, which enables a controlled experiment with potentially-efficient new processes/resources and to create structures that help organizational units to learn from failure, when and if they occur. Support of the top-management is essential - so that employees get the confidence that the IE is taken seriously, or that PE will really stand behind the development and commercialization of good ideas (Hisrich & Kearney, 2012).

The appearance of new competitors and new strategies, changes in processes, products and designs and similar, represent an opportunity for managers. Internally-entrepreneurial managers must: be focused on results/efficiency, rather than on activities, to observe the employees as responsible people who want to achieve results, to be ambitious and competitive, to develop the ability of conflict resolution;, to realize that the organization is a system of interlinked subsystems and that together form a whole and to be motivated to innovate and change - not only for ourselves, but for all employees (Prokopenko & Pavlin, 1991).

The task of management is to stimulate inter-functional cooperation and teamwork, because a response of the organization slows down (especially when dealing with large systems) because of the limited perspective of individual functional areas, which makes difficult for the execution of tasks, coordinate with each other and contributes to conflicts between functional managers (Babic et al., 2008). In order for an organization was fully effective in IE, every part must make a contribution in fostering entrepreneurial initiatives. New ideas should not come only from the organizational unit responsible for research and development, but also the rest of the organization should (could) show initiative and agility. Each organizational function has a role in encouraging corporate entrepreneurship (Goffin & Mitchell, 2010):
a) *Research and development* - is, for many managers, the source of all new ideas. The truth is that most initiative comes from there, but companies that rely too heavily on the organizational part fall into the trap of manufacture sophisticated products that the market doesn't need. Management of entrepreneurial initiatives is much more than establishing a research and development tool that produces new technological solutions. It is advisable to service companies, instead of this function, establish teams to develop innovative ideas.
b) *Marketing* - plays a key role in encouraging corporate entrepreneurship. Its task is to identify the needs of customers, using creative approaches to market research. It has to be involved in the innovation processes, especially in stage of initiating and defining new product/service, when deciding on price, market position and strategy of launching the market. Good marketing is a factor that recognizes/supports the idea of a new enterprise and contributes to its transformation into a successful product.
c) *Production/service provision* - even though, as part of the operating functions, has one of the most important roles when it comes to entrepreneurial initiatives, its managers often do not understand. They are too focused on maximizing the efficiency of current operations, thereby limiting the capacity to make long-term competitive advantages. It is much easier to copy the new products offered by competitors, than the entrepreneurial processes. This fact is often overlooked especially in service organizations.
d) *Supply and distribution* - as part of the operating functions, constantly in touch with customers and suppliers, which are an inexhaustible source of ideas and an integral part of the (sub) systems for improving processes and products, both in terms of inputs and in terms of the final performance.

e) *Finance and Accounting* - often seen as a function that has no role in fostering IE, however, provides important support in evaluating and calculating the potential yield of entrepreneurial projects. Sometimes just financial managers have the final say on which projects offer the optimal combination of lower risk and higher yield (and are compatible with the available resources and capacities).
f) *Human Resource Management* - provides the activities of recruitment, employment, development and motivation of staff, who are key players in building entrepreneurial organizations. A creative atmosphere characterized by smaller teams is easily lost when the organization begins to grow, so that the personnel function must act proactively and systematically in building an entrepreneurial organizational culture.

3. THE CURRENT MODELS OF INTERNAL ENTREPRENEURSHIP

Models are abstractions that reflect key elements of a complex problem or structure by eliminating less important details and, thus, make the problem much easier to understand. They represent a subjective, abstract (simplified) image of the system, describing the elements of that system and its connection. Models are used to describe business processes, understand the current state of business and model the new processes.

3.1 Models of internal entrepreneurship in the world

Lippitz and Wolcott (2010), in their research model IE indicate that there is no single model that can be successfully applied in every company. There are two dimensions that are under the direct control of management, which consistently make a difference in how companies approach the IE. The first dimension makes the ownership of the new enterprise or the facts of who, within an organization, claims ownership rights to the newly created product/service as a result of internal/corporate entrepreneurship. The second dimension makes the distribution of resources, and whether there is special separate funding for activities of IE or resources are obtained by need. By combining these dimensions, the matrix forms four dominant models: Opportunistic, Enabling, Advocacy and Manufacturer. Each model represents a special way to strengthen IE activity within a company (Wolcott & Lippitz, 2010, p. 74-82):
a) *Opportunistic model*, according to which the IE is based on the exploits and happy circumstances of individuals often referred to as "project champions". These are people who fight against all obstacles (including those coming from the company itself), creating new jobs. In this model, the ownership of the new venture is not pre-determined, within the company there are no resources specially designed for such ventures.
b) *Allowing model,* according to which the IE is no predetermined ownership of the new venture, but there are resources that are specifically designed to create new products or services. The main assumption of the model is that employees in companies will be willing to develop new concepts if they are given adequate support. Well placed, this model is suitable because top management has an opportunity to introduce innovative young employees, thereby developing young leaders. In this model it is important to note that not only the resource allocation is essential, but also the development of employees and the commitment of top management.
c) *Advocacy model,* under which the company provides modest budgets for the main group activities. Organizations that implement this model sponsor and support innovation, coordinating IE associated with the business units. However, ownership of the new venture is not strictly defined.
d) *Manufacturer's model*, according to which the aim is to encourage entrepreneurship hidden within the organization. In this model there is a clearly established ownership of the new venture, which is almost always in the hands of the parent company. This is the most structured and formalized model IE. The company applying this model aims to protect development projects from wasting resource spending and to encourage co-operation between business units, build a business, and create an open way for managers to follow career development opportunities outside their parent business units.

3.2 Models of internal entrepreneurship in Serbia

Despite the need and necessity of introduction and development of IE in all organizational systems of the public sector, the current state of the practice of public sector in RS indicates unsatisfactory low level of development of IE. Based on research (Balaž, 2015) "Limited entrepreneurship in the organizational system of the public sector of the Republic of Serbia," it was determined that the IE in the public sector of the RS is somewhat below the national average. Public companies are, in fact, the least entrepreneurial. IE is under-represented, or not at all, in this kind of enterprises in PE. There are no standardized procedures and guidelines that would allow: a) introduction, b) the operation and/or c) the development of this concept. For this reason, the definition of a model implementation (for all three phases mentioned) IE in PE in RS should serve as support to public enterprises, i.e. to guide them on how to ensure the realization of this concept (which are all steps and elements that should, on this occasion, to meet and to raise awareness about the importance of IE). All mentioned phases available in master thesis of Jeremić from 2016). In this work, as noted, only a model of operation IE will be shown (step b).

In setting implementation model (introduction, operation and/or development) IE in PE, it is necessary to define the most important goals and IE restrictions in PE Republic of Serbia. After the introduction of IE, it is necessary to ensure that a given model works in PE, to achieve the objectives and eliminate the key limitations, but that allows further development of the concept of IE in PE. As such, the model helps PEs to be more competitive, successful and socially useful. Based on the state of practice in the model include the requirements identified and directed to improvement of activities and elimination of defects. Research has led to identifying the critical points, or restrictions that hinder the development of model IE (Jeremić, 2016).

The key limitations are: a) lack of recognition of potential application of IE in PEs; b) The lack of incentive for/to the innovation; c) The legislative and regulatory constraints; d) inadequate dedication of top management of PE-s; e) The fear of failure and a general resistance to change; f) Negligence of state/local administration, as owner of PEs; g) Too hierarchical levels; h) Lack of ideas and/or anything else.

A necessary precondition for the functioning of the IE is management support/management PE (or state, if she is the owner). It is hard to imagine that the company can successfully develop new ideas, and at the same time there is no support from the top of the hierarchy. However, no less important is support of lower-level managers, who are in direct contact with the internal entrepreneurs and, in this sense, can act stimulating and restrictive on them.

The study (Jeremić, 2016, pp. 65-66) defines the steps of introducing IE in PE, thus creating the conditions for the functioning of the IE in the USA:

- Defining internal documents that are approved, encouraged and supported by IE in PE,
- Identifying and allocating resources necessary for starting entrepreneurial ventures (provided time, equipment, technology, space, knowledge…)
- Definition of the budget that is dedicated (and available) for generating (and checking) entrepreneurial ideas and to launch enterprise
- Defined system of rewarding and encouraging staff (dealing with IE),
- Informing and educating of employees about the concept of IE,
- Creating organizational structure, based on which the IE is incorporated into the plans of enterprises
- Designing organizational culture based on entrepreneurial initiative, which projects a unique message to employees - to share common values and behavioral style,
- Determination of one and/or more than one person (team of people) who will be the mentor (s)/facilitator (s) who supervises/monitors the progress of enterprise and provides (it) necessary advice, contacts, help,
- Organizing trade fairs of entrepreneurial ideas, events and/or competitions for the selection and presentation of entrepreneurial ideas

For IE to function in PE, they need to have an entrepreneurial orientation. Entrepreneurial orientation has five dimensions, which shape the style of decision-making and practice of managers. These five dimensions are: autonomy, innovation, proactive, competitive aggression and risk taking. **Autonomy** implies independent action when implementing new ventures. The teams working on the identification and implementation of new ventures have a certain degree of freedom of action, necessary time to improve ideas at its disposal but also the greater powers for the further implementation of selected ideas. IE occurs in those organizations which encourage **innovation and creativity** of its employees. **Proactivity** refers to activities aimed at finding new opportunities. Those organizations that operate proactively look to the future and try to always go one step ahead of its competitors, closely following market trends, changes in consumer needs, as well as changes in the environment. **Competitive aggressiveness** refers to the steps that a company takes to overcome competitors. **Taking risks** relates to the company's willingness to embark on a new venture, even if the outcome is not completely certain. To IE function in PE, they should maintain and apply the above five elements (Suarez, Lanzolla, 2005). Also, the IE should become an integral part of PE, not just sporadic activity (Dess et al., 2007).

Public enterprises should monitor changes in the environment, competitive behavior (if they have in their business activities), monitor technological changes, etc. in order to adequately adjust their business or IE processes. It is also necessary to monitor the behavior of citizens, monitor their needs and, on the basis of all analyzes, work on the development of the implemented IE model. Permanent employee training on new changes and innovations on the market is one of the ways that will contribute to the continuous development of the existing IE system. PEs should preserve the current status of management solutions for IEs, in order to ensure the competitiveness and satisfaction of citizens as a user of PE's products/services.

4. RESEARCH OF CHARACTERISTICS OF MODEL OF INTERNAL ENTREPRENEURSHIP IN PUBLIC ENTERPRISES OF THE REPUBLIC OF SERBIA

Research problem that has inspired this work (as part of the master-work of first author) refers to insufficient (insufficiently-evident) manifestation/expression of IE in PE of the Republic of Serbia. Empirical research IE in PE was conducted with the initial idea to identify the perceptions and attitudes of employees on the implementation in phases: f1) the introduction, f2) functioning and f3) development IE in PE.

4.1 Null hypothesis and its structure

To solve the problem of rarely perceived function/presence of IE in the PE, the null hypothesis has been defined:

H(0): It is possible to make a model of the operation of the IE in PE. It is decomposed into four individual hypotheses: H(1), H(2), H(3) and H(4).

H(1): The IE performance model in PE shows that there should be a legal regulation of the IE application in PE.

H(2): The IE performance model in the PE shows that there should be the provision of time and other resources needed to express IE in PE..

H(3): Model of IE and PE-matter shows that there should be opportunities for presentation of research results in the field of IE in PE.

H(4): The IE performance model in PE shows that there should be the choice and application of selected, promising IE results in PE.

4.2 Research Methodology

The research operation of IE in PE in RS is based on the use of different methods. The main method, used for the foundation of a research problem, is the review and analysis of the literature (Table Research). It was then performed the research in the field (Field Research). The method of testing employees in the PS (survey) for data collection was used; a questionnaire was created on the model of functioning of the IE in the PE of Serbia, in order to collect data on the attitudes and knowledge of the employees in the PE on the functioning of IE in their organizations. The questionnaire contains three groups of data: the respondent, the company/organization in which it works, and the attitudes/knowledge of the respondents. Research questions were followed by variants of the answers - to explain the respondents in order to get their opinions, attitudes, statements (measured, mostly, according to the Likert scale). Field research (using the questionnaire) was carried out in September and October 2016 in PEs on the territory of RS. Statistical data processing and analysis was used by the SPSS (Statistical Package for Social Sciences), or statistical methods implemented in this software, which enable fast and accurate results to be obtained.

The sample populations, animated for research, included 60 subjects employed in PEs of the RS of which is employed in PE established by the state 37, and the other (23 subjects) were employed in companies founded by the local self. Geographically, respondents (at the time of the research) located in cities/municipalities: Belgrade, Ub, Smederevo, Lazarevac, Kraljevo, Stara Pazova,...). When selecting a sample, it was taken into account that, in the sample, equal representation of different groups of employees in PEs was ensured.

Scientific and social justification for research is to use the results to be realized real entrepreneurial potential of PEs in RS, respectively, to (one) could provide assistance and support to these companies. Recommendations (based on the results of the research) can benefit to the country, management and employees of PEs, as well as the following researchers of this and related topics. Defining IE model contributes to the achievement of competitive advantage of PEs, the reduction of public expenditures and losses, more motivated employees, increasing revenues of PEs, greater satisfaction of the citizens who use the services of PEs and the overall economic recovery of the Republic of Serbia.

4.3 Field research results

This chapter presents the results of research models of functioning IE in PEs of Serbia or displayed responses (analyzed) to research questions from the Questionnaire. All research questions are associated with individual hypotheses and examine the possibility of making this model.

In the process of checking the authenticity of the individual hypotheses **H(1)**: "Model of functioning IE in PEs shows that there should be legal regulation of application of IE", set the research questions Rq 25-28. Results of respondents' answers (mostly reviews) are shown in Tables 1-4.

Respondents' response to the research question (hereinafter: Rq) No. 25 are assessments of the truthfulness of the statement "The job agreement or other legal documents of the PE in which you are working is provided that you can use Enterprise Resources (space, technology, tool,...) at the time when you want, even outside working hours. ", are given in Tab. 1. Responses of respondents to Rq 26 are estimates of the truth of the statement "In the public company in which you work, if you want to be involved in entrepreneurial ideas and ventures, you can work in different periods" and are given in Tab. 2

Table 1: Distribution of answers on the use of resources PE

Assessment of the availability (for IE) of the PE resource		Percent
Rq25	1.0	26.7
	2.0	20.0
	3.0	41.7
	4.0	5.0
	5.0	1.7
	Total	95.0
Missing		5.0
Total		100.0

Table 2: Distribution of answers about provision of time for dealing with IE-TV

Provide time to handle IE		Percent
Rq26	No answer	3.3
	Only after regular working hours	33.3
	Only within working hours	21.7
	Within and outside working hours	41.7
	Total	100.0

Answers of respondents to Rq 27-28 given in Tab. 3-4. On Rq27 48, 3% people answered they do not have time provided for dealing with IE, instead of 41,7% who have 41,7%. On Rq28, 8,,3% answered that they do not have mentor for help with IE.

Table 3: Distribution of answers on the available share of time to deal with the IE

Allowed portion of time for dealing with IE		Percent
Rq27	0% of working time (WT)	48.3
	To 30% WT	41.7
	30 – 50% WT	6.7
	Over 70% WT	1.7
	Total	100.0

Table 4: Distribution of answers about the existence of a mentor/helper

Existence of mentor for help in dealing with IE		Percent
Rq28	Missing	1.7
	Yes	15.0
	No	83.3
	Total	100.0

In the process of checking the authenticity of the individual hypotheses **H(2)**: Model of IE in PEs functioning shows that there should be the provision of time and other resources required for the expression of IE in PEs", set the research questions Rq 29-33. Results on the answers of respondents (estimate levels of agreement with the given statements) are shown in Table 5. There are the answers to research questions:

a) Rq 29 ("PE where you work provides trainings / seminars relating to business entrepreneurship and encouraging IE, to help employees acquire the necessary knowledge and skills for the implementation of this concept. "),
b) Rq 30 (" employees who want to improve in the field of IE know to whom they can turn for the necessary consultation and assistance ".)
c) Rq 31 ("In PE you work, employees who (need to) find new business opportunities is provided time to work.")
d) Rq 32 (" In the PC in which you work, employees who (should) find new business opportunities, are provided the resources necessary for entrepreneurial activities (possibility to use offices, equipment, tools, technology whose owner is the company). "), and
e) Rq 33 (" in the PE, in which you work, employees who (should) find new business opportunities and entrepreneurial ideas, is provided the access to databases (based of which they can get the information needed to undertake entrepreneurial ventures).

Table 5: Breakdown of responses to the research questions Rq 29 – Rq 33

Research questions	1	2	3	4	5	Missing	Total
Rq 29 - Training of staff of IE in PE	40.0	23.3	20.0	11.7	5.0		100.0
Rq 30 - Familiarity employees about the existence of support for the necessary assistance and consultation	23.3	33.3	33.3	8.3	1.7		100.0
Rq31 - provision with the time needed to deal with IE-TV	30.0	20.0	38.3	6.7	3.3	1.7	100.0
Rq 32 - Providing the necessary resources	25.0	28.3	33.3	11.7	1.7		100.0
Rq 33 - Providing access to databases	20.0	30.0	40.0	8.3	1.7		100.0

In the process of checking the authenticity of the individual hypotheses **H(3)**: "Model of IE in PEs functioning shows that there should be opportunities for the presentation of research results in the field of IE in PEs", set the research questions Rq 34-37. Results on the answers of respondents (estimate levels of agreement with the given statements) are presented in Table 6. There are the answers to research questions:

a) Rq 34 ("in PE, in which you work are organized fairs of entrepreneurial ideas, events and / or competitions for presentation of entrepreneurial ideas, to which employees can present their ideas and research results in the field of IE. "),
b) Rq 35 (" Management PE in which you work attends events / fairs / exhibitions and similar. IE and uses the opportunity to support their employees and encourage them to be more entrepreneurial.")
c) Rq 36 (" If this form of support IE does not exist in your company, do you know whether other PE in our country support the presenting of research results in the field of IE in this way. "),
d) Rq 37 ("How employees of PE in which you work in are motivated to deal with IE?"). On this question employees rounded up the offered answers. 33% respondents didn't answer, 16,67% said they are not motivated to IE, 6,67% answer was "I do not know", 1,67% give their own answer and 41,67% rounded op more offered answers where the answers are arranged in a normal distribution, with an equal frequency of representation of all responses.

Table 6: Composition of the research questions Rq 34 –Rq 37

Research questions	1	2	3	4	5	Missing	Total
Rq 34 - The existence of events to present the results of IP	31.7	35.0	20.0	8.3	3.3	1.7	100.0
Rq 35 - The presence of IE management events	28.3	21.7	33.3	11.7	1.7	3.3	100.0
Rq 36 - Presentation of results in practice in other PE manifestations	28.3	20.0	36.7	13.3	1.7		100.0
Rq 37 - Motivating employees to IE	Open-ended question						100.0

In the process of checking the authenticity of the individual hypotheses **H(4**): "Model of IE in PEs functioning, shows that there should be a choice and application of selected promising results IE in PEs.", set the research questions Rq 38-39.

Table 7: Distribution of answers about the existence of a case of IE

Existence case IE		Percent
	1.0	30.0
	2.0	15.0
Rq38	3.0	33.3
	4.0	18.3
	5.0	1.7
	Total	98.3
Missing	System	1.7
Total		100.0

Table 8: Distribution of answers on the number of entrepreneurial ventures

Existence case IE		Percent
	a) None	28.3
	b) 1 to 10	20.0
Rq39	d) 10 to 100	5.0
	e) More than 100	3.3
	f) Do not know	43.3
Total		100.0

4.4 Discussion of research results

Checking the truthfulness of general hypothesis H(0): "It is possible to make a model of the functioning of the internal entrepreneurship in PEs" is carried out based on checking the authenticity of four single hypothesis: H(1), H(2), H(3) and H(4). Thereby, for each of them, is defined at least one research question. Thus, the authenticity of individual hypothesis H(1) - H(4) checks through the (already presented) research questions.

To check the accuracy of the individual hypotheses **H(1)**: "Model of the IE in PEs functioning shows that there should be a legal regulation of IE application", were harvested and analyzed the research questions Rq 25-28. Based on the analysis of said response, it can be concluded that the employees of PEs of RS is allowed to work on entrepreneurial ideas and ventures in different periods, but they are not (sufficiently) provided the percentage of time for dealing with IE, and that they were not provided with a mentor/helper which monitors the progress of enterprise and which provides the necessary advice, contacts, help. From this it can be concluded that a single hypothesis **H(1)** is not true there is no evidence of its truthfulness.

To check the veracity of individual hypotheses **H(2)**: "Model of IE in PEs functioning shows that there should be the provision of time and other resources required for the expression of IE in PEs", set the research questions Rq 29-33 in the Questionnaire. On all five questions correspond to tick the number that represents the evaluation / level of agreement with a given statement. Based on the analysis of the mentioned answers, it can be concluded that employees of PEs are not provided trainings / seminars related to the entrepreneurial business and encourage IE-ness that employees who want to improve in the field of IE do not know to whom they can turn for the necessary consultations and assistance to them is not provided time to work on entrepreneurial ventures, nor the resources necessary for entrepreneurial activities, nor access to the databases. Based on this, it follows that a single hypothesis **H(2)** is not true, i.e. there is no evidence of its truthfulness.

To check the veracity of individual hypotheses **H(3)**: "Model of IE in PEs functioning, shows that there should be opportunities for the presentation of research results in the field of IE", set the research questions Rq 34-37. Based on the answers to these questions it can be concluded that in PEs of Serbia do not organize events and/or competitions for the presentation of entrepreneurial ideas, and nor the management nor leadership do not attend these events. Employees in PEs cannot say for sure whether the other PEs in our country is such practice of support to IE. No employees are (sufficiently) motivated to deal with IE. From this it follows that a single hypothesis **H(3)** is not true, i.e. there is no evidence of its truthfulness.

To check the veracity of individual hypotheses **H(4)**: "Model of IE in PEs functioning shows that there should be a choice and application of selected promising results IE in Pes", set the research questions Rq 38-39. Based on the above-mentioned issues, it can be concluded that in PEs is not expressed (not enough) application of selected promising results IE, i.e. that in practice poorly or that are not realized entrepreneurial ventures based on the results achieved by using IE-ness. From this it follows that a single hypothesis **H(4)** is not true, i.e. there is no evidence of its truthfulness.

Analysis of answers to all the questions in the research, it follows that the four individual hypothesis H(1), H(2), H(3) and H(4) have not been proven, that is, in PEs is not regulated use of IE there is no support post of a IE in terms of providing time and other resources required for the expression of IE in PEs, as well as an opportunity for the presentation of research results in the field of IE-ness. By analyzing the results, it was also found that, in the practice of PE, entrepreneurial undertakings based on the results achieved by applying the IE are not sufficiently implemented. On the basis of this, it can be concluded that the general hypothesis **H(0):** "It is possible to create a model for the functioning of IEs in PEs" has not been proven.

5. CONCLUSION

Internal Entrepreneurship (IE) is, today, necessary to transform the existing public enterprise (PE) in viable market units, which are able to compete with its competitors. Defining the model of functioning of IE would contribute to the PE in the Republic of Serbia become more competitive, socially useful and become market-oriented. This model should serve as a support and guidance to PEs how to enable the introduction, operation and development of this concept. Based on the research presented in this paper, one can recognize the presence of a lack of entrepreneurial spirit in the PEs in Serbia, despite the existence of the potential of IE in PEs in the Republic of Serbia. This was confirmed by the respondents - participants in the here-described study, with their responses they showed that, with the possibility of using work time to deal with IE, as well as with the use of offices, equipment, tools, and with the provision of a mentor / helper (to whom they could turn for necessary assistance) and with defined reward system and encourage employees, IE could become an integral part of the operations of public enterprises of the Republic of Serbia.

Results of here-presented research, first of all, can and are designed to the state, as owner of public enterprises that, through the support of IE in PEs ensure: increasing effectiveness and efficiency of these enterprises, increase public revenues, reduction of losses of these companies, increase employee satisfaction, as and citizens - users of services/products of public enterprises. They can be of use to the management/leadership of PEs in an effort to increase the performance (to operate positively and to improve the image you have of citizens of the Republic of Serbia). To students and scientists who are engaged in research in the field of entrepreneurship it would help to this form of his work extend to public companies and, finally, readers could use this work as a good source of information for further thinking on this topic.

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AN APPROACH FOR MANAGING SMEs BASED ON KPIs IN STARTING PHASE OF COMPANY'S LIFE CYCLE

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Abstract: *Object of research in this paper is to evaluate possibility of creating key performance indicators for managing small and medium-sized companies in initial phases of company life cycle. Research is based on the literature analysis and field research in small and medium enterprises. The poll is conducted on small and medium-sized companies in Republic of Serbia. The main research tool used in the poll is the questionary of choice of the right key indicators of performance for managing - by their initial phases of life cycle. The results of the research have shown that it is possible to create key indicators of performances for managing small and medium-sized companies, by the initial phases of their life cycle and those are the main things that are presented in this paper.*

Keywords*: Key Performance Indicator, Small and medium-sized enterprises, Enterprise life cycle, Initial phase of Enterprise life cycle.*

1. INTRODUCTION

SMEs are representing legal entities that operating within their business environment, within developed business mission and vision, with a goal to deliver results based on the purpose of their existence. According to the research (Ministry of Economy of Serbia, 2014, p. 77), SMEs are representing 29% of total number of companies (including legal entities and enterpreneurs) operating in the territory of the Republic of Serbia. Considering only business enterprises as legal entities, excluding entrepreneurs, this number of SMEs rises up to 99% (more precisely: 99.47%), which points to the great importance these legal entities - both for the state itself and for its inhabitants.

In addition to basic, legal, characteristics that differentiate SMEs from other enterprises, SMEs have certain characteristics. According to (Sajfert, Djordjevic, Bedjic, 2006, p. 163), the most important characteristics of SMEs are: (1) Small size, which varies based on the industry; (2) Centralization of management (the owner is also the manager); (3) Low level of specialization, due to concetration of functions at the level of management and decision making activities; (4) Intuitive and low level of job management strategy formalization, based on the fact that in SMEs, the owner (manager) is involved in operative daily routine together with employees (administration, shop flor workers) and able to adjust strategies and operations symulateously; (5) Simple and flexible internal communication and information sharing, based on everyday face to face dialogue (in contrast to communication and information flows in large enterprises, based on written and formalized documents); and (6) A simple system of external information sharing and communication, based on more frequent contact with suppliers and customers, which ensure the mutual understading of needs, desires and opportunities.

The topic of this paper is the research on the possibility to determining the quality of the management in small and medium enterprises (SMEs) that are in the initial phases of the company life cycle. This means that, firstly, it is necessary to identify the possibilities for creating Key Performance Indicators (KPIs) relevant for business environment and circumstancess in certain phase of company life cycle. The idea is to present the basic characteristics of SMEs and the initial phase ("Courtship") of its life cycle and, based on these data, to create a set of KPIs relevant to managing SMEs at that stage.

Therefore, set of performance indicators should be evaluated in order to be able to sasify the needs of "Courtship" as the initial phase of the SME's life cycle. Based on practical experience and studying theoretical knowledge (taking into account already conducted research) and considering characteristics of certain phase of company life cycle, together with identfied problem (pathological and normal) occurring at a particular stage, it is necessary to examine the possibility of creating universal set of KPIs that will be adequate to manage SMEs in the initial phases of the life cycle (and even in the here-observed phase of "Courtship").

2. BUSINESS LIFE CYCLES IN SMEs

The company is born, it develops and grows, become old, and eventually dies, just like a life, The difference between the life cycle of any living being and company is that the company does not necessarily have to die. Between life and death there is sometimes a thin line, only the one who manages himself, the company, in the right way, ensure survival and / or rejuvenation. The life cycle represents the life flow of the entities that are taken into consideration, decribed with different life cycle phases and relevant characteristics. In theory, there are various life cycles classifications (by object, by purpose, etc) impacting the development od different theories and models of life cycles related to product, service, organization, technology, enterprise, etc.

According to the theory of Isak Adizes, the founder and professional director of the Adiez Institute, the creator of the Adiges methodology and the well known consultant, the life cycle of each enterprise consists of the ten phases shown in Figure 1. The first phase begins just before the formal establishment of the company, while the last phase can start long time before the formal quitting of company. The reason lies in the fact that the company is not born at the time of official enrollment in legal books, but it arises with the first idea created at the mindset of enterpreneur. The same comment can be done related to the death of an enterprise, it is never sudden or happen at the moment; the enterprise goes to the last stage of its cycle at the moment when the last willingness of improvement is lost, regardless of the different image that its managers, owners and / or directors have. Each phase, if the company steps in the right path, leads to the next one. Despite the fact that different business circumstances (positive or negative) lurking at every step, so the company is tempted to stray into a dead end or simply get lost on the life cycle direction. After a period of unsuccessful effort to overcome the "challenges" from the current phase, ther is high probability of company death.

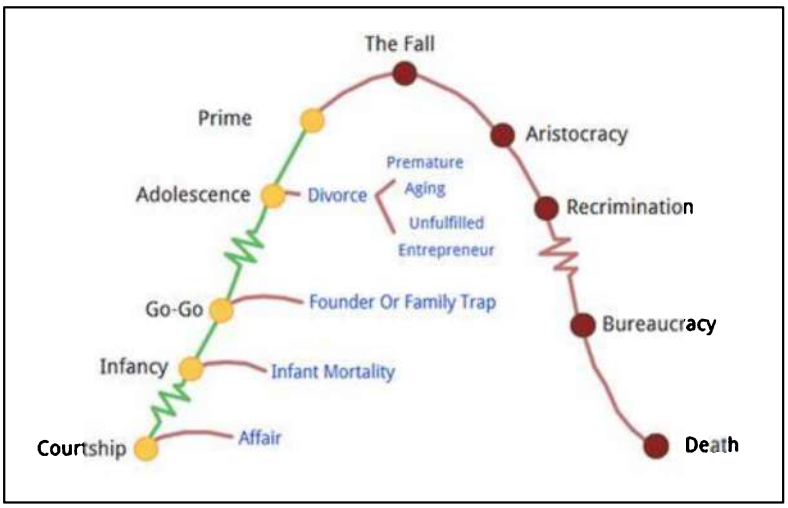

Figure 1: Business life cycle by Isak Adizes (Source: Adizes, 2007)

The first phase, known as the Courtship, according to Adizes (Adizes, 2007, p. 26), precedes the creation of a business entity, at the moment business exists only as an enterpreneural idea. The founder of the SME does not leave the idea of his future company. The entrepreneur is continuously evaluating the circumstances and temptations in which he could be found in the future. It's a dream that haunts him everyday. He already cerates imagination of product and / or service acceptance on the market. The founder should be reasonably-unreasonable person - to fanatically hold on to his convictions, but also to hear the voice of truth (Adigees, 2007, p. 34). The next part of the paper will show the possibilities of creating adequate Key Performance Indicators (KPIs) for managing SMEs in the first phase "Courtship" in the company life cycle.

3. PERFORMANCE MANAGEMENT IN SMEs

The management system is an organized set of integrated management elements aligned together with common purpose to managed part of the system (Omerbegović-Bijelović, 2006, p. 31). According to Omerbegović-Bijelović & Krsmanović (2013, p. 5) the quality of management is reflected in its effectiveness (to produce the desired output) and efficiency (to increase the relation of the output and inputs). Quality is measured based on the achieved results, considering management performance and relevant performance indicators.

Performances represent the measure of success in achieving business goals. For each performance can be identified one or more performance indicators that describe the performance status/appearance. Indicators are quantitative or qualitative measure by which, directly or indirectly, it is possible to estimate or understand the level of accomplishment for a particular goal, as well speed, time or deadline for achieving the relevant goal (Simeunovic, 2015, p.4).

Quality of management (Omerbegović-Bijelović, 1998) describes multiple attributes (performance indicator) of management. (The performance indicator reffering to quality of management represents an attribute or description of the quality of management as an entity.) Each performance is measured by certain indicators. Not all the performances are equally important for the system of management, or any other system whose behaviors are observed. Based on this, it comes as necessary to understand the importance of selected/relevant indicator of each performance of the observed system. Then the quality of the management system (or the quality of any other system, but in this case, the management system will be considered) can be calculated based on following eqaution (1):

$$UQact = \sum_{i=1}^{n} gact(i) * \alpha(i), \tag{1}$$

where: *UQact* – actual quality of management system; *n* – number of atributes (performance indicators); *gact(i)* – Score of atribute *i*; *α(i)* – Importance of atribute *i*.

Monitoring the development of the SME management system, as well as further measurement and improvement of the quality of management in SME, is based on implementation of adequate set of KPI. Ussualy, the capacities of human resources in SMEs are limited (and even the entrepreneur as unique resource in SME), the problem is manifested by lack of the SMEs management competencies, particularly for solving issues characteristic for certain phases of the SMEs life cycle. In this paper, attention is focused on the initial phase of SME management - "Courtship".

4. PERFORMANCE MANAGEMENT IN INITIAL PHASE OF SMEs LIFE CYCLE

The first stage of the company's life cycle is the "Curtship" phase. It represents a period in which the SME does not exist legally, there is only an idea about the future company. The founder of the company at this stage is an entrepreneur. Entrepreneurship is a very dynamic process that requires enormous energy and passion for creating, implementing new ideas and creative solutions (Isaković, 2015, p. 3). The basic characteristics of managing the entrepreneurial process, according to Horvat, 2013, page 3, are:

- Readiness to take up business risk;
- Ability to bring together a great team;
- Creativity necessary to utilize the needed resources;
- Ability and skills to prepare a good business plan;
- Visionary skills to recognize a situation where others do not see / are reluctant to recognize it.

Currrent phase is about managing the process of establishing a new company, with enterprenur as founder role and only one responsible to manage the process. Key moment for future of newly established company is understanding of business opportunities and market/environment circumstancess, prior starting the new company's operations. As an important tool, it is recommended to use the Business Plan to establish foundations for future business and ensure justification of the business idea from beginning.

Quality of management in this phase depends exclusively on the founder's capabilities. During Courtship phase, if founder is avare and well prepared, he can establish the future business and management processes of SMEs. As well, the founder can (should) define the purpose, mission and vision of his future company. The main characteristic of the phase is following: everything depends on the founder and his desire for success. One of the main stepping stone in this phase is founder readiness to understand and aquire basic theoretical approaches of managinig SMEs and understanding the complexity and circumstances of the business itself.

From the aspect of management (Atanasov, 2016, p. 24), the value of the performance indicator represents information indicating whether the selected control action, in the expected manner, impact on the observed performance. Performance represents a variable / characteristic of a particular object in a managed subsystem (Atanasov, 2016, p. 26). Performance represent the achievements or effects that a company achieves in different areas and aspects of doing business, over a specific time period. Another definition (Pesalj, 2006, p. 5) identify additional role of performances, in process of transforming available inputs into requested outputs, where performances demonstrates efficiency of engaged inputs. In order to set the

foundations for evaluating the performance results, followed by an evaluation of the results of the operation of a managed object that is described by performances, the company needs to establish adequate measurement system. Measuring system and the instruments of that system (Tadic, 2015, p. 78), can be classified into categories: measure, measure, performance indicator and key performance indicator.

Each business life cycle refer to business issues relevant for specific phase. For the growth and development, it is needed SME to focused on solving or overcoming the problem of the certain life cycle phase. These problems (challenges) needs to be managed systematically - by implementing SMEs performance management system and set of selected performance indicators (KPI package). By achieving positive and expected values of the indicator related to the problem associated with certain phase of life cycle (identified in the previous management control cycle), it is confirmed the fulfillment of preconditions for improving the system of management to next level, positively impacting business performance overall. In the initial stages of the life cycle, the main goal is continuously to move to the next life cycle phase - all the way to the "Top Form" phase, where company needs to stay as long as possible.

5. SMEs MANAGEMENT BASED ON KPIs IN THE FIRST PHASE OF LIFE CYCLE

Implementation of adequate performance indicators in performance management system represents precondition for improving the effectiveness of management, according to Atanasov (2016, p. 17). Foundations of performance management system are bult through selection of adequate performances and set of adequate performance indicators identified by the phases of the company's life cycle (identified based on the needs of certain company's life cycle phase).

The goal of the research is to present an overview of the existing knowledge in the area of SMEs management based on performance indictators (KPI, SMEs, life cycle of the company) in order to contribute to theoretical knowledge base. At the same time, the goal is to identify an adequate set of performances and relevant performance indicators that represent the needs of entrepreneurs in the RS - owners of SMEs (for illustration purposes) in the initial phase of the company life cycle.

The operational objectives of the research are: 1) Identification of the problems of SMEs in the initial phase of the life cycle ("Courtship"); 2) Identification of the managing object – by solving the problems identified in certain phase of life cycle; 3) Identification of performances related to managed object and adequate performance indicators, and 4) Selection of key performance indicators (from the set of possible performance indicators). The overall goal is to identify operative management tool (which, in this case, is theroreticaly general purpose, but it can be applied in each SME, with a certain level of adjustment to the activities and specifics of the company); this requires identification of a KPI set relevant for the initial phase of the life cycle - "Courtship".

5.1. The research metodology

Based on the analysis of the available theoretical literature and defined topic and objectives of the research, a general assumption / basic hypothesis is H(0): It is possible to choose the set of KPIs relevant for managing SMEs in the initial stage of the enterprise's life cycle ("Courtship").

Apart from the general hypothesis, two individual hypotheses are defined (Figure 2):

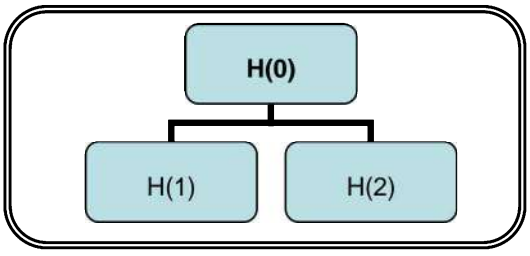

Figure 2: Hypotheses structure

H(1): It is possible to define indicators for each SMEs managerial perforamance in starting phase Courtship in company life cycle.
H(2): It is possible to select set of relevant KPIs for starting phase Courtship in company life cycle.

To test the individual hypotheses for solving the defined problem adequately, for the individual hypothesis H(1), were defined following research questions (RQ):

- RQ(1.1): Based on which performance is SMEs managed in the "Cortship" phase?
- RQ(1.2): Can be identified at least one indicator for each performance of the observed problem in "Courtship" phase?
- RQ(1.3): Which KPIs are used to manage SMEs in the "Courtship" phase?

For the individual hypothesis H(2), the following research questions have been defined:

- RQ(2.1): What criteria are used to select the set of performance indicators of the corresponding problem in the “Courtship” life cycle phase?
- RQ(2.2): Based on which theoretical knowledge, identified performance indicators can be considered adequate to manage the problem in the “Courtship” life cycle phase?

By the method of field survey, the authors carried out research through data collection. A Questionnaire on Key Performance Indicators (Jeremic, 2017) for the management of SMEs in the initial phase of the life-cycle "Courtchip" was created. Based on the Questionarre date were colleacted from entrepreneurs, the founders / owners / managers of SMEs. As individual hypotheses H(1) and H(2) have been tested by survey, it is necessary to indicate that they can not be proved with full certainty due to the limited reliability of the frequency method used to evaluate the results obtained by the Questionnaire. The results are suggested, based on the frequency of responses, which should also be considered a field research limitation.

The survey was conducted on a sample of 35 respondents employed in SMEs in the Republic of Serbia (Jeremić, 2017). The survey was based on the following sample structure - by sex: 35 of the respondents, 20 respondents (57.14%) were male, while 15 were female (42.86%) female. Structure of the sample according to the level of education of the respondents: out of 35 respondents, 5 (14,29%) with completed secondary school, 6 respondents (17,14%) with completed postgraduate studies, employees with completed higher education were 9 respondents (25,71%), while the highest number of respondents with completed university (bachelor) is 15 (42.86%). The structure of the sample according to years of working experience indicates that the highest number of respondents with a working experience from 5 to 15 years - 14 (40%), 10 respondents from 15 to 25 years of working experience (28.57%), 9 respondents have a working experience up to 5 years (25.71%), while 2 respondents (5.71%) have a working experience of 25 to 35 years.

5.2. Research results

This chapter presents the results of a survey of key performance indicators for managing SMEs in the initial phases of the life cycle. The confirmaion of the general hypothesis H(0) ("It is possible to choose the set of KPIs relevant for managing SMEs in the initial stage of the enterprise's life cycle ("Courtship")") is checked through the verification of the truths of its components - the individual hypotheses relevant to the initial phase of "Courtship". For the Courtship phase, Adizes and Horvat identified six problems of the phase (Table 1), on the basis of which the authors highlighted two of the most significant problems (challenges) of the phase: (1) Testing the reality of the possible realization of entrepreneurial idea, and (2) founder is ready for business actions and is fully committed to the idea. For each of the above characteristics, the authors presented the recommendations with the control objects in Table 2 in order to create the conditions for managing business by characteristics relevant of Courtship phase.

RQ(1.1), RQ(1.2) and RQ(1.3) have been set up to test the individual hypothesis H(1) ("It is possible to define indicators for each SMEs managerial perforamnce in starting phase Courtship in company life cycle.").

Table 1: Characteristic of phase Cortship in company life cycle, according to Adizes and Horvat

ISAK ADIZES				*ZVEZDAN HORVAT*		
N°	**Regular problems**	**Patologic problems**	**Problem description according to Adizes**	**N°**	**Regular challenges of phase**	**Treats to business survival**
1.	Excitetment, testing the reality	Reality is not tested		1.	Testing the idea/concept	No testing of idea/concept – market and business reality is ignoreed
2.	Checking details	Missing details check	Enterpreneur should be ready to answers: 1. WHY starting the business or certain activity? 2. WHO should perform activity? 3. WHAT needs to be done? 4. HOW to do it? 5. WHEN to do it?	2.	Excitement	Fear and doubt
3.	Founder's has a control	Low control level by founder	Founders are very vulnerable to those who promise to help with sales or financing. Founders - who are more committed to their products than control and ROI (return on investment) - end up, losing control of their companies (in favor of the owner of the capital or / and the "owner of knowledge").	3.	Founder's full control	Control is uncertain and vulnerable
4.	Focus on product and added value creation	Profit orientation	The motivation of the founders should be directed towards meeting the needs of the market, creating values, ie. product-oriented - until they develop products of the appropriate quality, capabilities and functionality.	4.	Focused to deliver results	Exclusive orientation to profit or a lack of commitment to future profits
5.	Realistic expectations	Unrealistic, fanatic expectations	Realistic expectations - depends on several factors: the complexity of starting the job, the time needed to get the first positive results, the degree of necessary innovation, understanding business environment and different cicrumstances.	5.	Focused on vision	Unrealistic, fanatic expectations
6.	Expectations directly linked with risk level	Expectations not linked with risk level	The company is founded when the founder takes the calculated risk. The risk can be manifested in several ways: by leaving the previous job, by renting a new business space, or by undertaking an obligation to deliver a product on a specific date.	6.	Commitment is in proportion to the risk	Commitment is in opposite proportion to the risk

Source: (Adizes, 2007, p. 28-37) and (Horvat, 2013, p. 23)

The research question RQ (1.1) "Based on which performance is SMEs managed in the "Cortship" phase?" was considered through the literature (Adizes, 2007), the authors identified the performances relevant for Courtship phase, considering the challenges characteristic SMEs management in the observed phase (Table 2) and grouped according to a characteristic of controled object in the phase, shown in Table 3.

The research question RQ(1.2): "Can be identified at least one indicator for each performance of the observed problem in "Courtship" phase?" evaluated based on theory and practice that gives a definitive answer to this question, the performance should be described by at least one indicator, otherwise its identification would be insuficcient (Atanasov, 2016). Based on this, the authors identified one or more performance indicators for each identified performance of managed objects - at the initial phase of the life cycle. Identified performance indicators for managed object in the initial phase Courtship are shown in Table 3.

Table 2: Managed object – defined based on the potential issues in „Courtship“ phase

Nº	Challenged of phase	Reccomendations	Managed object
1.	Testing the reality of enterpreneural idea	In order to test the reality of entrepreneurship idea realization, it is recommended to create a business plan - which will be the basis for starting the business, as well the tool for testing the "reality" of the entrepreneurial idea, through the activities: • Defining mission, vision and decomposition of goals; • Defining the program of production / services, including the initial assortment; • Defining ownership structure and team structure; • Market research: supply (resources, input barriers, competitors, potential suppliers, substitutes, competitors) and demand (customers, consumers); • Business environment research (PESTLE analysis); • SWOT-analysis of entrepreneurial venture; • Financial projections of operations and sources of financing; etc...	Business plan
2.	The founder is ready for acting and fully commited to business idea	It is necessary to examine the personal motives, readiness and responsibility of the entrepreneur for creating the company. Peter Draker highlights six basic characteristics of entrepreneurs: need for achievement and success, creativity, risk taking, trust in self and boldness (self-confidence), need for independence and autonomy and motivation, energy and engagement. It is necessary to determine how much the founder is ready to invest in his / her enterprise (time, money, knowledge, other resources, ...) and how much he is willing to take risks (to cancel the previous job, leased business space, enter into the realization of the idea. .).	Competences of founder

Table 3: Performance indicators in Courtship phase of life cycle

Object	Performances	Performance indicators (for planned unit of time)
Business plan	Quality of Business plan creation process (BP)	• Efficiency of BP preparation (1) = Actual time of BP preparations/Planned time of BP preparation BP*100 [%] • Efficiency human resources in BP preparation = Number of BP revisions [1]
	Business plan creation costs (BP)	• Actual costs of BP preparation / Planned costs of BP prepration BP*100 [%] • Total costs of BP preparation [financial unit]
	Identified stakeholders	• Number of identified stakeholders [1] • Number of identified potential investitors [1] • Number of potential investitors contacted before engagement of selected investitor [i=1,2,...,n]
	Business plan level of delivered expectations	• Level of delivered expectations for potential investitor "i" for BP = Perceptible quality (PK) BP for potential investitor "i" – Expected quality (OK) BP for potential investitor "i" [Unacceptable quality of BP (OKi BP> PKi BP); Satisfactory quality of BP (OKi BP ~ PKi BP); Ideal quality BP (OKi BP <PKi BP)] • Stakeholder satisfaction with business plan [Measure the satisfaction of each category of business plan stakeholder, where the grades are: 1 - Totally dissatisfied; 2 - Partially dissatisfied; 3 - Not satisfied, not dissatisfied (as uninterested); 4 - Satisfied with this business plan; 5 - Very satisfied with this business plan.] • Achievement of the founders' expectations from BP = Perceived quality (PK) BP by the founders - Expected quality (OK) BP by the founder; [Unacceptable quality of BP (OKo BP> PKo BP); Satisfactory quality of BP (OKo BP ~ PKo BP); Ideal quality BP (OKo BP <PKo BP)]
	Invetsments in Business plan ralization	• Number of agreed investments [1] • Value of agreed investments [€]
Founder's competencies	Ivensted time of founder	• Founder's invested time = Founder's invested time in planning of new company establishment / Founder's available time*100 [%]
	Founder's readiness to take the risk	• Enterpreneur's readiness to take the risk [1 – Ready to invest "free" time (minimal risk); 2 – Ready to invest time dedicated to family (low risk level); 3 – Ready to invest own financial found (moderate risk); 4 – Ready to invest time impacting work-life balance (time dedicated for healthy life style) (high risk level); 5 – Ready to take the bank loan or to engage other financial sources (Very high risk, full risk)]
	Founder's readiness for future invenstments	• Measure of founder's readiness to focus on newly created company in the future [1 – Founder is ready in the future to dedicate minimal resources (time, financials, networking, etc) to ensure implementation of enterpreneural idea (minimal dedication); 2 – Founder is ready to dedicate necessary resources for starting idea implementation (small dedication); 3 – Founder is ready to dedicate necessary resources for starting business (moderate dedication); 4 – Founder is dedicated to work full working time (8 working hours) (normal dedication); 5 – Founder is ready to work on the newly created company 24 hours, 7 days per week, or "as much as needed" (total dedication)]

The research question RQ(1.3) reads: "Which KPIs are used to manage SMEs in the "Courtship" phase?". For mentioned phase, on the basis of the most important characteristics of the phase, the authors identified two objects (Business plan and Founder competencies). The goal of the research was participants to select three performances and one indicator for each of them, based on priority for their business. (Note: for objects

that are linked with more than three performances, the ranking of the offered performances according to significance 1 - The most significant performance, 2 - Very significant performance, 3 - Significant performance, for objects that are described with exactly three performances, this ranking will not look at the work - so as not to be overburdened with the excessive number of data, because all three are considered to be the chosen performances). As the Business plan was described with five performances, it was first necessary to select the three most important ones - according to respondents. Table 4 presents the response frequencies of the respondents, while in Table 5 shows the values of responses obtained by multiplying the frequencies with a corresponding weight.

The research question RQ(2.1) reads: "What criteria are used to select the set of performance indicators of the corresponding problem in the "Courtship" life cycle phase?". According to Vujovic (2012, p. 38), the criteria that should be taken into consideration while identifying performance indicators are following: relevance, reliability, credibility, up-to-date, comparability, empathy and simplicity.

Table 4: Responses frequency for „Business plan"

"Business plan" performances	Frequency [1]			[%]		
	1 – Most important	2 – Very important	3 - Important	1 – Most important	2 – Very important	3 - Important
1	*2*	*3*	*4*	*5*	*6*	*7*
Business plan creation quality	11	9	11	31,43	25,71	31,43
Business plan creation costs	15	8	4	42,86	22,86	11,43
Identified stakeholders	2	3	4	5,71	8,57	11,43
Business plan delivered expectations	2	5	11	5,71	14,29	31,43
Investing in Business plan realization	5	10	5	14,29	28,57	14,29
Total:	35	35	35	100,00	100,00	100,00

Table 5: Selection of most important performances for „Business plan"

"Business plan" performances	Value (Frequency x Ponder) [1]			
	Frequency (Most important) x Ponder (9)[1]	Frequency (Very important) x Ponder (6)[2]	Frequency (important) x Ponder (3)[3]	Total value
1	*2*	*3*	*4*	*5*
Business plan creation quality	99	54	33	**186**
Business plan creation costs	135	48	12	**195**
Identified stakeholders	18	18	12	**48**
Business plan delivered expectations	18	30	33	**81**
Investing in Business plan realization	45	60	15	**120**

The research question RQ(2.2) reads: "Based on which theoretical knowledge, identified performance indicators can be considered adequate to manage the problem in the "Courtship" life cycle phase?". The authors, based on literature and acquired knowledge (determining the adequacy of the individual performance indicator depending on the circumstances of the business is shown in the dissertation of Atanasov (2016)), identified performance indicators for managing individual characteristics (problems / challenges) at the initial stages of life cycles. These performance indicators are subject to update or change, in line with specificity of each company, different activities and business cisrcumstances. The adequacy of the identified performance indicators can not be fully determined as in this paper they were done to meet the needs of the paper topic and completing the picture of the analysed paper topic.

[1]Most important performance received ponder 9.
[2]Very important performance received ponder 6.
[3]Important performance received ponder 3.

Table 6: Selection of performance indicators in phase „Courtship“

	PERFORMANCE INDICATORS	Frequency [1]	[%]
Business plan	Quality of Business plan creation process (BP)	35	100,00%
	Efficiency of BP preparation	24	68,57%
	Efficiency human resources in BP preparation	11	31,43%
	Total costs of Business plan creation	35	100,00%
	Actual costs of BP preparation / Planned costs of BP prepration	9	25,71%
	Business plan creation costs (BP)	26	74,29%
	Invetsments in Business plan ralization	35	100,00%
	Number of agreed investments	10	28,57%
	Value of agreed investments	25	71,43%
Founders competencies	Ivensted time of founder *Participation of Founder's invested time in planning of new company establishment*	12	34,29%
	Founder's readiness to take the risk *Founder's readiness to take the risk measure*	30	85,71%
	Founder's readiness for future invenstments *Founder's readiness for future dedication to business*	26	74,29%

During the survey, while selecting the performances, the respondents were asked to select one indicator for each performance. As only one performance indicator was identified for individual performance, respondents had the opportunity to decide whether this indicator could be considered the key to the observed phase of the life cycle. The authors decided that, in case of "solitary" indicator if more than 60% of respondents answered positively, this indicator is seen as crucial. The response frequencies of the respondents are shown in Table 6. Based on the research, the authors formed the KPI for the life-cycle phase "Courtship", shown in Table 7.

Table 7: Key performance indicators in phase „Courtship“

Business plan	Quality of Business plan creation process (BP)
	*Efficiency of BP preparation (BP) = Actual time of BP preparation / Planned time of BP preparation*100 [%];*
	Actual costs of BP preparation
	Total costs of BP preparation [financial units]
	Investments in BP realization
	Value of agreed investments [financial units]
Founders competencies	Founder's readiness to take the risk
	Founder's readiness to take the risk [1 – Ready to invest "free" time (minimal risk); 2 – Ready to invest time dedicated to family (low risk level); 3 – Ready to invest own financial found (moderate risk); 4 – Ready to invest time impacting work-life balance (time dedicated for healthy life style) (high risk level); 5 – Ready to take the bank loan or to engage other financial sources (Very high risk, full risk)]
	Founder's readiness for future invenstments
	Measure of founder's readiness to focus on newly created company in the future [1 – Founder is ready in the future to dedicate minimal resources (time, financials, networking, etc) to ensure implementation of enterpreneural idea (minimal dedication); 2 – Founder is ready to dedicate necessary resources for starting idea implementation (small dedication); 3 – Founder is ready to dedicate necessary resources for starting business (moderate dedication); 4 – Founder is dedicated to work full working time (8 working hours) (normal dedication); 5 – Founder is ready to work on the newly created company 24 hours, 7 days per week, or "as much as needed" (total dedication)]

The presented research examines the possibility of creating set of KPIs for SMEs in the initial phase Courtship in the company life cycle. Based on collected data (theoretical knowledge and practical - the survey), analysis and conclusion about the previously set hypotheses was made. The confirmation of the general hypothesis H(0) was verified by verifying the truth of individual hypotheses H(1) and H(2).

The individual hypothesis H(1) ("It is possible to define indicators for each SMEs managerial perforamnce in starting phase Courtship in company life cycle.") was checked through the research questions RQ(1.1)-RQ(1.2), formulated to test the truth of the hypothesis. In order to obtain answers to these questions, the authors analyzed the characteristics of the "Courtship" phase in the company's life cycle (Table 1), by identifying the managed object in the observed phase (Table 2), as well as performance and performance indicators characteristic for the considered phase Table 3). Also, the procedure for selecting the performance

for one of the identified objects in the "Business Plan" phase is presented, based on the survey response frequencies (Table 4 and Table 5). Based on mentioned, it can be concluded that the individual hypothesis H(1) is confirmed.

Individual hypothesis H(2) ("It is possible to select set of relevant KPIs for starting phase Courtship in company life cycle.") was checked through the research questions RQ(2.1)- RQ(2.2), where participants were asked to select key set of indicators for the observed life cycle phase. The hypothesis testing was conducted on the basis of the Questionnaire, where respondents, employed in SMEs, selected performance and indicators that they consider to be crucial for a particular phase. The selection of the KPI for the phase Courtship is shown in Table 6, and the selected KIPs have been aditionaly decribed with the measurement systems - in Table 7. Based on the abowe, it can be concluded that the individual hypothesis H(2) is true / confirmed.

On the basis of the confirmed truth of the individual hypotheses H(1) and H(2), it can be concluded that the general hypothesis H(0) "It is possible to choose the set of KPIs relevant for managing SMEs in the initial stage of the enterprise's life cycle ("Courtship")" is confirmed as well.

5. CONCLUSION

Each company can identify position in the company life cycle according to the specific characteristics appearing in the business. SMEs are companies that have the most modest resources, and therefore they need more driving energy that will influence the growth and development of the company's business and market position. At the beginning of the life cycle (in the phase called "Courtship"), SMEs are faced with different problems, mostly related to financials – and in this phase they are mainly focused on financial performance indicators. In the initial stages of life cycle, following the upward path along the life cycle and, slowly, achieving success, SMEs should start introducing into their management and non-financial performance and indicators (which can give them more general insight into the business).

The problem, explored in this paper, is the possibility of identifying set of KPIs for managing SMEs in the initial phase of the life cycle ("Courtship"). The results of the survey confirmed the general hypothesis (H(0): " It is possible to choose the set of KPIs relevant for managing SMEs in the initial stage of the enterprise's life cycle ("Courtship")). KPI package for the observed initial phase of the life-cycle "Courtship" are also created. The adequacy of the presented set of KPIs has not been fully explored, but the idea was to present the possibility of managing the phases of the life cycle of SMEs - using KPIs, and to point out the potential and importance of this business practice.

The result of the research is a tool that can be developed, and and as well tested in specific business circumstances in practice (in different SMEs). Testing the tool would lead to the possible directions of its development, and it would be desirable to create several KPI packages of the observed initial phase of the life cycle ("Courtship ") that would be releavant to certain types of business (according to the size of the company, the activity it deals with, etc.). It is also possible to extend the research and selecting the set of KPIs to all (initial and other) phases of the company's life cycle.

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PLANNING OF THE ACTIVITIES OF THE FAMILY FIRM SUCCESSOR PREPARING IN SERBIA

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Abstract: *This paper presents an important aspect of always current issue of "family business succession". It is about the preparation of the family business/firm (FF) successor or, to be more precise, about planning/designation of contemporary activities of the FF successor preparation in Serbia. The intention is to indicate to the owners and potential FF successors as the most important groups of interested parties (stakeholders) for successful FF succession and thus for a good/planned preparedness of future successors. The research of the solution from the reference books (in theory and practice) helped identify potential activities in the FF successor preparing (development of their ownership competences, i.e. for FB management); then, field research of Serbia resulted in the (plan of) acceptable contemporary activities of the FF successor preparing which suit the circumstances (economy situation but also to the cultural model) in Serbia. The generated plan of activities (per phases) represents the tool of the FF owners in Serbia, for their potential successors and also for the remaining stakeholders: it may be used in planning (as well as in comprehensive management), preparation of potential FF successors.*

Keywords*: Family firm/business (FF), FF Succession, FF Successors competencies, FF Successor preparing, The activities in the FF successor preparing, Plan of the activities of FF Successor preparing*

1. INTRODUCTION OR ABOUT FAMILY BUSINESS

The evidence to the importance of family firms is provided by the data that they represent 80 percent of all registered business entities in the world, that they generate 70 percent of the world GDP (EY Economic Barometer, October 2017). However, the statistics does not support the success of family firm succession since approximately 70 percent of family firms disappears after the "departure" of the owner while only 30 percent of these goes through the transfer from the first to the second generation, and barely 12 percent from the second to the third (Kets de Vries, 1993). According to the data of the Economic Barometer from 2017 conducted by Ernnst & Young, 22 percent of the Serbian entrepreneurs currently at the top of their company took it over from a family member or another person, while only 15 percent of the Serbian companies were succeeded from a family member (EY Economic Barometer, 2017). The research about the status of family firms (2014) in Serbia, conducted by companies Chapter4PR and ProEduca indicate that about 60 percent of companies in Serbia have operated for less than 20 years. Totally 84.5 percent of them are founded by their current owners, 11.9 percent are succeeded and 3.6 percent bought. The data also show that 67.9 percent of the companies are managed by their first owner, while the managing role is assumed by the second generation in 29.2 percent of cases and only 2.4 percent of the companies was succeeded and managed by the third generation of owners. According to this research 9.3 percent of founders are planning to retire by 2018. Relatively high "mortality" of the succeeded companies (family firms) is strongly related to (insufficient or/and inadequate) competency of the successors and also with their readiness to assume the role of the owner, manager, (internal) entrepreneurs. There is no company, not even family firm, which can afford the risk of losing "the most responsible one", so the tendency is to have a ready (potential) successor. This is where the inspiration for the research presented in this paper –about the planned preparation of the family business successor preparing stems from.

2. SUCCESSION OF THE FAMILY BUSINESS

In Serbian companies 40 percent of current owners plan to leave the company to family inheritance (EY, 2017), which fits into the European average of 46 percent (Freund, et al., 1995). The information of particular concern –only 3.5 percent of interviewees plan to, immediately after completed studies, take over the family business –is provided by the study conducted by Ernst & Young (2014). It indicates that there is the problem of (planned) preparedness of the family business successors who –due to the preparation of insufficient quality –are not capable of coping with the problems which the family firm faces during the succession and later. If, during a longer time period, the need for planning, preparing and implementing of the process of family business succession is ignored, the family firm may be in serious trouble.

The succession process may be divided into three phases: F1) planning of the personal development of potential successors; F2) involvement of successors in the family business and F3) assuming of the leadership position in the company. Planning of the personal development (F1) involves: formal (Sharma, et al., 2003; Morris et al., 1996) and informal education (Neubauer, 2003; Morris et al., 1996), gaining work experience outside the company (Morris et al., 1996), as well as the inclusion of consultants from the environment of the subject company (Sharma, et al., 2003). The implementation of (F2) second generation into the process of succession involves relations and connections established by the successor on individual, interpersonal and organizational level (Filser, 2013), taking into consideration legal, financial, tax and psychological aspect (Ip i Jacobs, 2006). In order to preserve the tradition of family entrepreneurship, the firm owners should accept the planning of succession as a process which involves the acceptance of the succession as a long-term process, clear defining and appointment of persons responsible for this process and persistent and quality preparation of the following generation for assuming of the leader function in the firm (F3).

The problem of family firm successor preparing stems from the fact that the successor, by entering the firm starts assuming the authority of the founder. Based on that, Davis (1968) defined three models in family firms:

- Model 1: "Strong father and weak son", where the father is the personification of power and strength. His relation toward employees may be described as idyllic, unlike his relation toward his son, who usually lives in luxury and abundance. The most important reason of the failure in these family firms is that the father fails to transfer his strength and devotion to his son, i.e. "the father is everything that the son is not". The son respects the father too much and, as the time passes, he loses the interest and ambitions.
- Model 2: "Conservative father and progressive son", when the role of the father is less dominant and the relation between the founder and the successor is reflected in the age difference. In this mode, it is usually talked about the father who started "from the scratch" and who possesses very little formal education (or does not possess it at all), while the son acquired higher education (very frequently abroad) and is in charge of the innovations and their implementation in the firm. After retirement, the father wants to enjoy the fruits of his work and frequently is dedicated to his grandchildren. The succession in this model is a slow and long-term process and ends with the death or retirement of the funder. This model, according to the mentioned research, proved to be the wisest and the most successful in the process of family firm succession.
- Model 3: „Ramified family", which refers to the involvement of several family members in the company management. It is a very frequent situation that one brother is in charge of production and the other one for sales. The more harmonious the relations in the family are, the greater is the chance for the survival of these family firms, since, very frequently due to family conflicts, the company is split and/or sold.

The success of the family firm succession should be observed in the context of the relation of the founder/ predecessor (current owner/ legal owner/ director) and (potential) successor(s). The success of the transition depends to a great extent on their relation (Venter et al., 2005), but also on the communication between them and within the family itself (Wing, 2011; Filser et al., 2013; Morris et al., 1996; Bigliardi i Dormio, 2009; Maciel, et al., 2015). Family and business goals, in most of the cases, are not identical within the family. What connects them is the role of the family in the very defining of these goals; reaching the goals may be accompanied by conflicts, but, eventually, the sense of belonging to the family and family firm is strengthened. The lack of plan and communication (within the family) about the succession and takeover is very present at family firms. (It certainly refers to Serbian family firms taking into consideration the traditional cultural heritage –that the succession is not the topic for discussion before the death of the founder (and opening of the will, if it exists).) The death of the founder represents one of the crucial reasons for the successor takeover of the company (Freund, et al., 1995).Apart from the fear of death, Howorth and Ali (2001) emphasize also the fear of loss of respect and strong connection of the owner with the firm as main reasons for the resistance which appears with the founder. Everything that the founder sees as a threat, the interruption of the daily routine is related to the loss of the status of the "hero" which he enjoyed in his environment. One of the potential family firm succession scenarios shows how successful family firms have defined fixed age limit for the retirement, which refers to all members. Even if the owner neither takes the retirement into consideration nor prepares the successor once the retirement limit is established, he is aware of the certain time period he has to prepare the successor.

For the founder's success his dedication and the dedication of the entire family are of crucial importance (Sharma et al., 2003). It also includes the wish of the owner to leave the firm to descendants (Tatoglu et al., 2008), as well as the wish of the successors to take over the family business (Venter et al., 2005). The necessary conditions for successful implementation of succession with the second generation are: planned dedication of the successor for the long term (Fox et al., 1996), his competences and suitable education (Tatoglu et al., 2008; Bigliardi i Dormio, 2009), experience outside the company (Morris et al., 1996) and psychological preparation of the successor, top management, family, employees (Neubauer, 2003). In order

to realize the process of the selection of potential successor, it is necessary to have a successor ready to assume one day (when it is required) the managing role. If the successor himself conducted improperly in the process of successor preparing it may undermine his authority and create resistance with the employees (and even the family). The competency of the second generation is based on the planned education of the successor and represents the basis for their inclusion in the family firm operation –according to the "plan of potential successor preparing". An important factor in the very competency of potential successors is the experience which may be acquired in two manners: a) By work –in different forms of engagement in the family company (student internship or/and labor relation); b) By internship in other companies or/and establishment of the labor relation in another company for a definite period of time (prior to the planned succession). Barach et al. (1988) state that most of the successors immediately after schooling enter the family firm and the same authors conclude that the more successful successors are the ones who, prior to the company takeover, have work experience in some other companies (acquired immediately after schooling). The successor acceptability (for all interested parties) represents an important factor for the selection of the potential successor to the managing function in the family business.

The change of generations in family firms bears great life changes with both generations changing the balance of power in the family and the firm itself, in a certain manner, starts over. The successful transition from the founder/owner to the successor is more probable/ successful in families with the relations of harmony and love (Morris et al., 1996, Venter et al., 2005, Maciel, et al., 2015). For the change of generations with family firms the harmonious relations within the family are extremely important.

The family tradition, values and the sense of belonging represent an important feature of the family firm. Members of the family sense belonging to the company to a greater extent than employees who do not belong to the family and also they have stronger motivation to overcome problems in the firm (compared to other employees). The values cherished within the family, family culture and communication play the key role for successful termination of the process of family firm succession (Tatoglu et al., 2008; Wing, 2011; Morris et al., 1996; Bigliardi i Dormio, 2009; Santiago, 2000; Campbell et al., 2007). If the family does no share family values, the very succession is significantly aggravated. Therefore it is very important that the family members openly express their opinions, views and attitudes about these values –in order to identify their attitude toward family firm/business. Here the manner of mutual communication of family members is of essential importance.

As a successful model of succession Royer et al. (2008) emphasize the Japanese model of succession of the family business: it is more successful than others because it focuses, apart from the nuclear family (sons, daughters, brothers and sisters) to the extended family, too (sons-in-law, daughters-in-law, brothers and sisters of the second and third generation). Klaus Kobjoll, the owner of the famous and multiple-award winning hotel Schindlerhof, believes that the greatest entrepreneurs, by the rule, are not founders, but the second generation, with the "eagerness" of the founder (Kobjoll, 2007).

3. ACTIVITIES OF THE PLANNED PREPARING OF THE FAMILY BUSINESS SUCCESSOR

With regards to different models as well as the differences in the environment and cultural standards, it is not recommended to "transplant" other's models even in the case of the family business/ firm/ company successor preparing –unless it is planned for a long term and realized consistently. It is sensible to get familiar with other's models, but to accept those features (of that model) which may be "received" in a specific environment (in this case, in Serbia). Therefore, in this chapter, other's models/plans of activities of successor preparing are presented.

The last German emperor –Wilhelm II –said: "The first generation builds, the second one manages and the third one studies art history". Thomas Mann, famous writer and Nobel Prize winner, who spoke about the decline of German civic ideology of Wilhelm age in his piece "Buddenbrooks". Mann's novel is current today, since it depicts four generations of an old, respected merchant family and the authors of this paper see it as a case. In practice, current owners and potential successors, even before planning/activity defining of the successor preparing, have the problem of successor selection and then, just in case of the succession of the family business (i.e. for each successor) and the problem of determination of corresponding activities of their preparing. The additional problem could be caused by inadequate transfer of knowledge and experience (especially if also they –knowledge and experience are inadequate) to (potential) successors. A special aspect (or danger) in the preparation planning for potential FB successor may be inadequate motivation or his directing to te activities according to which he does not show the competency or wish at all.

As basic activities of the preparation for succession, according to foreign theory and practice, the following may be isolated: a) sending for schooling or additional schooling; b) frequent presence in the family firm; c) sending to training, seminars, courses, etc. There are many activities which may significantly facilitate the

succession in the family business: d) work in family firm; e) participation of the successor in defining of the family policy of succession; f) participation in decision-making at meetings; g) beginning of the career in another company; h) mutual agreement of successors and current owners; i) participation at the workshops for the successor preparing; j) occasional work of potential successors in the other's practice; k) gradual inclusion of the successors in the family firm operation, etc.

From the group of previously stated activities the "constant presence in family firm" is isolated. In majority of family firms there is a great generation gap between parents (current owners or/and managers) and potential successors. The presence of successors, from an early age, in the family firm may reduce the disagreement in the assuming of the managing role in the family firm since through the continual presence the successor is closely introduced to the functioning, meaning and the potential of the family firm, develops the understanding for the family business and their role in it and the surrounding is prepared/accustomed to their presence. In these cases it is possible to plan all the activities and provide reality and accomplishment of such plans.

Just like individuals, all families are unique and different –each in their own way. In Serbia, in 58 percent of the companies, families significantly contribute to the work within the company (EY, 2017). (The examples are MONA, AMC, GARDEN CENTAR, etc.) The succession is to a certain extent emotional –since there are different interests and plans of individuals within the family. In Serbia, many entrepreneurs start alone, without great help of the institutions. As the time passes, as family business grows, the tendency for the formalization of the organizational structure and the employment of professional managers grows, too. The founder find it difficult to accept that their children have grown up and that they should be let go; this, for founders, represents a great, double challenge: professional –since they see the firm as their child and emotional –biological child has grown up and moves on independently.

4. RESEARCH OF THE ACTIVITIES OF THE FAMILY BUSINESS SUCCESSOR PREPARING IN SERBIA

The research of activities, as a phase of the planning of the successor preparing, requires the special attention to be focused toward the solution to the problem: "Which of the contemporary activities of the successor preparing (implemented in developed countries) are necessary and applicable in Serbia in order to have a successful succession?" The issues of importance also refer to the length of the preparation process, the sphere of the competency development, combining of the successor preparation with other aspects of life, organization/participation of planning and realization of the successor preparing, etc. Via a questionnaire (for owners/successors of the family company) and the representation of cases, the data about contemporary activities, participants, errors, problems, and attitudes referring to the family business successor preparing are collected based on which the set of contemporary activities of the family business successor preparing is defined and applicable in Serbia.

4.1. The researched problem

"Succession is one of the most critical steps in the evolution of the family business. What is kept secret by the family, what is not said, i.e. what remains unspoken, weaknesses inside the family, communication, lack of experience and other, will most probably cause the conflict, non-functional and irrational conduct during the succession" (Deschamps B., Cisneros L. (2014), p. 1). There is a great number of problems which the successors and potential successors face. The basic problem whose solution is being looked for is how to introduce in Serbia the practice of planning (and later realization) of contemporary activities of potential successor preparing (and also, with the defining of activities, to introduce the specification of participants, resources, time, manner, etc.). To be more precise, the solutions (plan elements) for the activities of family business successor preparing and they should be contemporary (applicable in the developed world) and acceptable in Serbia.

In Serbia, at the early XXI century, the first (after war) generation of the company owners is still dominant and it is characterized by the complete control by founders (while the other generation still bears with itself the burden of "the great father" and must prove itself to partners and family). The constant proving may sometimes be too big of a burden for the successor, for which he is still not ready (because he is expected to be at the same level as well as the predecessor, to maintain the similar vision of the family firm and long-term goals set at the time of the establishment). For economic as well as psychological/medical reasons, it is important that the second generation enter the job according to its own motives, just as it is important that the founders (or/and current owners/managers) do not pressure their children with the entrance into the family business. It has been expected that the research (presented in this paper) in Serbia also shows that, in most of the cases, the plan of preparatory activities does not exist and in cases when it exists, it is not

quality enough, its realization does not have sufficient attention and support. For the inspection of the stated expectations the corresponding methodics/"methodology" was developed.

4.2 The research methodology

The main technique of the here described research is in written communication, i.e. via a questionnaire (so-called non-experimental research) and via the case analysis. In this manner, the conduct and need of the interviewees may be observed, as well as the solutions presented in cases. For the purposes of the observed research the questionnaire is made with three groups of questions: a) on interviewees (owners and potential successors); b) on family firms where the interviewees work and c) on research topics –related to individual hypotheses.

4.2.1. Hypotheses about activities of FB successor preparing

The research started with the basic hypothesis H(0): It is possible to define/plan contemporary activities of the family business successor preparing applicable in the Republic of Serbia. General hypothesis H(0) means that, currently, the activities of the family business successor preparing in the Republic of Serbia are not accessed adequately, so there is room for improvement –the introduction of contemporary activities, from the practice of developed countries. The assumption is based on the fact that a great number of family firms have the problem in the determination which activities are necessary so that the successor could be adequately prepared for the succession.

Apart from the general hypothesis, two individual hypotheses are defined (Figure 1):

H(1): It is possible to define/plan contemporary activities of the family business owner in the family business succession preparing, applicable in the Republic of Serbia.
H(2): It is possible to define/plan contemporary activities of the potential successors in the preparation for the assuming of a specific role in the family business in the Republic of Serbia.

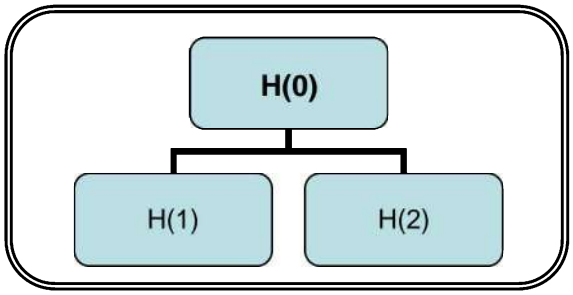

Figure 1: Hypotheses structure

In the inspection of the veracity of hypotheses, the intention is to go from the inspection of the veracity of individual hypotheses H(1) and H(2). The veracity of individual hypotheses is inspected (for each hypothesis individually) per research questions (RQ); for H(1) –based on responses to RQ no. 8-14 and for H(2) –to RQ no. 15-23. Then, based on the answers to the stated RQ, the conclusion about the veracity of the basic hypothesis H(0) is reached.

4.2.2. Sample of the population participating in the research

The sample consisted of 100 interviewees (out of that 37 female), current owners of family firms and potential successors. The number of participants –according to questions –fluctuates significantly, according to the willingness of the interviewees to respond to certain types of questions, which is why some of the questions referred to owners and the other to potential family firm successors.
In the paper Mirkovic (2016) the sample structure is presented in great details. Here is indicated that: 44 percent of interviewees are age 18-30 and 26 percent of age 45; 46 percent are with faculty education, 24% with higher level of education, 32 percent are founders, 20 successors in the role of owners/managers and 48 percent potential successors; 79 percent possess one firm each, and 4 percent possess three or more firms; 56 percent of their firms deals with the service rendering, 26 percent production and others combine production and services.

4.2.3. Research place and time

The research was conducted electronically, via Google Forms in October 2016.

4.2.4. Research manner

In the subject research the questionnaire consists of 6 questions about the Interviewee, one question about the scope of activities where the Interviewee works (described in chapter 4.2.2) and of 37 questions about the family business successor preparing, among them 7 research questions referring to H(1) and 9 questions to H(2). (The remaining questions are not closely related to the observed hypotheses). Here the responses to the selected research questions are presented (in tables) (since the organizer SymOr2018 limited the length of papers). Additional research deals with activities in three cases of family business successor preparing –in different scopes of activity and different phases of life cycle of the family firm.

4.3. Research results

Double "field research" was conducted (via electronic questionnaire and the analysis of three cases), accompanied by generation of the (potential) part of the plan of family business successor preparing which refers to the list of contemporary preparation activities –acceptable in Serbia. Therefore the presentation of the field research results will be divided into two parts. The first part deals with the inspections of veracity of individual hypotheses (based on the analysis of the responses to the research questions from the Questionnaire) and the other –by presentation of three cases. They are also accompanied by the third part – the proposal of the set of contemporary activities of the family business successor preparing applicable (in the plans of family firms) in Serbia.

4.3.1. Field research results

The results of the research of the family business/ firm successor preparation activities concern:

a) Attitudes of current owners – among them there are entrepreneurs/ founders and managers/ successors of the family business (H(1)) i
b) Attitudes of potential successors (H(1;2)).

For the inspection of the individual hypothesis H(1), 7 research questions are generated (RQ); here are presented 5 RQ and answers to them (in tables 1-5). For the inspection of the individual hypothesis H(2), 9 RQ are generated but here are presented 6 RQ and answers to them (in tables 6-11).

Table 1: Answers to the question "*Do You have in your family a detailed plan of development and introduction of the following generation of successors in the family business*?" (Mirkovic, 2016)

Answer variants	**Number of interviewees** (u [1])	**Share in total number** (in [%])
No	37	42.0
Yes, but not detailed enough	36	40.9
Yes	15	17.0
Total	88	99.9

Table 2: Answers to the question "Have You and in what manner been prepared for the succession?"

Answer variants	**Number of interviewees** (u [1])	**Share in total number** (in [%])
No, I was just accepted	10	19.3
Yes, by schooling	1	1.9
Yes, by frequent presence in FF	3	5.8
Yes, by sending to training, etc.	1	1.9
Yes, but inadequately	5	9.7
I am the founder	32	61.4
Total	52	100.0

Table 3: Answers to the question "*What (which activities) do you recommend for the FB/FF successor preparing*?" (Mirkovic, 2016)

Answer variants	**Number of interviewees** (u [1])	**Share in total number** (in [%])
Work at the firm	29	46.0
Education and work/internship	22	35.0
Workshops for the successor preparation	3	4.8
Start of the career in another company	7	11.0
Participation at the meetings	1	1.6
Participation in the designation of the succession family policy	1	1.6
Total	63	100.0

Table 4: Answers to the question "*By the application of which of the following activities does the participation of the owner reflected in the preparation of the successor?*" (Mirkovic, 2016)

Answer variants	**Number of interviewees** (out of 52)	**Share in total number** (u [%])
By schooling of the successor	45	86.0
By sending the successor to additional training, courses, etc.	26	50.0
By sending the successor to work and to be an intern in other companies	7	13.5
By occasional work and gradual inclusion in the FF operation	44	84.6
Through constant advising and providing support to successors	37	71.0

Table 5: Answers to the question "*Have you, and based on what, chosen your family business successor?*" (Mirkovic, 2016)

Answer variants	**Number of interviewees** (u [1])	**Share in total number** (in [%])
I have not chosen yet.	22	42.3
I have not, they need to be tested	3	5.9
I have not, they are still young	11	21.1
I have, based on the competences	7	13.5
I have, based on ambitions	2	3.8
I have, based on education	5	9.6
Yes, to each successor equally	2	3.8
Total	52	100.0

Table 6: Answers to the question "*According to Your opinion, which activities are necessary in the very process of family business successor preparation?*" (Mirkovic, 2016)

Answer variants	**Number of interviewees** (u [1])	**Share in total number** (in [%])
Gradual introduction in the FF operation	12	25.0
Education, work and internship	6	12.5
Introduction to future obligations	7	14.6
Gradual progress through FF	3	6.2
Owner support and dedication	8	16.6
Directing of the owner (and family)	3	6.2
Everyday participation in FF operation	9	18.9
Total	48	100.0
Other	5	10.4

Table 7: Answers to the question "*What type of pressure did you encounter in your selection as the potential successor?*" (Mirkovic, 2016)

Answer variants	**Number of interviewees (out of 48)**	**Share in total number (in [%])**
By family members	29	60.4
By the environment	21	43.7
Fear of failure	42	87.5
Fear of complexity	25	52.1
Disappointment of the one doing the preparation	25	52.1
Other	5	10.4

Table 8: Answers to the question "*Have You ever performed the job which was in a way similar to the job You want to succeed?*" (Mirkovic, 2016)

Answer variants	**Number of interviewees** (u [1])	**Share in total number** (in [%])
Yes	22	45.8
No	18	37.5
Without previous work experience	8	16.7
Total	48	100.0

Table 9: Answers to the question "*What was your first function in the family firm?*" (Mirkovic, 2016)

Answer variants	**Number of interviewees** (u [1])	**Share in total number** (in [%])
Executive	35	72.9
Manager	9	18.8
Other	4	8.3
Total	48	100.0

Table 10: Answers to the question "*How much have the proper education and directing by the owner and family helped You in the process of preparation and assuming of the role in the family firm?*" (Mirkovic, 2016)

Answer variants	**Number of interviewees** (u [1])	**Share in total number** (in [%])
They were helpful a lot	28	58.3
They were of key importance	6	12.5
I am preparing; I still have to work in another firm before I succeed the business	3	6.3
They were not helpful	11	22.9
Total	48	100.0

Table 11: Answers to the question "*Which of the following activities of the owner and family members, according to your opinion, influence the success of the family business preparation and succession?*" (Mirkovic, 2016)

Answer variants	**Number of interviewees** (out of 48)	**Share in total number** (in [%])
Timely planning of potential successors preparing	39	81.2
Proper knowledge and experience transfer to potential successors	32	66.7
Successful motivation of the successor	26	54.2
Proper directing in the successor education	14	29.2
Other	0	0.0

4.3.2. Case studies

In the inspection of the veracity of individual hypotheses, apart from the research of references and "in field" the analysis of three cases of family business/firm succession is applied and they vary in the phase of life cycle in which the companies are. The first case refers to active preparation of the successor of family firm which is in the phase of transformation from hobby to business. The second case refers to the preparation of the successor –"adolescence" while the third company is before the top shape.

Case study 1: **Micro family firm (in the "courting" phase toward "development age" phase)**

Beekeeping in the family Atanasov represents a part of the tradition for more than one century. However, due to contemporary way of life in the urban environment, last two generations of the family members (from the second half of the 20th century) considered beekeeping as a hobby –doing it near Belgrade, at rented fields. The statement of Bennedsen et al. (2007) that "the sex of the first child impacts the succession in the family firms so much that the percentage of successful transition from the founder to the successor is by 32.7 percent higher in families where the first-born babies were male" finds the confirmation in this family: first-born child –son Nikola, goes to schools and, during the weekends, studies with the help of his Father about bees, honey, honey production technology, protection, etc. He obtained his faculty education for operative management (at the FOS, doctorate). He recognized the business potential of his father's (and family) hobby –beekeeping and helped his father in deciding to turn his hobby into a more professional activity (purchase of beehives, then purchase of the property).

The hobby grows into a business which brings modest income to the family budget (by selling bee products to close friends). During 2014 the "successor" from the second generation of beekeepers in the family presents the idea to turn the *beekeeping* hobby into a small family firm for the production of bee products. The father and the son decide to mutually by the equipment for collecting (extracting), keeping and packing of honey, as well as for "moving" of beehives in the search of season-available pastures. "Beekeeping company Atanasov" is currently (2018) in the process of establishing a small family company, in the transition from the "courting" into "development age" phase and Nikola Atanasov, PhD more diligently studies the theory of Entrepreneurship, SMC management and Management Quality Improvement and Problem

solving in practice the newly acquired knowledge. The family expects soon to have the company officially registered at the Business Registers Agency. Nikola is gaining improvement in a prestigious multinational company.

Case study 2: **Small family firm (in the "adolescence" life-cycle phase)**

The production of furniture and metal structures represents a part of a family tradition of two generations of the Mirkovic family. The successful family business –STADIUM, at their land (in Belgrade) and within their premises attracted (apart from the father and mother) also the sons (older –designer and younger -lawyer). The second generation due to new approach to the market (both in Serbia and abroad), brought the increase of production and sale. The Mirkovic family, from 1992 to 2018 founded two companies. Simultaneous with the business development, the sons are schooled in the spheres they are interested in (and which may help with the family business). All four members of the family are schooled for different areas of business and make a team (it is true, for now, incomplete –as far as the functions in the company are concerned). The youngest, Pedja, after he completed the law (and simultaneously with the work in this area –in someone else's company), completed master studies in the Entrepreneurial management of SMC at FOS. All this time he works also in the family company (which is now, according to Adizes, in the "adolescence" phase).

Through personal experiences of the co-authors of this paper the activities of the family business successor are preparing are identified: the schooling for the field which the successor Predrag selected (and which is important for business: law). Simultaneously, apart from the law, Pedja is working on the inclusion in production and business activities of the company. Work activities in someone else's company with gradual introduction into the operation of the family firm brought him: the introduction to all rights and obligations, gradual progress through the firm hierarchy, solving of the conflicts with the current owner/father, directing by the owner and family members and everyday participation in the operation in the company.

Case study 3: **Medium family firm (in "adolescence" phase toward "top shape" phase)**

The family firm SUNCE of the Marinkovic from Kragujevac was founded by (the grandfather) Aleksandar (1929) –as a family workshop for the locksmith work. He was succeeded by his son Ljubisa who brought 50 employees in the production of PVC joinery. His sons, brought up in the business environment (where the mother also has her business) are specialized for the production director (older-Dusan) and for the director of the family firm (younger, Vladimir). After high school, Dusan remained in the company and Vladimir after completed education at the Faculty of Philology at FOS completed the specialist studies of SMC Management and then master studies and PhD studies in marketing.

The family, apparently, worked all the time on the development of the family business but also on the successor preparing. They managed to bring the firm to the pre-top phase (since they operate according to the contemporary production program, use robots, have business with domestic and foreign partners, grow and develop the business and its management, etc.). In the social aspects they are also successful: their reputation grows constantly, their sons have successful families and successors and Vladimir continues his professional development for the firm management. No, ten years since Vladimir's beginnings at FOS, it may be said that Ljubisa and his wife directed their sons wisely and that, they provide all the time proper support and example (so that they can also direct wisely their children –according to their desires).

The three presented cases also (as well as the previous research questions and their responses) show that both individual hypotheses are based on facts and true. These conclusions are based on the confirmed assumption that it is possible to find contemporary activities for the preparation of potential family business successors, applicable in the Republic of Serbia.

4.3.3. Contemporary activities of the family business successor preparing in Serbia

The activities of the potential successor preparing are necessary to split in a few phases. Through the previously planned activities for the successor preparing, the very succession in the family business is facilitated. The *phases* (and corresponding groups of activities) *of the planned family business successor preparing* could be:

1) *The phase of the awakening of the awareness of the family business/firm*: The initial phase of the activity preparation; starts from an early age, where the successor is, in an informal manner, introduced to the family firm (through visits and games, etc.), by listening to family conversations about the business and family history, by using old "data carriers": photography, letters, journals, gramophone records, and by the application of digital 'accomplishments" (out of which some are already put *ad acta*: cards, magnetic strips and discs, floppy discs, and CDs, cassette deck, video cassettes, etc.)

2) *The phase of informing about the family business/firm:* In this phase, the potential successor is introduced to the products/services which are produced/provided by the firm to business associates and to economic basics of the operation of the family company (as the source of income for their parents and himself).
3) *The phase of the introduction in the practice and family business/firm*: the preparatory activities in this phase refer to the beginning of performance of simple tasks in the family firm –during the summer break or free time of the family business successor. It is characterized by the performance of various activities, based on which the interest/affiliations of the potential successor will be discovered; it provides more quality planning of the potential successor preparatory activities. Through the first operation activities the successor acquires the work habits for the practice. With more quality planning of preparatory activities there is also the directing related to education. The planning of this activity is important because of the successor formal education based on which then the practical knowledge is acquired. The activities which are also desirable in this phase are: the practice in another company –dealing with similar activities as well as different forms of professional training (workshops and courses) as well as constant advising of the successor and support providing, etc.
4) *The phase of the planning of the family business/firm successor preparing:* of the potential successor for the assuming of the role of the "leader" of the family business starts with the initiation of "work with full working hours" in the family firm, where, through the activities the succession is prepared on a daily basis. Surely, at the beginning these are simple activities (such as the participation at the business meetings and the introduction to the existing obligations, following of the instructions of the current owner for further improvement of the potential successor), but, with the time, the successor moves upwards –at the hierarchy ladder of the family firm –through the activities themselves, which are more complex (e.g. the participation in the decision-making policy in the family firm, moving to a better work position and assuming of greater responsibilities and authorizations). That is the manner of development of the potential successor and advancement –since the moment of the very assuming of the managing role in the family firm. What should not be left out are the activities provided by the remaining family members and the total environment. The role of the predecessor/owner in the development of the family business/firm successor is changed with time; his help in the planning of the successor preparing refers more and more to the psychological part of the successor preparing activities (such as: motivation and support provision).
5) *The phase of the family business/firm successor competencies improvement*: post-successive activities refer to further "improvement of own skills" (of already "realized" successor), since for the successful business operations it is not sufficient just to be competent for the technology or operation and business, but it is necessary to develop competencies also for the identification and the use of business relations (and opportunities for work), for the relations with the environment, information about scientific discoveries, appearance and action in various occasions (where the culture, education, various types of literacy, including the digital one, moral, humanity and values are "tested"), etc. With that, the successor of the family business must take care of his health (healthy life styles: the balance of the work and free time, amount of sleep, nutrition, recreation –physical culture, etc.) as well as to be active (and loved) member of the family and respected in the society (Future seems to be looking for a renaissance man again).

Contemporary activities of the family business/firm successor preparing identified in the world may appear also in the plans of family business/firm successor preparing in Serbia; no doubt, their realization may successfully prepare the successors of the family business. It provides successful application on the top of the family business/firm, and thus successful management of the family business/firm.

4.4. Discussion about research results

The subject research was conducted with the purpose of defining contemporary activities which may be helpful in the family business successor preparing, with the tendency to be really applicable in Serbia today. Different aspects of potential successor preparing are taken into consideration.

Based on the data collected in the field (responses to 7 research questions in the Questionnaire) and three cases, the veracity of the individual hypothesis H(1) was shown ("It is possible to define/plan contemporary activities of the family business owner in the preparation of potential family business successors, applicable at the Republic of Serbia"), i.e. this individual hypothesis is also confirmed. Based on this (and the interviewees –potential successors of the family business/firm made their statements), it is defined what the contemporary (applicable in the developed world) activities of potential family business successors are –in their preparation for the role of the successor applicable in Serbia, too.

From two sets of contemporary activities of the potential family business/firm successor preparing (i.e. from the perspective of the owners and their potential successors) the mutual/adjusted (harmonized and

synchronized) contemporary activities of the owners and their potential successors in the potential successor preparing for the takeover of the family business/firm management applicable in Serbia are defined.

Therefore, based on all previously stated and elaborated results in great details (field research, three cases and presented (per phases) the set of contemporary activities of potential successor preparing for the family business/firm takeover) it may be concluded that the basic hypothesis H(0) ("It is possible to define contemporary activities of the preparation of potential successors of the family business/firm in the Republic of Serbia) is confirmed.

5. CONCLUSION

The topic of this paper is the research of plans, i.e. contemporary (existing in the practice of developed countries) activities of the preparation of potential family business (i.e. family firm) successors. The most important participants in this "work" are (current) owners of family firms and their (potential) successors in business. At the same time, also all other family members (especially if they have share in ownership of the subject business/firm), and even wider environment (business partners, local community, state, etc.) have interest in having the activities of the business/firm successor preparing being performed adequately –both from the perspective of the (potential) successor and from the perspective of the current owner (legal owner/director of the firm).

The problem of defining of (for Serbia) adequate, contemporary and acceptable activities of the business/firm successor preparing has been researched from the aspect of both most important participants: "the current owner" and "potential owner". Both parties responded to the research questions and helped choose contemporary (in application in developed countries) activities which enter the plans of family business/firm (potential) successors preparing. The research is supported also by presentation of three case studies of the family business successor preparing for companies in different phases of life cycle.

Based on the foreign and domestic theory and practice, the list of activities for the potential family business successors preparing was defined. From the scientific perspective, the contribution of this paper is in the application of the scientific methodology in defining of elements (activities) for planning of the family business successor preparing and, simultaneously, in the elaboration of the planning methodics for this field (which creates the potential for the quality improvement of the planning of family business successor preparing, for the increase of probability of the successful replacement "at the top" of the family firm and for the improvement of this firm management quality improvement).

Further research in this field would be related to the sample volume (for all questions) –which could initiate the performance of two independent researches. Also, the search would go in the direction of the quality of family business/firm succession (performance, indicators, key indicators and their importance, measuring systems and quality measure) as well as in the direction of finding the solutions for this quality improvement. The same research methodology could be applied in other areas of family business/ firm management, all small and medium-large and even large companies (Some other directions of potential research are stated in the introductory part of the IV Chapter).

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RESOURCE MANAGEMENT QUALITY OF SME IN THE FIELD OF FASHION AND DECORATIVE FABRICS RETAIL

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Abstract: *This paper provides an insight into the way in which the quality of resource management in SMEs for trading in fashion and decorative fabrics (FDF) can be determined. The results of the research of the problem of insufficient sale of textile goods in SMEs for the retail sale of FDFs are presented (insufficient for business to be positive). The idea is to ensure better management of such SMEs, which requires determining the quality of the observed management - and resource management (as well as all other relevant management objects) in such an SME. In addition to literature research, field research was also applied. The method of testing (survey) for the collection of performance data and indicators was used, which measures the quality of SME resource management for retail FDF. The results of the survey allowed to define the method of measuring the quality of SME resource management for retail FDF. It is estimated that this solution, with less adapting, is applicable in all SMEs who are engaged in trading and who notice the possibility of improving their quality of management (and even other management facilities in the company) by improving the quality of their business. The positive veracity of the defined individual hypotheses has been verified in the paper, and it can be concluded that the general hypothesis is confirmed: "H(0):It is possible to define the desired quality of resource management and determine the limits of tolerance".*

Keywords*: SME, Retail FDF, SME resources, Resource management, Quality Management*

1. INTRODUCTION

Insufficient sales of goods force small and medium-sized enterprises (SMEs), in that activity, to improve their business and improve the management of SMEs in the field of trade to achieve sales that enable the survival of these companies and greater satisfaction of interested groups. Improving the quality of business becomes an imperative of the modern market and global flows. Valtakoski & Witell (2018, p. 1144) stated that different SMEs' resources capabilities lead to different outcomes. Due to that, SMEs need to carefully consider which service capabilities (i.e. service resource) to invest in. Valtakoski and Witell (2018) showed that front office service capability has a positive impact on firm performance of SMEs.

The ultimate goal of the business is to achieve business excellence. Such defined goals, in the conditions of the global market, create preconditions for successful business and development based on meeting all segments of the society (consumers, partners, employees, owners, state administration, and general public). According to Todorovic, Kalicanin, Nejkovic (2015), the purpose of performance measurement is also reflected in the value of business management. In order to know what the direction should be, the quality of management (enterprise, resources, etc.) need to be measured. The presented example is in the area of assortment of fashion and decorative fabrics (FDF). It refers to the implementation of the service strategy, the impact of the defined strategy on the behaviour of consumers and the monitoring of consumer satisfaction with the service itself in trading.

The presented work consists of six sections. After the introductory, the second section of the paper shows the process of retailing of fashion and decorative fabrics (FDF) as well as SMEs that are in this activity. The third section defines the management of SME resources for retail FDF. The fourth section presents a survey on the characteristics of the quality management of SME resources in the retail of FDF. Following the survey methodology, results are presented with the discussion. Section 5 gives a conclusion. The literature is shown in section six.

2. SMEs IN THE RETAIL OF FASHION AND DECORATIVE FABRICS

According to Overdiek (2018) mostly starting small micro retailers have very limited financial resources and consequently they are experimenting with alternative business model (like e-business/e-retail) which additionally does not require huge material business resources. On the other side, small and medium-sized enterprise (SME) retailers, in particular, encounter significant challenges in defending market share and the implementation of marketing efforts to attract new customers (Hutchinson et al., 2015). According to *Radunović* and *Lovreta* (1995, p. 11), retail enterprises are intermediaries in goods trading between wholesale and end-consumers. If they do not use wholesale services, retailers mediate between manufacturers and consumers. On the basis of this, the turnover of goods takes place according to the

scheme: producer - retail - consumer. Procurement of retail companies is not limited, and they can also obtain goods from wholesale and retail enterprises, directly from the manufacturer, while wholesale is limited to manufacturers and importers. Accordingly, retail stores supply products from wholesale, directly from the manufacturer or combined. The enterprise will choose previous options according to following characteristics: the quantity of procurement, the width of the assortment, the cost of purchase.
Retailing is a process in the marketing channels, which include activities among the final consumers and wholesale, or the final consumers and manufacturing enterprises (*Stanković* & *Čavic*, 2013, p. 114).
According to Milošević (2015, p.33), retail trade is the main initiator of the economic development of one country and therefore is one of the basic economic activities of that country. The importance of retailing is also contributed by the presence of a large number of stakeholders.

One of the items that trade of fashion and decorative fabrics distinguishes as specific would be the remains of the material is so-called rests, which need to have a special low price to be sold. In addition to the rest, particular attention should be paid to process of purchasing goods. *Jokić* (2010, p.131) states that too much procurement of fashion items can lead to excessive stocks, which, along with numerous actions and price reductions, cannot be sold. However, in the opposite case, the lack of fashion items leads to dissatisfaction of customers who then turn to competitors, and this results in poor company reputation and decreased sales. The seasonality of the goods is usually solved by experienced sellers by applying a combination of wide and shallow assortment, given the uncertainty about the acceptance of certain products by customers. With the passing of the season and acquiring knowledge about the sales of particular items, the orientation is on the narrower, but also denser and deeper assortment. At the end of the season, traders tend to focus on selected assortment lines, and on certain types of products within these lines. In the offseason, the situation is most favourable if there are no longer seasonal products in the stock (*Jokić*, 2010, p. 132).

The model of organising sales that applies to the sale of fashion and decorative fabrics is an organisation according to customers. This model is very applicable to companies where sales depend on good, very close and long-lasting relationships with customers. Customer organisation is also interesting when customer needs are specific, so each customer's order is preceded by the process of solving the problems that the customer has. In the case of selecting fabrics for sewing some clothing materials, where the consumer explains the appearance of his model and the seller informs him and advises which material would be adequate for this model. The place and role of consumers in the retail market depends on (*Stanković*, 2010, p. 566): The speed of consumer service; „Possession of hearing" for changes on the demand side, as well as agile response to these changes; Creating a customised offer and individual consumer focus; Care for the needs and demands of consumers over an extended period of time.

The primary task of trade is to ensure the continuity of social reproduction, linking producers and consumers and aligning they're many, often contradictory, demands and interests (*Lovreta et al.,* 2011, p. 177),. "Trade in its place in reproduction represents a kind of "barometer" for registering all changes in the scope and structure of supply and demand in the market" (*Lovreta et al.*, 2000, p. 179). According to *Stanković* (2010, pp. 567-568), a learning-based dialogue is established between businesses and consumers. It means that retailers provide their consumers with an opportunity, to inform retailers about their own needs. In that sense, the consumers actively participate in the offer of retailers, with the new significant roll of modern customer. Based on that, the retailer can meet the requirements and satisfy the needs of consumers, and this business relationship is continuously expanding.

3. MANAGEMENT OF SMSEs RESOURCES FOR RETAIL FDF

SMEs have limited resources, grow rapidly and undergo significant organizational changes over time (Tatikonda et al. 2013; Valtakoski & Witell, 2018). For the operation of every technical or organisational system, according to *Omerbegović-Bijelović* (1998, p.37), besides the presence of resources, other essential elements that contribute to the management are: the plan - as the information, employees and human resources - their knowledge and readiness for action, the authority of the employees - as the potential for starting and conducting activities. In fact, these relevant resources contribute to smooth business. Indicators of completeness, timeliness and efficiency contribute to better quality of resource security.
This paper section will describe SME resources for the retail of fashion and decorative fabrics, and will presents how SMEs manage their resources.

3.1. SME resources for the retail of fashion and decorative fabrics

According to *Figar* (2015, page 44), some resources are universal for all companies, and some are unique. Companies create and use them only for their own needs. Resources with their special purpose are at a higher level than standard resources. The resources that are engaged in the retail of FDF are the following (*Omerbegović-Bijelović*, 2006, p. 101):

- Location and business-production space
- Equipment for a realisation of operation (machines, tools, etc.)
- Working objects - raw materials, materials, components, etc.
- Energy, fluids, water
- Human Resources
- Funding
- Time
- Information and knowledge
- Communication

The SMEs resources for retail of the FDF are as follows: Retail stores, goods and human resources. From these resources, the following performances which significantly influence the quality of resource management, are derived from,:

- The performance "quality of the sales store" - one of the most important factors for selling are the "location of the retail store" and "attractive sales space";
- The performance "quality of goods" - which represents parameters of properly selected goods, in accordance with consumer needs;
- The performance "quality of human resources" - which is considered crucial for retail, because sales staff are the key resource in retail business sales.

3.2. How SMEs manage their resources

The primary purpose of resource management is to adequately procure and exploit all business resources and especially those unique to a particular type of business. By separating the performance and further, the key performance indicators, the information used in planning the strategy and guidelines for the quality of resource management comes up.

According to *Omerbegović-Bijelović* and *Krsmanović* (2011, p. 397), the management means cyclical activity, in which the following phases are continuously going: planning, organising, realising and controlling. The basic phases of the management process (including resource management) are (*Omerbegović-Bijelović*, 2010, pp. 139-153):

1) Management planning - the stage of creating and selecting the goal, decomposing the goals from the highest to the lowest level, defining the activities of achieving goals, balancing resource requirements and determining ways to meet these needs;
2) Organisation of Management - involves delegation organisational entity and individuals for the realisation of specific objectives and assigning authorisations to organisational units or individuals for acquiring and disposing of resources and for initiating activities necessary to achieve the set goals;
3) Realisation of management - as a phase with groups of operations for: a) preparing the subject of work object, i.e. resource, which means ensuring availability, i.e. acquiring sufficient amount of resources and delivering them to workplaces (so-called "job closure"); and b) transforming the form, content and/or object work position;
4) Controlling the management is a phase of the following groups of operations: a) controlling and measuring the value and intensity of the performance indicators; b) comparing the obtained and planned values of the observed performance indicators and finding the causes that led to the deviation; and c) creating recommendations and corrective measures that will be applied in the next management cycle (which should be more successful than the previous cycle).

Based on previously defined resource management performances of SMEs for MDT, indicators of these performances can be defined. These performance indicators enable management to review the quality of enterprise resource management (and even the quality of enterprise management). By analysing scientific and professional literature, for this paper, indicators of selected performance are defined:

1) For the performance of the quality of the sales store facility, the following indicators have been selected:

- Retail store distance from the centre of the town [km]
- Business premises arrange [1]
- Retail space area [m2]
- Area of the street side of the retail shop [m2]
- Distance from competitors' retail shop [km]

2) For the performance of goods supply quality, the following indicators have been selected:
- ROA = Net profit / Total assets (%)
- ROE = Net Profit / Equity (%)
- Realization of the sales plan (quantity) = Realized sales in the reporting period * 100 / Planned sales in the reporting period [%]
- Realization of the sales plan (money) = Realized sales in the reporting period * 100 / Planned sales in the reporting period [%]
- The coefficient of inventory turnover = Cost of goods and services sold / Average inventory balance [1]
- Average turnover time = 360 / Coefficient of inventory turnover, in [day / turn].

3) For the performance of human resources quality, the following indicators have been selected:
- Productivity [k.j./v.j.]
- Motivation [1]
- Customer satisfaction caused by employees behaviour [1]
- The average level of education [1]
- Employee satisfaction [1].

According to *Vujic* (2013, p. 625), in the present conditions of the increased offer of goods, consumers are becoming more and more demanding, which results in quick satisfaction with a particular customised product or brand. There is an increasing desire for new and better quality products on the market. There is a real turning point in the world market, and it is emphasised that the key to competitiveness is the quality of products, resources and other elements in business.

4. SURVEY ON CHARACTERISTICS OF RESOURCES MANAGEMENT QUALITY OF SME IN FASHION AND DECORATIVE FABRICS

Most small and medium-sized retail enterprises have a problem with resource management due to their limited availability. By researching the quality of resource management in retail FDF, key performance indicators have been highlighted, which will - in the further process of measuring the resource management quality - serve for comparison with the results from previous measurements and point out the guidelines for planning strategies and operations to improve the quality of resource management.

The company expects that key performance indicators will provide answers to questions that the company needs to determine the quality of resource management. In order to obtain efficient and effective management, it is necessary for the organisation to ensure that key performance indicators provide information that is accurate, measurable, reliable and usable for the implementation of corrective measures.

Research on the quality of resource management for SMEs engaged in the retail of textile goods is based on the use of different ways of determining the quality of resource management.

4.1 Research methodology

The specific problem that is being investigated in this paper relates to characteristics of resource management quality (RM) of SMEs that deal with retail FDF. It means that it is necessary to define the performance of this quality and their indicators. Then, a "pattern" for determining the quality of the RM should also be determined. This information is later used in determining the quality of enterprise management, tracking this quality through history, for comparison with competitors, defining measures to improve business results / and selling FDFs) and others.

One of the methods used for the theoretical foundation of the research problem is the review and analysis of literature (i.e. table research). Relevant literature, as well as Internet sources, were used correctly. In field research, a survey method with the questionnaire was used. The crated questionnaire was on the quality of SME resource management for the retail of textile goods.

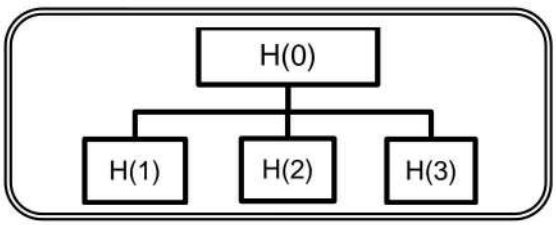

Figure 1: Structure of the main hypothesis

Given the complexity of the issues discussed in this paper, the main hypothesis is defined: H(0): It is possible to define the desired quality of resource management and determine the limits of tolerance. The general hypothesis H (0) can be further decomposed into individual hypotheses:
H (1): It is possible to define the resources that are most significant for the quality of the SME business in retail FDF.
H (2): It is possible to define the quality of resource management as a function of the value of their key performance indicators.
H (3): It is possible to determine the limits of tolerance for the quality of resource management for SMEs that deal with a retail of FDF.

All three individual hypotheses refer to defining the quality of resource management. To obtain the necessary data of research object (the selection of key performance indicators, and the determination of tolerance boundaries, it is necessary to consult the practitioners in this field. Therefore, a questionnaire was made to gather relevant data from owners and employees in SMEs that retail in FDF, and verify proposed hypotheses.

The questionnaire consists of three parts: information about the respondent, information about the company, as well as the attitudes and statements of the respondents about the subject of the research (to determine the performance and their importance, key performance indicators and the quality of the resource management). The survey was conducted on the territory of the Republic of Serbia, in November 2017, on a sample of 35 owners and employees of SMEs in the business of FDF retail. The obtained sample was from following cities and municipalities: Ub, Belgrade, Novi Sad, Sabac, Smederevo, Požarevac, Valjevo, Obrenovac, Lazarevac).

4.2 Results of research and discussion

Starting from the general hypothesis H(0): It is possible to define the desired quality of resource management and determine the limits of tolerance, the truthfulness of the proposed general hypothesis H(0) is proved through three individual hypotheses: H (1), H (2), and H (3). In order to verify the truthfulness of the individual hypothesis H(1): "It is possible to define the resources that are most important for the quality of SME business in retail with RTF", first research question (RQ1) was proposed. RQ1 is about the significance of the observed SMEs' resources for retail in FDF.

Table 1 presents the observed resources of SMEs for the retail of textile goods. Respondents were offered three groups of resources (RQ1, Table 1) for evaluation. They were evaluated according to their significance, percent, i.e. distributing 100 [%] among these three resources. It was possible to "vote" on more resources with the same or different importance (in percentage up to 100%) Two respondents did not answer this research question in compare to 33 respondents who did it.

The most significant resource (Table 1, RQ1), with the highest percentage value, is "goods" (40.61%), followed by "human resources" (31.96%) and "sales facilities" (27.43). This distribution is accepted as assigning coefficients of significance to the observed resources. This result in Table 1 confirms the individual hypothesis H(1): It is possible to define the resources that are most important for the quality of SME business in retail with RTF."

To verify the truthfulness of the individual hypothesis H(2): "It is possible to define the (desired) quality of resource management as a function of the values of their key performance indicators (KPI).", the research questions RQ2-RQ20 were set up.

The majority of questions include answers based on the Likert scale. For each of the statement in question - the respondent was required to show the degree of agreement with the statement, with response from a set of 1 to 5, where "1" is the lowest estimate, and "5" - the highest score. The Researches questions RQ2, RQ8 and RQ15 required the respondents to round off offered responses as the selection of most important performance indicator.
The second research question (RQ 2) is: "Which of the mentioned indicators best demonstrates the importance of a retail object as a SME's resource for retail in FDF"? Table 1 shows the respondents' answers to this question. The most valuable indicators were: Retail store distance (54.3%), business premises arrange (20%), and distance from the competitors (17.1%).

Location of the retail facility is marked as an indicator that best demonstrates the significance of a retail store as a SMEs' resource for FDF retail. Furthermore, all respondents were asked to reply to the additional research question: "Estimate the value of indicator that presents distance of the retail facility from the town

centre (RQ3). According to the results of the survey, the average values of the distance of the retail facility from the centre was 4.43, which represents a high value on the scale of 1-5, with high of importance.

Table 1: Research results - research questions: RQ1 - RQ7

RQ	Question	Respondents answers	Frequency (%)
1	Significance of observed retail resources performance	Retail store	9 (27,4%)
		Goods	13 (40,6%)
		Human Resources	11 (31,9 %
2	The Indicators that best show the importance of retail store as a SME resource.	Retail store distance from the town centre	19 (54,3%)
		Business premises arrange	7 (20,0%)
		Distance from competitors' stores	6 (17,1%)
		Area of sales space	2 (5,7%)
		Area of the street side of the building	1 (2,9%)
RQ	**Estimates of indicators value (scale 1-5)**	**Mean**	**Std. deviation**
3	Retail store distance from the town centre	4,43	0,65
4	Business premises arrange	4,34	0,72
5	Area of sales space	3,57	0,85
6	Area of the street side of the building	3,66	0,87
7	Distance from competitors' stores	3,40	1,12

In the research question no. 4, respondents were asked to assess the value of the Business premises arrange on a scale 1-5 (Table 1, RQ 4). The average value was 4.34. Similarly, the average estimate values on others research question RQ5, RQ6, and RQ7, with performance indicators are respectively: Area of sales space was 3.57; Area of the street side of the retail shop was 3.66 (on scale 1-5); Distance from competitors' stores was 3.40.

Table 2: Research results - research questions: RQ8 - RQ14

RQ	Question	Respondents answers	Frequency (%)
8	The indicator that best shows the importance of the goods a SME resource	Sales realization plan (cash)	10 (28,6%)
		Inventory turnover ratio	8 (22,9%)
		Sales realization plan (quantity)	7 (20,0%)
		Average turnover time	7 (20,0%)
		ROE - Return on equity	2 (5,7%)
		ROA - Return on assets	1 (2,9%)
RQ	**Estimates of indicators value (scale 1-5)**	**Mean**	**Std. deviation**
9	ROA - return on assets	3,80	0,90
10	ROE - Return on equity	3,86	0,97
11	Sales realization plan (quantity)	4,14	0,83
12	Sales realization plan (cash)	4,34	0,72
13	Inventory turnover ratio	4,46	0,74
14	Average turnover time	4,29	0,75

Answers to the research question (Table 2, RQ 8) "Which of these indicators best demonstrates the importance of goods in a retail store - as a SMEs' resource for dealing with retail FDF", show that these are: A sales realization plan (cash) with 28,6%, inventory turnover ratio (22.9%), sales realization plan (quantity) (20%) and on average turnover time (20%). The average estimate of key performance indicators values related to their importance for the resource goods are (Table 2, RQ 9-RQ 14): ROA - return on assets (3.80); ROE - Return on equity (3.86); Sales realization plan - quantity (4,14); Sales realization plan - cash (4.34); Coefficient of inventory turnover (4.46); Average duration of one craft (4.29).

Distribution of the answer to the research question no. 15 which presents the indicator that best demonstrates the importance of human resources in the retail FDF business is given in Table 3 (RQ 15). The results of the response on the scale 1-5 show the following most important indicators: Customer satisfaction with employee services (54.3%) and employee productivity (28.6%). Table 3 also shows the average response values to research questions (RQ16-RQ20) related to the importance of the following key performance indicators: Productivity of employees (4.60); Motivation of employees (4,69); Customer satisfaction caused by employees behaviour (4.83); Average level of education of employees (3,49); Employee satisfaction (4.66).

The results for the research questions in Table 1 (RQ 2-7), Table 2 (RQ 8-14) and Table 3 (RQ15-20) and the conclusions drawn from these data confirm the proposed individual hypothesis H(2): "It is possible to

define the (desired) quality of resource management as a function of the values of their key performance indicators (KPI).",

Table 3: Research results - research questions: RQ15 – RQ20

RQ	Question	Respondents answers	Frequency (%)
15	The Indicators that best show the importance of a human resources as a SME resource?	Customer satisfaction with employee services	19 (54,3%)
		Productivity of employees	10 (28,6%)
		Employee satisfaction	4 (11,4%)
		Motivation of employees	1 (2,9%)
		Average level of employees' education	1 (2,9%)
RQ	**Estimates of indicators value (scale 1-5)**	**Mean**	**Std. deviation**
16	Productivity of employees	4,60	0,60
17	Motivation of employees	4,69	0,47
18	Customer satisfaction caused by employees behaviour	4,83	0,38
19	Average level of employees' education	3,49	0,89
20	Employee satisfaction	4,66	0,54

The research questions (RQ21-RQ23, Table 4) are defined in the process of verifying the truthfulness of the individual hypothesis H (3): It is possible to determine the limits of tolerance for the quality of resource management for SMEs that deal with a retail of FDF.

The RQ21 are related to the determination of the desired upper limit for assessing the quality of resource management in the observed company. The average values of respondents' responses to RQ21 were 4.46. Similar, the question RQ22 was about (acceptable) lower limit for assessing the quality of resource management in an enterprise. The average value was 2.77 on a scale of 1-5. Regarding the assessment of the current quality of resource management in respondents' enterprises, in Table 4 (RQ 23) the average results of the respondents' responses were 3.91 on a scale of 1-5. This result, which represents the level of quality of resource utilisation, is considered adequate because the desired upper and lower limits are defined within the framework.

Table 4: Research results - research questions: RQ21 - RQ23

RQ	Respondents estimates (scale 1-5)	Mean	Std. deviation
21	Desired upper limit of resource management quality	4,46	0,51
22	Desired lower limit of resource management quality	2,77	0,77
23	Assessment of the current quality of resource management	3,91	0,70

According to Omerbegović-Bijelović (1998, p. 57), in order to determine the real condition of the resource management quality, it is necessary to measure data on current state of business performances.
The survey results in Table 4, confirm individual hypothesis H (3): It is possible to determine the limits of tolerance for the quality of resource management for SMEs that deal with a retail of FDF.

The real state of the quality of resource management in the SMEs dealing with retail FDF in Serbia (at the end of 2017) is obtained from the respondents estimates, according to the following formula QRM (where: CIP is Coefficient of Importance of selected Performance, and EVIP is Estimated Value of Indicator that best represents selected Performance):

$$QRM = \sum_{j=1}^{3} \mathrm{CIP(j)} \times \mathrm{EVIP(j)} \quad (1)$$

$$QRM = 0{,}274 \cdot 4{,}43 + 0{,}406 \cdot 4{,}34 + 0{,}319 \cdot 4{,}83 = 1{,}214 + 1{,}762 + 1{,}541 = 4{,}517 \ [1]$$

In our survey we selected following indicators that best represent observed performance: 1) For performance Retail store (CIP = 0.274) it is: retail store distance from the centre of the town (EIVP = 4.43); 2) For performance goods (CIP = 0.406), it is: sales realization plan (cash) (EVIP = 4.34); 3)For performance human resources (CIP = 0.406) it is customer satisfaction caused by employees behaviour (EVIP = 4.83).

The truthfulness of the individual hypotheses H(1), H(2), and H(3) is verified, and it can be concluded that the general hypothesis H (0) is confirmed.

5. CONCLUSION

Defining the quality of the management of small and medium-sized enterprises (SMEs) dealing with the retail of fashion and decorative fabrics (FDF) can also improve the management of the SME itself. Therefore, the

significant performance of the management of the resources of such SMEs and the corresponding quality indicators are defined; This allows generating measures to improve the management of resources that are engaged in retail (for more successful / higher quality business, i.e. increasing retail sales of these SMEs). The results show that respondents recognize the importance of certain management indicators, as well as the objectives and importance of management. The survey results also show that the quality of resource management can be defined. The research process in the retail of FDF was difficult due to the resistance of owners, employees and their over-ambitious presentation of the current quality of resource management of SMEs. The response rate in the survey was low due to the resistance of owners and employees of SMEs. This could be observed as the limitation of this survey. A part of data was collected by distributing on-line questionnaires to respondents, without direct contact. Therefore, the respondents did not have the opportunity to get explanations of possible uncertainties in research questions. Besides the survey confirmed proposed individual hypotheses H (1), H (2), and H (3)) was the main hypothesis H (0).

The survey limit was the method of frequencies used to evaluate the results. Future research directions would be, comparison of small, medium-sized and large enterprises in the field of the resource management quality improvement.

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PROBLEMS WITH RESOURCES MANAGEMENT IN CATERER-SME IN THE DIGITAL AGE

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Abstract: *This paper deals with the research of relationships to the problems of SMEs management (management of small and medium-sized enterprises), as well as management of catering/restaurant SMEs (RSMEs) in Serbia in the digital era (with the typical use of ICT and, consequently, the necessity of data). The example given refers to the resources management (RM) in catering RSMEs; the first steps of "problem management" (or "problem solving") are observed here - identifying and registering the problem (i.e. generating and storing data). These data are also used to determine the Management Quality (MQ) and for Management Quality Improvement (MQI). The issue with the RSMEs that we look into is the lack of records (lack of databases and / or data files, both electronic and / or hard copy) about the problems identified in RM enterprises. The general hypothesis implies that it is necessary and possible to identify and register problems occurring in RSMEs; this means that it is necessary and possible to generate and store problem data, and subsequently use them to determine the MQ, even the MQI. The survey was carried out in November 2017, on a sample of 35 SMEs owners in Serbia, in the catering business. It has been determined that there is a need and possibility to detect and register problems (as the first stages of problem solving / problem management), but that, in practical terms, the problems are modestly observed and even more modestly registered, which interferes with (and even prevents) MQI; thus threatening the quality of catering services and the quality of RMSEs, diminishing the success of the tourism industry, even the entire economy (of Serbia). The results help ICT designers, MQI consultants, scientists, and especially managers, namely all those who are seeking to improve the quality of RMSEs, as well as the management of complete enterprises (and RSMEs) - so that they can work on problem solving (with RM and other areas of management - even with the lack of data) and to deal with MQI (for which they need data). The results are applicable not only to RSMEs, but also to all SMEs and other types of organizational systems, but also may be an inspiration for further research in the areas mentioned here: problem solving / Problem management, Resources management (RM), SMEs management, Management quality (MQ), Management Quality Improvement (MQI), as well as in other areas of management.*

Keywords: *Enterprise management quality (EMQ), Management quality improvement (MQI), Resource management, Small and medium enterprises (SME)*

1. INTRODUCTION

In the 21st century, for a long time, the problem is not related to technologies (farming methods, plastic toys production, or persuading customers to opt for a particular product / service), machinery and automatization, not even to financing, advertising, data and information handling. Solutions are now being sought to create new needs, to open up new markets, to use still unused management resources, and new principles of organization and other tools for improving MQ in the enterprises (even SMEs), and all for greater competitiveness and more successful business (Omerbegovic-Bijelovic, 2016/2017b).

Since the MQ is a measure of fulfilling the purpose of management, it (through performance, indicators, key indicators and their measurement systems) determines the actual and desired MQ and compares their differences with a tolerant (difference). When this difference is greater than tolerant difference, the situation is perceived as a problem and corrective action is defined (and taken). In this process, a variety of data (a lot of data) are used (the entire history of the behavior of the management object and the planned and realized management decisions). They rely on ICT implementation in the management of large databases, because it assumes the availability of these data and the application in generating management decisions - even the decisions regarding MQI. As SMEs, as a rule, do not have many choices and have very limited amounts of resources, it is more important that their decisions are right, that is, based on the right data processed in the right way. This is also true for solving business problems and for basing the decisions on the right data and processing methods - in generating management decisions on corrective actions.

This paper deals with one kind of relationship to problems - as an ongoing topic in all organizational systems. More precisely, it is observed whether (and how) the problems are observed and registered - to serve as an incentive for further, more successful problem management (and their resolution). For starters, this work is

important for identifying and registering problems, but also for further development of scientific support for Problem solving, Quality improvement, and thus for Management Quality Improvement.

To illustrate this, we use RSMEs as a special type of SMEs operating in Serbia nowadays. The lack of data on the types and intensity of the problems they face, and the solutions applied to these problems, is perceived as a research problem. But for "diving into" the research, a thorough preparation is required. In this case, it means getting familiar with the following topics: RSMEs, resources of RSMEs and their management, problems with (management) resources of RSMEs. Then it is possible to investigate the problem(s) encountered by everyone who seeks to improve the quality of SME. With no data, any attempt to help such companies is either based on memories and feelings, or needs to wait for the previous collection of data - until "history of occurrence and problem solving" is done. More on these topics can be found in Zivadinovic (2018).

2. RESOURCE PROBLEMS IN CATERER-SME

In every area of management in the company (as well as in the RSME) there are problems - with the possibility of predicting them, more or less. It depends on the management how careful the RSME will be in looking for the first symptoms of the problem (or even in predicting them), as well as in the ways of "fighting" the problems. One thing is certain: there is no permanent success in dealing with the problems if that is not done systematically (consciously, intentionally, publicly - at least for participants, based on authentic data, with recording and storing data, and with the adequate use).

Of course, the purpose of solving the problem, the type of the problem, the object in which the problem was manifested, the resources involved in occurrence of problems and their solving, the availability of data on the problem, the intended data processing methods, the future application of the solution, and other aspects are important and some of them are discussed in this paper.

2.1. Caterer-SMEs

"Catering is an important business, which is mostly a part in the structure of tourism; its capacity enables the realization of tourist traffic in a particular tourist place, a specific region and the country as a whole". (Rikic, 2001, p.235) According to the UNWTO (2017) World Tourism Organization, tourism turnover has reached a value of 1087 billion (in 2013). The increase is recorded worldwide and relates not only to tourism in general, but also to the catering business as a significant part of it. The rising trend is also reflected in the business of hotels and resorts as the largest catering companies, but it has the same effect on the RSME (performing as catering companies: restaurants, cafes, bars, fast food restaurants, family-type apartments, mini-hotels, etc.), more details in (Zivadinovic, 2018, p.13).

The trend of employment increase in the service sector continues, so catering is an attractive activity (especially since the modern man spends much more than 8 hours a day, and there is no time, no energy, and no interest also in preparing the meals. Furthermore, RSMEs have remained the places for socializing, negotiations, celebrations, having fun ... and even eating.

2.2. Resources of RSMEs

Resources are "all possible tangible and intangible goods that make organizational systems alive" (Omerbegovic-Bijelovic, 2006, p.98). "We give the name "resources" to all material and non-material sources of material wealth and economic well-being. It should especially be emphasized that the population is a resource over resources" (Veselinovic, 2012, p.49). They" enter" the organizational system (here: RSME), participate in the transfer of values and in its addition, namely in creating more value for RSME products / services. They are the "transmitters" of value (materials and the product itself, but also the object, equipment, etc.), as well as creators of value - human resources, business connections, etc. (Lazic-Rasovic & Omerbegovic- Bijelovic, 2006, p.5).

Like every company, SMEs, and those who deal with catering (RSMEs), use all of their business resources. In the aforementioned work of the co-author (Zivadinovic, 2018), numerous resources of the RMSEs are used as illustrations: location, facility and business space, material / foodstuff, employees, financial assets, as well as the market (service users). The specifics of resources in catering industry are also presented (Ibidem, pp. 5-59). It refers to people, most of all - their competence and behavior in the workplace (according to resources) in the RSMEs. Bearing in mind that each organizational system has two subsystems - management and the managed one, then one must not forget that the first one (management) performs based on data (and corresponding information and documents, as well as data handling tools). Management is based on data. Therefore, data must be the right type, reliable, accurate, available, and also to have the necessary quantities of them (and in time, throughout "history").

2.3. Resource problems in RSMEs in the digital era

In the business of each company (even RSME), when handling any resource (and their combination), besides creating and transferring values, there are problems and it is necessary to deal with them. These problems are related to the nature of resources, but also to the behavior of the system (RSME) towards specific resources (in terms of expectations from the resources, and also attitudes towards them).

Since catering entails a steady and close relationship with service users, special importance in RSMEs must be attributed to human resources (HR). The aspect of HR education and training for work in the RSME is often emphasized, but the significance of the variability of HR behavior and the difficulty in controlling such conditions are not disregarded (Bateson & Hoffman,2013). There are numerous problems in the HR management to be solved. The same holds true for the relationship to all other RSME resources. This is because "business performance in companies in the catering industry requires, above all, acceptance of these problems, dealing with them and overcoming them, involving all the participants and interest groups" (Zivadinovic, p.60).

In the digital era, there are also many other resource expectations, as well as many new responsibilities towards resources: the modernity / digitalization of objects, equipment, and communications, certainly, the availability of data and their interpretations (information, knowledge, ideas. Etc.). Therefore, when discussing MQ and the necessity for continuous improvement of MQI, the importance of having the right information at the right time, with the right processing and the use of data and information is emphasized.

When it comes to this resource (data), it is especially important that there is a will (as a resource) in companies (and RSME) to "face the truth" (in terms of disposing of data and information and their publicity / availability) as well as to provide relevant data. It further states that the data (both resource problems and solutions to these problems) are recorded and stored, and, before that, to predict the emerging of problems and to monitor the emerging itself. It is a serious set of activities in the area of "problem management" and there are few companies that can boast to deal with it in a systematic way.

3. A POSSIBILITIES FOR IDENTIFICATION AND DESCRIPTION OF RESOURCE PROBLEMS IN CATERER-SMEs RESEARCH

In reducing public resistance to data problems, and in facilitating more successful problem solving and improving the overall management of RSME problems, it is necessary to clearly define the research problem (whose object is the RM problem in RSMEs). It is also necessary to define the idea (general hypothesis and its structure) about solving the researched problem, to elaborate the research methodology and to consider the results of the research and the authenticity of the general hypothesis.

3.1. Reasearch problem

Bearing in mind the problems of successful management of RSMEs, and especially resource management problems in such RSMEs, as well as the history of occurrence and management of different categories of problems, the focus of this paper is to provide data for future researchers, consultants, competent managers, etc. In any subsequent attempt to help improve the quality of the management of RSMEs, they will need data on problems that may arise in RSMEs and ways of solving such problems. Therefore, for the purposes of writing this paper, it was necessary to define the problem that was to be solved.

The research presented in this paper, as part of the research conducted in the master thesis of the first author - Zivadinovic (2018), focused on the evident problem of the lack of adequate information (and data) in RSMEs. The lack of data on the history of occurrence of problems and their management in the specific RSME is particularly important. The aforementioned master thesis offered a model forsolving problems in resource managementof RSMEs; the first two steps refer to the detection and identification of problems (and operatively undertaken activities for their management). The reason for pointing out the importance of these two steps is the notion that RSMEs in Serbia do not pay enough attention on the data upon which the decision-making / management system is based. It seems that SME restaurant owners, in view of limited management competence, ignore the data on problem detection and management, and without them effective (nor efficient) improvements in management quality are not possible. Therefore, the authors of this paper addressed the issue of detection/recognitionand identification/descriptionof problems that may occur in RSMEs.

3.2. Research methodology

The aim of this paper is to verify the primary/general/basic hypothesis H (0):
H (0): It is possible to identify and describe problems in resource management inRSMEs.
This hypothesis is decomposed into three individual hypotheses (Figure 1):
H (1): There is a constant need to identify and describe resource management issues in RSMEs.
H (2): It is possible to identify problems in resource management in RSMEs.
H (3): Problems in resource management in RSMEs can be described.

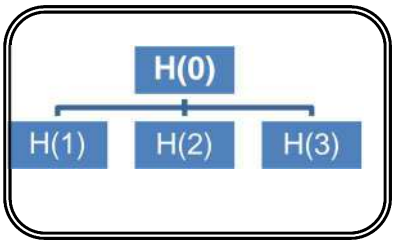

Figure 1: Structure of H(0)

The verification of the general hypothesis H (0) is performed upon theverification of all three individual hypotheses. The veracity of individual hypotheses is performed through "packages" of research questions (RQ) – and checked through "Table research" and through "Field research" which use a questionnaire as a research tool.

The questionnaire contains 7 questions about the "sample" (respondents, ie research participants, or owners of RSMEs). They are followed by 11 questions on RSMEs and 19 questions on the topic of identifying and describing resource problems in RSMEs. Research packages are defined for each of the three individual hypotheses: 5 RQ for H(1), 6 RQ for H(2), and 8 RQ for H(3).

The survey was carried out in November 2017, in SME restaurants (hereinafter RSMEs) in Serbia. The data (answers to questions in the questionnaire) were obtained through personal contacts with respondents (35 of them). All the examinees are RSME owners (of which 26 examinees belong to micro enterprises, 74.2%). The majority are men (27 examinees, 77% of the sample), and their age and work experience have (mostly) uniform distribution - in the interval of 20-50 years. They differ greatly by occupation (3 examinees (8.6%) are economists, 9 examinees (25.8%) are caterers, followed by 2 examinees (5.7%): chefs, butchers, graduated tourism managers (15 or 42.8%) named "other" as their occupation. According to the level of education of the examinees, the sample contains the highest (15 examinees, 42.9%) examinees with secondary school and faculty education (12 of examinees, 34.3%). Most examinees (24, 68.57%) own one company, and there are also some with more than two companies (3 examinees, 8.57%). Regarding the length of entrepreneurial role (ownership of SMEs), the answers are the following: 11 examinees (31.43%) are the owners for 5-10 years, 10 examinees (28.57%) are the owners for 10-20 years, 9 examinees (25.71%) are owners of the company for less than 5 years.

The enterprises owned by the examinees, besides catering, also deal with other business activities (wine production, shops, exchange offices, photography services, transport services, printing houses and music agencies), and have the following characteristics (in the main lines), ie. according to the indicators: a) The number of employees, the structure of the sample indicates that 18 examinees have less than 5 employees (51.3%), 8 examinees have from 5 to 10 employees (22.9%), the same as in the SME category from 11 to 25 of employees, while one examinee (2.9%) has more than 50 employees; b) The location of the catering facilities owned by the examinees, the majority (19, 54.3%) are in the city (of which 63.16% is located in the city center); c) Area of catering facilities, the majority (16 examinees, 45.71%) have facilities with area not larger than 100 square meters, although there are (6 examinees,17.4%) and those with facilities larger than 1000 square meters; d) How to approach the catering objects of the examinees, access by motor vehicles is provided almost in all (29 facilities, 82.85%); e) For the ability of employees to identify and solve problems, the examinees expressed (unreal) high reliability: for 20 examinees (57.1%), their employees deserve grade 3 (for problem solving), for employees (22.9%) they deserve grade 4, and 7 examinees (20%) give their employees grade 5 (for identifying and solving problems (Zivadinovic, 2018).

3.3. Research results

The research resultsare presented according to individual hypotheses, and within the hypotheses themselves according to research questions. The hypothesis "H(1): There is a constant need to identify and describe resource management issues inRSMEs" is verified through responses to 6 research questions that therespondents (owners of RSMEs) were asked to answer: RQ1 Are there problems of different categories in your company? The respondents (35 of them) were able to choose more than one answer; the structure of their answers can be seen in Table 1.

Table 1: Structure of responses on resource management problems in RSMEs

Potential responses on problems in RSMEs	Number of respondents	Score (in [%])
Interaction between the employees	24	68,57%
Interaction between the clients and the employees	19	54,29%
Location selection	14	40,00%
Construction and equipping of restaurants	14	40,00%
Organization of space in restaurants	14	40,00%
Storage of food	17	48,57%
Financing business activities (i.e. problems with financial assets)	21	60,00%

Several problems from different categories may appear in RSMEs (hereinafter RSMEs). All problems are, to a lesser or greater extent, related to resource management in RSMEs, hence the focus on resource management: RQ2: Do you often have resource management problems(human resources, facilities, equipment, food, water, energy, financial resources, etc.) in your company? Respondents' answers are presented in Table 2.

Table 2: Structure of responses on frequency of resource management problems

Possible answers	Number of respondents	Score (in [%])
Never	2	5,70
Very rarely	11	31,40
Sometimes	8	22,90
Often	14	40,00
Always	0	0,00
Total	35	100,00

RQ3: Do you have difficulty in classifying resource management issues (by category, people in charge...)? Respondents' answers are presented in Table 3. The respondents reported frequent and occasional occurrence of resource management problems (14+8=22 responses), as well as frequent occurrence of difficulty in classifying resource management problems (13+7=20). (There were opposite statements, but the objectivity of the RSME owners should be verified.)

Table 3: Structure of responses on difficulties in classifying resource management problems

Possible answers	Number of respondents	Score (in [%])
Never	3	8,60
Very rarely	12	40,30
Sometimes	7	20,00
Often	13	31,10
Always	0	0,00
Total	35	100,0

The responses to RQ4: How serious are the resource management problems that you meet in your company? are presented in Table 4.

Table 4: Structure of responses on gravity of resource management problems in RSMEs

Possible answers	Number of respondents	Score (in [%])
Problems are not serious	12	34,30
Problemsare very rarely serious	7	20,00
Problems are sometimes serious	3	8,60
Problems are often serious	13	37,10
Problems are always serious	0	0,00
Total	35	100,00

RQ5: Is there a need for identifying / detecting resource management problems in your company? Respondents' answers are presented in Table 5.

Table 5: Structure of responses on the necessity of detection of resource management problems in RSMEs

Possible answers	Number of respondents	Score (in [%])
It is not necessary	5	14,30
It is very rarely necessary	5	14,30
It is sometimes necessary	10	28,60
It is often necessary	2	5,70
It is always necessary	13	37,10
Total	35	100,00

According to the statements of RSMEs owners, the problems may or may not be serious, but they agree that there is a need to detect/recognize these problems; this indicates that they are aware of the potential gravity of RSME problems.

The hypothesis "H(2): It is possible to detect the problems in resource management in RSMEs" is verified through the answers to 6 research questions that the respondents were asked to answer:
RQ6: Do you find it possible to identify resource management problems? The structure of responses provided by respondents is presented in Table 6.

RQ7: How do you detect resource management issues in your company? The structure of respondents' answers is presented in Table 7.

Respondents agree that it is possible to detect/recognize problems; they also indicate the ways how to detect problems - which are mainly related to the personal experience of employees and/or to the gravityof failing to detect the problem. That is why further attention is directed towards organization of the problem detection.

RQ8: Who detects/recognizes problems in your company? The response structure is presented in Table 8.

Table 6: Structure of responses on possibility to detect resource management problems in RSMEs

Possible answers	Number of respondents	Score (in [%])
It is not possible	1	6,37
It is very rarely possible	2	2,13
It is sometimes possible	5	14,30
It is often possible	10	28,60
It is always possible	17	48,60
Total:	35	100,00

Table 7: Structure of responses on the ways of detecting resource management problems in RSMEs

Possible answers	Number of respondents	Score (in [%])
Problems are detected upon the outbreak of a scandal, i.e. everybody can detect them	3	8,60
Problems are detected upon their physical manifestations, i.e. everybody can detect them	1	2,90
Problems are detected through personal experience of the employees who point them out	14	40,00
Problems are detected upon financial difficulties (even endangering the business)	4	11,40
Problems lead to various consequences including image deterioration and closing down the business	13	37,10
Total:	35	100,00

Table 8: Structure of responses on the responsibility of employees for the detection of problems

Possible answers	Number of respondents	Score (in [%])
I am always the first to detect a problem	6	17,14
Employees in charge of certain operations detect problems in their sector	3	8,58
All the employees have to alert/detect a problem	6	17,14
There is a person in charge of detection and identification of problems	0	0,00
All together (I, the employees and the person in charge of detection of problems) are actively involved in identification of problems	20	57,14
Total:	35	100,00

RQ9: Do you have employees in your company who are trained to detect/identify problems? The response structure is presented in Table 9.

Table 9: Structure of responses on the presence of employees in charge of the detection of problems

Possible answers	Number of respondents	Score (in [%])
There is no such employee	14	40,0
We are currently training employees to detect/recognize problems	17	48,6
There is such an employee	4	11,4
Total:	35	100,0

The research (Table 8 and Table 9) shows that respondents believe that all employees in the RSME are actively monitoring the occurrence/threat of a problem, although a small number of RSMEs have a person in charge. It seems that RSME do not put enough effort into the detection of problems. Hence research questions on the procedures for anticipationof problems and warning against potential threats: RQ10 Do you have procedures for anticipation of problems in your company? The structure of responses is presented in Table 10.

Table 10: Structure of responses on procedures for anticipation of resource management problems

Possible answers	Number of respondents	Score (in [%])
There are no procedures for anticipation of problems	14	40,0
There are procedures for anticipation only of certain types of problems	5	14,3
There are procedures for anticipation of several types of problems	15	42,9
There are procedures for anticipation of all types of problems	0	0,0
There is a systematic app-roach to anticipation and prevention of problems	1	2,8
Total:	35	100,0

RQ11: Do you have, within usual procedures, mechanisms to alert you to a potential problem? The structure of responses is presented in Table 11.

Table 11: Structure of responses on alert mechanisms to resource management problems

Possible answers	Number of respondents	Score (in [%])
We do not have alert mechanisms	11	31,4
We monitor theemployees (health, focus, motivation)	4	11,4
We monitor all the resources	5	14,4
We sometimes use control cards with warnings	13	37,1
We regularly use control cards to detect a threat	2	5,7
Total:	35	100,0

According to respondents's responses there are generally no procedures for anticipation and warning against problems. They also claim tha they sometimes use control cards. (It should be verified whether this applies only to HACCP and food safety and safety of people involved in the process of "production", "delivery" and "consumption" of foods.)

In regard with the hypothesis H(2), the research indicates that there is no system for detecting and/or warning against a potential problem, and likewise, there is no clear, formal organization (procedure) of operation in case of ”imminent danger” (potential problems). Food related aspects are an exception, since they are regulated by standards and cannot be omitted in this kind of industry.

The hypothesis "H(3): It is possible to describeresource management problems in RSMEs" is verified through responses to 8 research questions that the respondents were asked to answer:
RQ12:Does your company keep records of problems? The structure of responses provided by respondents is presented in Table 12.
RQ13: What types of record-keeping procedures are practiced in your company? The structure of responses provided by respondents is presented in Table 13.

Table 12: Structure of responses on frequency of detected problems in RSMEs

Possible answers	Number of respondents	Score (in[%])
Never	10	28,6
Very rarely	6	17,1
Sometimes	3	8,6
Often	15	42,9
Always	1	2,8
Total:	35	100,0

Table 13: Structure of responses on documenting resource management problems in RSMEs

Possible answers	Number of respondents	Score (in [%])
We do not have alert mechanisms	11	31,4
We monitor theemployees (health, focus, motivation)	4	11,4
We monitor all the resources	5	14,4
We sometimes use control cards with warnings	13	37,1
We regularly use control cards to detect a threat	2	5,7
Total:	35	100,0

Respondents claim that there are detected problems in RSMEs, but they also remember and talk about some problems without written records.

The respondents' attitudes about the need for the "epic" treatment of RSME problems arise as answers to IP:
RQ14: Do you think it is necessary to keep records on resource management problems in your company? The structure of responses provided by respondents is presented in Table 14.
RQ15: What purposes are the data from records (databases) on resource management problems used for? The structure of responses provided by respondents is presented in Table 15.

Table 14: Structure of responses on the necessity to keep records in RSMEs

Possible answers	Number of respondents	Score (in [%])
It is not necessary	6	17,1
It is sometimes necessary when there is a major problem	10	28,6
It is constantly necessary to keep records	19	54,3
Total:	35	100,0

Table 15: Structure of responses on the purpose of keeping records on resource management problems in RSME

Possible answers	Number of respon-dents	Score (in [%])
To deal with similar problems (that might come up later)	14	40,0
To be able to subsequently analyze the cause of problems and determine why they occur	1	2,9
To define long-term ”corrective measures” for a specific type of problems	2	5,7
To prevent similar problems that might occur again	1	2,9
To prevent new problems and be able to handle them automatically	17	48,5
Total:	35	100,0

Respondents are aware that the problems RSMEs cope with should be recorded. (And even if the questions had a mere didactic effect, this research would be worthy.) Respondents opted in favor of the record keeping on problems–in order to solve similar (future) problems, with the idea of doing this automatically. (They do not seem to be acquainted with, always desirable and possible, methods of problem solving and improving the quality of management, which points out the necessity to learn about it or/and seek/receive professional help.)

Responses to RQ16 and RQ17 provide more information on recording certain types of problems (workplace injuries, for example) and specific data on problems (characteristics of problems) in RSMEs. It is evident that more attention is paid to bigger problems, and especially to consequences to the users of services (almost an entirely new viewpoint) and to material consequences of problems (prices, costs, penalties).
RQ16: What information on resource management problems are regularly documented in your company? The structure of responses provided by respondents is presented in Table 16.

Table 16: Structure of responses on types of recorded data on resource management problems in RSMEs

Possible answers	**Number of respond.**	**Score** (in [%])
Records on material con-sequences of problems	11	31,4
Records on financial con-sequences of problems	5	14,3
Records on consequen-ces to the reputation of company	6	17,1
Records on consequen-ces to the employees	0	0,0
Records on consequences to the users of your company	13	37,2
Total :	35	100,0

RQ17: What types of problems (by size) are documented in your company? The structure of responses provided by respondents is presented in Table 17.

Table 17: Structure of responses on the size of recorded problems in RSMEs

Possible answers	**Number of respondents**	**Score** (in [%])
Records on major problems	20	57,1
Records on middle-size problems	3	8,6
Records on minor problems	2	5,7
Records on all problems	9	25,7
No records are kept on any problems	1	2,9
Total:	35	100,0

By suggesting standardized descriptions of problems to the respondents (which they have accepted), it was also noted how, at the time of the research, problems in the RSMEs were generally described. In practice, the recordkeeping of problems is at a very low level (especially in terms of employee care); problems are still (epically, making "legends") "remembered" or/and ”notes are made” (meaning on small pieces of paper).
RQ18: Do you think it is possible to prescribe/define a standard description of problems in resource managament in RSMEs? The structure of responses provided by respondents is presented in Tab. 18.

Table 18: Structure of responses on defining standardized descriptions of resource management problems in RSMEs

Possible answers	**Number of respondents**	**Score** (in [%])
Problem descriptions cannot be standardized	4	11,4
Some parts of problem descriptions may be standardized	8	22,9
Half a description may be standardized	1	2,9
Almost anything about a problem can be described by a standardized description	4	11,4
Anything can be standardized (full problem description)	18	51,4
Total	35	100,0

RQ19: Which way of problem description do you use in your company? The structure of responses provided by respondents is presented in Table 19.

Table 19: Structure of responses on the ways how to describe resource management problems in RSMEs

Possible answers	Number of respondents	Score (in [%])
We remember problems and describe them later	11	31,4
We make notes on problems (we record the type of a problem and the date).	21	60,0
We keep thorough records on problems (who, what, when, where, how, why).	3	8,6
We document problems and sort them by gravity/ /category into the corre-sponding databases	0	0,0
Total	35,00	100,0

The hypothesis H(3) deals withthe possibility of problem description in resource management inRSME. From the responses provided by the respondents, it can be concluded that in practice this area of management is at a very low level (only major problems are described, the focus is only on the users and the survival of RSMEs, etc.). However, the support that the respondentsshowed for the problem description and the automatization of the job keeps faith in the potential and relatively rapid introduction of new management concepts for data management, as well as for the complete business operation and survival of RSMEs.

3.4 Discussion

From Chapter 3.3 it is evident that respondents (given their competence for RSME management)are relatively aware of:

a) The necessity to recognize and describe resource management problems in RSMEs, which confirms the hypothesis H(1);
b) The possibility of detecting/identifying resource management problems in RSMEs, which confirms the hypothesis H(2);
c) The possibility of recording resource management problems in RSMEs (and subsequently using the data from these documents to improve the management quality in RSMEs), which confirms the hypothesis H (3).

Since all three individual hypotheses (H (1), H (2), and H (3)) have been confirmed as true, the general hypothesis H (0) can be considered true as well, i.e. confirmed.

4. CONCLUSION

The authors of this paper aimed to show that it is possible to eliminate the main obstacle to improving the managementquality in RSMEs by making entrepreneurs, owners and managers of these (and all other) RSMEs "more aware". Their attention is focused on detecting the danger of potential problems, as well as on the needs and possibilities of describing and keeping records of the problems encountered by the organizations that they lead/manage. This confirmed the general hypothesis H (0): It is possible to identify and describe problems in resource management in RSMEs.

Field research surveyed the current (insufficient) practice of identifying and recording/describing problems, as well as the willingness of entrepreneurs, owners and managers of RSMEs to improve the practice. It brings hope that professionals dealing withmanagement quality improvements (consultants, designers, organizers, as well as managers, planners and other experts in quality management of organizational systems) will be able to do their job - based on actual data from the past/practice.

There is still a lot of work left for science – in terms of the sample size, objectivity (measurement) in the collection of attitudes and experiences of the respondents, methods for verifying the hypotheses, but also the same or similar research in large organizational systems (public enterprises and institutions, for example).

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EDUCATION PERFORMANCE INDICATORS FOR ENTREPRENEURSHIP IN THE SECONDARY SCHOOLS OF SERBIA AND IN THE WORLD

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Abstract: *The topic of this paper is the Secondary/High Education for Entrepreneurship (SEE) in Serbia, with the fact that there are still few secondary schools in which entrepreneurship is taught. More specifically, SEE performance indicators (IPSEE) are studied in order to enable the evaluation of the quality of education for entrepreneurship in secondary schools in Serbia. IPSEE should serve as a benchmark with the best examples from the world, and to inspire the massive offer of content from entrepreneurship at all levels of education. On the road to incorporation into the European education system, Serbia needs to get to know the diversity of the "European model" in detail, and to define the one that mostly corresponds to local needs and culture or that it generates itself, relying on the best models. The idea is that the best models of IPSEE are presented, compared and offered a choice that, at this moment, would correspond to secondary schools in Serbia. The intention is to help the creators of school programs in us, ie. To the Ministry of Education, but also to schools and teachers (to be able to monitor and improve the quality of their work), to enterprises (to provide adequate practice, for example), to students and their parents (to be active participants in the SEE system). The problem that is discussed here refers to defining the characteristics of SEE that at the moment correspond to national (as well as European) needs. This creates a model of Serbian SEE, with numerous functions to satisfy, considering the needs of practice (public administration, employment, education, enterprises and their structures, etc.). The contribution of this paper is in the systematic presentation and comparison of the IPSEE model, in concluding on the acceptable characteristics of SEE, as well as in reference to the directions of the development of model and practice.*

Keywords: *Entrepreneurship, Entrepreneurship Education in High-schools, Entrepreneurship Education Performance, Performance Indicators for Entrepreneurship Education, Usage of performance indicators.*

1. INTRODUCTION

According to Vukmirovic (2005), entrepreneurship becomes especially important and decisive in societies facing major and significant changes. This can be explained by the organic need for the structural formula for the development of society in the period of technological, economic, political, cultural, institutional and conceptual changes. These processes are led by certain people who behave in a specific way and have a specific value system. Modern entrepreneurship appears as a dynamic developmental combination of ideas, talent, capital, knowledge and risk. It is a new sociocultural phenomenon that enables the achievement of people's capabilities in the economic sphere. According to Piters and Waterman, modern entrepreneurship is developing in two directions: As an individual (external) entrepreneurship based on the market competition of small and medium-sized enterprises and usually represents a mixture of ownership, management and differences in one person or entrepreneurial group; As an internal (corporate) enterprise that appears in the form of new business units within large corporations, and associated with limited competition and the division of ownership, management and risk functions (interpreneusrhip). Academic studies of the phenomenon of entrepreneurship begin in the 18th century (Herbert, 2011, p. 241). According to Mutibarić et al, the characteristics of a successful entrepreneur are competent, creative, characteristic (moral), communicative, cooperative, etc.

2. EDUCATION FOR ENTREPRENEURSHIP

It defines education as a process of acquiring knowledge, skills and habits. It is a pedagogical and didactically designed process, more or less systemically organized (self)learning by which an individual adopts general and special knowledge about the world surrounding him, develops intellectual abilities, social and practical skills and habits, thus forming his own view of the world. There are different criteria for the classification of education. It is possible to talk about general, professional, political, specialist, classical, humanistic, economic, natural-scientific and other types of education (Milanković, 2014, p. 387). According to Đaković & Radojčić, the quality of education contributes to productivity, innovation, democracy and social cohesion.

Galloway suggests that the "cross disciplinary approach" of entrepreneurial education can affect a range of industry sectors, including art, science and technology discipline. In their evaluation and evaluation of a number

of entrepreneurial programs, Hytti and O'Gorman found that more successful programs were those who had the opportunity to integrate learning through general education, student experiences and the introduction of entrepreneurial education in other subjects.

According to Paunović (2010), the importance of education for entrepreneurship stems from the essence and importance of entrepreneurship as a key development resource, an action-oriented way of thinking and behavior and business philosophy that puts innovation at the core of interest. Increasing dynamics of technological changes, their globalization, increasing the level of competitiveness and the constant change of technology, especially information, in front of entrepreneurs, as "leaders of the new millennium" pose great challenges. According to Kecman (2016), practical teaching and working with this population must be carried out with the help of trained mentors. Mentors must organize work so that children learn through entertainment, in accordance with their inner desires and abilities.

3. HIGH-SCHOOL EDUCATION FOR ENTREPRENEURSHIP

In order to compare the performance indicators of educational models of education for entrepreneurship, a "desk research" was carried out: eight different countries with a built-in fruitful system were observed. Below is a brief summary of the most important facts of national SEEs. In Norway, entrepreneurship is studied at lower and higher levels; It is spread across six thematic areas and includes several programs for practice (See the Opportunities and Make them Work !; Program JA-YE; Lego League). In Austria there is a developed dual education system through which apprenticeship, practice (ALCA Voxne GMBH) is recognized. In Ireland, entrepreneurship is taught in multiple subjects; Entrepreneurship is characterized as a career guidance, a creative learning process, i.e. cooperation between students and teachers. Tiernan emphasizes that the themes of the Irish model are "What is Entrepreneurship", "Identifying Opportunities and Their Exploitation", "Creativity and Innovation", "Developing Entrepreneurial Culture in the Classroom" and "Teachers and Trainers in the Role of Entrepreneurs." In Finland, entrepreneurship, there are more practice companies (so students have the opportunity to develop a business plan for the company), the Student Company program (opening of mini-companies that operate with real money), teaching staff (prepared according to the model "training with personal experience in the field of entrepreneurship"). France allows for the creation of fictitious companies and competitions; teacher training is organized, and Entrepreneurship is integrated into many elective courses. Practice is being applied - according to the JA-YE program, where company rights are established In Germany, entrepreneurship is in the main elective subject, teacher training. Project: Junior Project; Fairs, national and regional competitions, Go! to school. Italy - Entrepreneurship is not included in the curriculum; The Professional Institute is a milestone for the study of entrepreneurship; Practice - Junior Achievement Italy; Teachers get involved in the program as support; Entrepreneurship is more stimulated by out-of-school organizations.

According to the Policy paper and measures for support for the development of entrepreneurship in Serbia, (2015). Unreformed education system, low level of knowledge and skills, and lack of educational programs and initiatives lead to an atmosphere in which the development of entrepreneurial spirit has been distorted.

4. RESEARCH OF THE PERFORMANCE OF MIDDLE/HIGH SCHOOL EDUCATION FOR ENTREPRENEURSHIP

Indicators are indicators that measure (qualitatively or quantitatively) a certain phenomenon. Educational indicators point to the quality of the educational institution. They are an indispensable factor in monitoring the quality of teaching and the work of the institution itself, and they can serve to uncover management reserves and improve the performance of these educational institutions. Each country, but also each school can / must have its own quality monitoring indicators; it would be ideal if they could agree - by educational institutions / types of schools) in order to compare the quality of their work. Based on indicators, the SEE program can be monitored and improved.

4.1 The problem being researched

The problem that is being investigated in this paper is based on the key performance indicators of SEE in Serbia and their adaptability for inclusion in the European education system. How SEE Performance Indicators enable the evaluation of qualitative and quantitative facts, factors and systems - which analyze the level of quality of education for entrepreneurship, should be used in different countries, in the present and the future, depending on the needs of the education system itself. This paper presents / analyzes the existing SEE systems (by examples of countries that have a successful educational system), through performance and their indicators. The problem of adapting the performance and indicators used in Serbia to those in the world is solved by comparing and choosing commonly acceptable performance indicators of SEE, that is, adapting Serbia's SEE to that used in Europe, while respecting national specifics. The core of the problem with the SEE model in Serbia lies in its inadequate adequacy for inclusion in the European education system (due to incomplete and inadequate implementation) and should be improved.

4.2 Research methodology

This paper uses partial analysis; More precisely (according to the criterion of the research subject), a comparative analysis is used, highlighting the similarities and differences in the subject of research (eg comparing the European model with our current SEE model). Descriptive analysis sought to clarify certain elements of the model, so that they were massively understandable in order to clarify existing models.
As a "response" to the problem, a basic hypothesis is defined (Figure 1):

H(0): It is possible to compare performance indicators of high high-school education for entrepreneurship (SEE) used in Serbia and other countries.

Specific hypotheses:
H(1): It is possible to present the performance and their indicators used for SEE in Serbia.
Individual hypotheses of the special hypothesis H(1):
- H(1;1): It is possible to present the performance used for SEE in Serbia.
- H(1;2): It is possible to present the performance indicators used for SEE in Serbia.
- H (2): It is possible to present the performance and their indicators used for SEEs in other countries.

Individual hypotheses of the special hypothesis H(2):
- H(2;1): It is possible to present the performance used for SEE in other countries.
- H(2;2): It is possible to present the performance indicators used for SEE in other countries.
- H(3): It is possible to compare the performance and indicators related to SEE in Serbia and other countries.

Individual hypotheses of the special hypothesis H(3):
- H(3;1): It is possible to compare the performance related to SEE in Serbia and in others countries.
- H(3;2): It is possible to compare the performance indicators related to SEE in Serbia and in other countries.

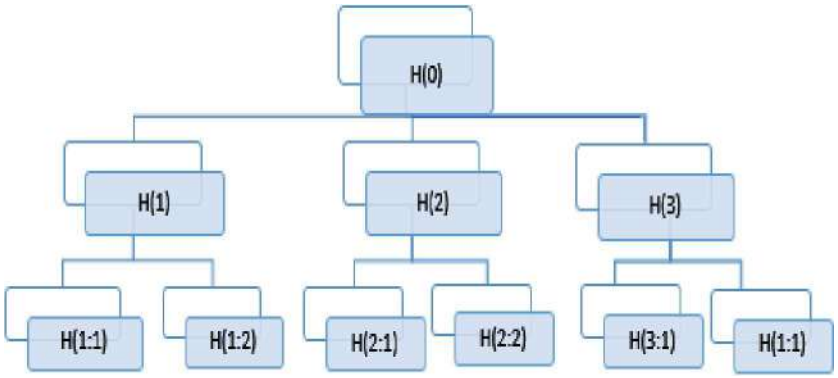

Figure 1: Hypotheses structure

The field research is carried out through a review of scientific papers on the topic of entrepreneurship education, as well as available documents published by the Ministry of Education of the observed countries. As for sources for models of foreign countries, relevant school sites and scientific works listed in "Literature" were used.

4.3 Research results

This section of the paper discusses the performance indicators of countries whose educational systems are mentioned as examples. Based on the available data, relevant parameters are presented and presented, by country.

a) Educational performance indicators for entrepreneurship in Norway

Perforation of the Ministry (Ministry of Research and Science, Ministry of Local Government and Regional Development and Ministry of Trade and Industry): Improving entrepreneurship education in all educational institutions. Based on the above, it appears that these ministries have a complex strategy for the improvement and development of education, which also includes entrepreneurship that is being studied in many secondary schools. Previously presented represents future performances, i.e. what should come from the activities of these ministries. Accordingly, indicators should be based on monitoring of implemented activities. According to Johansen, & Schanke, various forms of interdisciplinary projects in which schools, local employers and the public sector cooperate are also organized by schools.

Key Performance Indicators are:

- The status of the subject in secondary schools is an indicator that shows the subject of entrepreneurship as an elective or compulsory subject. Indicators of tertiary knowledge tend to explore the extent to which the application of theoretical knowledge is the basis for easier overcoming of practical activities. The performance that arises from these indicators is aimed at increasing the productivity and applicability of student knowledge in practical work.
- Practical knowledge indicators strive to check the efficiency of the application of pupils' knowledge in practice. The performance of these indicators has a wide range of users, of which direct users represent: students, schools and firms for practice.
- The indicator of own business, is an indicator that examines the number of students who started their own business after the completion of high school. Performance is again targeted at several users: the ministry (economy), school, student ... Indicator is the satisfaction of companies by the work of students.
- The indicators and performance of an action plan that can be identified under the See the Opportunities and Make them Work program are characteristic exclusively for Norway. This program aims at linking leaders and owners of educational institutions, teaching staff and students, and accordingly, the following indicators can be proposed:
- Number of students attending the program;The performance resulting from these indicators will indicate the qualitative and quantitative characteristics of the observed phenomena, and the aim is to develop strategies for improving and developing entrepreneurship (in terms of programs) and entrepreneurial education (based on students) based on the obtained results.

b) Performance indicators of education for entrepreneurship in Austria

The Austrian school system of education is based on dual education. Accordingly, Performance Indicators should examine the following:

- Number of interested companies for practice;
- Quality of knowledge provided to students by practice firms;

Performance Indicators at ALCA Voxne GMBH

- Number of schools involved in the program;
- Number of students involved in the program;
- The number of relevant subjects for working in the company.

c) Educational performance indicators for entrepreneurship in Ireland

Ireland is one of the countries with an innovative learning system and has long overtaken the traditional one. Characteristic of their education system is the emphasis on the difference in education for managers and education for entrepreneurs, so the following indicators should be examined:

- Number of students who are educated for future managers;
- Number of students who are educated for future entrepreneurs.

The performance of these indicators would show whether students tend to innovate and be entrepreneurial or to be effective in their business as managers. Given that a modern learning system is being implemented and the freedom is given to teachers and students, the following should be examined:

- The quality of the lessons learned from the perspective of students;
- Quality of teaching observed from the aspect of the professor;
- Self-evaluation of students;
- Development of personal skills and students' sense of responsibility.

d) Educational performance indicators for entrepreneurship in Finland

Finland is another country where the Ministry of Education is strongly committed to entrepreneurship within the entire education system. Ministries' performance would be related to the goals that they want to achieve, which is to integrate entrepreneurship into as many schools and subjects as possible. Therefore, some of the performance indicators would be:

- Number of pupils who study the subject of entrepreneurship;
- The quality of entrepreneurial culture and climate;
- Number of newly started start-up projects during the school year;
- Number of students who want to start their business after secondary education;

In accordance with their strategy, performance of the general model should be examined and demonstrated if they achieved the set goals based on the following indicators:

- Number of students who independently show initiative for entrepreneurship;
- Number of students who prefer simulation work (virtual enterprises;

- Number of students who prefer work in real companies.

e) Educational performance indicators for entrepreneurship in France

France is one of the countries where entrepreneurship within the strategy has been set as a multidisciplinary goal, and based on this performance would be related to achieving the set goals. In this case, the performance indicators would be:

- The number of subjects paying attention to entrepreneurship in some of their work;
- Ability of students to convert ideas into actions;
- Ability of students to define the main steps in projects;
- Ability of students to define risks and strategies;
- Ability of students to understand the company's life cycle.

According to Léger-Jarniou, Measurement of the evolution of the response after Training is real and allows certain ones optimism, especially on the rise self confidence and ability in problem solving.

f) Educational performance indicators for entrepreneurship in Germany

Germany, although one of the best developed European countries still has no integrated entrepreneurship in curricula. Performance would be aimed at demonstrating how much entrepreneurship is represented and how, through the following indicators:

- Number of secondary schools studying entrepreneurship;
- Number of teachers teaching teaching subjects in secondary vocational schools;
- Number of companies offering practice to secondary vocational school students;
- The number of students who started their own business after high school.

These indicators would examine how much entrepreneurship is represented in the secondary school system and how much learning this subject has brought about.

g) Educational performance indicators for entrepreneurship in Italy

Italy, a country known for creating the Bologna Evaluation System, did not integrate entrepreneurship as a teaching subject in secondary vocational schools. Indicators and performance have not been identified for this country, due to the similarity with the IA programs, so that there will not be any repetition.

h) Performance indicators of the Ministry of Education and Science of the Republic of Serbia

In 2005, the Ministry of Education, in cooperation with the Ministry of Sport, made a strategy for the introduction of entrepreneurship into secondary vocational schools and general education schools. The model presented in this document is more in line with the guidelines that should be guided by some concrete initiatives. However, entrepreneurship as a teaching subject did not get its place in high school programs to the extent that was expected. Based on the available information, it is concluded that the performance of the Ministry of Education is improving the education system for entrepreneurship in schools through an adequate curriculum. Therefore, the performance of the Ministry of Education are:

- Participation of the Ministry in improving the education system for entrepreneurship;
- Adopting a concrete program for education for entrepreneurship;
- Undertaking concrete initiatives for the introduction of entrepreneurship into the secondary education system;
- Dual education system adopted.

The indicators of these performances would be:

- Number of schools that have a teaching subject by 2016;
- The number of secondary vocational schools according to the types of teaching subjects that have already been included in their program (eg. economic, technical, agricultural, mechanical engineering ...);
- The number of teachers who are qualified to teach the subject of entrepreneurship;

These indicators also look at the past and into the future. The first indicator would show the real state, or how many schools actually have a teaching subject entrepreneurship. Furthermore, this indicator also has a qualitative dimension, and the following indicators could be examined:

- The quality of current programs in schools (divided by type of school);
- The quality of teaching in the subject of entrepreneurship in secondary schools;

Quality of teaching qualifications currently held by teachers who teach entrepreneurship;

- Qualification of teachers required to hold classes in the subject of entrepreneurship;
- Quality of practice firms that are open to student practice;

- Quality of students' knowledge after practice in business entities.

h1) Performance indicators of secondary vocational schools and general education schools

The performance of secondary vocational schools and general education schools would increase the productivity of the education system (dissemination of knowledge) and the increased number of students interested in a particular type of school. Each school wants their students to come up with concrete and useful knowledge, which is the purpose of each educational system.

By introducing the subject, entrepreneurship (according to the guidelines of the author's model of education for entrepreneurship) can significantly contribute to increasing practical skills through this course. In order to follow this trend (increasing knowledge), the following indicators should be used:
- Number of (total) students attending teaching subjects entrepreneurship;
- The number of directions on which the teaching subject is taken up;
- Number of available literature for the subject of entrepreneurship;
- The number of classes envisaged for the subject of entrepreneurship;

After quantitative indicators, qualitative ones can be identified, and this implies another performance, which is the quality of the current model of entrepreneurship programs in secondary schools in which they exist. The following indicators again include checking the quality of the current state and checking the future:
- The quality of the current curriculum for entrepreneurship;
- Quality and contribution of improved model and curriculum for entrepreneurship;
- Quality of students' knowledge with an improved model of the program;
- Achieved students' results in competitions.

h2) Performance indicators of the teaching staff for teaching classes in the subject Entrepreneurship

The performance indicators of teaching staff on the subject of entrepreneurship are directed towards the quality of the educational staff and the number of teachers who fulfill this quality. The quality of teaching staff has already been said that the Ministry of Education should make a list of necessary qualifications on the basis of which this indicator could be measurable.

Teacher performance ie. teaching staff whose weight can be:
- Adequate conditions for teaching;
- Possibility of professional development;
- An adequate general model for entrepreneurship education;
- Adequate curriculum;

Quantitative indicators to check these performance are:
- Number of classrooms providing adequate conditions for teaching in the subject of entrepreneurship;
- Number of students attending teaching subjects entrepreneurship;
- Number of seminars and other activities that were attended for professional development;
- The number of working hours envisaged for the subject of entrepreneurship;

Qualitative indicators that can be measured are:
- Quality of the curriculum for the school year;
- Quality of the curriculum by course;
- Quality of seminars attended and other professional development activities;
- The quality and outcome of teachers' activities;

h3) Performance indicators evaluated by pupils

Performance by which students are more difficult can be focused on improving their skills and competences, the quality of theoretical and practical knowledge gained on this subject, as well as satisfaction in the work and study of entrepreneurship. Another perfromance to which it is tended is the possibility of employment after the acquired education.

Indicators that evaluate performances are:
- Assessment by teachers;
- The number of competitions and other activities in which the student participated related to subject teaching;
- The quality of the achieved results of the aforementioned activities;

h4) Performance indicators evaluated by business entities

Performance indicators evaluated by businesses that will be listed can be applied in the future when most schools really introduce the subject of entrepreneurship and when they start to take students into practice. The performance of business entities would be directed towards more productive work in the business sectors, satisfying the quality of students' work, as well as ensuring that in the future there will be already trained personnel for work in their company.

The indicators of these performances can be as well as to date qualitative and quantitative character:
- Number of professional staff in the role of mentors of professional practice;
- The number of students who have reached the practice satisfactorily;
- The number of students to be employed by the company after the completion of education;
- Quality of business improvement achieved by pupils' work;
- Quality of student learning improvement in practice;

i) Overview of comparable indicators of the performance of our country and the observed countries

In this paper, general models of education for entrepreneurship of selected European countries are presented as well as an overview of the indicators and performances in our country directed at the users of entrepreneurial education models. In each of these countries, including ours, there are the same beneficiaries of the education program for entrepreneurship and are listed collectively:
- Ministry (education, science and development, etc.);
- Schools;
- Teaching staff;
- Students;
- Practice firms.

The performance of the ministries globally is an improvement of education for entrepreneurship at all levels of education. School performance strives to increase the productivity of the education system (dissemination of knowledge) as well as the increased number of interested students for a particular type of school. The performance of teachers is a tendency towards an improved education system as well as adequate guidelines for the individual curriculum. The performance of students aims to improve the quality of theoretical and practical knowledge, as well as the use of acquired knowledge in further work and education. The performance of the practice firms implies more productive work in the company, increasing the satisfaction with the work of students, as well as providing trained and skilled personnel to continue working in the company. Common indicators can be:
- Status of the subject;
- Territorial knowledge indicators;
- Practical knowledge indicators;
- Indicator satisfaction of students by the work of students;
- The quality of the lessons learned from the perspective of students;
- Quality of teaching observed from the aspect of the professor;
- Number of secondary schools studying entrepreneurship;
- Number of teachers teaching teaching subjects in secondary vocational schools;
- Number of companies offering practice to secondary vocational school students.

4.4. Discussion of research results

Individual hypotheses H(1;1): "It is possible to present the performance used for SEE in Serbia" and H(1;2): "It is possible to present the performance indicators used for SEE in Serbia" are confirmed through part 4.3. Results research, where indicators and performances of stakeholders, ie stakeholders in Serbia are listed. Thus, the special hypothesis H(1) can be considered confirmed.

Individual hypotheses H(2;1): "It is possible to present the performance used for SEEs in other countries of the world" and H(2;2): "It is possible to present the performance indicators used for SEEs in other countries of the world" confirmed through a more detailed overview of indicators and performance in the observed countries (in section 4.3). Thus, the special hypothesis H(2) can be considered confirmed.

Individual hypotheses H(3;1): "It is possible to compare the performance of SEEs in Serbia and other countries" and H(3;2): "It is possible to compare the performance indicators related to SEE in Serbia and others countries "were confirmed in section 4.3.i)" Overview of comparable indicators of the performance of our country and the observed countries ". Thus, the special hypothesis H(3) can be considered confirmed.

By confirming the truth of specific hypotheses (H(1), H(2), and H(3)), the general hypothesis H(0) is confirmed, which says that it is possible to compare performance indicators of high school education for entrepreneurship used in Serbia and in other countries.

5. CONCLUSION

This paper points to the SEE performance indicators that can be observed in the observed countries, as well as in Serbia. As for European countries, performance indicators of SEEs are formed by measuring them and pointing to the goal (in them) of the already implemented activities. The real situation regarding SEE in our country is quite different. A small number of schools generally incorporate the subject matter of entrepreneurship into their curriculum, education model and curricula. Therefore, in this paper, performance indicators are proposed based on existing knowledge and on the basis of prediction and projection of future educational needs. (This SEE model is proposed in the author's master's thesis, defended by FON, the Entrepreneurial Management of SMEs module, 2016). The goal is, in the near future, that more schools will place this subject in their curriculum. Therefore, performance indicators have been identified; they can monitor the current state, as well as project the (desired) situation in the future. Although the SEE of our country is late for the European SEE mode, common indicators have been found (for monitoring the state of SEE, for calculating SEE quality, for comparison with other values and for encouraging further progress, which is very important - to check if , after education, we are approaching successful and developed countries.

The stated hypotheses in the work are confirmed, and the work is mostly used by the mentioned stakeholders (state, ministry of education, schools and teachers, companies - partners, etc.). By taking concrete initiatives, the Serbian Ministry of Education, Science and Technological Development can accelerate, at the same time apply, the inclusion of the Entrepreneurship in the Secondary Education System; dual education system enables students to check and improve their knowledge in practice. Teacher qualifications for teaching this subject need to be systematized and carefully accredited. Furthermore, when checking and establishing shortcomings in terms of qualifications, the Ministry's education ... should be taken care of for the improvement of teaching staff, which is achieved through master-classes, but also through less formal education channels (seminars and other types of activities). Regarding the quality of practice firms, this, looking to the future, requires better, more thoughtful activities, and time is needed (which is related to the experiences of student practice). The last indicator coincides with one indicator of the Ministry of Education. The author of the paper considers that the follow-up of students in continuing their careers (how many were employed after secondary school and how many continued their education at a higher level of education), should be monitored by schools, and the data sent to the Ministry of Education - in order to assess the success of initiating the initiative for the introduction of entrepreneurship in secondary schools. The directions of further research concern the quality of SEE, SEE Costs, links of educational programs from entrepreneurship - at all levels of education, and so on.

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BUSINESS ASPECTS OF PUBLIC-PRIVATE PARTNERSHIP IN DIGITAL ECONOMY ENVIRONMENT

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Abstract: *This paper emphasizes strategic orientation of public-private partnership according to new investment trends. Competitive advantages of the public-private cooperations in the conditions of European management are analyzed, considering strategic deployment of contracting parties. The relation between European integration and the development of public-private partnership is researched, under the influence of different European funds framework on managerial decisions. Integration processes referring economic indicators are pointed out, with the objective of analyzing their impact on the microeconomic level of public-private collaboration. Enhancement of efficiency and European business models is a precondition for development of knowledge based management in the European Union framework. Original contribution of European funds activities is important, in the discontinuity conditions of the European inclusion environment. Digitalization is a component for strengthening the competitiveness and preparing societies and economies for the future of European Union.*

Keywords*: Public-private partnership, Business, Digitalization, Capital Funds, European Union*

1. INTRODUCTION

Public-private partnerships in developing countries are becoming a new source of long-term economic stability in the broader sense, with a particularly significant impact on sustainable development of small and medium enterprises (Osei-Kyei and Chan 2017). Different approaches to the risk management, defining budget constraints, the financial performance indicators and resource allocation consists out of combination of private and public sector as part of the effective long-term partnership. Cooperation with the private sector created a new framework for pricing strategy, reducing the total cost, but also to increase the transparency of the results achieved within this type of partnership. Empirical studies suggest that a particularly important catalyst for economic growth in the transfer of knowledge is through greenfield investment projects and concessions (Hodge and Greve, 2018). These projects also provide the ability to share responsibility and reform in relation to the partnership, where often the private sector fulfils operational obligations with the aim of increasing efficiency, while the public sector assumes the responsibility of implementation of regulatory policy and oversight of project management. Given that these projects are based on long-term contractual cooperation redistribution of business risk, in order to increase the quality of products and services, the synergistic effect of the association of resources leads to the establishment of financial stability and the protection of important public and private interests (Madden, Phillips and Beth 2018). Implemented as a contractual or institutional partnerships, with frequent support by co-financing from EU funds, which implies their significance for the financing, construction, reconstruction and management of infrastructure facilities.

Taking into account that public-private partnerships can be formed for a common good or the provision of public services for which the state is required by law, projects last up to 50 years, and is therefore very important optimization of capital investment expenditures on the basis of equality of the contracting parties (Madden, Phillips and Beth 2018). Feasibility study, output specifications and determine the qualifications of interested parties shall be based on a detailed analysis of the economic feasibility of the project. Estimates of the expected investments, height guarantees private partner and expected demand is an important part of the analysis. Obtaining capital subsidies and foreign donations depends on the local authorities, who examined the legal, social and environmental risk management and is thus a very important optimization of capital investment expenditures on the basis of equality of the contracting parties (Bayliss and Van Waeyenberge, 2018).

2. THE IMPORTANCE OF BUSINESS MODELS FOR PUBLIC-PRIVATE PARTNERSHIP

The new conditions of market economy require the timely adoption of optimal business decisions in order to achieve the planned economic results of operations. The current global environment requires flexible adaptation to new markets, due to the existence of different quality and quantity of basic resources such as knowledge, capital and technology. The management of these resources is the key for future optimal and

* This paper includes the research results of the author realized on Project No. 179081 financed by the Ministry of Education, Science and Technology development of the Republic of Serbia

sustainable development of a company. Thus we could define a business model as a form of managerial equivalence scientific test method, based on the hypothesis that later empirically tested, which in turn delivers the appropriate methodological conclusion (Magretta, 2002).

Feasibility study, output specifications and determine the qualifications of interested parties shall be based on a detailed analysis of the economic feasibility of the project. Estimates of the expected investments, height guarantees private partner and expected demand is an important part of the analysis(Uzunkaya, 2017). Obtaining capital subsidies and foreign donations depends on the local authorities, who examined the legal, social and environmental risk management. Thus, optimization of capital investment expenditures on the basis of equality of the contracting partiesis very important (Hodge and Greve, 2018). Feasibility study, output specifications and determine the qualifications of interested parties shall be based on a detailed analysis of the economic feasibility of the project. Estimates of the expected investments, height guarantees private partner and expected demand is an important part of the analysis (Uzunkaya, 2017). Obtaining capital subsidies and foreign donations depends on the local authorities, who examined the legal, social and environmental risk management.

Public-private partnership is a newer model of diverting risk using modern technology, know-how by creating core competencies in the context of the knowledge based economy, the education of highly skilled labour force and an efficient use of infrastructure. The establishment of common interest increases proportionally the potential profits of company and economies of scale. Budget restructuring to new development objectives is adjusted according to the degree of competitiveness and innovation, which was given the private sector. Transparency and broad focus of covering running costs are particularly noticeable, meaning that the complex procedure of preparing the project proposal must be adapted to the requirements of the private sector, and thus expand the capacity and cooperation between enterprises. Multiple choice modalities of private sector involvement encouraged a large number of participants in the project, which affects the orientation of risk to subjects who have the greatest interest of its elimination (Uzunkaya, 2017). The operations of the contracted performance depend on the number of uncontrolled market factors, which are yet another reason to accurately determine subcategories of risk. Method comparators costs in the public sector compared to the cost of implementation of a public-private partnership in relation to the costs that would have been achieved if the project is implemented through public procurement.

Extensive methodology is used for microeconomic analysis of changes in a dynamic business environment with the aim of reducing the residual risk and incentive principles of efficient use of public funds. Combined models of the management contract and service delivery creates many advantages, with the private partner is paid for services on behalf of users, by mutual monitoring and evaluation of the results. The impact of public-private partnership in the manner of functioning of the public sector includes the provision of expert guidance, informing the public about the concept of the project, the development of open capacity and encourage intensive cooperation in the area of public service delivery centralized control of the project (Uzunkaya, 2017). The identity of networked business entities when it does not change, which increases the efficiency of capital mobilization and combines organizational capacities of cooperation (Xiong, Zhao and Yuan, 2017). The ratio of public-private partnerships is based on an advanced exchange of information with the aim of providing quality products and services for mutual benefit.

Since the projects are public-private partnership created on the basis of many forms of cooperation contract, it is relevant to analyze the various examples of partnerships, as well as their importance in developing countries (Osei-Kyei, R. and Chan, A.P.C. 2017). Connection management practices of companies, multidimensional approach to business challenges, the mutual financial support for the implementation of business ideas are some of the multiple benefits of managing this type of project. The complexity of the project management and the creation of competitive advantage in the long run have been observed within the analyzed case, and facilitated coordination of priority areas of business.

3. CONTEMPORARY PUBLIC-PRIVATE COOPERATION IN THE CONTEXT OF EU DIGITALIZATION

Promoting development of the public-private partnerships in the European Union is based on the extensive support of European Funds, the European Commission and European banks. Projects of public-private partnerships in the territory of the European Union encouraged the efficient system of incentives, which in the formation of a single EU energy market should serve as an example for the application of the same measures in developing countries. Suitability of business instruments in the development phase of the project is designed according to specific needs and the technological intensity of the investment (Klabe, 2009).Overcoming obstacles to project financing small and medium size is achieved by forming a program for investment support and technical cooperation in the form of providing assistance with feasibility studies, structuring of programs, business plan development, financial audits, implementation of the project and so on

(for example, JEREMIE - Joint European Resources for Small and Medium-sized Enterprises). Instruments of the European Investment Bank and the European Bank for Reconstruction and Development provided support to projects in phase of product commercialization.

The European Commission has established a strategy of Energy in 2020 with the aim of achieving greater sustainable development of the public-private cooperation in all EU countries in order to increase the competitiveness of the market, based on the knowledge economy. Eliminating disparities between countries is a prerequisite for economic development, and the political cohesion provide extensive financial instruments within the European Union. The European Regional Development Fund (ERDF - European Regional Development Fund) to promote economic and social cohesion participation in the development and structural change in the region the EU, with a view to reducing regional disparities. The Fund stimulates the transfer of eco-technology and knowledge in the small and medium enterprises, with the aim to increase efficiency and the use of private funds investment in underdeveloped areas (Osei-Kyei and Chan, 2017). Areas of intervention include all sources of renewable energy, with companies in the field of biomass energy main beneficiaries of ERDF, with over 200 million in 2012 (Directorat-General Regional and Urban Policy, 2017). By 2020 it is planned that 6% of the total cost of the ERDF to be set aside for renewable energy in countries with economies in transition (as it will get more funds for research and development) and 20% for developed countries (Directorat-General Regional and Urban Policy, 2017). The European Social Fund (ESF - European Social Fund), the European Commission is responsible for the social stability of countries, boosting productivity and promotion of environmentally friendly entrepreneurship. A special focus is on a holistic approach to business and the provision of equal opportunities for employment of all members of society. It acts as a multiplier of the financial indebtedness of private funds through participation in risk management. ESF fund to promote investment in public private partnerships from the perspective of employment growth.

We can give an example of successful public-private partnerships in the field of renewable energy production. Balancing the public sector's profitability needs and economics interests of private parties is based on energy performance contracting schema, that minimizes the difference between the net profits gained by contractual parties (Carbonara and Pellegrino, 2018). According to statistics EREC (European Renewable Energy Council) since 2005, there is a constant increase in employment in the renewable energy industry, but in 2009, employment measured in the amount of 550,000 jobs (EREC, 2011). Less developed countries in the EU that have a special benefit from ERDF and ESF funds are Portugal, Greece and Slovakia. From 2007 to 2013 these two funds invested funds in the amount of 4.760 billion euros (European Commission, 2017). In that period, the ERDF is only in the city of London has invested 182 million euros, in which it plans to half of the energy used is from renewable sources, but also to cooperate with private partners within the project (Directorat-General Regional and Urban Policy, 2017). Structural funds can function as an innovative holding funds that is through business intermediaries rely on other forms of financing, including grants, guarantees, equity investments, etc. Financial engineering instruments are invested in the sustainable development of small and medium enterprises and supplement the energy efficiency of the urbanized areas (EREC, 2011). Public-private partnership is also significant with aspects to competitiveness increase of international business in digital economy environment (Sofronijević, Milićević and Ilić, 2014).

JEREMIE instrument, developed with cooperation of the European Investment Bank and the Commission of the European Investment Fund, serves as financial leverage in financing small and medium enterprises through private funds with less reliance on grants. The need for renewable energy grant JEREMIE covers from developed network of holding funds in 15 EU member states, which have a wide range of financial instruments renewable nature. Responsiveness to market conditions is high, considering that it is a process and not on the fund, which is financing instruments adapted to the cycles of deployment (Carbonara and Pellegrino, 2018). So far invested about 3.5 billion EUR in SMEs in this program, with the intention that by the end of 2015 (EIF, 2011). The fully adjust the EU's cohesion policy to promote sustainable energy through new business creation support.

JESSICA (Joint European Support for Sustainable Investment in City Areas) program was created to support investment in sustainable urban development and renewal of existing infrastructure through promoting close ties with the private sector. Program is proper support through structural funds revolving instruments and so far has thus invested a total of 1.6 billion euro in energy efficiency measures (Deloitte, 2011). Financial engineering instruments that are commonly used are (Deloitte, 2011):

- VCMF (Venture Capital Mutual Funds) funds, which are not constituted as legal entities, but consist of a number of specific continent run by the managers of the fund. VCMF not bear the tax burden and flexible in character, but they were also very useful instruments support;

- A joint stock company, through which it invests in other funds through long-term bonds. The only shareholder of this society is the state, which guarantees for the entire amount of the debt;
- Fund loan guarantees for small businesses, which as a financial institution, supported by both the countries in which to invest, develop a series of benefits and guarantees for loans.

Program for research and development of the Horizon 2020 is the successor of the Seventh Framework Program FP7 and includes all EU initiatives together, based on the concept of a triangle of education, research and innovation. The program of safe, clean and efficient energy will last for six years, starting from 2014, with the clear objective of reducing the use of primary energy, which should not amount to more than 1,474 Mtoe (million tonnes of oil equivalent) by 2020 (European Commission, 2017). The program provides the infrastructure, the use of thermal energy, encouraging the development of eco-industries and sustainable energy financing. Innovation approach projects under Horizon 2020 are focused on technology extraction of harmful gases, energy networks with self-regulation, energy storage and its connection with the current system, new concepts of integration of the underground energy storage, etc (Carbonara and Pellegrino, 2018). The outcome of the initiative development of "smart" cities of the agreement the mayor more than 5,700 cities around the world that are committed to these cities achieve higher energy efficiency than planned under the EU's 20/20/20 (European Commission, 2017).

The digital transformation of societies is a complex multidimensional phenomenon that needs to be addressed through the application of systematic approach across sectors and across domains (Matusiak and Kleibrink, 2018). Institutional capacity of public company can be very beneficial in terms of smart specialization of partnership, while technology transfer from private sector can lead to long run economic sustainability. Tangible assets and activities are supporting research commercialisation by targeting capacity increase and systematic business planning. Cooperation in the region is essential, with special focus on opening up geospatial datasets to the public (Matusiak and Kleibrink, 2018). Effective use of heterogeneous technology in digital environment is a precondition for developing digital single market. As a part of broader digital transformation strategy, public-private collaboration is pointed towards innovation and competitiveness. A well-articulated combination of public and private sector can result in an extensive knowledge transfer and synergy effect for the scope of synchronized business objectives. Important opportunity for innovation ecosystem development is also a data infrastructure development for macro-regions. Great example is program digitalization of data infrastructure that will encompass whole Danube region. Project called “Danube Data and Service Infrastructure” makes impressive advancements in field of harmonized data set on various issues related to the region (Matusiak and Kleibrink, 2018). Evidence-based innovation strategies and quality enhacement in terms of research and development capacity are already deployed for public-private partnership of Western Balkans.

Joint Research Centre of European Commission is actively working on creating a “Digital Agenda for the Western Balkans”. One of the EC Enlargement Strategy flagship initiatives is dedicated Digital Agenda for the Western Balkans. This is crucial component for strengthening the competitiveness of the region and preparing our societies and economies for the future EU membership, and future as such. The Strategy outlines inclusion of the Western Balkans countries at the Council meetings and European Commission working groups in areas of common interest- it is important energy, transport, digital policy, research and innovation are mentioned among those and that the inclusion starts as soon as possible. Serbia is also aware of the need and benefits of the regional cooperation in these areas- from security, to technology transfers, digitalisation of industry, start ups etc. There is no reason Serbia should not cooperate much more in building technology parks, regional - cross border start up centres, enhancing cooperation between our scientific and economic actors. Digitalisation and technological development poses in addition huge challenges as well as opportunities - it will also influence the future of jobs and employment. Uncertain set of skills should be prepared, in addition to the digital ones.

The "Intelligent Energy for Europe" (IEE - Intelligent Energy Europe) is part of the framework program for competitiveness and innovation. IEE aims to raise awareness about the transformation of the market by building new capacity and coordination of projects with technological and financial point of view. Since 2003, more than 600 projects have been supported by the IEE (European Commission, 2013). Rational use of energy, reduction of transport costs of energy, monitoring the impact of other industrial sectors are some of the actions taken enforced by the IEE. Typically financed projects the volume of 1 million EUR. From 2007 through the IEE provided the approximately 730 million investments for RES (European Commission, 2013).

Close cooperation with the International Energy Agency in accordance with the ELENA program is implemented external expertise in projects of mutual cooperation in the amount of 6-50 million, requiring the participation of at least three companies in the field of renewable energy (European Commission, 2017). It is estimated that by the end of the program will be invested a total of more than 6 billion in the energy sector. The "Intelligent Energy for Europe" (IEE - Intelligent Energy Europe) is part of the framework program

for competitiveness and innovation. IEE aims to raise awareness about the transformation of the market by building new capacity and coordination of projects with technological and financial point of view. Since 2003, more than 600 projects have been supported by the IEE (European Commission, 2013).

Rational use of energy, reduction of transport costs of energy, monitoring the impact of other industrial sectors are some of the actions taken enforced by the IEE. Typically financed projects the volume of 1 million EUR. From 2007 through the IEE provided the approximately 730 million investment for RES (European Commission, 2017). ELENA (European Local Energy Assistance) is an initiative of the European Investment Bank for technical assistance, financial structuring during the initial phase of the project. Currently ELENA funded 31 projects, which will bring energy savings of 913 GWh, eliminate 496,000 tons of carbon dioxide and about 25,000 new jobs (European Commission, 2013). External control and the establishment of standards in project management ELENA preparing management for the difficulties in the process of project financing and management costs.

Some of the suggestions for business risk hedging of contemporary public-private partnerships are:

- reduction of financial leverage ratios, which most of the risk takes the borrower;
- shorter period of repayment, in order to minimize operational risk, the use of cash sweep processes (borrower used the excess cash flows for payment of debt);
- requirements for larger DSRA (debt service reserve account) and MRA (maintenance reserve account) indicators, in order to ensure reserves from the current lack of repayment of the loans;
- flexible structure of debt (upside sharing) as well as the concept of fulfilling the obligations arising from the debt above the planned level, for the period when the cash flow above the average level. This bank provides the potential variation in the exploitation of energy sources.

The accelerator facility would provide equity and quasi-equity capital Fund to innovative small and medium enterprises (SMEs) at the early stages of their development. This facility could also be used to provide finance in support of SMEs commercialising their products or services (Cumming, Haslem and Knill, 2017). The financial instrument under consideration would involve a co-investment product providing equity financing to SMEs financing (equity and quasi-equity) at the early stage of their existence and ensure the technology transfer. While it is difficult to quantify the expected impact of such a facility conducted by public-private parntership, it is possible to assess qualitatively that the expected effects would be important, both in terms of jobs and economic growth as the current financing conditions almost preclude the launching and development of innovative SMEs (Cumming, Haslem and Knill, 2017).

The objectives of this Capital Fund are to:
- Strengthen equity financing and quasi-equity financing for companies in pre-seed, seed, creation, development and turnaround stages;
- Support the companies in any stage, based on a good business plan;
- Strengthen the capitalization of SMEs with high growth potential (innovative or traditional);
- Encourage the structuring of capital market, including Business Angels;
- Fill the lack of the existing equity financing supply in the country (business angels, investment funds etc.) and attract, among others, outside investors who currently do not operate.

In the long run, this facility could represent a major opportunity for the Serbian economy to diversify and move in the upper segments of the production value chains. The main value added areas expectedly generated by the implementation of this financial instrument is as follows: promoting entrepreneurship, improvement of companies' projects, creation of new innovative enterprises, possibility to focus on special categories of final beneficiaries (in terms of investment amounts and SME development phases) and risk sharing with the private sector (co-investment funds).

Start-ups and innovative SME in the pre-seed, seed, creation, development and turnaround stages. The focus of the accelerator facility would be small innovative SMEs at the very early stage of their existence (creation or early development). Risks and advantages related to the implementation are:
- Part of the investment will come from the financial intermediary (co-investment funds) in the SMEs capital using IPA resources, its own resources and attracting other investors to mobilize its own resources;
- Access to support provided by the support facility, for example: access to an incubator facilities and coaching by an experienced entrepreneur, support in conducting market research, feasibility studies and "market testing" as well as information on other existing mechanisms for the development of innovation and/or entrepreneurship in general;
- Its purpose is to create synergies with other venture capital and investment funds as well as attract investors from Serbia and abroad.

The percentage of the public contribution in the financing of each operation will vary depending on the phase of the SMEs in its life cycle. The manager of the co-investment fund will be an independent entity that makes all investment decisions/divestment as a professional manager, economically and legally independent. The governance of the co-investment funds should include mechanisms to avoid potential conflicts of interests within the manager co-investment funds of public-private partnership. The details of the Call for Expression of Interest shall ensure that the financial intermediaries have the necessary permissions and approvals to exercise the activities as a fund manager. The selection of the financial intermediary will cover the provision and blending of both equity financing and quasi-equity financing for public-private capital fund (Cumming, Haslem and Knill, 2017). The groups targeted include SMEs of all development stages (seed, creation, development and turnaround stages) using funding from EU funds.

The financial instrument could draw on the EU funds and be blended with funds provided from other financing sources (grants or loans). Grants are usually provided in the initial phase (when the company is in the idea generation stage and/or creation of prototypes). The accelerator facility would support companies to commercialise these ideas or prototypes (in the ready to be marketed stage) (Cumming, Haslem and Knill, 2017).

4. CONCLUSION

The strategic orientation of public-private partnership provides an important basis for the realization of competitive advantages in European Union terms, the achievement of business success in the long run and the development of European cooperation. The specificities of the market and industries, created in the environment of diversified business elements and under specific feasibility study conditions, lead to the growing need for European companies to place their products and services on the market through public-private partnership, often in the presence of hypercompetition. Digitalization inputs are of the great importance for a strategic commitment of providing long-term successful business collaboration, which implies the development of new public-private models. In doing so, there is a specific European contribution to the development of the theory and practice of public-private joint efforts, which is derived from the commited support of European funds. Digitalization is becoming an important part for smart specialisation and contemporary data restructuring. In this sense, there is an increasing attention of entrepreneurs, but also of all those who want to apply examples of best practices in order to improve their business. On the other hand, European business and management face new challenges, but also limitations and above all challenges from the global environment, which imposes a proactive approach with the implications of managerial actions at the microeconomic level in the future of public-private partnership.

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INTRODUCTION OF THE NEW SERVICE ON SERBIAN TELECOMMUNICATION MARKET: VIRTUAL PHONE NUMBER

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Abstract: *This paper presents the solution for keeping the private mobile number private, and having multiple phone numbers while still using only one SIM card. Namely, the virtual phone number service is presented as a simple solution. Virtual phone number means having one or more additional mobile phone numbers, whose incoming calls are forwarded to the original phone number. It provides a higher level of control regarding incoming work-related phone calls. Other most common uses, advantages and disadvantages of proposed implementation are listed, also. The current market situation is favourable for virtual phone number service in Serbia. Based on market analyses and financial assessment, the idea should be implemented in the near future.*

Keywords*: temporary phone number, virtual phone number, SIM-less, privacy, ads web portals*

1. INTRODUCTION

Serbia has over 120 mobile phone subscribers per 100 people (World Bank, 2016), meaning that there are people with two or even more mobile phone numbers. There are a lot of possible reasons for having multiple phone numbers, and some of them are overcoming coverage issues and having all the benefits from different subscription plans. But, the most common reason is separating work and private life and saving personal privacy.

Mobile phone, as instrument has changed roles in the family, modified interpersonal relations, re-defined the limits of communicative possibilities, rewritten the present functioning of institutions such as hospitals and schools, intensified work dynamics, rationalized the organisation of work relations, in a word, changed society (Fortunati, 2002). Almost everyone has access to at least one (mobile) phone and can call anyone on the planet. Mobile phones are “always-on-us” communication devices (Kuo, Wu, & Deng, 2009) and this is an additional reason to control who will be able to contact us and when. Some researchers are dealing with prevention of private phone number leakage via mobile phone applications (Pak, Cha, & Yeo, 2015). Unfortunately, there are situations when we cannot evade giving contact information, which then can be misused. Below are listed some of the most common cases in which people expose their private number:

- Selling stuff via ads
  People who are selling stuff on online portals are required to leave contact information, including a phone number. Depending on the nature of merchandise and demand for it, they can get a significant number of phone calls. After the ad is expired or removed, the number often remains on cached pages and is displayed in a search engine query results. Even thou the ad is not active anymore, the user gets unwanted calls even for months.

- Entrepreneurs not having a separate work phone
  Entrepreneurs, craftsmen, traders usually use a private phone number for the business. This causes receiving business-related calls on the private number, even after working hours, on weekends, and holidays.

- Loyalty programmes
  It became common practice for businesses to offer loyalty programs to their customers (Bolton, Kannan, & Bramlett, 2000; Yi & Jeon, 2003). Those loyalty programs are usually a way to discounted products or some other financial benefits. One of the potential problems with joining loyalty programs is unwanted disclosure of private phone number and receiving unwanted calls and messages.

This paper presents an idea for evading exposure of private phone number in mentioned and similar situations. The proposed system is named “virtual phone number”, meaning that you have additional phone number without actually owning SIM (subscriber identification module) card.

Medhanyie et al. (2015) discovered that many of the health workers complained about carrying two phones, work phone and their private phone. As a result, many of them stopped carrying their private phone and

started using the smartphone as their primary phone. The great advantage of using virtual phone number is a possibility to receive phone calls to two phone numbers while having only one mobile phone (without dual SIM feature).

In the last six months, a few solutions for this problem emerged, and all of them are intended for mobile operators. Operators have to integrate the specific solution into the Internet Protocol (IP) Multimedia Subsystem (IMS). Those solutions cost hundreds of thousands of euros (Metaswitch, 2018; SmarTone, 2018; Swytch, 2018). Disadvantages of these systems are high integration costs and requirement of all operators' support on the specific market. It cannot be expected for Serbian telecommunication market to get a system like this in the near future. On the other side, there is a simple solution for this problem, which though wouldn't provide all the features offered by the previously mentioned systems. Namely, the suggested solution would give the most essential feature - incoming calls - in the short time period and with the small investment required. The only drawback of this kind of solution is the unavailability of outgoing calls and SMS.

After making an introduction to the problem, the paper is organised as follows. In section two the virtual phone number is presented with more details, steps needed for the idea to be implemented and key market segments. Section three contains basic financial assessment of proposed idea, and finally, conclusion is in section four.

2. VIRTUAL PHONE NUMBER

A practical example of a virtual phone number in action is presented in Figure 1 and can be described in following steps with example of selling a used car using a web portal:

1. Seller chooses his virtual phone number, which will be used for his car ad;
2. When a potential buyer calls the virtual phone number, it is forwarded to seller's primary phone number;
3. After the car is sold, seller cancels virtual phone number and receives no more calls, as his primary phone number has never been listed and cached.

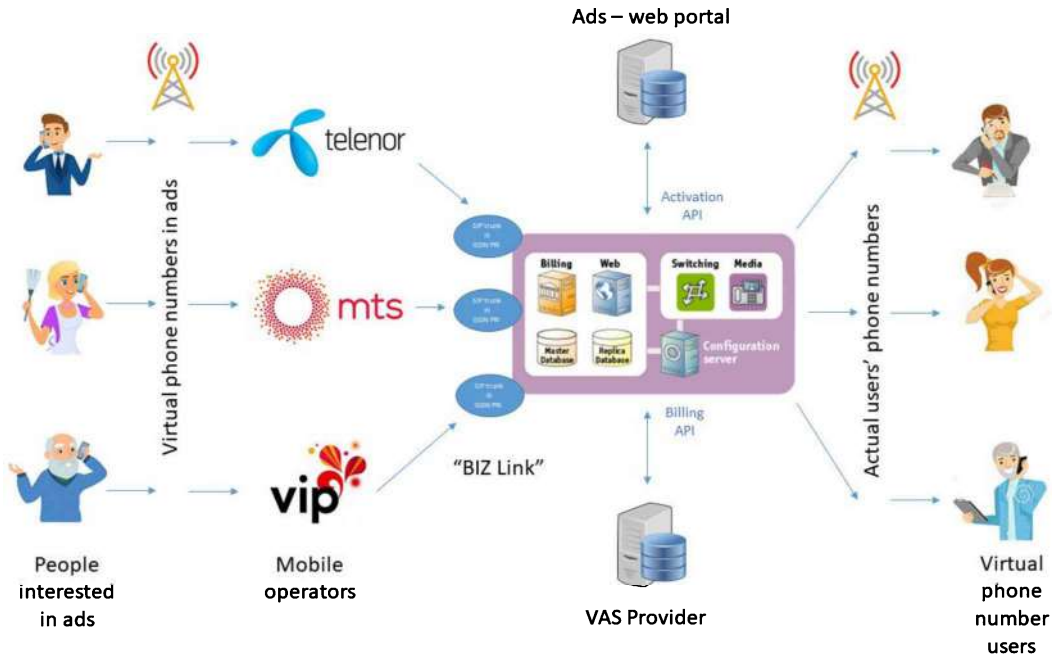

Figure 1: Illustration of the suggested solution

Virtual phone number renting can be temporary (ads and other short-term needs) or on long-term (business phone number for craftsman and entrepreneurs).

To implement the idea, the following steps have to be taken:

1. Opening a new company;
2. Presenting the idea to the operators, with emphasis on the simplicity of implementation (no need for any interventions on the operators' system);
3. Renting a range of numeration scheme from a mobile operator;
4. Negotiating business model with web portals;
5. Development and installation of system for call forwarding.

Development and installation of the system include developing API (application programming interface) for integration on web portals and Value-Added Service (VAS) Short Message Service (SMS) provider, but also portal for user settings (valid for up to 30 days). It is estimated that the service can be offered at the market in the near future.

In the following subsections, the key market segments are presented.

2.1. Ads web portals

There are a lot of web portals with ads, like *Halo oglasi*, *KupujemProdajem*, *Polovni automobili*, who are potential business partners. Namely, those portals have two primary sources of income: 1) paid, featured ads, and 2) rented banners for advertising. By offering them a share in revenue from virtual phone number service, they will most certainly be interested in collaboration, as this would be their third income channel.

When the seller is leaving ad on the portal, in the step where he enters his phone number, he would be offered to temporarily rent the virtual phone number for receiving calls. All calls would be forwarded to his own phone number. In that way, he would keep the privacy of his phone number, as it is not used for the ad. Also, the virtual phone number is used only while the ad is active. This prevents receiving calls regarding the inactive ad.

Most of the sellers will accept this offer for the symbolic price of RSD 200 monthly. The alternative for keeping the phone number private is much more expensive. It would require purchasing prepaid SIM card, and additional mobile phone. Besides being cheaper, getting a virtual phone number is much more simpler, as it is available as a part of the process of creating an ad.

The only expense for web portal is time needed for integration. This means creating API functions for communicating with virtual number server, and it requires a few programmer-days, which is already hired for maintaining web portal.

2.2. Entrepreneurs and craftsmen

Virtual phone number, which can be used for business purposes, enables keeping the private number undisclosed and reserved for the family and private usage. Also, it allows the user to define the time of the day when he is available for receiving calls.

Using virtual phone number on long-term has a couple of advantages: there is no need for carrying multiple mobile phones; user can define working hours on the portal – only in that time period calls are forwarded; there is no need for additional SIM card (postpaid contract or prepaid recharge); it is possible to forward calls to voice mail after working hours or to the other employee who is working in the other shift. Practically the user is getting a “company phone number”, which can be forwarded to other employees if that is the business requirement.

2.3. Avoiding SPAM calls

After using a primary phone number for a couple of years, we are getting attached to it, all of our friends and business partners have it, and we are not gladly giving it to the third parties. We never know if they will misuse our phone number. On the other side, it is required to leave the phone number in most of the loyalty program applications. What follows afterwards are usually unwanted phone calls, questionnaires, SMSs, which never ends.

Owning a virtual phone number allows us to never disclose our private phone number. We would be giving virtual phone number instead and avoid getting unwanted phone calls, while still having benefits of using a loyalty program.

3. FINANCIAL ASSESSMENT OF PROPOSED IDEA

Napitupulu and Kartavianus (2014) showed that ease of payment does significantly affect purchasing decision online, so the most convenient payment method for potential customers is suggested, Value-Added Service (VAS) Short Message Service (SMS) (Kuo et al., 2009).

The payment procedure on the example of leaving ad on web portal would be:
1. The customer creates an ad and enters his phone number;
2. The web portal is offering the virtual number service, and the customer chooses to use it;

3. The customer gets SMS to confirm with “yes” if he wants to use the virtual number service;
4. The service is active, and the customer sees the assigned virtual phone number.

Initially defined price for the service would be RSD 200,00 monthly. The income will be shared in a way that mobile operator gets 40% of VAS SMS price (RSD 80.00) for renting numeration scheme and connection (Integrated Services Digital Network Primary Rate Interface – ISDN PRI or Session Initiation Protocol - SIP); web portal gets 30% (RSD 60,00) and Virtual number company 30% (RSD 60,00).

Analyzing most popular web portals specialised in ads in Serbia, the number of published ads is collected on 06. March 2018 (Halo oglasi, 2018; KupujemProdajem, 2018; Nekretnine, 2018; Polovni automobili, 2018). The data is presented in Table 1.

Table 1: Number of ads on most popular web portals

Portal	Website	Number of ads
KupujemProdajem	www.kupujemprodajem.com	1.846.327
Halo oglasi	www.halooglasi.com	393.862
Polovni automobili	www.polovniautomobili.com	191.353
Nekretnine	www.nekretnine.rs	107.205

Those are only some of the most popular web portals. Let’s assume that there are 2 million ads in Serbia and one user has two ads on average. Based on small survey results, 13% of web portal users would use the described service, but again with taking conservative assumption that only 2% of them buy virtual number service, we are getting the figure of 20.000 users and over RSD 1 million in monthly revenue.

The initial investment would be roughly RSD 700.000 for servers, portal and API development, and integration with ads-specialised web portals. Based on these estimations, the presented idea shows excellent potential for fast return on investment.

It should be noted that other types of revenue, like previously mentioned entrepreneurs and craftsmen, people who would like to avoid spam and private phone number revealing, are not taken into consideration. Also, with less conservative assumptions (more than 2% of sellers accepting the virtual phone number service) for web portals and including the revenues from other consumer segments the revenue would be significantly higher.

4. CONCLUSION

Gant and Kiesler (2002) state that until the beginning of the twentieth century most people lived close to their workplace and that their co-workers were often members of the family or friends. With the availability of modern technologies, like electricity, motorised transportation, communication systems the separation between work and personal life grew. The same authors listed socialising during weekends, commuting to work and having a separate personal or social life as twentieth-century concepts. The virtual phone number is another step in that direction. It provides a higher level of control regarding incoming work-related phone calls.

The current market situation is favourable for virtual phone number service in Serbia. On one side, there are no mobile operator integrated solutions present, as they are costly and require a lot of efforts to implement. On the other side, there is a demand from users, and present alternatives are both too expensive and complicated for everyday usage (owning the separate mobile phone and additional SIM card). Based on market research and financial assessment, the virtual phone number will surely be a successful venture.

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CREATIVITY, INNOVATION, AND INTELLECTUAL CAPITAL IN THE DIGITAL AGE 784

Biljana Stošić, Dragan Vasiljević, Radul Milutinović
THE ROLE OF INTELLECTUAL PROPERTY DIAGNOSIS IN INNOVATION PROCESS 785

Ognjen Žarić, Jelena Borocki, Aleksandar Vekić
THE ROLE OF HUMAN CAPITAL IN THE FUNCTION OF THE INNOVATION POTENTIAL OF THE REPUBLIC OF SERBIA 792

Maria Serena Angelini, Alessandro Gennaro, Simone Labella
DISCLOSURE ON INTELLECTUAL CAPITAL IN THE AGE OF INDUSTRY 4.0: EVIDENCE FROM ITALIAN CAPITAL MARKET 799

Biljana Bajić, Biljana Stošić
AGILE APPROACH IN INNOVATIVE MEDICINE DEVELOPMENT 807

Đuro Kutlača, Lazar Živković, Dušica Semenčenko
INNOVATION ACTIVITIES AND COMPETITIVENESS OF THE COMPUTER PROGRAMMING SECTOR IN SERBIA 816

Dijana Štrbac, Đuro Kutlača
INNOVATION ACTIVITY IN SERBIAN ENTERPRISES 823

Mirjana Miljanović, Ilinka Unković, Milimir Vasiljević
THE IMPORTANCE OF USING DIGITAL COMMUNICATIONS WITHIN CREATIVE INDUSTRY 831

William Proud, Vesna Damnjanović
THE EFFECTS OF BUSINESS CASE STUDY COMPETITIONS AS A TEACHING METHODAUTHENTIC LEADERSHIP: CONCEPTUALIZING AND DEVELOPMENT 837

THE ROLE OF INTELLECTUAL PROPERTY DIAGNOSIS IN INNOVATION PROCESS

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Abstract: *Innovation critically depends on a range of conditions such as finance, skills, markets, competition and standards, policy framework, and, what is of great importance, intellectual property rights (IPR). The intellectual property system can be seen as one of the most critical role in innovation process today. Rights such as patents, trademarks, designs and copyrights, enables innovators exclusive right to use their knowledge creations and to facilitate knowledge and technologies transfer. Although the relevance of the intellectual property is obvious, that is confirmed in a practice, companies don't use it in the suitable range. Therefore, the aim of this paper is to present the importance of having an adequate insight into intellectual property conditions and prospects for the companies; to indicate the appropriate IPR for different stages of innovation process; to present the importance and the role of IP diagnosis and audit for companies of different sizes; to identify different maturity models with different patterns in a form of archetypes that are in line with the degree of IP practice.*

Keywords*: innovation, intellectual property, diagnosis, IP audit, maturity models*

1. INTRODUCTION

The realm of intellectual property (IP) goes beyond than just innovation and interferes into many areas of art, culture and commerce. In the same way the scope of innovation is spreading beyond the established fields where IP traditionally had a major impact. As a consequence we can see some new fields where IP has become very important such as business model innovation, open collaboration and social and community-based innovation. Achieving success in the field of innovation in the years ahead, is closely related to understanding of how changes in the future may impact, and be impacted by, shifts in IP (Taplin, 2013). IP is spread all over the business development and strategies, from product development to design, from service delivery to marketing, and from raising financial resources to exporting or expanding its business through licensing or franchising. It should ensure the trust, confidence and loyalty to the consumers (Sukarmijan & Sapong, 2014).

In spite of the enormous relevance of the IP, SMEs (Small and Medium Enterprises) barely consider the strategic value of their IP. The study conducted by the Office for Harmonization in the Internal Market (OHIM) in 2015 that showed that only 9% of European SMEs being IP owners, which is quite poor. Notwithstanding, these companies, on behalf of IP ownership, on average generate 32% more revenue per employee then others. SMEs' have a significant contribution concerning innovation performance but they are in a subordinate position to the large companies in regard to IP use, due to constraints corresponding to their size. Generally, SMEs can be considered as driving force of innovation, but they have difficulty to turn this potential into a competitive advantage (De Leon & Fernandez Donoso, 2017).

Lots of companies are unaware of the importance of IP. Different surveys clearly marked how low is the percentage of public awareness about IP and that it is only understood by institutions and organizations which are involved in the field (Sukarmijan & Sapong, 2014). Thus, the objective of this paper is to discuss the significance of IP to companies of different sizes which often tend to neglect IP as business asset, to indicate the interdependence of innovation and intellectual property, to emphasize why it is important for companies to do the IP pre-diagnosis and audit and to propose different maturity models that can be used for the assessment of the intellectual property management within the company.

For researchers, this paper may be interesting because it discusses a very important topic and gives the systematize review of the latest literature on the topic of innovation and intellectual property. On the other hand, for practitioners, the paper may be interesting as it emphasizes the importance of intellectual property and IP diagnosis and audit.

Starting from this point the paper is organized in tree main sections, first related to interdependence of innovation and intellectual property, describing the importance and furthermore, necessity for companies to protect their inventions, second related to explanation of the role that have the IP diagnosis and audit, and fourth related to different maturity models of IP practice.

2. INNOVATION AND INTELECTUAL PROPERTY RIGHTS

Managing innovation better than competitors may be observed as one of the main objectives of today's business. One of the ways to realize this is to use different intellectual property rights. It can be said that if some invention is left unprotected, the larger companies may immediately take a chance to adopt and commercialize this invention at a more affordable price, which can be a big lost for original inventor (Sukarmijan & Sapong, 2014).

Intellectual property rights (IPR) enable some company to protect its intangible assets and to profit based on the exclusive rights gained by this right from their creative and broadly innovative activities. Studies have shown that value of Intangible assets account for more than half the value of companies. Nowadays when companies compete more on innovation, creativity and quality than on price, the intellectual property has become powerful tool (http://ec.europa.eu/growth/industry/intellectual-property_en).

An IP right represents a legal right that is based on the relevant national law. The existence of one such right is confirmed only when the requirements of the relevant IP law are met and, eventually, if required, registered. This IP rights have enabled the grant, generally for a limited period of time, based on property of right that makes monopoly position that keep out all others to have commercial benefit from the invention. There can be found different types of IP rights (Figure 1) (Kalanje, 2009).

Figure 1: Intellectual property rights

Since intellectual property rights enables the creation of revenue and is used to protect the company's competitive position, there is a need for better understanding of the IPR in innovation management for a various reasons: (1) R&D is increasingly being conducted in countries where IPR protection is still weak; (2) IPRs are of critical importance to research partnerships and projects; (3) open innovation paradigm is shaking up the conventional understanding of IP protection. IPRs are important on both the micro- and the macro-level, and are subject to analysis on the regional, industrial or firm level (Candelin-Palmqvist, Sandberg, & Mylly, 2012).

The IP system should play a significant role since it enables innovative companies to gain and retain its innovation-based advantage. To have benefits from innovation, one company should take into consideration the full range of IP issues throughout all stages of the innovation process. To protect an invention one of the many roles that IPR may have for the company (OECD, 2011):

- global market positioning
- signaling current and prospective value to investors, competitors and partners
- accessing knowledge markets and networks
- defending themselves from patent infringement suits
- blocking rivals from patenting related inventions
- using patents in negotiations over technology rights.

Hall and Harhoff (2012) emphasized particularly important role of IPR in accessing external finance, especially in the venture capital market. Patents often represent the only collateral (required by the banks) that knowledge-intensive start-ups can use to raise funding. An effective IPR system enables lead time for growing the businesses before being imitated. For new or innovative companies, especially SMEs, time is critical point in a sense of raising funds, supply chain development and reaching the market. Additionally, effective patent protection may allow a new firm to compete on the basis of differentiation rather than on the basis of costs. Effective patent system also allows companies to license their invention. In some cases, costs and complexity of the patenting process may be considered as hampering innovation factors, but apart from that if used strategically patents can serve as a reliable source of new, additional or higher revenue for SMEs.

Cockburn and MacGarvie (2011) in their research underlined patents can be considered as a constraint for new companies' entrance especially in software industry. Patenting is one of the most common adopted strategies to discourage the entry of rival companies (Stošić, Vasiljević, & Milutinović, 2015). Based on previous, it can be said that fostering of IPR usage by SMEs should be regarded as an integral part of innovation policy.

3. IP AUDIT AND IP PRE-DIAGNOSIS

A comprehensive IP management strategy should be a considered as one of the key parts in the company's business strategy. It is vital for some company to have a good understanding of exactly what IPR own or control. IP assets need to be inventoried and managed in much the same manner as other company assets.

Intellectual property audit is considered as the first step in IP asset management strategy that may be used for business strategy development or for company assets evaluation (Wilson & DeCarlo, 2003). IP audit is a tool used for gathering information on how IP assets relate to the company business in order to integrate IP strategy into business strategy. Since a value of a knowledge based, innovative company lies mostly in IP assets and other intangible assets, investigation of IP asset is required for evaluating the company's business (Fahmi, 2007).

In order to perform an IP audit, the nature of the company's business must be understood, and understanding of company IP assets is prerequisite for assessment of the company value (Fahmi, 2007). With that respect, various factors need to be analyzed such as company's business goals, competitors and related risk and opportunities in order to estimate the value of the IP assets.

IP audit can be performed by the company's personnel or by an external counsel whereby top-down and bottom-up approach may be applied. In top-down approach the company management is being interviewed, whereas in the bottom-up approach the relevant information is collected from all the employees. The latter approach may require more time, but it provides thorough analysis of IP assets identifying not only the created IP, but linking it with the structure of the organization, i.e. where the IP is created and by whom it is created (Wilson & DeCarlo, 2003).

Identification and record of internally developed and externally acquired IP as well as determining ownership of the identified IP is seen as the principal goal of IP audit. As other aims of the audit Chang and Yastreboff (2003) are proposing strategic measures of IP management within business strategy and operations, as well as measures regarding IP policies and practices for identification, protection and treatment of IP. The IP audit specifically includes identification of company policies and practices in managing IP including identification, protection and treatment of IP, including management of trademarks, confidentiality, invention disclosures and governing IP and secrecy in relations with the employees (Ch'ang & Yastreboff, 2003).

Beside the above mentioned objectives of the IP audit, Chang and Yastreboff included valuation of identified IP as IP audit objective. The valuation may refer to qualitative valuation only, stressing the benefits of the IP assets to the business. However, it may additionally include quantitative valuation aimed at assessing economic value of the identified IP assets. They have proposed an approach for defining IP audit scope depending on the motivation for audit, which may refer to the purchase of acquisition of another business and general review of IP asset management strategy (Ch'ang & Yastreboff, 2003). Regardless of the motivation for IP audit, the authors propose three IP audit stages. Stage 1 refers to defining the scope and identification of IP assets, identification key risk areas concerned and assessment of IP management policy and procedures. In stage 2 substantive audit of each IP asset is identified, including the issues of creation of IP asset, its ownership, scope and term of protection. Stages 1 and 2 are performed by personnel interviewing and are followed by stage 3 referring to analysis and reporting on recommendations on effective IP management.

French Industrial Property Office – INPI developed another IP audit approach, called intellectual property pre-diagnosis (IPD), tailored for innovative SMEs with the objective to support SMSs in integrating industrial property strategy into their development strategy (Battistelli, 2088). More specifically the IP audit is aimed at (1) raising company awareness on IP, (2) stressing the relevancy of IP policy and (3) identification of courses of actions. The IP audit not only facilitates access to innovation networks and technologies, but to innovation funding. It also enables easier entering into partnerships and technology transfer agreements, as well as enforcing of IP rights.

For that reason INPI developed and offered IP audit service tailored to the needs of SMEs called Intellectual property pre-diagnosis (IPD).

Following the experience of INPI, the European Patent Office (EPO) has also recognized the need for support of innovative SMEs that typically lack both information on IP protection and IP management. Namely, there have also been recognized the need for both IP protection and IP management by SMEs, which is preferably carried out consistently by means of a proper IP strategy in order to keep competitive advantage based on innovativeness (EPO, 2017).

Subsequently, the EPO adopted the service and the methodology developed by the INPI and offered it for implementation by the European Patent Organization members states in 2008 and now after, 10 years several national IP offices, including the Serbian Intellectual Property Office, have still been delivering the IPD. It has also been offered to the research organizations like universities and research centers (EPO, 2017).

The scope of the IPD is not only registered rights like patents, trademarks and industrial designs, but unregistered IP like copyright and trade secrets as well. It also takes into consideration business process and information about suppliers and other key players like partners and clients (EPO, 2017). Namely, the intellectual property is identified and analyzed in business context by understanding companies' competitive advantage. This is followed by the measures for IP protection and further IP management through IP strategy and IP management procedures.

The IPD is conducted in four phases. In the first phase the auditors prepare for the interview by gathering publicly available information on the SME organization, its products, projects and other activities, and by reviewing recipients IPR and other publications. This is followed by the interview that is conducted based on questionnaire containing six groups of questions. The first group of questions is related to company products, processes, services and market, as well as its competitive advantage. The second group of questions relates to innovations, R&D activities and technology. The third group is related to company organization, human resources and training activities. More specifically it may include gathering information on how knowledge is gained, adopted, exchanged and managed especially among those who actively participate in it, like R&D departments. The fourth group of questions is related to other parties like suppliers, partners, sub-contractors, clients as well as to legislation regulating the business (national, EU legislation, standards). The fifth group is related to registered IP like patents and trademarks and unregistered IP like copyright and trade secrets that are protected by contracts. The interview is followed by the phase of report drafting and final phase of report handover.

4. THE OVERVIEW OF DIFFERENT INTELLECTUAL PROPERTY MATURITY MODELS

It can be said that different tools developed for IP diagnosis and audit at the same time represent the basis for identifying maturity levels in the context of intellectual property. The key purpose of the maturity models is to capture different patterns in a form of archetypes according to the degree of IP practice. Different maturity levels should depict the current situation in the company. Moreover they should present insight of how companies approach to intellectual property, and propose measures for further development. One of the main objective of this models is understanding of interrelationship between different dimensions (which differ for different maturity models). Lower maturity refers to low knowledge of the IP while effective and efficient use of the IP represents the characteristics of higher maturity levels (De Bruin, Freeze, Kaulkarni, & Rosemann, 2005). One company can pass through different maturity levels meaning that it met all the requirements or improved their knowledge in the sense of the IP practice.

In the field of intellectual property various maturity models can be found, such as those presented in Enjolras, Galvez, Camargo and Morel (2015), Moehrle, Walter and Wustmans (2017), Gibb and Blili (2013).

Enjolras, Galvez, Camargo and Morel (2015) apply the AIDA methodology to IP management, approach from the Henri Tudor Research Centre (Luxembourg). This methodology, initially used in sales, has progressive character (A – Attention or the company is familiar with the main principles of IP; I – Interest or

the company started with the application of IPR; D – Desire or company regularly manages IPR in all phases of new product development; A – Action or company values and markets its intangible assets). As we can see, these levels of maturity are formed with respect to IP practice. This method is applied through a serious of questions that are set up for the company. Based on the answers, given during the interview, the outcome is generated and it can be used to address the key issues and key advantages of the company. It also gives comparison of the company in regards to ideal position. This method can be adapted for different business sector or profile of company. One of the main disadvantage of the method is that questionnaire is too long and it require a lot of time for realization.

Gibb and Blili (2012) introduced one more approach to IP management for SMEs through a framework that enables the detection of the current situation along with possibilities for further development. They identify twelve capabilities (six related to operational and other six related to strategic level) that make up dimensions of the model against which to benchmark companies. This model for intellectual asset governance is described through five progressive maturity levels (Dormant – the company is unaware of the importance that IP has in the business; Ad-hoc – company engaging IP management in the value chain but as reaction on external influence; Dynamic – company has a clear commitment to the IP management; Ambitious – company apply proactive strategy which is in line with the general strategy of the business; Pioneering – company apply strategy which is in line with both general strategy and business model, it may have separate IP department).

Moehrle, Walter and Wustmans (2017) proposed 7D patent management maturity model. This model is applying both top-down and bottom-up approach, meaning that it suggests five core dimensions which are in line with the identified five main principles (strategic principles), and two supporting dimensions (serve as to support the guiding principles). Five core principles are: portfolio, generation, intelligence, exploitation and enforcement. They are activated through separate management decisions (for example, company doesn't want to enforce some patent). Supporting dimensions of organization and culture should strengthen the core dimensions and express a limited power of patent managers in influencing the maturity levels. Each dimension (core and supporting) comprise elements that are to some extent separable and performable on different levels (Portfolio contains lifecycle management, portfolio management, strategy fit). From the bottom-up approach, this model includes patent functions, meaning that patent doesn't have only function of protecting some invention from the imitation but also for technology monitoring and forecasting as well as gathering of information about the competitors. Therefore, they identified 24 capabilities related to patent functions which are assigned to above mentioned dimensions. The demonstration of how elements of patent management are represented by means of capabilities, this model suggests five maturity levels: (1) level N – Neglector; (2) level 1 – Starter; (3) level 2 – Intermediate; (4) level 3 – Performer; (5) level 4 – Conductor. The 7D model is applied through five steps. Once the model is adjusted to the companies' environment, the maturity level of each element is determined. Then one can seek the targeted maturity level by identifying, prioritizing and implementing measures for the further development of each element.

There are a lot of different maturity models proposed by different authors and institutions. All of them have the same idea to describe the capabilities through different maturity levels, and all of them should propose measures for further development.

5. THE ROLE OF IPR APPLICATION IN THE INNOVATION PROJECT

Concerning the relation between intellectual property maturity level and innovation process success, it is very important for companies to recognize the role of IP practice in the different stages of innovation process. As it can be seen from the Figure 1, patent search is relevant throughout all stages of the innovation process (phases based on Cooper's Stage-Gate model (Cooper, 2011)), having somewhat different purposes, starting from an early ideation stage. For example, the main role provides the possibility to check if some patent is free of charge (doesn't need license) in the earlier steps of the project, to see if there is a need for licensing of the existing patent, to do the search on novelty of own invention ideas, and in later stages to be an early warning system for competitor activities. Patent application is usually part of the development and later stages, and is afterward followed by patent search (search of patent database, for example Espacenet that allows better overview of the field and better communication with competent authorities).

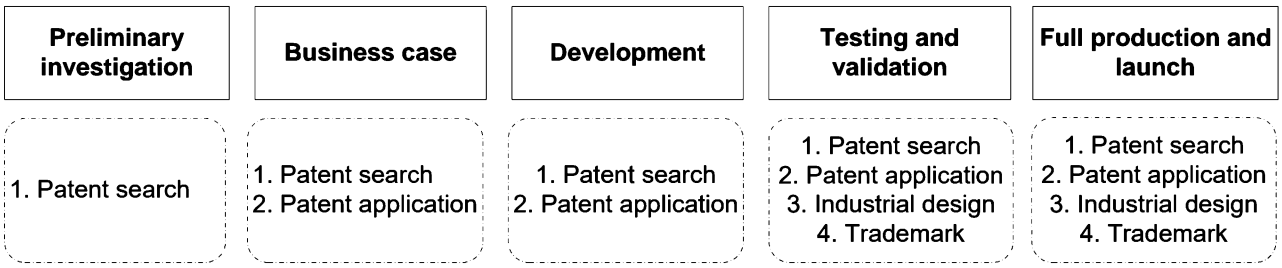

Figure 2: IP over the innovation process (adapted from (Gennari, 2013))

Industrial design is typical for later stages, starting with the design of the prototype. It is closely related to the utility test which should confirm the appropriate design through variety of prototypes (rapid prototyping). Trademark as IPR is preferable used in the later stages after having checked the novelty by trademark searches. Trademark can be developed earlier but it is best to register it shortly before entering the market with the product or service (Gennari, 2013).

5. CONCLUSION

Managing intellectual property on a strategic level became a necessity since it enhance the companies' possibility to achieve competitive advantage. Companies of different sizes, especially SMEs, are constantly being exposed to various challenges, so it is important for them to face that challenges and take measures in direction to exploit the IP and protect it wherever possible. Like everything else in the company, IP must be managed, valued, monitored if the full potential wants to be derived, and before anything of this, company must acknowledge the value of IP and to see it as an inseparable business asset. Clearly, the IP become a key factor in the innovation process, starting from the creation of new ideas to their launching on the market as products or services. Of big importance for companies which has this approach is to know and to understand how to manage intellectual property through stages of the innovation process. if don't, it can be found various IP support services that may assist SMEs in acquiring the knowledge of the value of their IP and knowledge of all IPR as well as their advantages and inconveniences. To be aware of its intellectual property and advantage that it can obtain by the property, company should use the IP audit or IP pre-diagnosis or to use different maturity models. This kind of support services except making the company be aware of the meaning and importance of IP, they have been used to measure the competencies company has in IP management and to make some proposals for improving the current situation if the company' current situation is on the lower maturity levels.

Having the aforementioned in mind, in can be concluded that much more effort should be invested in the direction of the IP management, and that companies, if not till now, should use IP support services such as diagnosis, in order to improve own protection and to seize better position within the competition. This paper can be considered as a starting point for the future research which should be directed to improvement of the diagnosis.

Disclaimer

The views and opinions of Dragan Vasiljević expressed in this article represent his personal thoughts, not necessarily representing the policy and position of the Intellectual Property Office.

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THE ROLE OF HUMAN CAPITAL IN THE FUNCTION OF THE INNOVATION POTENTIAL OF THE REPUBLIC OF SERBIA

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Abstract: The subject of this research is connection between educational system and the innovative potential of the Republic of Serbia. Special importance is given to factors such as government expenditure on education; government expenditure on education per pupil (secondary); assessment in reading, mathematics, and science; pupil-teacher ratio (secondary); tertiary enrollment; graduates in science and engineering; tertiary level inbound mobility. The aim of this work is to illustrate impact of human capital on the creation of the innovative potential of selected country. The second part of the paper is devoted to detailed research of the educational system of the Republic of Serbia and movement of state on the ranking list of the Global Innovation Index.

Keywords*: innovation process, human capital, innovation of the state, education, universities*

1. INTRODUCTION

Innovations are concept that is broadly defined as the commercialization of new knowledge. It is recognized as one of the key drivers of growth and productivity (Ganotakis, 2012). It is also described as a product or service, a continuous or discontinuous, radical or incremental change that creates a new value (McCormick and Maalu, 2011). According to the Organization for Economic Co-operation and Development (OECD, 2013), such value creation implies the implementation of new or significantly improved products, processes and marketing or organizational methods in companies. Group of authors (McAdam, Reid, Harris and Mitchell, 2008) point out that the importance of innovation is that they are the result of increasing global competitiveness; reducing product life cycle; and rapidly changing consumer demands.

Emphasizing the importance of innovation, it is important to note that such process requires a large investment of both material and intangible resources. However, even those investments do not imply a secure success in creating a new value, because there are certain barriers on the way to the goal. They can be classified in many ways, but most often differ according to the place of origin - barriers in the company's internal and external environment (Piatier, 1984).

As the topic of this paper focuses on the importance of non-material resources, special attention is paid to human capital, which together with the lack of internal resources and technical expertise; the management of time, culture and systems fall within internal constraints. In this regard, (Barañano, 2005) in the SME research in Portugal reveals two barriers to innovation, and one is one that refers to the lack of quality human resources. However, this author is not the only one who has identified this problem. Authors from Portugal (Vieira, 2007); Spain (Madrid-Guijarro, Garcia and Auken, 2009); Great Britain (Tovstiga and Birschall, 2007); Germany (Tiwari and Buse, 2007); Cyprus (Hadjimanolis, 1999); Czech Republic (Necadov and Scholleva, 2011); Switzerland (Comtesse, Hodgkinson and Circle, 2002); France (Galia and Legros, 2004); Italy (Iammarino, Sanna-Randaccio and Savona from Italy,2006); Brazil (Mussi and Spuldaro, 2008) and, finally, from Iran (Kamalian, Rashki and Arbabi, 2011), they also concluded that an ever-present limitation in innovation relates to human resources. They defined this deficiency as: lack of knowledge quality for managing innovation; recruitment of adequate human resources; lack of specialists in the innovation area; or insufficient investment in employees. Based on these researches, exceptional importance of human capital can be seen.

2. RESEARCH METODOLOGY

This study uses two variables. One is educational system of the Republic of Serbia, which was analyzed on the basis of The Statistical Office of the Republic of Serbia. Due to lack of specific data in the above-mentioned source, we also used data from reports published by important organizations such as UNESCO, OECD and the World Economic Forum. The second variable is the rank of the country for innovation. In order to analyze this parameter, the Global Innovation Index (GII) reports were taken.
The way in which this index was calculated implies an average of two sub-indices: Innovation Input Sub-Index and Innovation Output Sub-Index, after which the results were ranked on the scale from 0 to 100.

Innovation Input Sub-Index that should enable innovative activities which are: (i) Institutions, (ii), (iii) Infrastructure, (iv) Market sophistication, and (v) Business sophistication. Innovation Output Sub-Index implies two indicators: (vi) Knowledge and technology outputs; and (vii) Creative outputs. This research is oriented towards human capital, so attention was given to the second group of indicators called Human capital and research.

All indicators are composed of several sub-indicators, but only those that fall into Human capital and research are shown below: (i) Education -Expenditure on education; Government expenditure on education per pupil, secondary; School life expectancy; Assessment in reading, mathematics, and science; Pupil-teacher ratio, secondary; (ii) Tertiary education - Tertiary enrolment; Graduates in Science and engineering; Tertiary level inbound mobility; and (iii) Research and development (R&D) that will not be used for further analysis. We found the reasons this to be high costs of SMEs research and taking risk in such steps. Therefore it requires finding alternative ways of innovation, which imply a focus on internal resources and ability of the company itself (Rammer et al., 2009).

3. IMPORTANCE OF HUMAN CAPITAL IN THE INNOVATION PROCESS

Human capital is a set of knowledge, skills, creativity, intelligence and abilities that an individual possesses (Becker, 1964). It is essential part of innovation and also significant, because it represents the main source of new ideas and knowledge within the company (Snell and Dean, 1992). It is also the embodiment of better education and higher productivity (Santos-Rodrigues et al., 2010; Storper and Scott, 2009).The authors (Edvinsson and Malone, 1999) have a similar theory, and in their work they point out that human capital includes competence (knowledge and skills); attitudes (motivation and behavior); and intellectual agility that is related to ability to innovate, imitate, create change and solve problems.

The relationship between human capital and state-level innovation is named conversation, according to Bourdieu (Bourdieu, 1986), or different forms of capital that can be converted into resources and other forms of economic viability. At the individual level, the process has been studied and confirmed by several authors (Becker, 1964) and in general, the argument is that those who are educated have a better work experience and invest more time, energy and resources in improving their skills - leading to positive results, both at the individual and at the social level (Dakhli and De Clercq, 2003).

4. THE IMPACT OF EDUCATION ON THE INNOVATION POTENTIAL OF THE ECONOMY

In the theory of human capital and economic development, there is a hypothesis that knowledge and skills human resources possess directly raise productivity (Becker, 1964) and increase the economy ability to develop and adopt new technologies (Nelson and Phelps, 1966). On the other hand, (Lundvall and Johnson, 1994) emphasize that higher education has an impact on innovation for two reasons: people with diplomas can find and develop new technologies; and the educated population can contribute to technological advancement.

When it comes to the impact of education on state innovation, a low level of education in underdeveloped areas is an obstacle to the development of innovations in such countries. Historically, it is possible to establish a clear link between education and various eras of industrialization. For example, in the pre-industrial phase, education needs were referred to basic literacy, while in the industrial phase, needs were transferred to medium and later to professional skills. However, the post-industrial era, in which we are currently living, is characteristic by it's necessity of significant share of the population with tertiary education (Aubert, 2005).

On the other hand, Prais examined how the education system can boost total productivity (Prais, 1995). This author points to the need for a balance between academic staff dedicated to academic issues and the encouragement of professional development to enable future employees and to enable current students to acquire technical skills that will later help them to create innovations in companies (Dakhli and De Clercq, 2003). It can be concluded once again that innovations that contribute to creation of a competitive advantage are strongly linked to the knowledge of human resources.

5. RESEARCH RESULTS

According to the Global Innovation Index for 2017, the Republic of Serbia is 62nd out of a total of 127 countries. This is the state only in front of Bosnia and Herzegovina, while all other countries of former Yugoslavia are in front of the Republic of Serbia.

The number of students in the Republic of Serbia is continuously increasing as indicated by the red line in Figure 1. In the academic year 2016/2017, 262.108 students were enrolled in tertiary education and this is the largest number of enrolled students in higher education institutions in the history of the country. In comparison with academic year 2015/2016, it is 10.946 more students and with 2006/2007, 23.398 more students.

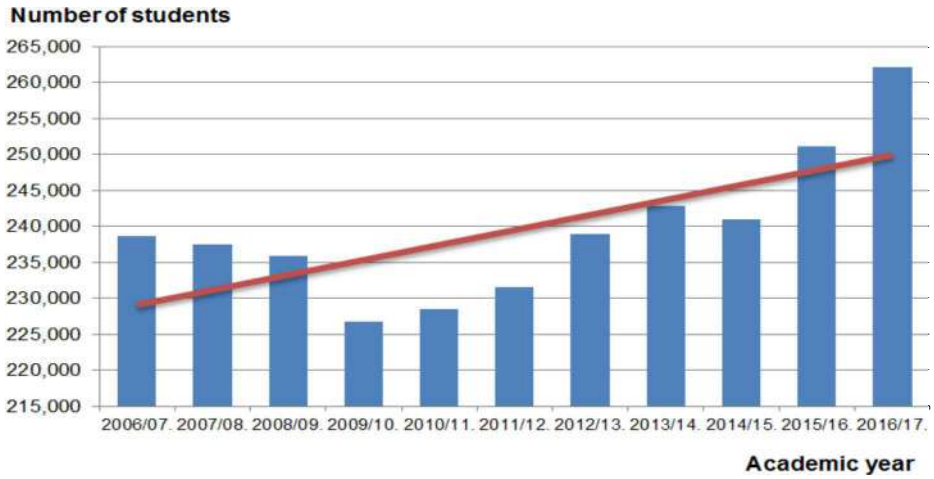

Figure 1: Number of enrolled students at universities from academic year 2006 to 2016, the Republic of Serbia
Source: Statistical Office of the Republic of Serbia, 2017

According to the Global Innovation Index, it can be noted that the Republic of Slovenia is the most innovative state of all countries of the former Yugoslavia, since the innovation potential was measured at the national level (Global Innovation Index, 2017). Taking into account the data of number enrolled students in the academic year 2016/2017, it can be said that the Republic of Serbia is in a more favorable position than the Republic of Slovenia in which, in the same period, the number of subscribers decreased by 36.000 compared to ten years ago and amounted to 79.547. However, in order to fully confirm this research, it is necessary to take into account the population of the states and see if this number is really positive.

By dividing the population of the two countries from 2016, an amount of 3.42 was obtained, which is an indicator of how many times the Republic of Serbia should have more students than the Republic of Slovenia. On the other hand, value 3.29 is the result which shows the ratio of the number of young people in higher education institutions in the countries in the academic year 2016/2017. Considering the previous amount of 3.42, it is possible to conclude that the Republic of Serbia still has fewer students, but that percentage is not so negative.

Table 1: Number of enrolled students at universities, according to gender and state/private property in academic year 2016/2017, the Republic of Serbia

	Total	Man	Woman
Total	**262.108**	**115.206**	**146.902**
State universities	189.553	78.309	111.244
Private universities	28.678	14.381	14.297
State high schools	39.731	20.218	19.513
Private high schools	4.146	2.298	1.848

Source: Statistical Office of the Republic of Serbia, 2017

Also, one of the indicators of the Human Capital and Research Indicator, is number indicator of Graduates in Science and Engineering. In academic year 2016/2017, including total number of students, 61.748 had access to engineering, manufacturing, construction and natural sciences. If this number was expressed in percentage, that would be 23.56%. The shown result is slightly less than the amount of the previous academic year (23,91%).

On the other hand, in academic year 2016/2017, 10.964 students graduated in the field of engineering, manufacturing, civil engineering and natural sciences, out of which 51.596, representing 21.25% (in academic year 2015/2016 - 20.81%). Compared with the Republic of Slovenia indicator, which is 25%, this is a worse result.

Another important indicator of Human Capital and Research sub-indicators is Expenditure on Education. Although this parameter is very important for the education system of state, the problem of finding it in the national documents of the Republic of Serbia was noticed. Therefore, UNESCO data that is shown in the Global Innovation Index reports was also used, and shown below in Table 2.

Table 2. Expenditure on education of the Republic of Serbia

	2008.	2009.	2010.	2011.	2012.	2013	2014.	2015.
Government expenditure on education								
% of GDP	**4.71**	**4.75**	**4.59**	**4.49**	**4.43**	-	**4.18**	**4.04**
% of total government expenditure	10.84	10.94	10.51	10.6	9.6	-	9.1	9.19
Government expenditure per student (in PPP$)								
Primary education	6.723,19	6.876.14	6.552,35	6.607,45	-	-	-	6.569,74
Secondary education	1.608.64	1.609,23	1.592,8	1.693,25	-	-	-	1.673,06
Tertiary education	4.739,17	4.825,61	5.188,85	5.383,72	5.251,46	-	-	5.054,66

Source: UNESCO UIS. Serbia, 2018

The GII measures innovation potential of the Republic of Serbia since 2008, while data on the percentage of GDP, that the Government allocates for education, is publicly available on the UNESCO site for the period until 2015. For this reason, the correlation link is reviewed for the period from 2008 to 2015. Accordingly, based on Figure 2, it can be concluded that parameter value of the Government expenditure on education is continuously decreasing. At the same time, such investments in this chart do not affect the position of the state on the ranking list GII. It is noted that the government expenditure on education parameter corresponds to the position of the state on the GII ranking list in the next year. In other words, if the Government of the Republic of Serbia allocated 4.59% of GDP in 2010 for education, this percentage contributes to the state's potential in 2011. However, the conclusion that investment in education (not) affects the position of the Republic of Serbia in the GII is irrelevant. Two reasons for this were found: (i) the number of entities observed is very small for such conclusion, and (ii) there is a possibility that other indicators influenced the improvement of state position at the level of the Global Innovation Index. Since two real movements in Figure 2 are not harmonized, it is stated that investment in education has no correlation with the rank of the Republic of Serbia on the GII.

In a document entitled "The Republic of Serbia Public Finance Review for 2015 by the World Bank Group" it was written that "The government finances all levels of education, but most of the costs - about 42% go to primary education, about 22% to secondary and about 25% tertiary education " (World Bank Group, 2015).

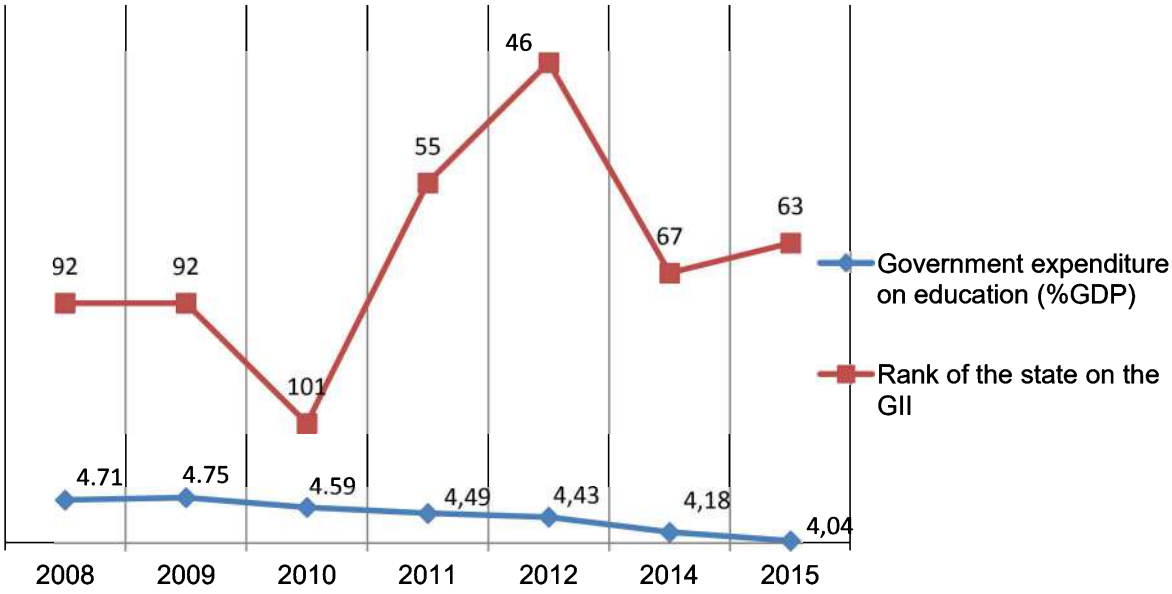

Figure 2: Level of Government expenditure on education and Rank of the state on the GII
Source: Global Innovation Index, 2017

However, out of all indicators that affect the country innovation, PISA (OECD PISA, 2015) results in mathematics, science and reading represent the worst segment of indicators Human capital and Research. In 2012, the average OECD in mathematics was 494 points and the Republic of Serbia had 449. In the reading field, the country scored 446 points (OECD average 496) while it completely dropped out of science - 445 points (the average OECD- 501). Similar situation occurred in 2009 - from 442 points (OECD average 493), mathematics 442 (OECD average 496), and science from 443 points (OECD average 501).

According to latest report (Population Census), that can be found on the website of Statistical Office of the Republic of Serbia (Statistical Office of the Republic of Serbia, 2011), only about 10% out of total population in the Republic of Serbia was highly educated. More precisely, out of total number of men, 10% were highly educated, 6% had higher education, 54% secondary education, 20% primary education, 8% were incomplete primary education and 1% were without scholar education. On the other hand, of the total number of women, 11% were with higher education, 5% with higher education, 44% with secondary education, 21% with elementary education, 14% with incomplete primary education and 4% without scholar education. It was noted that 1 - 2% of the total population have unknown education. However, due to already mentioned continuous increase in enrollment of young people to universities, it is expected that the next survey will show better results than those in 2011.

6. CONCLUSION

It can be concluded and confirmed that human capital is essential for development of innovations. As it turned out, the state power is contained in the intellectual and cultural performance of society, but in the traditional tangible assets. Therefore, the belief is that future belongs to those countries that are rich in knowledge, because they will create changes and new knowledge which bring innovations with them. What does not benefit the Republic of Serbia is the World Economic Forum's Global Competitiveness Report (The world economic forum, 2017), showing that for 2017 - 2018, the Republic of Serbia, out of a total of 137 analyzed countries, has 134th place. According to report "The Country Capacity to retain talent for 2016-2017" out of a total of 138 countries, Serbia is on the 137th place (The world economic forum, 2016) and in 2015 – 2016 report on the last 140th position (The world economic forum, 2015). Therefore, it is concluded that the main precondition for success in the 21st century is investment in knowledge, skills, creativity, intelligence, innovation and ability of society. Of course, it is rather necessary to establish and implement clear mechanisms in the government strategy for education development. Consideration of this very important issue will lead the Republic of Serbia to progress more rapidly, according to the developmental criteria. For more sensitive progress, a high level of engagement of all relevant factors will lead to development of human capital, as an unbearable category in the development of a modern society. Allocation for education and science from total GDP must be increased, in order to show positive trends and improve these results in future.

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DISCLOSURE ON INTELLECTUAL CAPITAL IN THE AGE OF INDUSTRY 4.0: EVIDENCE FROM ITALIAN CAPITAL MARKET

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Abstract: *Matter of interest is the disclosure on Intellectual Capital (IC) in the era of global "knowledge economy" or global "knowledge society". The aim is to verify the level of disclosure that Italian companies have on the components and on the relevance of their IC. Using the "Content analysis" and a specific method already tested in managerial literature, we propose a report that measures the intellectual capital with the adoption of 21 functional indicators, which consider specific aspects of intangible assets of a firm. Applying the content analysis to financial statements of 31 companies included in FTSE Italy Technology Index and FTSE Italy Financial Services Index, we find that the level of overall disclosure is, on average, moderate but increasing. Observing the disclosure index related to the specific component of intellectual capital considered in this research, all the aspects of IC have benefited, on average, of an improvement in the level of external communication.*

Keywords*: Intellectual capital, corporate disclosure, knowledge resources, financial statement*

1. INTRODUCTION

This paper focuses on the relevance of intellectual capital (IC) in the era of global "knowledge economy" or global "knowledge society". In the last few years an increasing number of companies have realised that the conditions for running a competitive business in turbolent markets are innovation and flexibility. Indeed, the knowledge resources of a firm represent an increasing part not only of its products, but also of its value because they allow to innovate, compete and grow. Therefore a company's strategic development may depend on the whole organization being ready to make use of distinctive knowledge resources. The main developed economies around the world has been characterized by an increasing exploitation of knowledge resources (i.e. employees, customers, processes and technologies) by small medium and large enterprises. Being able to take advantage from that kind of resources will be a decisive condition for the firms, at the present and in the future, to have success and growth.
In this context, it raises a need to employ the best tools and methods to support and measure the knowledge creation and application, and to structure an effective knowledge management system. All of the components of IC should be considered and improved, to obtain a strong competitive advantage. The intellectual capital statements represented a way for managing and bringing focus to the development of the company's knowledge resources. Providing a status of the company's knowledge through text, figures and illustrations, the intellectual capital statement is a useful tool for companies wishing to improve and apply systematically its intangible assets, human expertise and relationship power.
The intellectual capital statement is one of the tools of voluntary disclosure that a company could use; it may integrate the set of information already given by the financial statement, which is the main tool of mandatory disclosure. However, a relevant part of Italian companies, including those listed in capital markets, do not use the intellectual capital statement to communicate outside their effort to develop knowledge resources. Therefore, it is the duty of the mandatory communication, i.e. of the financial statements, to provide that kind of information. This is the reason why, given the relevance of knowledge resources, we consider interesting to check quality and quantity of information about the intellectual capital reported in the financial statements.

2. LITERATURE REVIEW

Over the past 30 years, there has been a remarkable increase in articles, books, conferences and job titles all related to the primary issue of harvesting intellectual capital through knowledge management.
Although we study the disclosure of Italian companies on the components and on the relevance of their intellectual capital, the analysis of measurement models of intellectual capital was necessary to understand the drivers that compose the IC in order to orient the choices of items considered in our model of analysis.
The strategic rule of the intangible assets, which have evolved from "needed to win" resources to "needed to play" resources, has been confirmed from the 90s. In 2001, Thomas Stewart, former editor at Fortune magazine, proposed a cover story by exclaiming that brainpower and intellectual capital were becoming America's most valuable assets. Intellectual capital quickly became part of a new lexicon describing novel forms of economic value. It belonged to a paradigm where sustainable competitive advantage was tied to individual and organizational knowledge. Reliance on traditional productive tangible assets such as raw

materials, fixed capital, and land no longer accounted for investments made and wealth created by new and prospering companies. Instead, leveraging knowledge assets became the key reason attributed to corporate success stories during the dawn of the internet age (Bontis et Al., 2010).
The reasons for this evolution can be brought back to the real market and to the financial market changes. The first one is characterized by a demand which has moved to more sophisticate goods and services, which have a strong technology connotation or a distinctive character; secondly one there is a widening gap from the market value to the book equity with all the connected consequences (even negative – fraud).
The evolution of the rule of the intangible resources in business management has led to an evolution of the accounting studies, developing pricing models that can be distinguished between pure currency paradigms and integrated currency paradigms. Simultaneously there was the affirmation of the intangible assets strategic rule and the necessity of their measurement. The pure currently paradigms try to estimate the intangible constituents using only monetary values, for example to unite the immaterial resource value with the difference between the market value and balance sheet value. The integrated models create new approach and estimation methodologies, base on the joint use of monetary measures and physical-technical measures that are able to take particular innovative features of the immaterial resources.
While the accounting researchers were focused on the concept of value and the cost and the initial expense of the immaterial resources, in the other discipline the attention of professors and academics was dedicated to knowledge, information, brand, reputation and human resources management process; a wider item list that was difficult to manage for them because there wasn't enough information (Johanson and Henningsson, 2007). The common ground between the ideas of the academics is represented by the concept of IC, which is a still widely debated notion because the doctrine and the procedure have proposed a whole host of definitions, which sometimes are similar but not exactly the same and no one has been generally accepted, but the components can all be lead back to human capital, structural capital and relational equity.
Nowadays, there are many methods for measuring the intellectual capital, the doctrinal approach affirms that a model can be considered scientifically valid if underlying model can be frame in the "weakly defined" model category – that overtakes the four conditions of clarity, objectivity, robustness theoretical and generality. Then, in this work, we try to overcome the current model limits by identifying a method which can become a common practice. The different approaches for knowledge measurement can be divided into four principal categories:

1. Direct Intellectual Capital methods (DIC). This method estimates the monetary value of the intellectual capital (knowledge) by the identification of the components that make up the knowledge. Once that the components have been defined, they are commended individually and also using an aggregated ratio. For example, fall in the category: EVVICAE by McCutcheon (2008), FiMIAM by Rodov e Leiaert (2002), Intellectual asset by Sullivan (2000), Total value creation by Anderson and McLean (2000), Value Explorer di Andriessen and Tiessen (2000), Inclusive Valuation methodology by McPherson (1998), Accounting for the future by Nash (1998), Technology broker (intellectual capital audit) by Brooking (1996), Citation-weighted patents by Dow Chemical (1996), HR Costing/Accounting by Johansson (1996);
2. Market Capitalization Methods (MCM). These methods calculate the difference between the market capitalization of the organization and its net asset. This value is the knowledge value in the organization ownership. For example Q by Tobin (1950), Invisible balance sheet by Sveiby (1989), Calculated intangible value by Stewart (1997), Stock and flow by Bolisani and Oltramari (2012), are part of this category.
3. Return on Assets methods (ROA). The ROA is and index which is calculated by dividing the average pre-tax income of the company, related to a certain time period, for the company's average assets (related to physical assets). In this case, the same concept is applied to the business knowledge which the methods of this category calculate the economics return. The ROA calculated in this way can also be useful when is related to the ROA of different years or is related to the ROA of different companies of the same sector. For example, Knowledge Capital Earnings by T Lev (1999), Economic Value Added by Stern and Stewart (1997), Value Added Intellectual Coefficient by Pulic (1997), are part of this category;
4. Scorecard methods (SC). These methods identify the different components of the intellectual capital (and of the business knowledge) and on these are calculated the appropriated indicators and index which are introduced in a schedule or in a graphic, according to the classical approach of the balanced scorecard (Kaplan and Norton, 1996). For example, ICU report by Sanchez (2009), InCas by EU (2008), RICI by Schiuma, Lerro and Carlucci (2008), Knowledge asset value creation map by Schiuma and Carlucci (2006), IabM by the Japanese Ministry of Economy and Industry (2004), SICAP by many authors (2004), National Intellectual Capital by Bontis (2004), Index by Topplinjen/Business IQ, Sandvik (2004), Public sector IC by Bossi (2003), Danish Guidelines by Mouritsen, Bukh and others (2003), IC-dV AL Bonfour (2003), Intellectus model Sanchez-Camizares (2007), Knowledge Asset Methodology by the Global Bank (2002), IC Rating by Edvisson (2002), Value Chain Scoreboard by Lev (2002), Meritum T by Meritum Guidelines (2002), Intangible asset statement by Garcia (2001), Value creation index by Baum et al (2000), IC-Index T by Roos et al

(1997), Balanced scorecard by Kaplan and Norton (2006), Holistic accounts by Ramball Group (1995), Skandia Navigator T by Edvisson and Malone (1997,) Intangible Asset Monitor by Sveiby (1997), are part of this category.

Some methods constitute widespread practise, even in a limited context; such as: the Danish Guidelines, the IABM method, remarkably diffused in Japan (support by the Japanese government), the Citation weighted patents method promoted and implemented by Dow Chemicals and the Business IQ method. Nevertheless, the usage of these methods is cordoned off a specific company, a sector, a geographic area and no one of these have achieved a state of global acceptance and may not succeed in the future.
The methods that can be considered more firm in terms of objectivity and identity are the methods which belong to the ROA category or that one "adjusted" to the knowledge measurement, such as the Accounting for the future or the Q of Tobin (for these methods there is not clear definition of concepts and proprieties), while SC approaches are more frail in term of objectivity and generality.

3. METHODOLOGY

3.1. Method and dataset

Our research aims to verify the level of disclosure that Italian companies make on the components and on the relevance of their intellectual capital.
The methodology applied in our research job is based on the "Content analysis" (Krippendorff, 1980; Yi and Davey, 2010), that requires a survey and consequent analysis of data and information in financial statements about knowledge resources. As a methodological approach frequently used in social communication and in environmental communication (Hackston and Milne, 1996), the application of this method is based on five stages:

- Choice of the report to classified the information;
- Choice of the analysis unit with which is assessed the presence or the absence of the research information (the sentences, the paragraph, the page, the entire document);
- The coding procedure and the evaluation of its robustness;
- The codification;
- The ex-post verification of the reliability of the reach data.

Effectively, the choice of the report, for the information classification about the intangible assets of the company, has been placed on the methodological scheme formalized by OECD (Guthrie et Al. 1999). The measurement report of the intellectual capital of the companies is divided in three sections:

- The interior section is referred to the organized capital (divided in intellectual proprieties and infrastructure assets), which is represented by the set of codified know-how within the company structure, the capacity for innovation and research, the efficiency of internal processes, the corporate culture, the degree of cohesion of the management and the ability to attract new skills;
- The external section of the relationship capital is based on the wealth of relationships established with the market, with stakeholders and with current and potential customers;
- The human capital section, is expression of the set of knowledge, skills and abilities of the people who work in the company.

Every section is measured with the adoption of functional indicators – at all 21 items – which measure specific intangibles. Compared to the original report, in the external section we have changed the franchising agreements index with the ethical and environment index. As analysis unit for the assessed of the presence or absence of the information search by the indicator we decided to use "the sentences" because it is considered more reliable than a print page or than an entire paragraph (Hackston and Milne, 1996). More specifically, each sentence is associated at a score that could represent one of the different intangible asset indicators, measured with the semantic differential with a coefficient between 0 and 3. Indeed:

- Score 0 is assigned when the information isn't qualified (not quantitatively reported with reference to the traditional accounting documents - balance sheet and income statement not described qualitatively in other documents - the management report, the code of ethics, etc);
- Score 1 is assigned when the information is qualified only qualitatively or only quantitatively (with reference only to the traditional accounting documents - balance sheet and income statement for the quantitative aspect or only to the management report, the code of ethics or other corporate documents for the qualitative aspects);
- Score 2 is assigned when the information is qualified both quantitatively and qualitatively;
- Score 3 is assigned when the information is quantitative qualified and specificly it is qualitatively in-depth (the strategic and competitive nature of the agreement is specified).

With regards to the implementing rules of the "content analysis" one of the critical elements for its operation and adjustment is about the "strength" (Krippendorff, 1980) of the codifying procedure because the classification scheme could suffer from the subjective assessment of the researchers (Guthrie et Al, 2004). Following that literature, it is possible to identify different kinds of "strength":

- The reproducibility: referred to the risk of making codify systematic errors when more than one researcher is involved in the activity;
- The care: referred to the researchers ability to apply the codify procedure uniformly in different time periods;
- The stability: referred to the possibility to link the reproducibility of the results with a determinate standard laid down in advance.

INTELLECTUAL CAPITAL COMPONENTS	*Score*	*Disclosure Index*
Structural Capital		
Patent	$p1 \in (0,3)$	
Copyright	$p2 \in (0,3)$	
Brand/trademark	$p3 \in (0,3)$	
Intellectual property disclosure index		$IPDI = \frac{(p1 + p2 + p3)}{3} \in (0,3)$
Corporate Culture	$p4 \in (0,3)$	
Management processes	$p5 \in (0,3)$	
Information systems	$p6 \in (0,3)$	
Networking systems	$p7 \in (0,3)$	
Research projects	$p8 \in (0,3)$	
Operational capital disclosure index		$OCDI = \frac{(p4 + p5 + p6 + p7 + p8)}{5} \in (0,3)$
External Relation Capital		
Clients	$p9 \in (0,3)$	
Loyalty	$p10 \in (0,3)$	
Distribution channels	$p11 \in (0,3)$	
Partnership	$p12 \in (0,3)$	
Research agreements	$p13 \in (0,3)$	
Financial Partnership	$p14 \in (0,3)$	
Licensing agreements	$p15 \in (0,3)$	
Franchising agreements	$p16 \in (0,3)$	
Ethics & Environment	$p17 \in (0,3)$	
*Reputa*tional Capital disclosure index		$RCDI = \frac{(p9 + p10 + p11 + p12 + p13 + p14 + p15 + p16 + p17)}{9} \in (0,3)$
Internal Capital		
Training programs	$p18 \in (0,3)$	
Employees	$p19 \in (0,3)$	
Business process knowledge	$p20 \in (0,3)$	
Business process competencies	$p21 \in (0,3)$	
Human Capital disclosure index		$HCDI = \frac{(p18 + p19 + p20 + p21)}{4} \in (0,3)$
INTELLECTUAL CAPITAL DISCLOSURE INDEX		$\boldsymbol{ICDI = \frac{IPDI * 3 + OCDI * 5 + RCDI * 9 + HCDI * 4}{21} \in (0,3)}$

The empirical research concerns the analysis and the quali-quantitative study of the financial statements of a sample of companies listed on the Italian stock market, relating to the fiscal years 2010 and 2016. In particular, the sample comprises the listed companies included in the "super sector" indexes FTSE Italy Financial Services and FTSE Italy Technology, listed at the "Borsa di Milano".

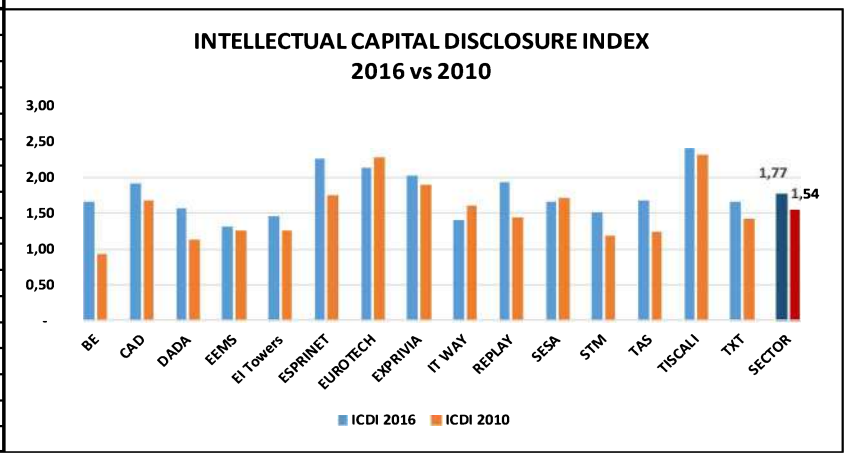
FTSE Italy Technology	FTSE Italy Financial Services
1. Be	1. Anima Holding Spa
2. Cad it	2. Azimut Holding
3. Dada	3. Banca Generali
4. Eems	4. Banca Ifis
5. Ei Towers	5. Banca Intermobiliare
6. Esprinet	6. Banca Sistema
7. Eurotech	7. Conafi Prestito
8. Exprivia	8. Dea Capital
9. It Way	9. Exor
10. Reply	10. Gequity
11. Sesa	11. Lventure Group
12. Stmicroelectronics	12. M&C
13. Tas	13. Mittel
14. Tiscali	14. Mutuionline
15. Txt	15. Tamburi Investment Partners
	16. Tecnoinvestimenti.

Therefore, to apply the content analysis, 62 financial statements relating to 31 listed companies were examined.

3.2. Evidences

Applying the content analysis to financial statement of companies included in FTSE Italy Technology, it results that the level of overall disclosure is moderate but increasing. Indeed, the Intellectual Capital Disclosure Index of the examining sector moves from a level of 1,54 in 2010 to a level of 1,77 in 2016 (+15,1%). Just 3 companies of the sector have worsened their overall level of disclosure, having the other 13 bettered their one.

LISTED COMPANIES	INTELLECTUAL CAPITAL DISCLOSURE INDEX		
	ICDI 2016	*ICDI 2010*	*Δ %*
BE	1,66	0,94	*76,9%*
CAD	1,91	1,67	*14,9%*
DADA	1,57	1,14	*38,5%*
EEMS	1,31	1,25	*5,2%*
EI Towers	1,45	1,26	*15,2%*
ESPRINET	2,26	1,75	*29,1%*
EUROTECH	2,12	2,27	*-6,6%*
EXPRIVIA	2,01	1,89	*6,4%*
IT WAY	1,41	1,60	*-12,1%*
REPLAY	1,94	1,44	*34,1%*
SESA	1,66	1,71	*-2,9%*
STM	1,50	1,18	*27,2%*
TAS	1,67	1,24	*34,6%*
TISCALI	2,41	2,30	*4,6%*
TXT	1,65	1,41	*16,6%*
SECTOR	**1,77**	**1,54**	***15,1%***

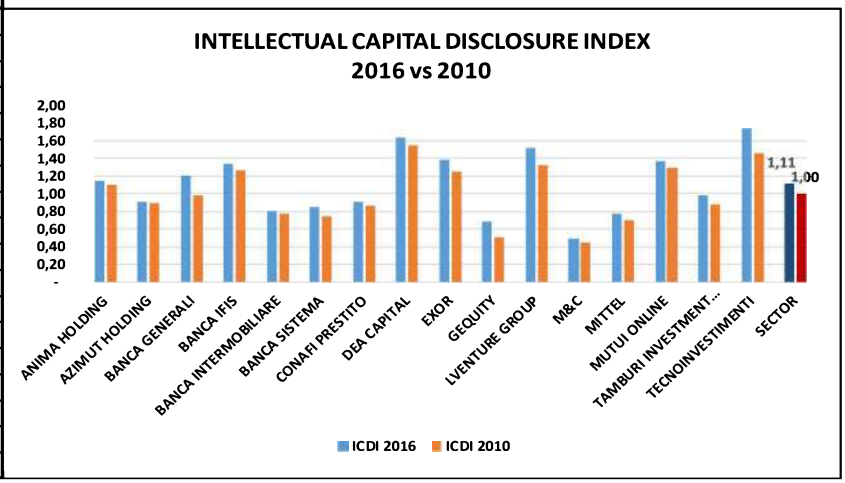


Observing the disclosure index related to the specific component of intellectual capital considered in this research, all the aspects of IC have benefited, on average, of an improvement in the level of external communication. The highest level of disclosure is concerning the communication of intellectual property and operational capital, the worst is inherent to the human capital. In terms of improvement between 2010 and 2016, the largest increase in the disclosure index is recorded for operational capital.

LISTED COMPANIES	INTELLECTUAL PROPERTY DISCLOSURE INDEX			OPERATIONAL CAPITAL DISCLOSURE INDEX			RELATIONAL CAPITAL DISCLOSURE INDEX			HUMAN CAPITAL DISCLOSURE INDEX		
	IPDI 2016	*IPDI 2010*	*Δ %*	*OCDI 2016*	*OCDI 2010*	*Δ %*	*RCDI 2016*	*RCDI 2010*	*Δ %*	*HCDI 2016*	*HCDI 2010*	*Δ %*
BE	1,00	1,00	*0,0%*	2,60	1,20	*116,7%*	1,22	0,78	*57,1%*	0,50	0,25	*100,0%*
CAD	1,33	1,67	*-20,0%*	2,40	2,00	*20,0%*	1,67	1,22	*36,4%*	1,75	1,25	*40,0%*
DADA	2,00	1,33	*50,0%*	1,80	1,20	*50,0%*	1,33	1,22	*9,1%*	0,50	0,50	*0,0%*
EEMS	1,67	1,00	*66,7%*	1,40	1,60	*-12,5%*	1,67	1,33	*25,0%*	-	0,50	*-100,0%*
EI Towers	1,33	2,00	*-33,3%*	1,40	0,80	*75,0%*	1,67	1,56	*7,1%*	1,50	1,00	*50,0%*
ESPRINET	2,00	1,00	*100,0%*	2,40	1,80	*33,3%*	2,11	2,22	*-5,0%*	2,50	2,25	*11,1%*
EUROTECH	2,67	3,00	*-11,1%*	2,00	2,20	*-9,1%*	2,56	2,67	*-4,2%*	1,00	0,75	*33,3%*
EXPRIVIA	2,00	2,00	*0,0%*	2,20	2,20	*0,0%*	2,00	1,56	*28,6%*	1,50	1,25	*20,0%*
IT WAY	1,67	2,00	*-16,7%*	1,40	1,40	*0,0%*	1,78	2,00	*-11,1%*	0,50	1,00	*-50,0%*
REPLAY	1,67	1,33	*25,0%*	2,40	1,80	*33,3%*	1,56	1,11	*40,0%*	1,50	1,00	*50,0%*
SESA	1,67	2,00	*-16,7%*	2,00	1,80	*11,1%*	1,78	1,89	*-5,9%*	0,50	0,75	*-33,3%*
STM	2,33	2,33	*0,0%*	1,20	0,60	*100,0%*	1,89	1,56	*21,4%*	0,50	0,50	*0,0%*
TAS	1,67	1,33	*25,0%*	1,80	1,20	*50,0%*	1,89	1,78	*6,3%*	1,00	0,50	*100,0%*
TISCALI	3,00	3,00	*0,0%*	2,80	2,60	*7,7%*	2,22	2,11	*5,3%*	0,50	0,50	*0,0%*
TXT	1,67	1,67	*0,0%*	1,80	1,40	*28,6%*	1,78	1,44	*23,1%*	1,00	1,00	*0,0%*
SECTOR	**1,84**	**1,78**	***3,8%***	**1,97**	**1,59**	***24,4%***	**1,81**	**1,63**	***10,9%***	**0,98**	**0,87**	***13,5%***

Applying the content analysis to the financial statement of companies included in FTSE Italy Financial Services, it results that the level of overall disclosure is not sufficient, and lower than the sector considered above. However, the Intellectual Capital Disclosure Index of the examining sector moves from a level of 1,00 in 2010 to a level of 1,11 in 2016 (+10,7%). All the companies of the sector have bettered their overall level of disclosure.

LISTED COMPANIES	INTELLECTUAL CAPITAL DISCLOSURE INDEX		
	ICDI 2016	*ICDI 2010*	*Δ %*
ANIMA HOLDING	1,14	1,10	*3,8%*
AZIMUT HOLDING	0,91	0,89	*2,4%*
BANCA GENERALI	1,21	0,99	*22,5%*
BANCA IFIS	1,34	1,26	*6,3%*
BANCA INTERMOBILIA	0,81	0,78	*3,5%*
BANCA SISTEMA	0,85	0,74	*14,4%*
CONAFI PRESTITO	0,91	0,87	*5,0%*
DEA CAPITAL	1,63	1,54	*6,0%*
EXOR	1,39	1,25	*11,0%*
GEQUITY	0,68	0,51	*33,8%*
LVENTURE GROUP	1,51	1,32	*14,1%*
M&C	0,49	0,44	*9,8%*
MITTEL	0,77	0,69	*11,2%*
MUTUI ONLINE	1,36	1,29	*6,1%*
TAMBURI INVESTMENT	0,98	0,87	*12,4%*
TECNOINVESTIMENTI	1,74	1,46	*19,1%*
SECTOR	**1,11**	**1,00**	***10,7%***



Observing the disclosure index related to the specific component of intellectual capital considered in this research, all the aspects of IC have benefited, on average, of an improvement in the level of external communication. The highest level of disclosure is concerning the communication of operational and human capital, the worst is inherent to the relational capital. In terms of improvement between 2010 and 2016, the largest increase in the disclosure index is recorded for operational capital.

LISTED COMPANIES	INTELLECTUAL PROPERTY DISCLOSURE INDEX			OPERATIONAL CAPITAL DISCLOSURE INDEX			RELATIONAL CAPITAL DISCLOSURE INDEX			HUMAN CAPITAL DISCLOSURE INDEX		
	IPDI 2016	IPDI 2010	Δ%	OCDI 2016	OCDI 2010	Δ%	RCDI 2016	RCDI 2010	Δ%	HCDI 2016	HCDI 2010	Δ%
ANIMA HOLDING	1,00	1,00	0,0%	1,40	1,40	0,0%	1,22	1,00	22,2%	0,50	0,50	0,0%
AZIMUT HOLDING	1,00	1,00	0,0%	1,00	1,00	0,0%	0,89	0,78	14,3%	0,50	0,50	0,0%
BANCA GENERALI	0,67	0,67	0,0%	1,60	1,20	33,3%	0,78	0,89	-12,5%	1,50	1,00	50,0%
BANCA IFIS	1,00	1,00	0,0%	1,60	1,40	14,3%	1,22	1,44	-15,4%	1,25	1,00	25,0%
BANCA INTERMOBILIA	0,67	1,00	-33,3%	0,80	0,60	33,3%	1,22	1,11	10,0%	0,50	0,50	0,0%
BANCA SISTEMA	0,67	0,67	0,0%	1,00	0,80	25,0%	1,00	0,89	12,5%	0,50	0,50	0,0%
CONAFI PRESTITO	0,67	0,67	0,0%	1,00	0,80	25,0%	1,33	1,56	-14,3%	0,50	0,50	0,0%
DEA CAPITAL	1,33	1,33	0,0%	2,00	1,80	11,1%	1,67	1,44	15,4%	1,00	1,25	-20,0%
EXOR	1,33	0,67	100,0%	1,40	1,60	-12,5%	1,33	1,56	-14,3%	1,50	0,75	100,0%
GEQUITY	0,67	0,67	0,0%	0,80	0,40	100,0%	0,56	0,56	0,0%	0,50	0,50	0,0%
LVENTURE GROUP	1,33	1,00	33,3%	1,80	1,60	12,5%	1,44	1,33	8,3%	1,00	1,00	0,0%
M&C	0,67	0,67	0,0%	0,40	0,20	100,0%	0,44	0,67	-33,3%	0,50	0,50	0,0%
MITTEL	0,67	0,67	0,0%	0,80	0,60	33,3%	1,22	0,89	37,5%	0,25	0,75	-66,7%
MUTUI ONLINE	1,33	1,33	0,0%	1,40	1,40	0,0%	1,78	1,56	14,3%	0,75	0,50	50,0%
TAMBURI INVESTMENT	0,67	0,67	0,0%	1,40	1,00	40,0%	0,78	1,11	-30,0%	0,50	0,50	0,0%
TECNOINVESTIMENTI	1,67	1,33	25,0%	2,20	2,00	10,0%	1,33	1,11	20,0%	1,00	0,50	100,0%
SECTOR	0,96	0,90	7,0%	1,29	1,11	15,7%	1,14	1,12	1,9%	0,77	0,67	14,0%

By comparing the two considered sectors, we observe that the companies of FTSE Italy Technology present a level of disclosure significantly higher than the other sector.

SECTOR	INTELLECTUAL CAPITAL DISCLOSURE INDEX		
	ICDI 2016	ICDI 2010	Δ%
FTSE Italy Technology	1,77	1,54	15,1%
FTSE Italy Financial Services	1,11	1,00	10,7%
Δ %	60,0%	53,9%	n.a.

This finding is confirmed examining all the elements of intellectual capital.

SECTOR	INTELLECTUAL PROPERTY DISCLOSURE INDEX			OPERATIONAL CAPITAL DISCLOSURE INDEX			RELATIONAL CAPITAL DISCLOSURE INDEX			HUMAN CAPITAL DISCLOSURE INDEX		
	IPDI 2016	IPDI 2010	Δ%	OCDI 2016	OCDI 2010	Δ%	RCDI 2016	RCDI 2010	Δ%	HCDI 2016	HCDI 2010	Δ%
FTSE Italy Technology	1,84	1,78	3,8%	1,97	1,59	24,4%	1,81	1,63	10,9%	0,98	0,87	13,5%
FTSE Italy Financial Services	0,96	0,90	7,0%	1,29	1,11	15,7%	1,14	1,12	1,9%	0,77	0,67	14,0%
Δ %	92,5%	98,4%	n.a.	53,3%	42,6%	n.a.	58,7%	45,8%	n.a.	28,4%	29,0%	n.a.

4. CONCLUSION

The research aims to measure the level of disclosure on intellectual capital that characterizes some Italian listed companies. Applying the content analysis to financial statement of 31 companies listed on Milan Stock Market, we measured 21 functional indicators representative of the 4 main aspects of IC, attributing to each one a coefficient between 0 and 3.

It results that, on average, the level of overall disclosure is moderate both in 2010 and 2016; but comparing the results of this 2 fiscal years, the level of disclosure appears to be significantly increasing. Observing the disclosure index related to the specific component of intellectual capital considered in this research, all the aspects of IC have benefited, on average, of an improvement in terms of communication.

The highest level of disclosure is concerning the communication of intellectual property and operational capital, the worst is inherent to the human capital. In terms of improvement between 2010 and 2016, the largest increase in the disclosure index is recorded for operational capital.

Comparing the companies included in FTSE Italy Technologies Index with those included in FTSE Italy Financial Services Index, it results that the level of overall disclosure of the seconds is not sufficient, and lower than the first ones. This finding is confirmed examining all the elements of intellectual capital. Anyway, almost all the companies of the 2 sectors have bettered their overall level of disclosure. This finding is confirmed examining all the elements of intellectual capital.

Concluding, the increase in the disclosure index, emerging from the comparison of the communication level in 2010 and in 2016, confirms the relevance of intellectual capital in the age of Industry 4.0.

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AGILE APPROACH IN INNOVATIVE MEDICINE DEVELOPMENT

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Abstract: *The paper presents key elements and features of innovation projects in pharmaceutical industry, especially concerning innovative drug development. Nowadays, in a time of dynamic changes and challenges, pharmaceutical companies (also known as Life Sciences) are facing dual imperatives to deliver innovative therapy that addresses unmet patient needs in a timely manner and to achieve profitable growth. Achieving these targets very often requires transforming the current business model or internal process improvement. The focus of this paper is to assess the possibilities of agile approach incorporation in iterative Stage Gate framework in innovative medicine development and also to try to identify what concrete actions can be undertaken in each phase in order to have more efficient and faster availability of innovative therapy which will be measured with appropriate innovation indicators.*

Keywords*: innovative medicine, agile, innovative process, pharmaceutical industry, research and development, efficiency*

1. INTRODUCTION

Pharmaceutical innovation is one of the driving forces behind the tremendous progress in life expectancy and better health we have experienced in the last 60 years. As a result of complex interaction and strong partnership between science, health care, and industry, pharmaceutical innovation represent a crucial contribution in improving public health and at the same time is the main driver for growth and competitive status in pharmaceutical industry.

Developing a new drug is a very complex, high risky and long process. From screening to reimbursement process, it's not easy to understand each and every stage of the long chain of events going from a scientific discovery to a packaged product on the shelves of a local pharmacy? The level of complexity and fragmentation throughout the R&D pipeline, pervasive government actions and regulations impact the flow of pharmaceutical innovation. Each of these stages can either accelerate or stop pharmaceutical innovation, meaning the difference between a new medicine and no treatment for patients.

Therefore, in order to increase R&D productivity, recommendation for representatives of research-based pharmaceutical companies, for those who still didn't, would be to deploy stage gate framework, phase designed process for new product development (NPD) based on project management and risk based approach. This challenge is difficult, but not impossible to overcome. Consequently, this will result in better project planning and risk mitigation strategy for project timelines, inter – dependency of projects, resource allocations, budgets and research outcomes (https://www.pharmafocusasia.com/articles/increasing-speed-randd-stage-gate).

The last but not the least, the most important is the agile methodology approach and the benefits implementation results, how to make the whole process more efficient, to improve speed to the market and to increase development productivity. When it comes to patients and medical treatment, the main success criteria of the project progress is timing. Time is of essence here.

2. KEY PHARMACEUTICAL INDUSTRY FEATURES

Global sales of medicines and pharmaceutical products represent the international expansion of medical technology that is the result of a highly intensive research and development in the countries exporting these technologies. At the same time, the importing countries benefit through improved health care, even if those countries do not participate in the process of research and development.

The pharmaceutical industry is responsible for the development, production and sale of medicines. The main characteristics of pharmaceutical industry and pharmaceutical market are strong competition, wide distribution, steady growth of the market and strict regulations (through price control and treatment costs). In the period from 2001 to 2016 pharmaceutical industry achieved the significant growth, ending 2016 in total

reached revenues 1105.2 billion USD. (https://www.statista.com/statistics/263102/pharmaceutical-market-worldwide-revenue-since-2001)

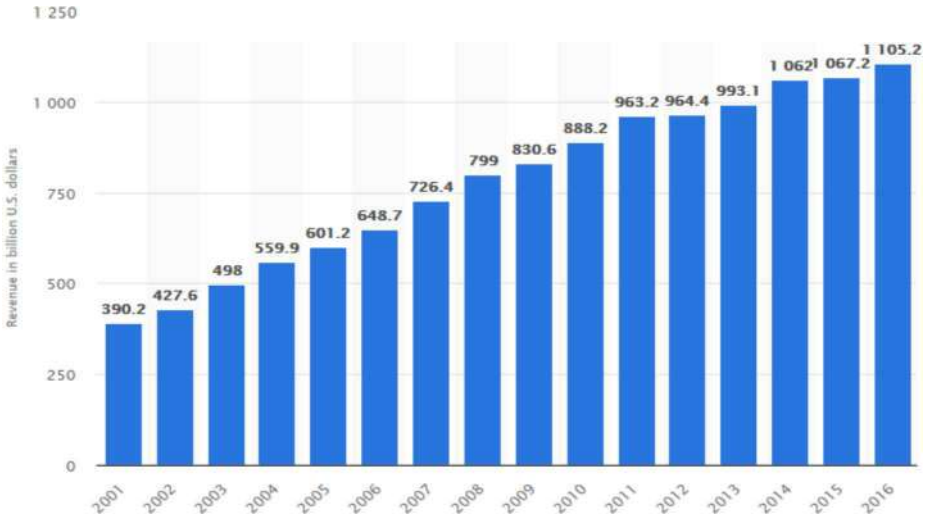

Figure 1: Revenue of the worldwide pharmaceutical market from 2001 to 2016 (in billion U.S. dollars)

Pharmaceutical companies are engaged in the research, discovery, development, production, and sale of chemical and biochemical compounds. The industry makes an essential contribution to improvements in the prevention and management of ill health and disease. In this way, the quality of human life is protected, preserved and improved. Innovative companies in pharma industry will not survive in the marketplace unless develop a succession of new products that are able to compete successfully with those manufactured by competitors or may also need to improve its established products to remain competitive in the face of other companies' new or improved products. Based on statistical estimation, investments in R&D should increase to over 180 billion USD by 2022: (https://www.statista.com/statistics/309466/global-r-and-d-expenditure-for-pharmaceuticals/)

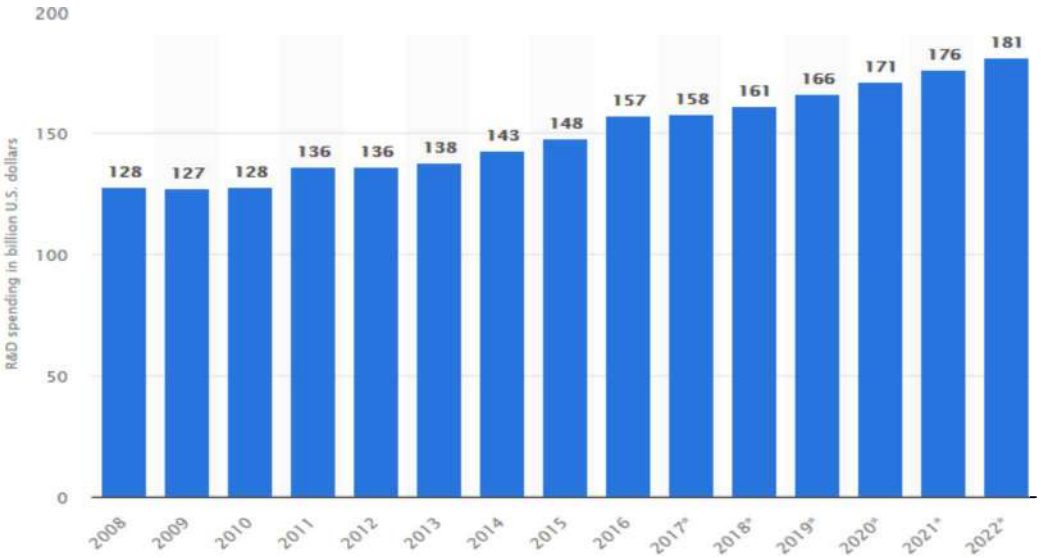

Figure 2: Total global pharmaceutical research and development (R&D) spending from 2008 to 2022 (in billion U.S. dollars)

R&D involves initial discovery, investigation, and pre-clinical and clinical testing of chemical compounds. Investing in R&D is critical for commercial success achievement in the pharmaceutical industry. The outcome of pharmaceutical R&D is risky and uncertain, it does not, however, guarantee success. Of the 5,000 to 10,000 screened compounds, only 250 enter pre-clinical testing, five enter clinical testing and one is approved by the FDA, Food and Drug Agency (Pharmaceutical Industry Profile 2012 Washington, DC:

PhRMA page 30, Fig 3). Developing a new medicine takes in average 10 to 15 years. On average, **only three out of ten** approved drugs recover average R&D costs.

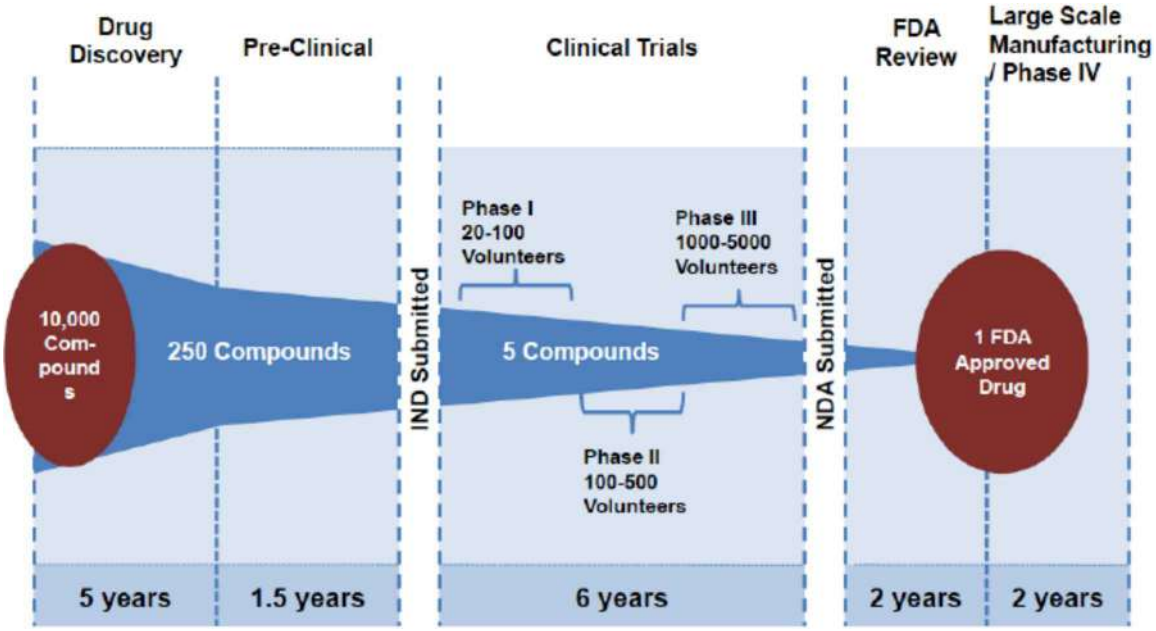

Figure 3: The Drug Development Process

IP protection is of paramount importance to this industry. **IP** (intellectual property) **rights drive innovative activity** and value creation across the pharmaceutical industry and national economies. Without the benefit of intellectual property protection, pharmaceutical companies could not undertake the massive research & development investments required to develop new medicines.

As a result of R&D successful process, pharmaceutical innovation responds to unmet public health needs, brings greater societal benefits such as releasing other healthcare resources, increasing work force productivity and improving macroeconomics through greater investment in human capital by healthy population (http://www.who.int/topics/innovation/en/).

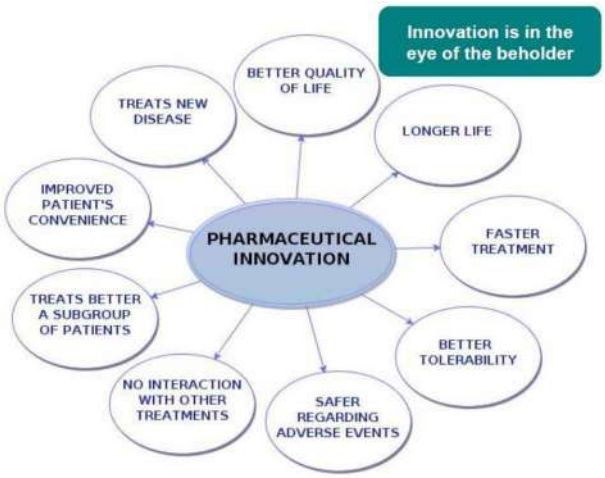

Figure 4: Value of innovation (Policy Passport MSD, Internal document)

Seven stakeholders have been identified as key role players in deciding whether a medicine is innovative, using different definitions of innovation at different points in the product lifecycle. The process starts with the *researcher*, who identifies the scientific potential of a particular molecule. It continues with the *investor*, who backs that belief with capital; the *regulator*, who approves the labelling claim; and the *pharmaceutical company*, which commits resources to the production and promotion of the treatment. Once a medicine has reached the market, it is the h*ealthcare payer, provider* and *patient*, respectively, who adjudicate on its innovativeness: the healthcare payer by paying a premium price for it; the provider by choosing it over other therapies; and the patient by taking it as instructed or even pressing for a prescription (Pharma 2020: Marketing the future Which path will you take?).

3. INTRODUCING AGILE PRINCIPLES INTO INNOVATIVE DRUGS DEVELOPMENT

In regards of stated above, launch of pharmaceutical innovation is long, complex, risky and expensive iterative process, resulting from cross- functional team interaction. At the same time, the benefits have been tremendous with ending result that pharmaceutical innovation is what helps the patient.

Lately, there is a huge pressure on pharma industry to shift their focus and investments on improving productivity and innovation access. This statement became almost an imperative. Constructive approach would require Stage-Gate framework including detail phase – review designed for New Product Development (NPD). NPD system is based on effective project management and risk approach. The stage gate framework (Cooper, 1990) is a series of systematic, constructive and cross functional reviews providing increased scrutiny over R&D projects, where the gates refer to key decision points at each important milestone of the project to assess: what has been achieved, whether it is sufficient, and based on the information available if the project can be moved to the next stage (https://www.pharmafocusasia-.com/articles/increasing-speed-randd-stage-gate). This approach will enable timely identifying any process and technology concerns and tracking of project performance progress. Incorporating agile methodology in existing Stage-Gate framework is resulting in hybrid model for innovative medicine development (Cooper, 2017). Added value in agile approach will result in improving speed to market which is critical when it comes to innovative therapy and unmet medical need and increasing development productivity. Generally speaking, agile development methods are introduced in software industry, mainly coming as request to adaptive planning, evolutionary delivery, timely – boxed iterative approach and flexible response to change (Cooper & Sommer, 2016). This is why it should be useful to have in mind set of 12 principles introduced by that The Agile Manifesto in IT (Langdon, 2017), established in 2001, and among them are:

- Working software to be delivered quickly and iterated frequently (in cycles of weeks rather then months - sprints);
- Working software to be primary measure of the progress;

The next-generation of innovation projects management incorporates elements of agile development, enabling usage of short time-boxed increments, in form of sprints and scrums, in which the deliverable is something that can be demonstrated to stakeholders (Stošić & Milutinović, 2017). Agile approach is focused on execution and ending project result. The main benefits are coming from:

- Better internal communication (daily scrum – morning meetings organized to discuss the potential issues;
- Increased visibility for management trough intuitive progress metrics;
- More flexible and efficient planning, agile is powerful tool for microplanning providing higher level of control;
- Improved customer feedback;
- Stronger motivation and engagement of project team consequently is resulted from better communication and control on higher level.

When it comes to medical innovation and agile approach – the main question is the way of driving more efficiency in terms of investments and timing and optimizing a long research cycles in order to have more accelerated process (Cooper, 2014). In the sense of innovative medicine development, lean approach in combination with agile methods produce synergy effect and significant contribution to process efficiency improvement by eliminating the not value added activities (Cooper, 2014).

In general, R&D and innovative activities for the successful development of pharmaceutical products go through the following phases (MSD Internal document):

1. Identification of disease area and specific disease target;
2. Identification of compounds showing the most promise for treating disease targets and for eventual testing in humans;
3. Assessment of potential for development and efficacy leading to approval for testing in humans;
4. Phase I clinical trials on volunteers and ongoing nonclinical studies to refine the compound's safety profile and to establish its dosage range;
5. Phase II clinical trials on patients with the targeted disease to further test the drug's safety and efficacy;
6. Phase III clinical trials to further determine the drug's effectiveness and benefits, as well as potential adverse reactions to it; and
7. Phase IIIb or Phase IV– Post-launch clinical trials following the appropriate local regulatory approval.

Considering phased approach, R&D productivity improvement can be measured (MSD Internal document):

- Using conventional methods of R&D based on the latest technology solutions;
- Implement risk based and quality approach at the early stage research;

- Project management methodologies in the place – in order to improve result and decision making done by management and parallel functions.

Internally speaking, pharmaceutical companies' capabilities assessment will investigate any gaps in process or technology, determination of strengths and weakness enabling successful implementation of innovation process (Edgett, 2014). To achieve these objectives, pharmaceutical company must have a sufficient capital structure to fund the large costs and bear the substantial risks involved in performing R&D.

Advancement in Drug Discovery and Development can be reached out with implementation of new approaches to clinical trials (roughly takes six to seven years) and using different and modern statistical methods. This will drive more efficiency in the process by reducing the cost and time to bring new medicine to the market, consequently making the process more agile.

Agile methodology can also be assessed in FDA approval process, by having more alignment between scientific discovery and FDA, ending with accelerated agency's acceptance of innovative medicine development. Applying the most modern technology and engaging strong staff infrastructure, FDA's medicine review can be perform without no delays that cause longer development stage, missed opportunities, cost increase and the most important impact - delays in patient treatments.

Considering activities in IV stage of the process, this is to emphasise the importance of local government actions and regulatory country specifics. Strong collaboration between science, healthcare and industry on the local level lead to improved policy outcomes: better health, human capital creation, higher productivity and economic growth. It's substantial for innovation to be recognized as priority for local health care system. First off all, agile character can be added in country regulatory approval as the first step is to get Marketing Authorization Statement from Drug Agency in order to have launched medicine in the market. According to Law on Medicines and Medical devices in Serbia, it's defined that local regulatory approval takes 210 + 30 days. Instead, process can be improved by implementing *fast track approval for innovative medicines, particular major breakthroughs as* it's done in EU. For instance, In France, some innovative products without competitors can be made available prior to Market Authorization under the system of Temporary Authorizations (www.efpia.eu). National health policies are the key role player for enabling pharmaceutical innovation launch and release. These include important government investment in basic biomedical research, strong intellectual property protection, an efficient and transparent regulatory process and a pricing model that focuses on value and not just costs.

4. A REAL-LIFE EXAMPLE IN SERBIA

Merck Sharp&Dohme is a global healthcare group of companies that provides innovative solutions in the field of health care through its medicines, vaccines, biologic therapies, and products for animal health, and consumer care products. The group operates under the name of Merck Co (US territory). As research-driven pharmaceutical company, primary activities are to discover, develop, manufacture, and launch innovative vaccines and medicines that treat and prevent human illnesses. Merck Co as one of the leading innovative companies, invests considerable funds into R&D activity, cooperating with a number of laboratories, medical centers and doctors from different countries.

Case study is related to immune oncology treatment and MSD's PD – 1 inhibitors launch in Serbia market.

Oncology market has been exploded a few year ago by launching a few significant oncology products. Globally, oncology innovation is energized by a number of immunotherapies, making up 31% of the total pipeline. Approvals of oncology late-stage medicines will be accelerated with many having gained FDA's Breakthrough Therapy Designation; 46% of the total number of breakthrough designations in oncology (http://static.correofarmaceutico.com/docs/2014/12/01/informe_ims.pdf). Immune therapies are expected to gain many follow-on indications using the immune system to target cancer broadly rather than targeting site-specific tumors. PD-1 targeting drugs that boost immune system response show robust clinical response in trials and strong potential to grow the market in the next five years. (http://static.correofarmaceutico.com/docs/2014/12/01/informe_ims.pdf).

According to In Market Sales data 2015, the value of total pharma market in Serbia was 600 mil EUR and oncology market was 40 mil EUR. As per the same resource, market share of MSD in oncology segment in Serbia was 0,9%.

The story of PD–1 origination is very interesting. There are some similarities with Fleming's discovery of penicillin, at least when it comes to randomness (Drucker, 1985). The beginning of PD–1 dated back to the

end of the last century and is linked to the company Organon. After 2 mergers, firstly, Schering-Plow acquired Organon in 2007, and only two years later, Schering Plow was acquired by Merck Co., so PD-1 was born in Merck. Details about the origin PD-1 inhibitor are listed in the article *The Startling History Behind Merck's New Cancer Blockbuster.* Phase I of clinical trials KN–001 started in 2011. Initially, the study enrolled 32 patients and later on ended up with more than 1.100 patients. The first observations have been given by Antoni Ribas, one of the main investigators in the melanoma study, in the following statement: "*Among the first 7 patients we enrolled, 6 patients had objective responses. I realized I was probably lucky and this high rate of responses would not hold up forever, but also realized that [pembro] was different from all the other cancer immunotherapy we had tested to date, all of which had response rates in the 10-15% range." Ribas emphasizes his "main concern was that the study as designed had very few additional patients to enter, and I could not go to sleep if the trial closed and I would have suitable patients who could respond like the others and no slots for them." His pleading apparently dovetailed with the strategy on which Merck had embarked. As Ribas notes, the study "eventually grew to include 655 patients with metastatic melanoma and a similar number of patients with lung cancer, becoming the largest phase 1 trial ever done in oncology." (Note: This extraordinary Phase 1 study was recently summarized by Eric Rubin and colleagues in the Annals of Oncology.)*

The result of clinical studies was that the FDA (Food and Drug Agency, USA), in 2013, ranked PD – 1 as "Breakthrough designation group of drugs," meaning that this therapy is a revolutionary advancement in the treatment of melanoma cancer. A year after, in 2014, FDA approved PD-1 for advanced melanoma, and Europian Medicine Agency (EMA) approval was obtained in 2015.

Applying project management methodology in PD-1 development in Serbia, defined WBS structure is presented in Fig 5 below:

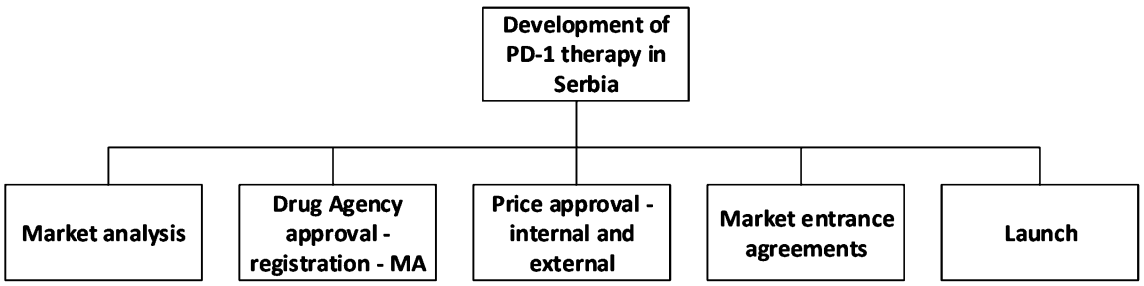

Figure 5: WBS project structure

As per data given by Serbian Medical Society, the annual number of newly diagnosed patients with melanoma disease is about 700, assuming that approximately 220 patients may receive treatment of PD-1, with stage IIIb or IV disease (170 patients are the first line), concluding that there is huge unmet need for melanoma treatment in Serbia. According to the Cancer Registry of the Republic of Serbia, 252 patients, in annual average died from melanoma, 149 men and 103 women. Compared to other countries in the world (Australia and New Zealand), Serbia with rates of disease belongs in the group of countries with a lower risk of disease, but the number of patients increases every five years by 20 percent, primarily due to uncontrolled exposure to UV radiation of the population in the last 50 years. The fact is that the number of patients from melanoma progressively increases and the risk group is younger population, around 40 years old. In 2016 and prior the leading medicine in melanoma therapy in Serbia was class BRAF.

Drug Agency in Serbia approved PD-1 for melanoma in May 2016. Basically, regulatory PD-1 milestones and *fast track approval*, gave the project of development PD – 1 inhibitors agile character based on "breakthrough" innovation.

Approval for price has been obtained in a very short period of time due to the statement of the public health importance. This is also one of the agile steps in the project path.

Innovative medicine launch requires strong cooperation between key stakeholders - Drug Agency, National Health Insurance Fund, Ministry of Health, Ministry of Trade, Republic Expert Committee, Central Commission for Medicines, Scientific Leaders, Patient Associations. National Health Insurance Fund (NHIF) has a critical role as decision maker in terms of funding when it comes to innovative therapy access. Based on EFPIA resource, rate of availability measured by the number of medicines available to patients in European countries for Serbia is low, since for the period 2013 – 2015 the Serbia took penultimate place, only Latvia had less products on reimbursement list in the mentioned period. This was consequently resulted by limited funds of National Health Insurance Fund for the purpose of innovative therapy access. If the higher

percentage of GDP is invested in health care system, than the county has stronger potential for innovative therapies implementation. Project has been strong supported by Scientific Leaders with high competency who recognized the importance of PD-1 even there were no local clinical trial results done for PD-1.

Public health authorities need to manage budgets under significant pressure. Innovative access agreements can accelerate access and improve the affordability of medicines. Managed Market Entry Agreements can serve as an effective catalyst for the rational uptake of innovative treatments. MSD is open to the development of innovative agreements that help to accelerate access for patients. By end of 2016 Market Entry Agreement has been concluded with National Health Insurance Fund. This way enables faster PD-1 delivery to patients which characterized this action as agile and in parallel this was process innovation since this was the first MEA implementation in Serbia (including also MEA agreements between NHIF and a few other pharmaceutical companies at the same time).

Very strong and dedicated cross-functional MSD team was involved in the project: Regulatory Manager, Market Access Manager/External Affairs Lead, Marketing Business Unit Lead, Medical Manager, Key Account Manager, Customer Service Specialist, Finance Analyst, including also General Manager. As very well aware of PD-1 potential based on clinical trials results done in other countries and driven by experience of other markets who already launched PD-1, team was empowered to lead this project and to perform as "one Merck" including strong collaboration, regular meetings and follow ups.

In the table 1, there is a CANVAS model defining Key Partners, Key Activities, Key Resources, Value Propositions, Customer Relationships, Channels, Customer Segments, Cost Structure and Revenue Streams (Cantamessa, M. & Montagna, F., 2016):

Table 1: Project presented by CANVAS model

<table>
<tr>
<td rowspan="2">Key Partners

Key patners for PD-1 development are: NHIF, Drug Agency, Ministry of Health ,Republic Expert Committie, Central Commission for Medicines, Scientific Leaders, Patients Associations, Phoenix Pharma;</td>
<td>Key Activities

Registration of medicine; Reimbursement list and Market Entrance Agreement (MEA); Increase awarness on prevention in melanoma cancer; Medical education;</td>
<td rowspan="2">Value Proposition

The most efficient therapy for melanoma pationts;
1st line for most efficacy;
Implementation in all advanced melanoma regardless of BRAF
Increase overrall survival rate (OS) and Progression Free Survival (PFS); Decrease Adverse Event (AE);</td>
<td>Customer Relationships

MSD as reliable partner in oncology market;
Scientific Leaders with high compentency who recognized the importance of PD-1 are very interested in innovative therapy implementation;</td>
<td rowspan="2">Customer Segments

Customers are Health Care Proffesionals (HCP"s), pharmacists, nurses, patients, Patient Associations
Focus is on 6 Centers and 50 HCP's Medical Oncologists and Dermatooncologists;</td>
</tr>
<tr>
<td>Key Resources

Key resources are innovative medicine, our Team, and ethical business approach;</td>
<td>Channels

Channels of distribution are Indirect using partner who is at the same time our distributor Phoenix Pharma.
Phoenix Pharma delivers medicine to the 6 referent centers where therapy can be received;</td>
</tr>
<tr>
<td colspan="3">Cost Structure
Expenses are our investements in medical education during National and International Congresses and events, Symposias, Round Tables, Advisory Bords, Expert Input Forums. Investments are also related to various commercial activities, drug donation and free goods;</td>
<td colspan="2">Revenue Streams
For our founder MSD BV revenue as actually sales, for local entity, MSD, revenue is achieved based on mareketing services performed and done in the country;</td>
</tr>
</table>

Launch activities are done in accordance with marketing plan. The main objectives are medical education and increase awareness on prevention in melanoma cancer. PD-1 was launched in January 2017 following with strong sales growth.

Tool for measurement innovative project performance are Key Performance Indicators (KPI's) which selection depends on organization or industry. Selection process is usually done based on management tools, such as balance scorecard is (Knoke, B. & Eschenbaecher J., 2012).

Sales per month in 2017 in EUR are presented In **Table 2**:

Table 2: Melanoma market Serbia 2017 (In Market Sales Dec 2017)

Class	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Total 2017
PD - 1	19,280	39,084	186,188	273,960	229,899	251,597	215,503	295,740	304,452	379,979	299,904	434,706	2,930,293
BRAF	1,896	75,423	256,600	258,925	335,934	58,781	28,776	11,597	-3,858			17,344	1,041,417

Market share per month is presented in **Table 3**:

Table 3: Melanoma market share Serbia 2017 (In Market Sales Dec2017)

Class	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17
PD - 1	91%	34%	42%	51%	41%	81%	88%	96%	91%	100%	100%	96%
BRAF	9%	66%	58%	49%	59%	19%	12%	4%	-1%			4%

As per In Market Sales data Dec 2017, PD-1 for melanoma was the medicine with the greatest absolute sales growth among all therapeutic areas during 2017 achieving the sales growth of 352 mil RSD.

At this point, one of the critical KPI's considering the nature of innovations in pharmacy is definitely time spend from idea generation to commercialization and medicine delivery to patients. Cumulating the agile actions in different project phases, from first clinical trials in 2011 to market delivery in Serbia in December 2016 ending with only 5 years of innovative project duration and innovative medicine development (in average it takes 10 to 15 years).

During the 2017 approximately 100 patients were treated with PD-1 for melanoma in Serbia. According to clinical studies results, around 50% will live five or more than five years and in opposite median survival would be from 6 to 9 months. Given that melanoma principally affects the younger population, this therapy for them means a longer life and hope that in the next 5 years a new "breakthrough" medicine can be launched to translate this deadly disease into a chronic. In the spirit of the mission and better access to innovative therapy, this is the most valuable achievement for research-based pharmaceutical companies that innovative medicines can help and improve lives of patients.

5. CONCLUSION

In this paper we discussed the possibilities of agile methodology implementation in innovative medicine development process and resulted outcome. Based on stated above, this question is challenged but step by step could be achievable particular now when pharmaceutical companies are facing uncertainty and risk coming from external environment and internally. At this point, this is to underline that the number of factors coming from different sides and stakeholders affect the innovation process if self, which makes the whole process even more complex (regulations, approval process, industrial and healthcare policy, efficiency in country healthcare system).

Obtaining R&D investments is first step in preparation for medicine innovation project, but not sufficient enough. Solution is in well-designed Stage-Gate framework, conceptual and operational road map, phased process with list of activities per iteration, enabling in that way systematic, constructive and cross functional reviews including project management and risk based approach. Adding to this framework the agile character, new hybrid module can be introduced aiming to improve process efficiency and medicine delivery. Implementing this module by shortening the project cycles, the innovative medicine development get accelerated approach in terms of faster project execution which is critical for patient treatment.

"Our industry is poised to translate our most promising scientific breakthroughs into meaningful treatments capable of tackling the most urgent and vexing medical challenges of our times. we stand committed to driving progress for patients today – and hope for tomorrow."

- Kenneth C. Frazier, Chairman & Ceo, Merck

"Today, delivering authentic healthcare innovation worldwide is more challenging and complex than ever. it demands a sharp focus on what customers need. It requires the development and delivery of data, knowledge and products that make a difference."

- Clive A. Meanwell, Md, Phd, Chairman & Ceo, The Medicines Company

"The process of making a new medicine is a marathon that requires endurance and commitment. We cannot reach our goals without the help of partners from inside and outside the company."

- Tadataka Yamada, md, Chief Medical & Scientific Officer, Takeda

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INNOVATION ACTIVITIES AND COMPETITIVENESS OF THE COMPUTER PROGRAMMING SECTOR IN SERBIA

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Abstract:*The research findings presented in major extracts in this paper are results of a survey of the software/computer programming (CP) sector in Serbia conducted by Institute Mihajlo Pupin from November 2017 to January 2018. The software industry has been the most dynamic and fastest growing sector in Serbia in the last decade. In this paper authors will present the key issues relating to innovation activities and international competitiveness of CP sector, as well as framework conditions which should be provided to companies in CP sector in order to maintain fast growth and strong international position. In particular, the focus is on the role of government policies in shaping the international competitiveness of the CP sector in Serbia. Specifically, the paper pays attention to the international competitiveness of software industry as to how it has developed the way it has in recent years and what have been the key factors that has strengthened this sector.*

Keywords*:Innovationactivities, Computer Programming Sector, Competitiveness, Serbia*

1. INTRODUCTION

Software development takes place across the economy. The tight links and complementary of the software sector with other industries are highlighted in several OECD studies (OECD, 2002, 2004, 2006). Serbian CP sector is capable of producing competitive software solutions, recognized all over the world. In recent years, the CP sector in Serbia has been becoming the most attractive sector of the economy. Rapid development and promotion of IT services, especially in the field of internet and mobile technologies, application development, and outsourcing, is evident. Recent data revealed by the national bank has indicated that software/computer programming (CP) sector in Serbia has become one among key sectors in economy. The CP sector has reached 760 million EUR export in 2017, with net effect of 463 million EUR (table 1).

Table 1: Republic of Serbia: Services, 2011 - 2017

Computer services (million of EUR)	**Y2011**	**Y2012**	**Y2013**	**Y2014**	**Y2015**	**Y2016**	**Y2017**	**Ratio: Y2017 / Y2011**
Export	170.888	221.287	295.832	344.416	454.736	589.820	759.716	444.57%
Import	126.774	149.280	160.819	172.343	166.902	193.325	296.288	233.71%
Balance	**44.115**	**72.008**	**135.013**	**172.073**	**287.834**	**396.497**	**463.427**	1050.50%

Source: National Bank of Serbia (NBS), http://www.nbs.rs/internet/english/80/platni_bilans.html , downloaded April 09, 2018

This is one of the facts that inspired authors of this paper (researchers at the Mihajlo Pupin Institute) to conduct a survey of the software/computer programming (CP) sector in Serbia from November 2017 to January 2018 as part of the wider set of activities under the development of the Smart Specialisation Strategy of the Republic of Serbia (JRC and IWB, 2017). One of the key research questions for survey of the CP sector in Serbia was: *What are the factors that make CP sector in Serbia competitive on the international market?*(Kutlača et al., 2018). In this paper we shall elaborate some of key issues relating to international competitiveness of CP sector, as well as framework conditions which should be provided to companies in CP sector in order to maintain fast growth and strong international position. This study was motivated by the need to understand factors that guide the software exports and competitiveness on international market. It is also important because the strategic loopholes could be identified so that the additional measures could be introduced.

2. CASE STUDY OF COMPUTER PROGRAMMING SECTOR IN SERBIA

2.1 Case study as part of the Smart Specialisation Strategy of Serbia

In the beginning of the year 2017 the Government of the Republic of Serbia has created an Interministerial Working Body (IWB) to develop a Research and Innovation Strategy for Smart Specialization (RIS3) in partnership with the European Commission's (EC) Joint Research Centre (JRC). Following the RIS3 methodology, main activities in 2017 were addressed to quantitative analysis of the available data, statistics and information, in order to identify priority sectors in Serbia which developing potential is based on research and innovation. One among identified priority sectors is computer programming (or software engineering, SwE)[1] sector.In order to better understand what features of this sector in Serbia are, additional case study is commissioned by the JRC; some results of this survey are presented in this paper. Finding of case study are based on three sources: online survey of companies; interviews with main stakeholders in the sector; analysis of statistical and other available data and information.
The online survey ran from 7 November to 25 December 2017, with questionnaire distributed to 1,089 software companies in Serbia; 195 companies responded to the questionnaire, and this is 18% response rate. Online survey, interviews and overall analysis, provided answers on number of pre-defined research questions, two of them are topic of this paper:

- What are the main strengths of the ICT sector in Serbia that could potentially be successful at theinternational (niche) market?
- What needs to be done to further develop these strengths?

2.2. Innovation activities of CP sector in Serbia

Innovation may be broadly defined as the successful commercial introduction of a new product, service or process. According to the OECD's Oslo Manual (OECD, 2005), innovation refers to the implementation of "technologically new products and processes and significant technological improvements in products and processes". Software innovation can be seen as a process leading to: development of a novel aspect, feature or application of an existing software product or process; introduction of a new software product, service or process or an improvement in the previous generation of the software product or process; and entry to an existing market or the creation of a new market (OECD, 2009a)

Serbian CP companies are mainly doing incremental innovations for existing technologies i.e. iterative improvement of an existing solution, not entirely new, but a new way to use existing technology.
The most of companies operating in this sector do not deal with the intellectual property rights. In the case of software contracts, generally, there is no comprehensive understanding of the intellectual assets generated in software development outsourcing and the related IPR involved and the contingency factors that determine when vendors are more likely to obtain IPR from clients (Chen et al., 2017).
General explanation for this trend is that new software solutions are rapidly developing and applying, which makes difficult to protect them in the form of patents. At the same time, it prevents the competition from copying them completely. In addition, for the realization of the projects, it is not enough to have software; the basic problem is its practical application in real control centres, its integration with the existing components, its adjustment to the specific requirements of users and maintenance.

Software innovation is often driven by user need and expectations, and at times in the development process, software designers often solicit users feedback. According to the respondents' observations, **key drivers for innovation** in Serbian CP sector could be summarised into the following:

- Market needs and market opportunities simultaneously taking into account "science push" and "market pull" factors. The need for innovation comes from analysis of the existing market and potential needs and necessity to adapt to market changes.
- Client's needs and requests - Rising customer expectations regarding service and quality. Recognizing the needs that users have and solving these needs on innovative ways are the important drivers for innovation. Clients have a problemor they are looking for small changes in existing solutions, Software companies usually identify technology that can be a solution for the client's problem.
- Internal capacities within the companies and innovative ideas come from workers.Idea forinnovations happens within the company very often by fostering internal competitions for new innovative solutions.
- Increased competition. Keeping pace with key competitors on the market.
- Participation in EU projects, cooperation with international partners.
- Internal estimation of business trends and technological development, world trends, examples of good practice, legislation etc.

[1]CP is name according to statistical classification of sectors; SwE is name widely adopted among software professionals

On the other side, **key barriers for innovation** in CP sector in Serbia are:

- The lack of investments, potential investors are still not active enough on the market.
- Small market and low demand on domestic market
- Modest R&D funding in Serbia. Scientific research system is completely separated from the economy.
- Slow and expensive patenting process
- Society is conservative, especially state administration - poor organization
- Adoption rate – the market slowly sets out the requirements for new solutions
- Lack of incentives for innovation from the government funds
- Lack of capacity and high-quality personnel. Education system does not provide a sufficient number of quality personnel in the sector
- The lack of staff
- Insufficient cooperation with universities
- Risk aversion

2.3.The main strengths and weaknesses of the CP sector in Serbia for international competition

Replies on the questions within online survey have provided number of factors that are important for positioning Serbian CP companies on international market: good quality of the products and services is the most important factor for creating competitive advantage; specialized expertise; previously acquired reputation and programming skills. Although the average score of importance is not on the same level in the statistical regions in Serbia, results of One-Way Anova statistical test showed no significant difference in the sources of competitive advantage between the regions by most of the indicators (Table 2). The significant difference exists only between Belgrade and Šumadija and West Serbia in the indicator Programming Skills. In contrast to Belgrade, programming skills are not competitive advantage on the international market for companies from Šumadija and West Serbia (Kutlačaet al., 2018).

Table 2: Average score of sources of competitive advantage per regions and statistical test of differences

Sources of competitive advantage	Belgrade	Vojvodina	South and East Serbia	Šumadija and West Serbia	One-way Anowa Sig.
Ability to design software	3,81	3,11	3,25	2	0,233
Programming skills	4,19	3,44	3,25	1,5	0,016*
Competitive price of products / services	3,81	2,78	2,5	2,75	0,171
Good quality	4,25	3,67	3,25	3	0,435
Prompt (Fast) Delivery	3,75	2,67	3,25	2,75	0,270
Specialized expertise in the field	3,87	3,56	3,75	3	0,809
Diversification - expanding range of products / services	2,75	2,11	2,5	2,25	0,651
Access to foreign partners and contacts	3,38	2,22	3,5	2,5	0,254
Diversification - expanding the range of products / services	2,47	2,35	2,61	2,21	0,655
A smaller distance from the market than the key competition	1,97	1,98	2,04	1,82	0,540
Access to local clients and contacts	1,88	1,95	1,96	1,78	0,325

Sources of competitive disadvantages on international market are presented in Table 3, with lack of qualified labour and weak marketing as the most important limiting factors (Kutlača et al., 2018).

Table 3: Importance of sources of competitive disadvantages on the international market

Sources of competitive disadvantage	Average score on the scale from 1 to 5
Lack of developers and designers	2,67
Weak marketing	2,60
Limited (low) expertise in specific areas	2,30
High price	2,17
Low quality	2,03
Limited programming capabilities	1,97
Poor designer skills	1,97

2.4.Factors that make CP sector in Serbia competitive on the international market

In search for answers to the question: "*What are the main strengths of the ICT sector in Serbia that could potentially be successful at the international (niche) market?*", number of interviews were conducted with all major stakeholders relevant for CP sector in Serbia. Interviewed participants have provided information for deeper understanding of two major factors that make CP sector in Serbia competitive on the international market:

1. Education and Human Resources; and
2. Performance.

Factor "Education and Human Resources" has been stressed by all interviewed stakeholders with particular attention on the following attributes (Kutlačaet al., 2018):

- well educated researchers and ICT professionals,
- relatively good education (with a lot of room and necessity for improvement),
- relatively well-developed human resources in younger generations, as well as language knowledge,
- existence of research institutes with long tradition in R&D,
- readiness to learn,
- courage and self-confidence to appear on the international market as competitors,
- highly qualified, motivated and innovative workforce,
- good engineering skills and mind set,
- cultural similarity with Western countries,
- lower labourcosts compared to western countries,

Factor "Performance" has been stressed by all interviewed stakeholders like previous one, with particular attention on the following attributes (Kutlača et al., 2018):

- exceptional and prolonged growth of Serbia's ICT sector (10-20% annual growth over a period of 10 years) makes this sector the absolute leader in Serbia's economy,
- relatively lower price of doing business in Serbia as compared to EU member states,
- relatively smaller size of our ICT companies should allow them to have easier transition into agile/collaborative mode of support to their end users,
- market potential for expansion (realistic potential of higher education sector and leading research institutions to substantially increase production of engineers in sought after areas of expertise, particularly at University of Belgrade, in a relatively short time frame),
- substantial support of Government of Serbia for this process at the highest level (both political and financial support),
- political stability and economic growth of Serbia as a country in the final phases of accession to EU,
- Belgrade's position as the de-facto centre of a wider market of around 50 million consumers with strong cultural and language ties located in countries that are already EU member states or are in some phase of the accession process
- niche markets that can grow around existing expertise:
    - gaming, entertainment and media,
    - efficient management of large infrastructure networks (big data, distributed data systems),
    - supercomputing (modelling of complex systems, visualization),
    - smart printing,
    - development of next-generation encryption technologies,
    - sector-wide integration built around data acquisition and management (particularly in agriculture, health and environmental applications),
    - robotics,
- potential for growth - Serbian ICT sector is still far from the saturation point,
- there are fewer intermediates in business cooperation,
- proximity and time zone with the whole EU,
- capability of producing the top-quality and highly innovative software solutions, as well as all necessary services, know-how, and applied research outcomes, that will follow such solutions, for a relatively lower costs, than well-developed economies.

2.5. Strategic partnership and cooperation with international partners

The level of internalization is generally high, since the vast majority of companies operating in this sector in Serbia are either branch offices of foreign companies, of domestic companies that use outsourcing business models i.e. develop solutions for foreign clients. More that half of the companies from the sample have formal contractual relationship with their partners from abroad. Joint venture and Licence agreement are the most common forms of cooperation with foreign partners (Table 4).

Table 4: Contractual form of cooperation with foreign partners

Form of cooperation	Total (%)
Joint venture	14,71%
License Agreement	14,71%
Manufacturer	11,76%
Authorized distributor	11,76%
Completely owned by a foreign partner	8,82%
A seller who provides significant technical support before selling	8,82%
Joint product development	8,82%
System partner	8,82%
Authorized reseller system	5,88%
Agreement on system integration	2,94%
Research and Development Agreement	0,00%
Agreement on joint production	0,00%

Individuals and enterprises from Serbia are still not purchasing knowledge on the global market and investing it into local economy. The opposite process is slowly becoming visible - the world is starting to identify and buy existing local knowledge and expertise. Foreign ICT companies usually establish their branches in Serbia attracted by highly qualified and well educated young personnel. Some of the most common forms of connection between Serbian and foreign companies include establishment of development centers by big well-known companies (e.g. Microsoft), acquisition of domestic company by foreign companies (e.g. DMS) etc. There are examples of fast growing companies that are influential abroad in its area of competence (e.g. Nordeus, ProSense) as well as number of companies and even individuals included in software and hardware outsourcing business. The quality of services offered is most important factor in the process of forming partnership with partners from abroad.

2.6. Framework conditions for maintaining fast growth and strong international position of CP sector

Observing two major factors that make CP sector in Serbia competitive on the international market, described in the section 2.3, interview stakeholders are asked to provide additional information concerning conditions which should be provided to companies in CP sector in order to maintain fast growth and strong international position. Collected answers could be grouped into three categories – first two representing mentioned factors, and supplemented with actions which should be launched by the government and regulatory institutions (Kutlača et al., 2018):

1. Education and Human Resources
    - significantly enlarge quotas for software engineering at public universities (particularly Faculty of Electrical Engineering - University of Belgrade, Faculty of Sciences - University of Novi Sad, Faculty of Organizational Sciences – University of Belgrade),
    - introduce more advanced university programs for cutting edge technologies (big data, AI),
    - finding solution for high school education and rising lack of teachers (e.g. petlja.org and their programming courses which are in curriculum sound like a good solution for elementary schools),
    - further investments in education system and stronger support to start-up and SME community, especially among young people,
    - organization of practical internships for students on a higher scale; developingsponsorship and recruitment programs,
    - develop a growing number of infrastructure organizations to support innovation,
    - better quality assurance,
    - the law on higher education which allows people from practice to influence changes in the curriculum,
    - more people - increase the number of students who will become IT professionals through support of formal and non-formal education,
    - work on the culture of entrepreneurship.
2. Performance
    - On business side: IT-SwE companies need to evolve from IT outsourcing to development of complete products, and expand range of services they offer to their clients – from IT development to product development with possible marketing support,
    - Reorientation from user-vendor approach to team work in agile structures,

- A "yeast-growth" process of Serbia's ICT sector has already started, one needs to feed it adequately and consistently in the next 5-10 years by:
  - institutionalizing and strengthening existing support for ICT of top level decision makers and building similar types of support at municipality levels,
  - building on successes and continuing the overall process of increasing the ease of doing business in Serbia,
  - strengthening financial instruments available to new business, particularly to new business such as ICT with high added value for a society,
  - substantially strengthening the innovation process (venture capital, angel investors, use of EU structural funds, joint projects of foreign and domestic ICT companies with leading research institutions in Serbia, setting up of strategic public-private partnerships)
- Promotion of the start-up concept, especially among young people

3. Governance and Regulation
   - a sound and long-life strategy of the Republic of Serbia, how to further motivate development of ICT sector in Serbia:
     - not to have just the lowest paid programmers here, working in outsourcing companies, but to really support development of a competitive R&D sector in ICT
     - smart specialisation strategy should span all government sectors, including all education levels, economy environment and constraints, industry, etc,
     - create a society of the digital economy
   - improvement of the regulatory framework, removing blocks from the legislative point of view.

3. CONCLUSION AND RECOMMENDATIONS

Presented analysis of the key issues relating to international competitiveness of CP sector in Serbia could lead to conclusion as answer on the first question *"What are the main strengths of the ICT sector in Serbia that could potentially be successful at an international (niche) market?*". It is important who is doing (*Human resources*) and how they doing this job (*Performance*). Therefore, answers on the second question "*What needs to be done to further develop these strengths?*" should be read as recommendations what should be done in the area of education and employment (considering *Human resources*), as well as in the area of business organisation (considering *Performance*).

The general conclusion is that Serbia is a very attractive partner on the international market in the CP sector. The key factors of the international competitiveness of Serbian CP sector could be summarized as follows: cost-effectiveness, great quality, high reliability, rapid delivery and state-of-the-art technologies in software development.

In addition, there are actions, measures and interventions which should be initiated, launched and maintained by the government and regulatory institutions under the common denominator: *Digitalisation of the economy and society of Serbia*. Although this process is in decades long delay, understanding that digitalisation is precondition for development of country is starting point and concluding finding for entire case study and this paper as well. Transformation capability of this sector on the Serbianeconomy has been the focus of attention in recent years. However, much of it depends on how this sector, especially the exports enables itself to innovate and face competition in highly dynamic society.

ACNOWLEDGEMENT

Research presented in this paper was supported by the Ministry of Education, Science and Technology Development of the Republic of Serbia, under the projects: "New technologies in intelligent transportation systems - application in urban and suburban areas", reg. no. TR 36005; "Research and Development of the Platform for Science Based Management of the Scientific and Technological Development of the Republic of Serbia", reg. no. III 47005.

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INNOVATION ACTIVITY IN SERBIAN ENTERPRISES

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Abstract: *The purpose of this paper is to identify patterns of innovation activity in Serbian enterprises in terms of their innovation expenditure, innovation turnover and typology of innovation.The data provided in this research are collected through the Community Innovation Survey (CIS) conducted by the Statistical Office of the Republic of Serbia. Innovative activity of Serbian enterprises is presented in a comparative perspective for periods 2012-2014 and 2014-2016. The most important findings are related to the relatively stable share of total innovative companies; increase of product and process innovation and decrease of marketing and organizational innovation; and unfavorable structure of innovation expenditure and innovation turnover. Research results could be considered as a starting point for further investigation and decision making.*

Keywords*: Innovation activity, innovation survey, enterprise, Serbia.*

1. INTRODUCTION

Concept of innovation has received a tremendous attention in the last few decades. The ability to introduce new technologies or processes is considered as the essential element of (re)industrialisation of modern economies.

Terms innovation and innovativeness are used in theory and practice to explain novelties on the level of organisation, sector or economy which improve their performances. The word itself has Latin origin; it comes from the word "*innovare*" which means "making something new". Majority of authors consider innovation as a process of turningopportunity into new ideas and of putting these into widely used practice (Tidd, Bessant & Pavitt, 2005).

Schumpeter is considered as a "founding father" of innovation theory. In the first half of the twentieth century he emphasized that innovation is the driving force of economic development through a dynamic process in which new technologies replace the old ones, and this process is called "creative destruction".

According to Schumpeter, the process of technological change has three phases. The first stage is the invention process, encompassing the generation of new ideas. Invention is forming a new thought having a potential to apply in economy. The second stage is the innovation process which includes development of new ideas into marketable products and processes. Innovation is the first commercial application stage of invention. Developing innovations is determined by the technological and economic conditions of the concrete firm. The third stage is the diffusion stage, in which the new products and processes spread across the potential market (Kaya, 2015).

The most famous definition of innovation is developed by the Organisation for economic cooperation and development (OECD) in Oslo Manual: "An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organization or external relations" (OECD, 2005, p. 46). This implies that there are several types of innovation: product innovations, processinnovations, marketing innovations and organizational innovations. Therefore, besides technological innovations, there are non-technological innovations which are not result of R&D, but still can be important for performances of business entities.

Innovation are usually assessed as complex activities, or as a "process through which the nation creates and transforms new knowledge and technologies into useful products, services and processes for national and global markets – leading to both value creation for stakeholders and higher standards of living" (Milbergs & Vonortas, 2004, p. 2). Therefore, innovation includes more activities than pure technology creation. It covers various resources related to product distribution or offering services.

Innovation comprises a number of activities that are not included in R&D, such as later phases of development for preproduction, production and distribution, development activities with a lesser degree of novelty, support activities such as training and market preparation, and development and implementation

activities for innovations such as new marketing methods or new organisational methods which are not product and process innovations. Innovation activities may also include acquisition of external knowledge orcapital goods that is not part of R&D (OECD, 2005).

It is useful to make distinction between terms “research and development” and “innovation” on one side and “technology” and “innovation” on another. R&D is a process of searching for new knowledge or new applications. It includes investments which might be successful or not. On the other hand, innovation means introducing new or improvement of existing products, services or processes. They can be the result of R&D, but not necessarily - can arise as a result of the intellectual process of an individual. Hence, innovation does not necessarily involve the investment of specific financial resources.

In contrast to innovations that represent the introduction of new methods, ideas, products or services, technology is a set of methods and techniques used in the production of goods and services. It usually relates to the development of technique and equipment based on the possessed knowledge. Therefore, innovations involve more activities than the creation of technology. They include a range of resources and activities related to placing products and services on the market.

2. INNOVATION AND ECONOMIC GROWTH

One of the most stable findings in macroeconomics is that innovations are an engine of economic growth. Innovations result in new technologies, products and services which boost productivity, create new market opportunities and improve standard of living.

The neoclassical growth model, also known as the “Solow-Swan” model, was probably the first modern model of economic growth to explicitly recognize the role of technology as a central driver of economic growth (Feige, 2015). Solow’s starting point was production function and main conclusion that the basic growth factors are: labour increase (population growth), capital increase (savings and investment) and improvements in technology. In his model, technology is produced exogenously and it is crucial for sustainable economic growth.

The assumption of neoclassical growth models that technology is created outside the model was criticized starting form 1970s since it was not in line with the fact that innovation activities are very much determined by the decisions of companies and individuals. One of the endogenous growth theories is Romer’s model which addresses technological spill overs (inwhich one firm or industry’s productivity gains lead to productivity gains in other firms or industries) that may be present in the process of industrialization (Todaro & Smith, 2012).

Different approaches have been used for exploring the relationship between technological change and economic growth starting from the historical perspective of Abramovitz (1986) to the neoclassical framework of Keller (2004), from the industrialization-focussed theory by Lall (1992) to the Evolutionary and Neo-Schumpeterian theories by Freeman and Louça (2001), Perez (2002)and Nelson (2006). The general consensus of these approaches is that the source of the development process is productivity growth which emerges as a result of technological progress (Bogliacino, Perani, Pianta, & Supino, 2009).

Relationship between innovation and economic growth can be investigated through a production function in which economic growth is result of growth in increase in labour and capital inputs, as well as increase in multifactor productivity (MFP). In such framework, contribution of innovation to growth can be found in three processes (Figure 1):

- a contribution resulting from technological progress embodied in physical capital; for example, investment in more advanced machinery or in new computers.
- a contribution resulting from investment in intangible capital, or knowledge-based capital, such as R&D, software, design, data, firm-specific skills or organisational capital.
- a contribution linked to increased MFP growth, reflecting increased efficiency in the use of labour and capital, a substantial part of which can be attributed to innovation, including social and organisational innovations as well as the spill over effects of investments in technology or knowledge-based capital, including at the global level (OECD, 2015).

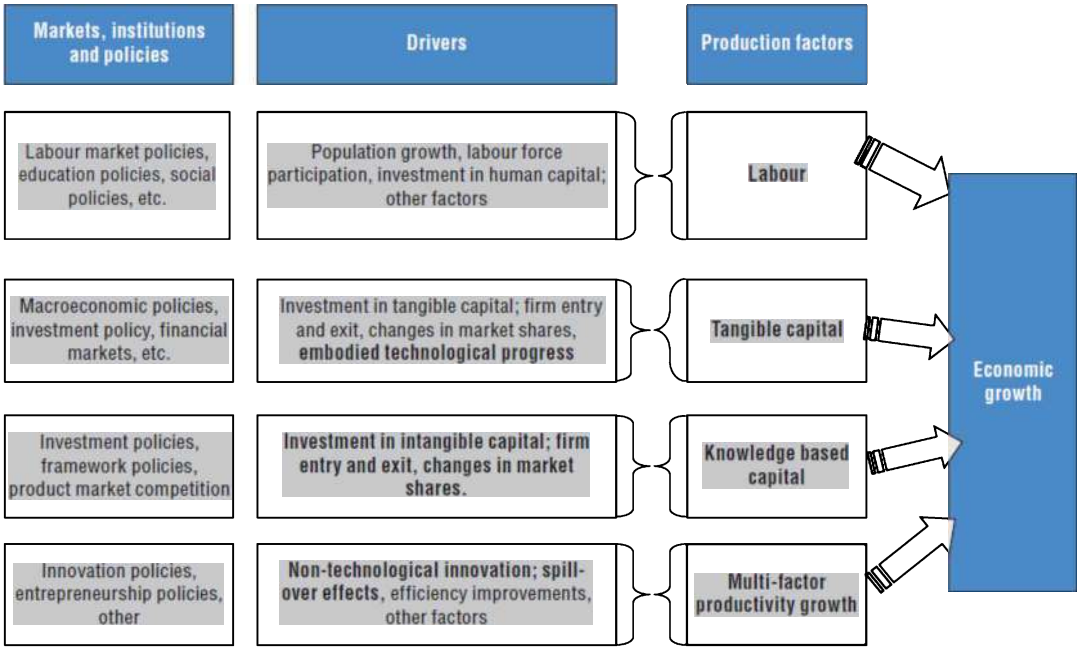

Figure 1: A simplified framework to analyse economic growth
Source: OECD (2015).The Innovation Imperative: Contributing to Productivity, Growth and Well-Being,OECD Publishing, Paris.DOI: http://dx.doi.org/10.1787/9789264239814-en, p. 18.

The innovative performance of a firm or a national economy very much depends on the overall framework in which innovative process is being conducted, i.e. on relationships and cooperation between different actors in a society. These actors are from business sector, academic institutions and government sector. The complex linkages between these sectors can be in forms of joint projects, staff exchange, cross patenting, co-publishing and may other. The network of these institutions and relationship between them is defined in literature as a national innovation system (NIS).

National innovation system in Serbia has many disadvantages. On a strategic level, Serbian NIS lacks the following: vision of technological development, national development priorities, relevant innovation policy and strategy, evaluation of programs, projects and organisations. There are also limitations of the Law on innovation activity which hamper innovation activity of the firms (Kutlača & Semenčenko, 2015).

There are significant differences between innovative activity in developed and developing countries. Bogliacino, et al. (2009) have summarized several stylized facts on innovation in developing countries:

- developing countries have distinct patterns of innovation from countries at the technology frontier,
- innovation needs both resources and integration of national systems,
- innovation is pushed by industrialisation and pulled by growth of markets,
- large firms are more likely to engage in innovation or spend for it,
- being exposed to international competition spurs innovation,
- in multinational corporations there is more innovation,
- the main obstacle to innovation is its economic cost and the lack of finance,
- the evidence of effects of innovation on productivity is weak.

These “stylized facts” explain the main difficulties in innovation activities in developing countries but also highlight the areas in which innovation policy could make improvements.

3. MEASURING INNOVATION ACTIVITY

Measuring technological change and innovation is important in term of calculating its effects on economic growth. The need for better understanding processes related to innovation activities and technology are also relevant for planning, implementation and evaluation of policies and programmes in this field. For example, decision makers should have information on the results in this area in order to make decision on the resources which will be invested in certain fields of science and technology.

Organisation for economic cooperation and development has developed a set of manuals which enabled international standardisation of methodology for measuring innovation activity on micro and macro level. Relevant publications are presented in Table 1.

Table 1: Standards for measuring scientific and technological activities

Scope	Publication title
Research and development	Frascati Manual: Proposed Standard Practice for Surveys of Research and Experimental Development, OECD, 2002. R&D Statistics and Output Measurement in the Higher Education Sector. "Frascati Manual Supplement", OECD, 1989.
Innovation	Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, OECD, 2005.
Patents	Using Patent Data as Science and Technology Indicators –Patent Manual, OECD, 1994
Human resources in R&D	The Measurement of Human Resources Devoted to Science and Technology – Canberra Manual, OECD, 1995.
Technology balance of payments	"Proposed Standard Method of Compiling and Interpreting of Technology Balance of Payments Data –TBP Manual", OECD, 1990.
Classification of industry per technological level	"Revision of the High-Technology Sector and Product Classification", OECD Science, Technology and Industry Working Papers, 1997/02.
Globalisation	OECD EconomicGlobalisation Indicators, 2010.
Bibliometrics	"Bibliometric Indicators and Analysis of Research Systems: Methods and Examples", OECD Science, Technology and Industry Working Papers, 1997/01.

Source: Authors.

The purpose of innovation metrics is to explain complex processes in modern economy based on knowledge and new technologies. The ways for measuring technological change and innovation process can be classified in three broad groups: innovation surveys, individual innovation and technological indicators and composite indicators.

Innovation surveys are a new source of information on technical change. It was realised some time ago that R&D do not tell the whole story about technical change as innovation is essentially an interactive process which involves a variety of types and sources of knowledge (Radošević, 1999). The most famous survey for measuring innovation is "Community Innovation Survey" (CIS) which represents the main statistical instrument for assessing innovation in the European Union (EU). CIS survey collects data on innovation activity in enterprises, i.e. on product, process, marketing and organizational innovation. The survey collects data on innovativeness per types of companies, types of innovation, innovation expenditures, cooperation in innovation activity, limiting factors, etc. Community innovation survey is launched every two years in all EU member states and countries members of European statistical system (Including Serbia).

Community innovation survey is a very broad research which includes various data sources: 1) internal (within the firm or within the enterprise group), 2) market (suppliers, clients, competitors, consultants and commercial labs, 3) education and research institutions (universities and other higher education institutions, government, public and private research institutes) 4) other sources (conferences, fairs, exhibitions, scientific journals and technical publications, professional and industrial associations) (Biagi,Pesole&Stancik,2016).

Community innovation survey in Serbia is conducted by the national Statistical Office since 2006 under the title „Research on innovation activity of business entities in Serbia". Companies which participate in this research have the legal obligation to provide accurate, complete and updated data, with the content and form corresponding to the demand of the official statistics. Also, there are penalties for the respondent if they fail to timely provide the requested data of if they supply incorrect data (Official statistics law,2009).

Interpretation of innovation surveys results should always take into account limitations of innovation statistics. For example, within the CIS the most used indicator is the average ratio of innovative companies. However, this indicator does not completely explain the scope of innovative activities of the company. If some company introduced only one new product it is counted equal with another firm introduced more innovations. Also, this survey collects only little information on the impact of innovation. It would be important to know how information affects productivity and profit of the companies (Szunyogh, 2009).

The connection between science, technology and innovation is reflected, among other things, through the existence of science, technology and innovation indicators. Individual innovation and technology indicators

are generally grouped into two broad categories: inputs and outputs. Inputs include indicators such as expenditures on R&D, human resources, while outputs include results such as publications, patents or innovations.

In addition to the basic division of scientific and technological indicators into inputs and outputs, there are also further classifications. One of them is division into inputs, outputs, results, and impact (Danish Agency for Science, Technology and Innovation, 2014).Inputs represent investments in an innovation process such as human and financial resources engaged in R&D. Outputs include activities that arise from the aggregation of inputs and other resources. Examples of output are scientific publications and international co-publications. Results are the consequences of research and innovation activities such as patents and citations. Impact indicators measure the economic and non-economic effects that research and innovation creates for the society as a whole. Examples of impact indicators are improving the quality of life and life expectancy, increasing total factor productivity and return on investment in R&D.

Individual indicators of scientific and technological development are used to a large extent for the creation of composite indicators that allow perception of the country's position in terms of the technological and innovative level achieved. There are a number of international initiatives to create aggregate indicators in this area. Some of them are: Summary Innovation Index, Knowledge Economy Index, Global Innovation Index, Global Competitiveness Index.

4. INNOVATIVE ACTIVITIES

Research of the Statistical Office of the Republic of Serbia on the innovation activity is carried out on the basis of a representative sample. The sample covers around 3500 small, medium and large enterprises. The obtained results are weighted and calculated at the level of the population of business entities.

4.1. Structure of innovation expenditures and innovation turnover

Survey on innovation activities of enterprises in Serbia covers innovation expenditure which are grouped in several categories: in-house R&D (current and capital expenditures for R&D only); external R&D; acquisition of machinery, equipment, software & buildings (R&D expenditures excluded); adoption of external knowledge from other business entities or organizations focused on innovation (know-how, patents, licenses); other innovative activities (design, training, marketing and all other expenditures).

The majority of innovation expenditures in Serbian enterprises are related to the acquisition of machinery, equipment, software and buildings in both observed periods (Table 2). Furthermore, the percentage of this type of innovation expenditures increased from 64,3% in the first observed period to 71,4% in the second observed period. This implies that Serbian companies are focused on purchase of already developed machinery and not on technology transfer processes which is in line with general trends in developing countries identified in literature.

Table 2: Structure of innovation expenditures

	Structure of innovation expenditures	
	2012-2014	**2014-2016**
Acquisition of machinery, equipment, software & buildings	64,30%	71,40%
In-house R&D	12,30%	18,90%
Other	11,30%	6,30%
External R&D	2,60%	1,80%
Acquisition of existing knowledge from other enterprises or organisations	9,50%	1,70%

Source: Statistical Office of the Republic of Serbia (2015). Indicators of Innovative Activities in the Republic of Serbia, 2012-2014, Release number 276;Statistical Office of the Republic of Serbia (2017). Indicators of Innovative Activities of the republic of Serbia, 2014-2016, Release number 197.

Consequently, only 12,3% (in period 2012-2014) and 18,9% (in period 2014-2016) of innovation expenditures are related to in-house R&D. External R&D has decreased in the second observed period and

in 2014-2016 it included only 1,8% of total innovation expenditures. This indicates a very low cooperation between business and research sector, which has been explored in various reports and studies.

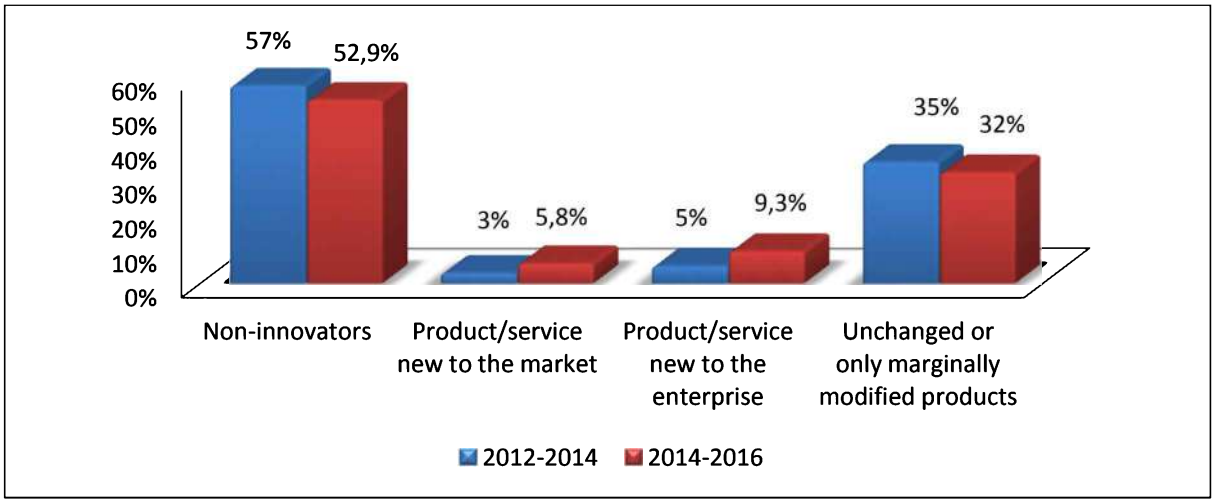

Figure 2: Structure of innovation turnover in Serbian enterprises

The data on the structure of innovation turnover show that the share of turnover from sales of unchanged or marginally modified products is dominant in both observed periods (Figure 2). However, it is visible that the share of turnover generated from product/service new to the market and new to the enterprise has improved in period 2014-2016. Namely, it has increased from 8,8% to 14,3%. Therefore, there is a slight improvement in the structure of innovation turnover in the second period, but these figures are still on a low level.

4.2. Types of innovations

The percentage of companies that have introduced new or significantly improved products in period 2012-2014 was 20,4%, while in period 2014-2016 it was 26,9% (Figure 3). Percentage of product and process innovation show increase between the two periods, while organisational and marketing innovation show decrease. The percentage of product and process innovation seems fairly highand can be partially explained as bias towards innovative firms which are more likely to respond to the survey.

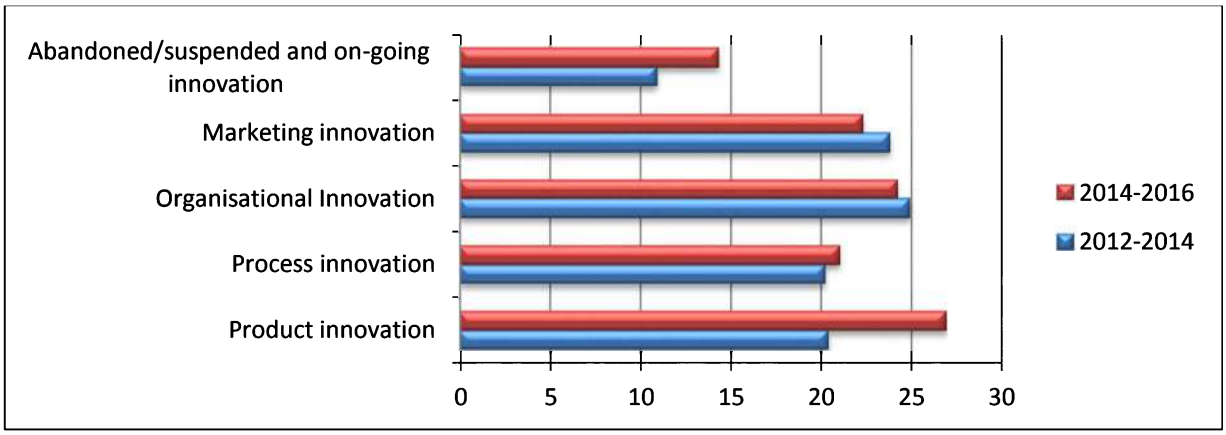

Figure 3: Types of innovation (in %)

In total, in period 2014-2016 around 41,2% of Serbian companies have introduced some type of innovation, while in the previous observed period this was 40,5%. Manufacturing enterprises were more innovative than services companies in both observed periods (Figure 4).

Relationship between the firm size and innovative activities is positive, i.e. large firms are more innovative. Percentage of innovative small companies is around 38% in both periods, while around 68% of large firms are innovative. This result is in accordance with many empirical studies which explore relationship between firm size and innovation activity.

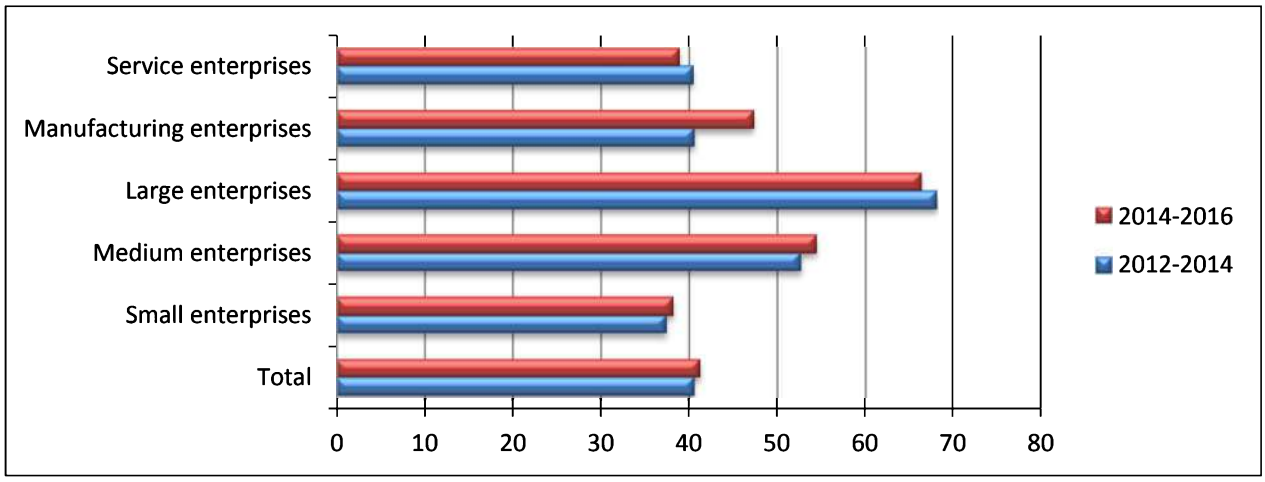

Figure 4: Structure of innovation per company size and type

When observed per NACE sections, in almost all economic activities there was an increase in the share of technological innovation (product and process innovation). The highest percentages of technological innovators are in the following economic activities: Administrative and support service activities; Professional, scientific and technical activities; Manufacturing and Electricity, gas, steam and air conditioning supply (Table 3).

Table 3: Share of product and process innovators by NACE sections

	Share of product and process innovators	
	2012-2014	**2014-2016**
Agriculture, forestry and fishing	18,7	32,2
Mining and quarrying	12,3	18,6
Manufacturing	34,2	**40,7**
Electricity, gas, steam and air conditioning supply	36,7	**40,3**
Water supply; sewerage, waste management and remediation activities	22,3	24,2
Construction	23,1	31,7
Wholesale and retail trade; repair of motor vehicles and motorcycles	23,4	21,5
Transportation and storage	23,3	25,2
Accommodation and food service activities	34,8	26,9
Information and communication	30,5	32,1
Financial and insurance activities	25,4	25,4
Real estate activities	9,6	5,1
Professional, scientific and technical activities	30,4	**41**
Administrative and support service activities	29,7	**43,8**

Source: Statistical Office of the Republic of Serbia (2015). Indicators of Innovative Activities in the Republic of Serbia, 2012-2014, Release number 276;Statistical Office of the Republic of Serbia (2017). Indicators of Innovative Activities of the republic of Serbia, 2014-2016, Release number 197.

5. CONCLUSION

There are theoretical and practical proofs that innovation boosts productivity, leads to higher economic growth and improves well-being of nations. The core of innovation policy agenda includes exploring various measures for assessing innovation activity on different level of economic system.

This paper elaborates only part of the results of two last Community Innovation Surveys in Serbia.Although there are various limitations of innovation surveys as a method of collecting data, the results of this research can serve as a good starting point for decision makers and creators of economic and innovation policies.

In general terms, innovation activity in period 2014-2016 is more favourable than in the previous observed period (2012-2014). However, the structure of innovation expenditure in both periods indicates: 1) strong focus on purchase of already developed machinery and not on technology transfer processesand 2) low cooperation between companies and research institutions in Serbia. The share of turnover from sales of unchanged or marginally modified products is dominant in both observed periods. Positive trend is increase of the share of turnover generated from product/service new to the market and new to the enterprise has increased for 5,5% in period 2014-2016 in comparison with the period 2012-2104.

In both observed periods, percentage of companies that have introduced some type of innovation was around 40%. Manufacturing companies are more innovative than companies from the service sector. Also, the percentage of innovative enterprises increases with firm size.Share of product and process innovation recorded increase between the two periods, while organisational and marketing innovation have decreased.

Acknowledgment

Research presented in this paper was supported by the Ministry of Education, Science and TechnologicalDevelopment of the Republic of Serbia, under the project: "Research and Development of the Platform forScience Based Management of the Scientific and Technological Development of the Republic of Serbia", reg. no. III 47005.

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THE IMPORTANCE OF USING DIGITAL COMMUNICATIONS WITHIN CREATIVE INDUSTRY

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Abstract: *Creative industries are winning industry and there is no question about whether they should be developed. For many cities in the world, creative industries were a new discovery and the best solution for revitalization and achieving greater recognition. Creative industries include a wider range of activities involving cultural industries, based on knowledge and skills, the capacity to convert knowledge into new competitions and ideas that affect innovation and application of knowledge. Thus they are defined as industries whose origin is based on individual creativity, skills and talent, and have the potential to create profits and new jobs. The purpose of the paper is to provide a better understanding of the importance of using digital communications within the CI. Empirical work was related to the analysis of the data of surveyed entrepreneurs on the use of digital communications corrosive use of social networks on the example of the city of Trebinje.*

Keywords*: creative industries, development frameworks, digital communications, social networks, enterprises*

1. INTRODUCTION

The creative industries in the last ten years have become a popular direction for the local development of cities. Many cities use them as a tool to stimulate economic development and to achieve greater visibility in a wider environment. Creativity is the driving force of the global economy. Countries that are able to develop and support an environment where the creative talents of the population are encouraged and successful are countries with high economic and social development. Creative sectors create large amounts of added value and support and enhance other sectors within the economy, such as production, tourism, and others, while at the same time forming a vibrant and innovative environment in the sectors where they are developed.

On a global scale, the creative industries sector faces a constantly changing characterized by the speed of the development and deployment of digital information systems and Information Communications Technologies. As the result of digital disruption, it has had significant impact on the whole value chain of the sector: consumption of cultural goods and services, discovery and distribution, creation and production. For sustainability of IC sector, enterprises must evolve business and operational models and practices. It involves new products, operational practices, and business models. Creative organizations have struggled to maximize the opportunities of digital technologies because of a piecemeal approach to their operational integration. Because of fragmented funding and investment landscape, this situation developed over the long-term. “Creative organizations also suffer reticent reaction to digital technologies’ importance and impact, especially on (Rudman et al., 2015):

- audience behaviors (e.g. altering perceptions of proximity and intimacy);
- artistic practices (e.g. on conventions and practices which are socially embedded rituals of experience);
- business models and practices (e.g. ownership, IP and contracts, new digital production methods, and digital distribution channels and consumption mechanisms).”

2. SOCIAL AND ECONOMIC IMPORTANCE OF CREATIVE INDUSTRY

Governments throughout the world are increasingly recognizing the importance of creative industries as a generator of employment and economic development. In addition to this, researchers have also contributed to the impact of creative industries on economic development in which creative industries, in addition to being the generator of economic growth and employment, have the potential to become the primary factor for the development of the entire economy, but also that some of its branches (architecture, design and etc.) can provide a secondary expansion of economic activities. Creative industries generate a series of overflowing effects on the rest of the economy in terms of increasing competitive advantage, improving innovation and improving social well-being (Kisić, 2011). Creative industries are mostly the privilege of the developed countries, because they require a high degree of innovation, expertise and used of the latest technologies.

With the global power of a particular state, the potential for their distribution and development is growing. They demand very innovative approaches when it comes to politics and legal incentives, because they exceed the competencies of only one of the policies, cultural, economic, urban, etc. At the local level, the sector of creative industries is mostly dependent on entrepreneurs in culture.

At a time when sophisticated technologies replace human beings, creative industries affirm human capital. The economic need for creativity has registered itself in the rise of new class, which is called the Creative Class….all mebers of Creatice Class – whether they are artists or engineers, musicians or computer scientists, writers or entrepreneurs – share a common ethos that values creativity, individuality, difference, and merit (Florida, 2012). Creativity is the ability to solve problems and create new knowledge. This is in fact the experience of thinking, reacting, and acting in a way characterized by a high level of innovation, originality and risk. Basically, creativity refers to creating new ideas or combining old ideas in a unique way and it is a prerequisite for innovation (Jovičić & Mikić, 2006). It is a natural resource with which all countries are equally endowed. However, not all countries are equally creative and successful in creating and applying knowledge. As an immanent human resource, creativity is evenly distributed in all countries, but this is not the case with knowledge. It is concentrated in only a few highly developed countries. Modern knowledge is very complex and for their development specific conditions are needed - primarily specialized personnel, then high technology and financing - which many countries cannot afford. Therefore, in the global economy, poor countries export creativity or educated human resources, while in developed countries knowledge becomes a value on the market. Finally, the underdeveloped countries are importing products and services of developed countries. As creativity lies in the essence of creative industries, which is by nature characteristic of a non-material (spiritual, intellectual) nature, then it is quite logical to conclude that within the creative industries, the largest part is the production of products and the provision of services related to intangible goods that are protected by copyright and related rights . This is because the notion of creativity, integrating human creation, spiritual content, determining form and originality, creates a common essential thread between creative industries and intellectual property rights.

On the macroeconomic plan, the direct impact of creative industries can be seen through the direct and indirect economic effects that cultural industries have on the development of the economy at the local, regional and national levels. “In the context of indirect economic effects, it is possible to speak about the impact they have on (Jovičić and Mikić, 2006):

- the development of the image of space and cities that is crucial for attracting investment and concentration of business activities;
- strengthening of identity in local, regional and national frameworks;
- strengthening of social capital;
- improvement of human development strategy;
- regeneration of deprived urban and rural environments;
- promoting social integration;
- improving the competitiveness of the region;
- adding creative and innovative elements to the concepts of urban development;
- strengthening endogenous regional potentials”.

Prerequisites for exporting creative products to the EU market are: copyrights, intellectual property, tracking world trends and using the Internet. Marketing innovations, generally observed, become an increasingly important determinant of sustainable competitive advantage, but particularly important over the last few years, are getting innovations in the field of internet marketing (Ilić & Marković, 2014).

3. INTERNATIONAL AND NATIONAL FRAMEWORKS FOR THE DEVELOPMENT OF CREATIVE INDUSTRIES

The international frameworks for the development of creative industries comprise numerous interconnected strategic documents, among which the Essen Declaration, the UNESCO Universal Declaration on Cultural Diversity, the UNESCO Convention on the Protection and Promotion of the Diversity of Cultural Expressions, the European Parliament Resolution on Cultural Industries and the Opinion of the European Committee on Economic and Social Issues on European Creative Industries (Convention on the protection and promotion of the diversity of cultural expressions, 2005). In addition to these documents, development frameworks are created by global and European organizations such as the Council of Europe, the European Investment Bank, the World Intellectual Property Organization (WIPO), the United Nations Conference on Trade and Development (UNCTD) and others (United Nations Conference on Trade and Development UNCTD, 2004).
The UNESCO Symposium on Culture Industries Development was held in Warsaw a year after the international congress of experts from the European Cultural Industry - a comparison of development concepts that resulted in practically the first European document on cultural industries - the Essen

Declaration (Universal Declaration on Cultural Diversity, UNESCO, 2001). It has been reiterated that the support and protection of artistic creativity is important for the cultural industries in Europe and the need for creating sustainable markets for cultural goods is emphasized. It is also necessary to develop regional cooperation, create structures for mutual support of neighboring countries, finance research and enable exchange of information on cultural and media policies and industries.

Advocating systemic approach to cultural policy as well as the importance of its implementation in Bosnia and Herzegovina started in 2002 by the project of the Council of Europe and an evaluation report on cultural policy in Bosnia and Herzegovina by Charles Landry (Landry, 2002). Then in June 2006, on the initiative of the Commission of the Council of Ministers to create a cultural strategy of Bosnia and Herzegovina, the cultural sector for the first time included in the revised Medium Term Development Strategy 2004-2007, which is only created the possibility that the cultural policy is considered as one of strategic policy development sociality which is adopted in 2008, with presented strategic goals, measures and conditions for implementation of the strategic framework for the development of the cultural sector in Bosnia and Herzegovina (Vijeće ministara BiH – Ministarstvo civilnih poslova, 2008). From the perspective of operational discourse, cultural policy of Bosnia and Herzegovina is based on the principles of cross-sectoral integration, in order to ensure effective links with other sectors and other components of the development process.

In Bosnia and Herzegovina:
The Federal Ministry of Culture and Sports performs tasks within the Federation's jurisdiction relating to different cultural domains (cultural heritage, museums, archives, libraries, publishing, performing arts, filmmaking, civil initiatives in the field of culture, etc.) and sport. The Ministry is divided into three sectors: cultural and historical heritage and culture (including the Institute for the Protection of Monuments), sport and youth center, while in other sectors legal and administrative and financial affairs are carried out. Support to programs through competitions is another activity that is being implemented by this Ministry (Mikić, 2012). *The Ministry of Education and Culture of Republika Srpska* is responsible for the implementation of cultural and educational policies in the Republic of Srpska. The Ministry is responsible for the protection and use of cultural heritage, museum, archive, library, publishing, theater, music, visual, film and estuarial activities, preparation of programs and agreements on cultural cooperation at the level of Republika Srpska, keeping a register of public media and performing other tasks importance for the development of culture in the territory of Republika Srpska. Within the Ministry are the Republic Institute for the Protection of Cultural, Historical and Natural Heritage and the Archives of the Republic of Srpska, and is also responsible for another eight institutions of importance for the development of culture on the territory of the Republic of Srpska (National and University Library of Republika Srpska, Museum of Republika Srpska, Museum Contemporary Art of Republika Srpska, National Theater of Republic of Srpska, Children's Theater of Republika Srpska, Public Film Company of Republika Srpska "Srna Film", Public institution "Književna zadruga").

No administrative authority recognizes the creative industry as its competence, nor does it have departments, functions, etc. in that sense which systematically deals with the issues of their development. Similarly, as in countries in the region (eg Croatia, Montenegro, Macedonia), no state authority, as the subject of its competences, does not have cultural or creative industries, and even less implementation of strategic projects for the development of these activities. The traditional structures of state government, which access creative industries through the sectoral or branch principle, are still dominant, that is, through recognizing certain branches such as publishing, film production and production.

4. ANALYSIS OF THE USE OF DIGITAL COMMUNICATIONS THROUGH THE USE OF SOCIAL NETWORKS IN THE FRAMEWORK OF CREATIVE INDUSTRIES ON THE EXAMPLE OF CITY OF TREBINJE

The empirical research was done on the example of the city of Trebinje and it was aimed at checking how many entrepreneurs from the creative sector use digital communications through the use of social networks. Paper (Ilić and Marković, 2014) has served as an inspiration to explore this issue, because in their research they showed that the growth of the share of internet social networks in total communication with consumers corresponds to the advantages that this form of communication leaves out in relation to other forms of communication. The authors of this paper conducted an empirical research on the use of new forms of internet marketing, and in particular marketing through social internet networks. Within this research, 27 companies were involved (approximately 30% from the creative sector). The survey was conducted through a questionnaire in September-October 2017. The survey was conducted through a questionnaire and involved 27 respondents (approximately 30% from the creative sector) in September-October 2017. The structure of the various social networks used by the companies in Trebinje as well as the results of the research conducted by the authors are shown through the following tables and diagrams, the importance of

using social networks is analyzed. In the diagram below (Figure 1), the percentage of companies that use social networks in business and those who do not use them.

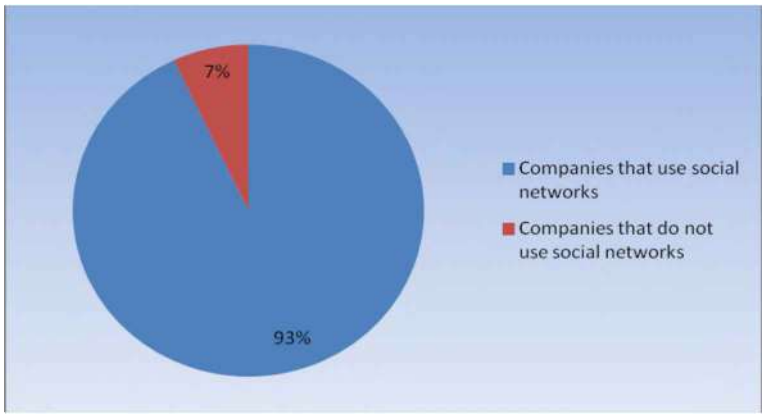

Figure 1: The percentage ratio of enterprises to the use of social networks in their business

Further analyzes include only those companies that use social networks in their business. In the following table (Table 1), the social networks that companies use the most in their business are shown.

Table 1: Social networks that businesses use the most

Most used social network	**Number of companies that used social network**
Facebook	25
Twitter	1
LinkedIn	0
YouTube	12
Instagram	14

The previous table shows that businesses use Facebook the most. Even all respondents use this social network. Next comes Instagram with 14 users, YouTube with 12 and others. The time period of using social networks among the surveyed companies is shown in the table below (Table 2).

Table 2: Time period of using social networks

Most used social network	**Number of companies that used social network**
Less than 6 months	-
6-12 months	-
1-2 years	7
2-3 years	8
More than 3 years	15

The percentage ratio of the use of social networks indicates that 40% of companies use social networks for more than 3 years, 40% of them from 2-3 years, and 28% of social network uses in the period of 1-2 years.

From (Figure 2) it can be seen that a large percentage (40%) of companies find that the use of social networks positively influences their business and a competitive advantage; a smaller percentage of them (20%) think that their business do not have changed significantly due to the use of social networks, or social networks have little impact on the competitive advantage of the company, while 40% of respondents did not give the answer.

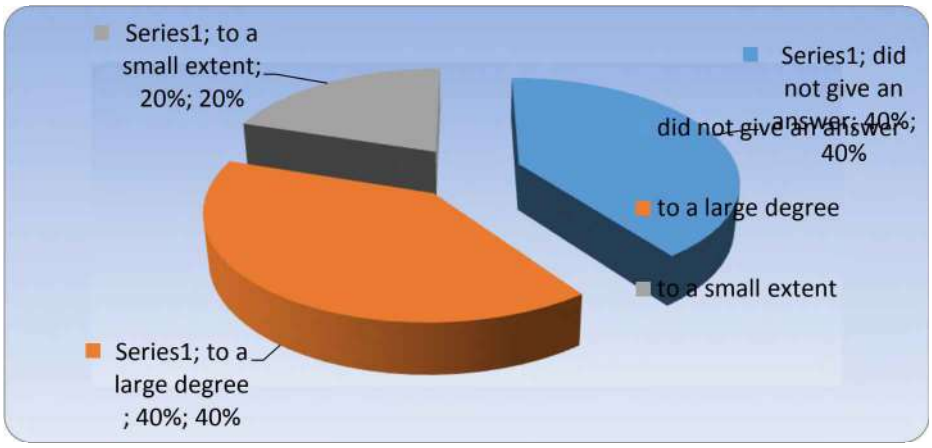

Figure 2: The influence of the social network on a competitive advantage

In the following diagram (Figure 3), the company answers the question about the effects of the use of social networks.

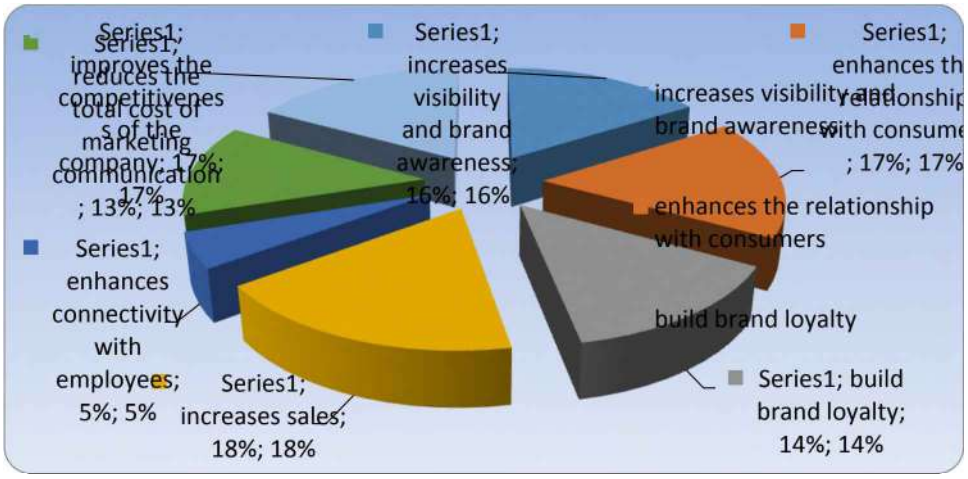

Figure 3: Effects of using social networks

The majority of companies consider that social networks have an effect on sales increase (18%), then improving the company's competitiveness (17%) and that social networks improve customer relationships (17%). 16% of companies consider that social networks increase visibility and brand awareness, build brand loyalty (14%) and reduce marketing communications costs (13%).

4. CONCLUSION

Creative industries are important for the development of modern economic flows and therefore open up opportunities for developing new forms of consumption and distribution; offer opportunities for employment (with non-standard forms and high flexibility of work) and widening and expansion of the market. Also, the creative industries are characterized by a high degree of propensity to innovate in business ventures and new projects that stimulate economic development. The fact is that cities are centers of culture and industrial growth, but in recent years we are surprised and motivated by new facts about the importance of creative industries for the city economy, employment and cultural diversity. Priority is given to those cultural professions that make profits and participate significantly in the development of the city economy (attracting experts, investments, infrastructure, tourism, etc.). It is necessary to systematically manage a cultural policy that is part of the general developmental city policy. Through this paper, the importance of using digital communications within the creative industries is highlighted. Participation in social networks enables companies to obtain reliable information about products and services, as well as to initiate two-way communication with the customer in order to create a strong link and buyer's trust in the brand. In order to achieve this, it is important to regularly update the latest news about events and new products, customer support areas, organize promotions as well as use social networks as a channel for finding new customers as well as employees. The aim of this part of the research was to examine the attitudes of domestic enterprises towards the use of social networks, as well as the impact of the same on the business of

companies. The conducted research included 27 companies of different sizes, levels of business (local, national, regional, international level), length of business and activities (service, production and service and production). In a survey conducted for the purpose of preparing this paper, in 2017 it was found that 93% of companies in Trebinje use social networks in business. The majority of companies use Facebook, because it is a network that has the largest number of users. Also, if companies use multiple social networks, this network is the most common and dominant in their business.

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THE EFFECTS OF BUSINESS CASE STUDY COMPETITIONS AS A TEACHING METHOD

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Abstract:*Case study competitions have been widely accepted and used as an efficient educational tool in business educationin last few decades. They are based on an outstanding experiential learning process and providea grounded, reasonable and desirable learning for business students. Even though case competitions might not be a novel research topic, global international case study competitions have hitherto been out of the research radars.The aim of this study is to examine the effects of mentoring on the development of practical knowledge and skills, and leadership potential of case competitors. The results indicate high positive relationship between the examined variables and the high level of predictability of practical knowledge and skills and both mentoring activities and leadership potential of case competitors.*

Keywords*:case study (teaching method), case competition, business school, overview*

1. INTRODUCTION

Business and management are considered as one of the most evolving fields, as the technology and globalization tend to profoundly reshape their practice (Farashahi&Tajeddin, 2018). Business education, on the other side, is developing at a much slower pace than the practice (Moratis, Hoff &Reul, 2006). Therefore, a great emphasize has been put recently on business and management majors for more relevant skills and escalating challenges for educators to close the gap between the knowledge and skills needed for the real world and the offering of business schools (Ungaretti, Thompson, Miller & Peterson, 2015). Most important questions are related to the need for more practically applicable tools (Greiner, Bhambri& Cummings, 2003) and their future use at the workplace (Jarzabkowski, Gulietti, Oliveira and Amoo, 2013). Consequently, business and management majors should get more problem-based and experiential learning.

For this purpose, both scholars and practitioners advocate for case study as the most appropriate teaching method, as it provides authentic, active and pragmatic application of theory to school practices (Sudzina, 1997). A specific form of active learning with case studies are case study competitions. Corner et al. (2006) infer that competitions are reasonable and desirable for grounded business learning. Case competitions are aimed at providing business students with practical skills and knowledge needed for their future jobs. Even though the stakes are high, this phenomenon has been out of the scholarly radars.

This paper aims to fill the lacuna in the present body of knowledge by examining the main factors affecting the development of practical skills and knowledge of case competitors. To answer this question, we hypothesized that mentoring and leadership potential are the main driving forces of the development of phronetic skills among students.

The remainder of the paper is organized as follows. Section 2 elaborates on the theoretical foundations of a case competition as a learning method in business schools. Section 3 depicts the quantitative method used in the study. Section 4 deals with the results of the study. Section 4 discusses these results in terms of the main findings, contributions, managerial and research implications, limitations and further recommendations. This section also deals with the concluding remarks.

2. RELATED WORKS

Traditional learning paradigm relies on a “spoon-feeding” pedagogy, where students are supposed to listen, memorize and reproduce the knowledge presented at classroom lectures. This approach is limited in terms of developing critical thinking skills which are highly important forsolving future real world problems and tasks. As opposed to this paradigm, a constructivist approach-driven experiential learning centers around the preparation of students for unstructured problems which reflect to their future actualization at the workplace (Cavaleri&Fearon, 2000). Constructivists advocate for the use of active learning methods. These methods

include case studies, debates, discussions, experiments, role plays and Socratic questioning (Popil, 2011). Among them, case studies arethe most broadly used in management education. Business schools use this method for more than 100 years (Mesny, 2013) and there is little evidence that this teaching method will disappear or diminish as the centerpiece of management education.

A broad body of evidence has been growing around the advantages and disadvantages of using case method in the classroom. On the upside, Farashahi&Tajeddin (2018) state that "case studies help students to integrate theories with business situations and develop alternative solutions for management and/or organizational problems". Also, case studies develop judgment and the ability to make business decision in highly competitive markets (Simons, 2013).An important benefit garnered from the use of case-based instructions are centered around the view of management as a multifaceted practice which may not always be reduced to generalized theoretical principles and concepts (Mesny, 2013). This refers not only to questioning operational issues that businesses face day-to-day, but "a critical questioning of business-as-usual capitalism from the perspective of multiple stakeholders, including managers, employees, unions, not-for-profit organizations, government, and the natural environment" (Bridgman, McLaughlin & Cummings, 2018).Accordingly, students learn how to formulate readings and to discriminate among them and learn how to frame and resolve business issues in accordance with the prevailing values (Greenhalgh, 2007).

On the downside, even after a century of usage, cases still lack of fully conclusive evidence on the effectiveness. One of the reasons for this is very broad usage of the term "case-method". When put in context, the term may broadly encapsulate benchmarking and evaluative cases (Mesny, 2013). Most of our colleagues will to some extant claim that they use case-method in the classroom. However, specific aspects of case-method teaching – educational objectives, instructors' preparation strategies, students' roles, structure of the feedback etc. – are rarely thoroughly developed.

A specific form of case-method learning is a case study competition. They emerged from the need to 'actionalize' management education and to 'expand teaching beyond classroomexperimentation to live action learning' (Raelin, 2009). Presently, a handful of business schools use case competition as a teaching method. The method originated in the United States where the participation was restricted to national schools, but the phenomenon has diverged around the globe in the last two decades (Damnjanovic, Proud &Ruangwanit, 2017). There is still a paucity of evidence on the effectiveness of this learning concept. Scarce studies on case competitions indicate that students who participate at case study competitions are better prepared for future career: job or internship possibility based on their preparation and experience at international level (Damnjanovic and Mijatovic, 2017).

The concept is generally based on organizing students into teams which are supposed to act as consultants to businesses (Desai, Tippins&Arbaugh, 2014). Some indicative recommendations for the adequate usage of case study competitions is given in Gamble &Jelley (2014). It is highly beneficial to provide continuous training and coaching to the teams to achieve superior performance (Karagozoglu, 2017). Accordingly, mentors play a vital role in the process of the student preparation for the competition (Proud et al, 2017).Following this, we hypothesize that:
H1: Mentoring positively affects the development of practical skills and knowledge of business students.

Students (competitors) are exposed to decision-making in various industries, challenged by different experiences of team work, they learn by doing rather than reading and listening, and get feedback for their work from a jury panel combined from experts from both academia and practice. However, not all the competitors will acquire practical knowledge and skills at case competitions. Hedlund et al. (2003) infer that practical (tacit) knowledge is highly affected by the leadership potential. Although this study was conducted for the military purposes, we will use the analogy with the business students and hypothesize that:
H2: Leadership potential positively affects the development of practical skills and knowledge of business students.

3. RESEARCH METHODS

3.1. Research approach

This study used was based on primary data and employed questionnaire as a research tool.Quantitative approaches are steadily gaining importance in business and management studies (Cameron & Molina-Azorin, 2011). The questionnaire was distributed to mentors at global international case study competitions. Since the aim of the study was to collect the data from the most important global case competitions, we used the list of competitions compiled by the Auckland University from New Zealand (the Champion Trophy

compilation). The questionnaire was distributed in both paper-and-pencil and e-version to the mentors of competing teams.

3.2. Research variables and measures

The questionnaire was divided into four sections. The first section examined the demographics of the examinees.

The second section (mentoring) was developed according to Dlacic, Damnjanovic&Ribaric (2016). This part included the inquires on Encouraging contact between students and faculty, Developing reciprocity and cooperation among students, Encouraging active learning, Giving prompt feedback, Emphasizing time on task, Communicating high expectations, and Respecting diverse talents and ways of knowing.

The third section (leadership potential) was based on Greenhalgh (2007) and the operationalizion from Higgs and Aitken (2003). It included the inquires on: Strategic leadership, Leading capability building, Leading political/stakeholder interface, Leading change, Intellectual leadership, Leading culture building, Building relationships and reputation, and Building personal learning.

Final section (practical skills and knowledge) was built upon the Jerrard (2005) and encompassed the following inquires: Critical and strategic thinking, Systematic industrial and labor related thinking, Analyzing the complex industrial and labor relations environment, Demonstrating an understanding of theory covered in the subject, Understanding specific roles in managerial practice, Demonstrating appropriate communication skills with other team members, Present material in a format appropriate to the role, the task, the audience, Improving Learning and Performance, Information Computer Technology (ICT) skills, Leadership skills, Interpersonal skills -Working with others (Team building), Conceptual skills (Problem solving and decision-making), and Functional skills (for example, strategic management). All the items were measured on a Likert-type scale (responds were coded from 1 – strongly disagree, to 7 – strongly agree).

3.3. Sampling procedure, data collection and processing

As aforementioned, the questionnaire was distributed to the mentors at global business case study competitions. The questionnaire was distributed to a total of 55 examinees. The sample was created as a referral chain, following Bodin, et al. (2016). Most of the examinees are affiliated in Europe and Middle East (33%) and North America (31%). The other regions covered were Asia-Pacific (22%) and Australia and Oceania (15%). The main field of interest of the examinees was management and strategy, followed bu finance and accounting (which jointly make 52.7% of the sample).

Data wascollected in thesecond half of 2017 as a partof a largerprojectaimed to provide aninsightintothedevelopmentofcasecompetitions as a teachingmethod. Theauthorscollectedthe data andafterthecollectionwascompletedthe data wasentered in SPSS (StatisticalPackageforSocialSciences). Quantitative data wasanalyzedwithdescriptivestatistics: percentages, meansand standard deviations. Interdependenceofdeterminants (independentvariables) andcontractmanagementefficiency (dependentvariable) wasdeterminedbycorrelation (Pearsonmomentstwotailedcorrelationcoefficientanalysis) and multiple regression.

4. RESULTS

4.1. Pre-analysis

Firstly, we conducted descriptive statistics, internal reliability analysis and correlation analysis. The results are presented in Table 1. The average means are relatively high with a relatively low standard deviation. Since the scores are composite, we examined Cronbach's Alpha as an internal reliability test. This results are particularly noteworthy as they range from .69 to .87 indicating high internal consistency (Lance, Butts &Michels, 2006). A strong and statistically significant relationship was found between all the examined variables. Particularly high relationship was found between mentoring and knowledge and skills of case competitors (r=.65) and leadership potential and knowledge and skills (r=.63).

Table 1 Descriptive statistics, internal reliability and correlations

	Mean	SD	CA	1	2
Mentoring	5.90	.68	.69		
Leadership Potential	5.75	.66	.79	.48**	
Knowledge and Skills	5.75	.62	.87	.65**	.63**

4.2. Main analysis

Since the study found a number of significant positive correlations, the next step was the examination of the influence and intensity of variables seen as independent to Knowledge and Skills. The results of the regression analysis indicated that the research model predicted 51% (R^2=.51) of the variance which is displayed in Table 2. As Durbin-Watson was d=1.876 (between two critical values 1.5<d<2.5), it could be assumed that there is no first order linear autocorrelation in the multiple linear regression data. Multicollinearity was further examined with the variance inflation factor, and we have not found high values for VIF.

Table 2 Regression model for Knowledge and Skills as a dependent variable

Variable	Coefficient	Std Error	t-statistic	Prob
Constant	1.12	.63	1.78	.08
Mentoring	.44	.11	4.13	.00
Leadership potential	.35	.10	3.36	.00
R square	.53	F		27.21
Adj R square	.51	Sig		.000
SE of regression	.423	Dependent variable: Knowledge and Skills		

The results indicate that mentoring has an immense impact on the development of practical knowledge and skills of case competitors. Nearly a half of the variability in the development of dependent variable is explained with the changes in mentoring. The leadership potential, also, significantly affects the development of business majors in case competitions.

5. DISCUSSION AND CONCLUSIONS

5.1. Key findings, implications and further recommendations

The aim of this study was to examine the relationship between mentoring activities and leadership potential of case competitors (business majors) on one side and the development of practical knowledge and skills. The study was focused on a 'premier league' of business case competitions. The findings indicate that mentoring plays an important role in the development of phronetic skills among students. This finding is in line with some previous studies. For instance, Spence (2015) reports that mentees appreciate the enhancement of self-confidence, employability skills and networks.Not only that practical knowledge gets facilitated through the mentoring at case competitions, but it ultimately drives the workforce readiness (Hartnett, 2016).

The study also confirms the hypothesized influence of leadership potential to the development of practical knowledge and skills among business graduates. One possible explanation for this result is that student-perceived developing leadership behavior is positively and significantly related to affective organizational commitment (similar to Marescaux, et al., 2016), which ultimately leads to more effective learning and acceptance of new skills.Still, empirical results from other studies infer that unstructured curricula and teaching methods do not improve leadership self-efficacy – or at least not the perceived one (Caza, Brower& Wayne, 2015).

In general, our results support the argument that case study competitions is a versatile and adaptable learning method, as it evolves at a much faster pace that lecture-based learning. Cases provided at global case study competitions are up to date and require proactive and problem-based thinking. Thus, as an experiential way of learning, it is highly effective in gaining tacit knowledge (Armstrong & Mahmud, 2008). It should be speculative to infer that case competitions should replace traditional learning methods. Traditional learning is more efficient in transferring large number of ideas to a large number of students (Ardalan, 2006). The idea is not to replace lecturing, but to extend by implementing extracurricular activities to gifted business majors.

This paper provides several implications for both scholars and practitioners. First, the study adds to a current body of knowledge related to the teaching philosophy. Not only that case studies can bring a 'spark' of real world to the classroom, but competition in case studies can dissect the way in which business majors will compete in future marketplace. Moreover, competing feature of the aforementioned phenomenon stretch out to business schools. Case competition, in a specific way, reflects the strength of a competing business school and builds its brand. The study also acknowledges that the support from the mentors plays a vital role in the actual development of competences among students. It could, however, be speculated that even unguided preparations for business case competitions might reflect to the development of knowledge and skills. Nonetheless, mentoring catalyzes and facilitates this process.

Being a quantitative by nature, this study has certain flaws. First, the size of the sample raises the question of the generalizability of study findings. Although the sample included the majority of mentors leading the student teams at premier global business case competitions, this cohort is relatively small and may not reflect the concepts and the effects of mentoring students at other case competitions (i.e. national or regional ones). Second, the study only analyzed two possible predictors of the developments of practice-needed knowledge and skills. An avenue for further studies is the inclusion of other possible variables into the model.

5.2. Conclusions

Case competitions are receiving more attention lately as a grounded method of learning in the business and management education. Business schools that compete at case competitions usually apply case studies in various courses: finance, strategy, marketing which helps students to develop problem solving skills and be familiar with using the case methods. Working with students in the classroom is not sufficient to prepare a team for a case competition. The case competitors usually have additional – extracurricular coaching needed to develop their practical and problem-solving skills. Being a close-to-the-real-world simulation of consulting practice, business case competitions are an utter way of providing a glance of the real business problem to be cracked in the classroom. This study finds that as undergraduates interact with professionals from the practice, and network and friend up with their peers from different cultures, they create a body of phronetic skills and develop leadership potentials.

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HUMAN CAPITAL IN THE DIGITAL ENVIRONMENT 844

Bojana Sokolović, Ivana Katić
IMPORTANCE OF THE ORGANIZATIONAL CULTURE IN THE DIGITAL AGE BUSINESS 845

Željko Gajić, Zoran Jeftić, Ljupča Stojanović
ANALYSIS AND FORECASTING IN THE ERA OF BIG DATA 853

Željko Pešut
VIRTUAL IDENTITY ON SOCIAL NETWORKS – NEGATIVE ASPECTS 860

Stefan Ramljak, Milena Popović, Gordana Savić
THE EFFICIENCY OF HIGHER EDUCATION STUDENT MOBILITY PROGRAMMES IN EUROPE IN 2015 865

Dejana Pavlović, Vladimir Obradović, Marija Todorović
DISPARITIES AMONG YOUTH LABOUR IN SERBIA 872

Ivana Milinković, Ivana Kovačević
VIRTUAL VERSUS TRADITIONAL TEAMS: TEAM DYNAMICS AND TEAM MEMBERS NEED SATISFACTION IN A LEARNING ENVIRONMENT 879

Jasmina Žnidaršič, Miha Marič
RELATIONSHIP BETWEEN WORK-LIFE BALANCE AND WORK ENGAGEMENT AMONG HIGHER EDUCATION LECTURERS 887

Arturo Lavalle
FACING INDUSTRY 4.0 COMPETENCES DEMAND: THE IMPORTANCE OF TRAINING OF TRAINERS 895

Jovana Jovanović, Tatjana Ivanović
CHALLENGES FEMALE EXPATRIATES FACE ON INTERNATIONAL ASSIGNMENTS 903

Nikola Petrović, Jelena Anđelković Labrović, Mateja Sela
THE USE OF LEARNERS ENGAGEMENT DATA FOR REPORTING: CLUSTER ANALYSIS 908

IMPORTANCE OF THE ORGANIZATIONAL CULTURE IN THE DIGITAL AGE BUSINESS

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Abstract: *This paper examines the importance of the organizational culture in the digital age. In the paper it is shown what are the major definitions of the organizational culture, and digital age as well. The most important researches in different fields of business in the global and digital age are shown. Also, authors mentioned the necessity of studying organizational culture as digital culture, and its influence on the business in the age of digitalization. The purpose of this paper is to emphasize significance of the organizational culture in the digital age in organizations, to contribute to achieving positive business results by doing business in different situations conditioned by the need for constant learning and adapting by adjusting business for Internet and computer use. Also the paper presents some problems that appear in the organizational culture, learning and communication related to digitalization.*

Keywords*: organizational culture, digital age, Hofstede's theory, learning, digital skills*

1. INTRODUCTION

In our digital and global age, employees in organizations should strive to become informed and engaged in digital community in an evolving digital culture. Furthermore, education of employees should be challenging in terms of learning through critical exploration of the Internet and participation in online communication in a way which will provide them with success in their work and easier adjustment to modern ways of doing business in conditions where the Internet is present in all areas of business. Today most business communications and transactions are conducted via computer mediated communication and email is the most familiar type of this communication. In fact, email plays a crucial role in establishing and maintaining business relationships, both within a company and with external contacts.

In the digital age, organizations need to reinvent themselves at a structural level and to become more flexible. It is important to identify major trends of digital skills for employees and managers. Organizational culture must be focused on learning, mobility, rewards and competency system which imply business value according to the right development in digital age.

Authors (Deepti Bhatnagar and Leena Bhandari) argue that organizational culture is a crucial organizational variable that can facilitate or impede the change process.

2. ORGANIZATIONAL CULTURE – CONCEPT AND DEFINITIONS

There is not one unique definition of organizational culture. By examining extensive literature of organizational culture and utilizing many of scientific and research papers, we can present organizational culture as the following:

Organizational culture presents system of assuptions, beliefs, values and norms of behaviour, developed and extended by the group in the organization, through common experience in interactions, manifested through symbols of their thinking and behaviour.
Autor Edgar Schein (Edgar Schein, 1984) in his work presented definition of organizational culture:

"Organizational culture is the pattern of basic assumptions that a given group has invented, discovered and developed in learning to cope with its problems of external adaptation and internal integration, and that have worked well enough to be considered valid, and, therefore to be tough to new members as the correct way to perceive, think, and feel in relation to these problems". A given group is a set of people who have been together long enough to have shared significant problems, who have had opportunities to solve those problems and to observe the effects of their solutions, and who have taken in new members. A group's culture cannot be determined unless there is such a definable set of people with a shared history.

According to The Business Dictionary (Business Dictionary) organizational culture includes an organization's expectations, experiences, philosophy, as well as the values that guide member behavior, and is expressed in member self-image, inner workings, interactions with the outside world, and future expectations. Culture is based on shared attitudes, beliefs, customs, and written and unwritten rules that have been developed over time and are considered valid.

Some authors, such as Needle (Needle D., 2004), point out that organizational culture includes organization's vision, norms, systems, symbols, language etc. Author defines organizational culture as collective values, beliefs and practices of employees, a product of factors such as history, size of organization, strategy, management style, national cultures and other factors. Corporate Culture however refers to culture deliberately created by management to meet strategic ends.

Cultural differences manifest themselves in several ways. From the many terms used to describe manifestations of culture, the following four together cover the total concept rather neatly: symbols, heroes, rituals, and values.

Organizational culture affects the way people and groups interact with each other, with clients, and with stakeholders. Also, organizational culture may influence how much employees identify with their organization (Schrodt, 2002).

Studying the literature, we can find different approaches to organizational culture. Some of them are:
- Person culture and market culture
- Adaptive culture and adhocracy culture
- Power culture, role culture and hierarchy culture
- Task culture and clan culture.

The most cited typology of organizational culture in the literature is typology by Harisson, which was later modified by Charles Handy (Handy C., 1993). According to this typology there is distinction between four types of culture:
- Power culture
- Role culture
- Task culture
- Person culture.

Charles Handy designed 15 dimensions, explained in the form of 15 items: the type of „boss"; the type of „well-behaved subordinate"; the way of determining company's priorities by its employee; the type of employee promoted within the organization; the way the organization treats its members; exerting control and influence within the organization; task distribution; employee motivation in accomplishing tasks; teamwork; team competition; dealing and managing conflicts; decision making; communication and control structure within the organization; ways of responding to external environment.

Handy uses the Greek Gods as metaphors for each cultural type because each God represented a particular trait or set of values.

- ZEUS CULTURE or power culture is based on personalities with power and influence coming from a central source, usually the leader. However, the success of the organization depends on the luck or judgment of key individuals. In this culture, personal contacts are more important than formal liaisons.

- APOLLO OR ROLE CULTURE underlies logic and rationality. Organizations with this culture have formal structures and well defined rules and procedures. The structure defines the authority and responsibility of individual managers. It is specific for large organizations with predictable work and stable environment.

- ATHENA'S CULTURE OR TASK CULTURE usually has matrix structure or it is organized in form of project teams. Management is seen as completing a series of projects related to problem solving. In this culture, ability to accomplish a particular task is more important than formal status. This is the culture of variety and creativity. Organizations with this culture are flexible and problem solving oriented.

- PERSON CULTURE is presented as DIONYSUS CULTURE. It is also named existential culture. It is found in an organization whose purpose is to serve the interests of the individuals within it. Organizations with this culture are characterized by management having lower status than professional work, and their success depends on the talent of the individuals.

One of the most used concepts of the organizational culture is Hofstede's culture framework.

Hofstede (Hofstede G, 1991) asserted that culture is learned from one's social environment but not inherited from genes. According to Hofstede (Hofstede G., 1993), culture is "collective programming of the mind that distinguishes the members of one group or category of people from others ".He argues that culturally everyone belongs simultaneously to several different kinds of groups and is variously influenced by different layers of mental programming within him or herself. Hofstede examined a large survey by IBM between 1967 and 1973 covering more than 70 countries. Author's first idea was that cultural features can be conceptualized and measured across specific dimensions.

The original four dimensions of the culture are (Hofstede, 1991):
- Power Distance
- Individualism/Collectivism
- Uncertainty avoidance and
- Masculinity/Femininity.

Some years later, authors (Kevin D. Lo, Richard D.Waters, Nickas Christensen,2017) added two more dimensions:
- Long term orientation/Short term orientation
- Indulgence- restraint.

POWER DISTANCE is the extent to which the less powerful members of institutions and organizations within a country expect and accept that power is distributed unequally.

INDIVIDUALISM/COLECTIVISM
Individualism is presented as a society in which the ties between individuals are loose: everyone is expected to look after themselves and their immediate family, and collectivism is a society in which people are integrated into strong cohesive in-groups from birth onward, which throughout people's lifetimes continue to protect them in exchange for unquestioning loyalty (Hofstede, 2005).
This dimension is defined as "the extent to which the members of a culture feel threatened by or are anxious about ambiguous and unknown situations." (Hofstede Geert, Hofstede Gert Jan, 2005).
Individualism can be defined as a preference for a loosely-knit social framework in which individuals are expected to take care of themselves and their immediate families only. Its opposite, collectivism, represents a preference for a tightly-knit framework in society in which individuals can expect their relatives or members of a particular in-group to look after them in exchange for unquestioning loyalty. At the individual level, individualism is consistently associated with overconfidence and over-optimism.

UNCERTANTY AVOIDANCE
The uncertainty avoidance dimension expresses the degree to which the members of a society feel uncomfortable with uncertainty and ambiguity. Countries exhibiting strong uncertainty avoidance maintain rigid codes of belief and behavior and are intolerant of unorthodox behavior and ideas. These societies value beliefs and institutions that provide certainty and conformity (Hofstede,2001).

MASCULINITY/FEMININITY
According to Hofstede, a society is called masculine when emotional gender roles are clearly distinct: men are supposed to be assertive, tough, and focused on material success, while women are supposed to be more modest, tender, and concerned with the quality of life. However, a society is called feminine when emotional gender roles overlap: both men and women are supposed to be modest, and tender, and concerned with the quality of life. (Hofstede, 2005).

The masculinity side of this dimension represents a preference in society for achievement, heroism, assertiveness and material reward for success. Society at large is more competitive. Its opposite, femininity, stands for a preference for cooperation, modesty, caring for the weak, and quality of life. Society at large is more consensus-oriented. Masculinity refers to the extent to which cultures strive for ego-goals and competitiveness. Masculine cultures stress stereotypical gender behavior, and the dominant values are success, money, competition, and assertiveness. Masculinity is not correlated with other Hofstede's dimensions.

LONG TERM/SHORT TERM ORIENTATION
The last dimension is the Confucian dynamism, which is known as Long-term vs. Short-term Orientation. It was added after the original four in order to distinguish the difference in thinking between the East and West. In terms of the choice of Confucian ideas, this dimension captures the extent to which people have a future-oriented mentality rather than focusing on the present. In societies with long-term orientation people know

many truths, and are thought to have more flexible thinking. Hence, they tend to be thrifty with money investment. Relationships are largely categorized on the basis of status. Meanwhile, in societies with short-term orientation, people believe that there is only one absolute truth and expect quick results, which represents a more static attitude (Barkema and Vermeulen, 1997).

According to Hofstede, long-term orientation stands for the fostering of virtues oriented towards the future rewards, persistence and thrift, in particular. However, short-term orientation stands for the fostering of virtues related to the past and present, respect for tradition, saving face, "and fulfilling social obligations," in particular. (Hofstede, 2005)

INDULGENCE-RESTRAINT
This dimension refers to the degree to which a culture allows for gratification or suppresses its regulations.

It is this set of Hofstede's dimensions that is now most frequently used in organization and management research. (Kevin D.Lo, Richard D.Waters, Nicklas Cristensen, 2017)

Hofstede's cultural dimensions are widely adopted in different areas of business, corporate risk taking and final business performance.

2.1. Researches of organizational culture in the literature

In the literature dozens of research papers which examine organizational culture using the Hofstede's theory of cultures appear. Hofstede's theory is used in many different fields of research work. Some of them are shown below.

Authors (Mohamed H.Thowfeeka and Azizas Jaarar, 2012) investigated impact of pedagogical approach in the formation of new teaching and learning platform (e-learning). They used Hofstede's model in their study. They studied the ways in which the instructors from South Eastern University of Sri Lanka adopt information system depending on their cultural differences, and, subsequently, what are the reactions related to its adoption. In other words, they studied how cultural factors influence instructors' information acquisition and the use of it in further work with their students. They pointed out that cultural factors can explain the behavioral variation of instructors in accepting and implementing e-learning system. They suggest cultural differences should be studied carefully before implementing an e-learning system. In that way, conventional teaching and learning methods can be overcome. The e-learning method is preferred by both students and educational administrators. The study focused on cultural factors in order to implement the new system successfully. The findings show a number of cultural factors that influence intention to accept an e-learning system and also reveal some of the significant indications over the cultural dimensions which should be carefully considered while implementing an e-learning system in an educational institution. The study notifies the educational institutions to focus more on cultural factors that would explicitly describe the view of instructors about e-learning acceptance at their institutions.

According to Nadia Z. Jaber (Nadia Z.Jaber, 2015) some fundamental culture values are found in the knowledge base of the Palestinian social culture. There is also a reflection of the values on teacher's classroom practices and on the effect of those practices on student's cultural identity in the context from a cultural perspective. In the paper, author used Hofstede's cultural framework. She described some fundamental cultural values in the five cultural dimensions of the Palestinian culture, using Hofstede's framework and its implications on teacher's classroom practices and student's cultural identity. After the research author agreed with Hofstede that cultural dimensions constitute another important component of culture in addition to cultural norms. It is emphasized that understanding and perceiving the dimensions of the Palestinian culture through analysis, interpretation and critique, can promote successful interactions and will help to recognize the impact on the identity, or in other words on students' cultural identities. This will further enable educators to create a culturally informed learning environment where the society can establish useful educational practices which motivate everyone involved in the learning – teaching process.

Johannes C. Cronj (Cronj J. 2011) interpreted cross-cultural blended teaching and learning using Hofstede's cultural dimensions. He studied experiences of professors from South Africa and students from Sudan during a two-year Internet supported Master's course in Computers in Education. The purpose of this research is to determine the extent to which Hofstede's quantitative static research could be used as a basis for an essentially qualitative dynamic interpretation. In his paper he tries to uncover what commonalities were constructed in the process. It was found that in this case, dimensions such as power distance and uncertainty avoidance tended to amplify each other, while together they resulted in a movement leading away from individualism towards collectivism. Three elements seem to play a role when cultures meet: reduction of communicative uncertainty, construction of shared meaning, and appropriate use of technology.

More research should be conducted to uncover the elements that are common to cultures because emphasizing commonalities seems more useful than trying to overcome differences.

Erkki K.Laitinen and Arto Suvas (Laitinen E, Suvas A.,2016) investigated the influence of Hofstede's cultural dimensions on financial distress prediction in companies in 26 European countries. Findings have shown that Hofstede's dimensions significantly moderate the effects of many financial predictors in failure prediction. The study concentrates on Hofstede's four original dimensions of national culture.

Some authors (Degens N, Hofstede Gert Jan, Beulens A, Krumhuber E, Kappas A, 2016) created a digital self-contained cultural general training due to the fact that digital intercultural training tools play an important role in helping people to mediate cultural misunderstanding. They found that experimental and story-based approaches may lead to different perceptions of participants. Later, they incorporated virtual characters to evaluate if experimental incidents in an embedded story can lead to an attribution of perceived differences in behavior to specific differences in culture and to users becoming less judgmental of inappropriate behaviors by people from different cultures.

Some researchers (Kevin D. Lo, Richard D, Waters, Nicklas Christensen, 2017) examined how Hofstede's six cultural dimensions are reflected on the official corporate Facebook pages from 259 organizations on Fortune magazine's Global 500 list. They tried to determine how Facebook is used by the Global 500 companies. They found that all these corporations have similar overall presence on Facebook, but the individual elements (About us, updates and media) are different in relation to cultural dimensions. This study might make important statements about the emergence of global social media culture.

One important study (I-Chen Lee, Carol Y.Y.Lin,Te-Yi Lin, 2017) argued about the difference of national intellectual capital from the perspective of national culture and illustrated how national leaders of policy-makers increase their country's national intellectual capital. Authors found that countries with high intellectual capital tend to exhibit a common culture of low power distance, weak uncertainty avoidance and individualism, in research sample of 26 countries. They suggest to increase the country's intellectual capital by striving for a culture of equity, freedom and safety. They argued that national culture, a deliberate effort of human beings to control the environment and reduce uncertainty, may be a potential factor that differentiates the intellectual capital of countries. Based on Hofstede's cultural typology, authors found that the five dimensions of national culture have different influence on national intellectual capital.

3. DEFINITION OF THE DIGITAL AGE

The early literature on the digital age dates back to a time when technical possibilities of information coding mainly consisted of computer programming and analogue data transmission (Valenduc G., Vendramin P., 2017). Alain Touraine (Touraine A., 1969) and Daniel Bell (Bell D.,1973) were the first authors who wrote that the post-industrial world would be dominated by intangible production and consumption, based on information processing and dissemination. Information is defined as 'the storage, transmission and processing of data as a basis for all economic and social exchanges' (Bell, 1973).

According to Elisabeth E. Bennett (Bennett E., 2014), organizational culture is central to virtual human resource development (VHRD), which was defined as a media rich and culturally relevant web environment that strategically improves expertise, performance, innovation and community building through formal and informal learning. The growth of virtual technologies increasingly locates human interaction, collaboration, and socializing within virtual spaces. Thus, virtual human resource development states that technology should be culturally relevant, as well as media rich, to have the best chance of improving human resource development outcomes, such as learning, performance, growth of expertise, innovation, and the bonding of a community together.

3.1. Examination of organizational culture in the digital age

Below follows an overview of research results in literature in the field of organizational culture in the digital age. Conceptualizing culture, according to some authors (Carlton N., 2014), refers to **digital culture** as the integration and adaptation of comprehensive computer technologies for practical, creative, and connective platforms and practices. As digital technologies have become every day routine, membership in digital culture has grown. (Lòpez A., 2012) New technologies in each part of business field and the use of computers have influenced people's communication, cognition, and behavior. McLuhan (McLuhan 1966) proposed we necessarily adapt to new ways of thinking and being in the world when we reorder our senses into new media.

In different researches, authors (Choi M, Cristol D., Gimbert B., 2018) identify levels of digital citizenship, defined in terms of individual's thinking, skills, and behaviors with regard to Internet use. (Choi M, 2016) The concept of digital citizenship is presented by five dimensions:

- Technical skills
- Local/Global Awareness
- Networking Agency
- Internet political activism and
- Critical perspective.

There is also a research paper in the field of future directions in the digital computation humanities for data driven organizations (Upadhyay S., Upadhyay N., 2017). The authors consider discipline of humanities and social sciences has been transformed by the digitalization of the world's knowledge, tradition, heritage, culture and expressions. In their work, researchers, scholars and academicians (Scrhreibman S, Siemants R, Unsworth J.,2008) attempt to understand how knowledge in the 21st century is transformed into information through computational techniques, particularly within computational artifacts and infrastructure. The authors present a roadmap to establish new modes of knowledge formation enabled by the massive transformation of knowledge, society and culture in the network and digital environment.

A study conducted by Mitra Madanchana and Hamed Taherdoost (Madanchana M., Taherdoost H, 2016) explores organizational culture and its effect on E-mail communication using Hofstede's theory of culture and organization. The study's results showed the influence of organizational culture on e-mail communication in the organization. Organizational culture can affect the way people communicate within the organization. Also, organizations have their own culture and way of doing things, implementing their mission and vision statement. As seen from previous definitions of organizational culture, communication in organization is one of the most important elements of organizational culture. Informational technologies play very important role in organizations and, consequently, e-mail is used extensively as a means of computer mediated communication. E-mails play a crucial role in establishing and maintaining business relationships, both within a company and with external contacts.

As a part of organizational culture, Alina Daniela Mihalcea (Mihalcea A., 2017) examined talent management in the digital age. Study focuses on identifying the major trends and strategies concerning talent management programs and development of digital skills for employees and managers. Human resources need to evolve skills for managers and employees in the digital age. By developing core of skills in this age, managers become distributors of content through social media platforms. The digital economy implies usage of new information and communication technology in innovative and efficient means by companies. The use of mobile and analytical technologies implies the need for training and professional development of the existing employees.

4. CONCLUSION

In this paper we aimed to explain the necessity of understanding the organizational culture in the digital age. The growth of virtual technologies increasingly locates human interaction, collaboration, and socializing within virtual spaces. It is important to understand what is the role of organizational culture in the new age, to emphasize potential power of leader's ability to change or shape an organizational culture and to identify factors that influence organizational culture in the age of digitalization defined as thinking, skills, behaviors and communications with regard to the Internet use. The development of the computational artifacts, social media, and network infrastructure has provided a unique opportunity to organizations and their leaders, to enhance their understanding of the organizational culture types and dimensions in the digital spectrum. The current literature research work explores the role of organizational culture in the age of digitalization and provides the future directions for the future researchers in our country. It is important to mention, future research should include research work in the field of organizational culture in the digital age in our county and involve both theoretical and practical exploration on the sample of companies doing business in our country.

By studying the organizational culture in the terms of digitalization, we can conclude that media is affecting everyone using computers on a daily basis, and every business has to become global. It means that organizational culture has to become global. Over the last few years, differences between national cultures become less significant. By using the Internet and computers in every field of work and our daily life, differences between people as well as companies from different countries are reduced. Sometimes it can be a disadvantage due to the fact of growing competition.

This way companies are faced with challenge to educate and train employees in a multicultural way, to evolve adaptive experiences related to new media uses, to use digital and internet tools in their daily

business, to communicate using technologies such as presentations, e-platforms, e-mails and online networks of commerce and exchange. For millennial generations it could not be a problem, but older generations, born before 1980, require additional attention by company management in terms of digital education and skill building, necessary for sustainability in the new age. New set of skills is necessary for the talent management as well, due to the presence of many social networks (Linkedin, Facebook, Instagram).

Communication as an element of organizational culture evolved in the past time. Conventional ways of communication are replaced with the new ones, digital and electronic. It is important to establish business communication as a part of strategic communication plan in a digital way, using digital literacy, using social media platforms, often using official language (for example English is the most common used language). E-mails and video conferences play a crucial role in digital communication and have replaced traditional ways of communication in organization such as letters, faxes, memos etc. Also, it should be mentioned that symbols have become more visual as well.

In conclusion, organizational culture in the digital age should be digital culture. Traditional values are thrown into oblivion such as collectivism at work and gender differences but there is more than necessity to study an organizational culture in terms of visual symbols, e-platforms, digital skills of employees, e-communications and modern values of business. As authors Blythe and O'Neill said, new media are actively creating, remediating and disseminating contemporary culture and cultural contexts (Blythe Light, O'Neill, 2007).

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ANALYSIS AND FORECASTING IN THE ERA OF BIG DATA

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Abstract:*The process of analyzing large quantity of data, as well as evaluating and forecasting, is very complex, since it's necessary to position oneself in regard to future events, which are susceptible to various influences unknown during the forecasting process and which may or may not happen. The process of analyzing and evaluating large quantity of data, and evaluation of its value and reliability, as well as finding relations, trends, patterns and correlations is very complex. With this in mind, prediction of future events is extremely difficult and requires high attention, trained analysts and applying modern scientific methods and techniques.*

Keywords*: Forecasting, Analytics, Business, Big Data, Decision making.*

1. INTRODUCTION

Under modern circumstances, monitoring business processes and decision making still represents a big challenge. Business management is being carried out under effects of globalization and rapid development of technologies which, on one hand offers the possibility of simpler access to information, raw material, business partners and buyers from all around the world, whereas on the other hand the business management becomes susceptible to the risks of consequences related to events and processes carried out in other business areas or parts of the world.

Availability of computers, smartphones and other personal devices, modern informational systems and systems for advanced database management have all enabled simpler, faster and more effective processing of large quantity of data. In addition, there has been an increase in the quantity of data that are generated worldwide with the different contents, formats and passed on via web pages, blogs, social networks, etc. This way, huge number of generated data may provide the managers with new knowledge relevant for decision making. The complexity of topics, contents, formats, scope and quantity of data create new problems for analysts that could be solved only if the existing methods and techniques would be adjusted to new conditions. Moreover, analysts should be prepared to assess the validity, select and process the data in an adequate manner and make analysis and create forecast. Simultaneously, the necessity arises to discover new ways to adapt to conditions under which it is becoming more and more difficult to correctly analyze information, identify risks, important processes and trends and forecast changes and significant events of decisive importance for selection of business strategy and policy.

In that situation, in the area of business management it is very important to properly analyze conditions under which the company is running, but also to predict possible changes that would affect success of the business. In the era of rapid and hardly predictable changes it represents a great challenge that could be overcome if the problem is approached in a comprehensive manner, by employing various experiences and results of the scientific researches in this area. In that environment, apart from traditional problems, modern business analysts face uncertain business environment and increased amount of the available data. However, the role of properly selected and well prepared business analysts and managers is still crucial in support of the decision making process.

2. BUSINESS ANALYTICS AND FORECASTING

Modern business conditions contribute the accelerated development of some disciplines that should be able to offer an answer based on scientific principles regarding the issue of how to make a business decision with less risk. To this end, development of business analytics is very important as it includes possibilities of the informational technologies, demands of the managers and challenges of making business both presently and in future.

Modern IT technologies provide efficient and affordable solutions for collecting and storing data, however challenges still remain. Key challenges of modern analysis can be grouped into three main categories based on the data life cycle: data, process and management challenges (Sivarajah, Kamal, Irani, &Weerakkody, 2017) .

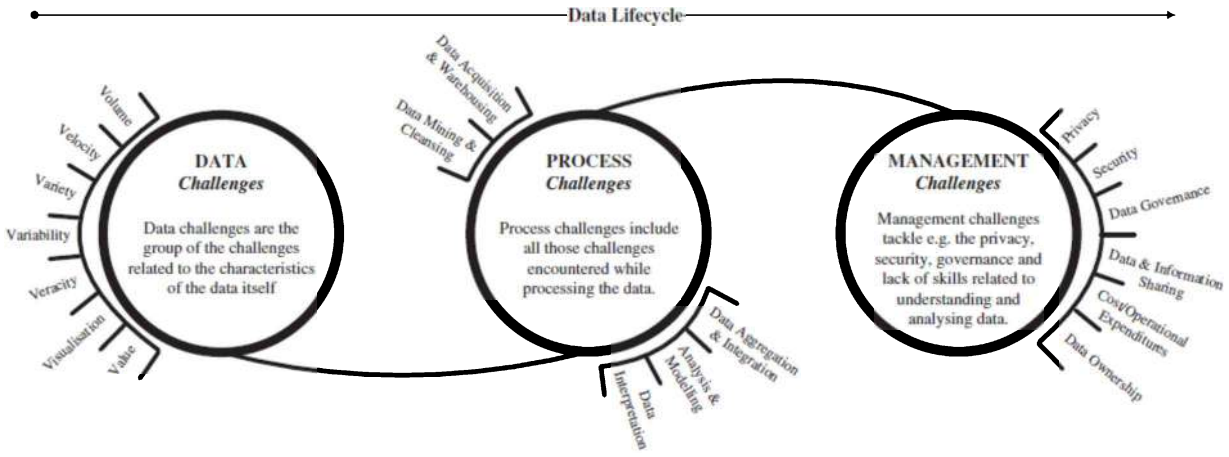

Figure 1: Classification of Big Data challenges **(**Sivarajah et al., 2017)

There are three main types of business analytics that offer various solutions – descriptive analytics, predictive analytics and prescriptive analytics (VujoševićMirko&VujoševićDušan, 2014).Particular significance should be attached to complexity-to-value ratio, offered by some areas of business analytics related to increased significance of forecasting future events in terms of proper decision making on further business moves.

At the initial level, there is a phase of reporting about certain processes as well as analysis of reasons why the results of production, sale etc. are such. In this part of descriptive analytics there are data and reports about current indicators important for business management, such as utilization of capacities, availability of stocks etc. The next phase of the predictive analytics includes assessment about what may happen as well as certainty and probability of certain events significant for business management. At the very top of complexity there is prescriptive analytics that should develop various scenarios and simulations in order to properly evaluate the results and consequences of decisions made.

New circumstances of business management characterized by rapid changes, numerous information and uncertain future force the organizations to rapidly adopt business policy, whereas business decisions encompass increased risks which could be minimized by modern disciplines (data analysis, visualization, simulations etc.) and advanced techniques supporting decision making under almost unpredictable circumstances (processing large quantity of data from various sources and of various type and reliability, forecasting etc.). Big data and business analytics have potential to enable evidence-based decision making through a single efficient process, and prepare high quality analysis and precise forecasts from high volumes of fast-moving and diverse structural and non-structural data (Gandomi&Haider, 2015).

3. PREDICTION AND FORECAST CHALLENGES

There are different types of predictions and forecast from the simpler ones, e.g. when we decide what to wear based on the weather forecast; to the more complex when assessments are made on the currency rate, raw material prices, economic changes, regional and global security assessments, etc. The latest researches suggest that not everyone has equal abilities to successfully analyze data and make accurate predictions. However, results confirm that it is possible to significantly improve these abilities (Tetlock& Gardner, 2015). Professor Tetlock, who is one of the pioneers of research in this field, started a research in 1984 which lasted for almost two decades in which more than 280 people of different profiles participated (politic analysts, journalists, analysts from different government institutions, etc.). Participants prepared over 27.000 different assessments which referred to events and occurrences in the time frame of the next ten years. Research results (Tetlock, 2006) showed how complex a prediction is, especially if it's for the longer period of time. However, it was noticed that some individuals have better results and that these prediction abilities can be improved.

Beside the academic community, significant number of government and private organizations and institutions are also interested in forecasting technics and methods. There are specialized organizations and agencies

which are working on gathering and processing information, evaluation and analysis, as well as predicting future developments. They use technics and methods which are based on experience and scientific principles, while analysts go through special training during which they gain necessary knowledge and abilities in order to make predictions more accurate and realistic.

Government intelligence organizations responsible for making complex security assessments are also interested in improving predictions. Many research conducted for the needs of USA intelligence community are especially interesting. For example, for the needs of IARPA –Intelligence Advanced Research Projects Activity (agency is responsible for developing and testing advanced technologies for improving the quality of analysis and for producing assessments in the framework of USA intelligence community) organized a forecasting competition that lasted from 2011 until 2015. In four tournaments conducted in that period, participants prepared probability estimates about many different, political and economic global events. Participants were recruited from research centers, universities, professional organizations and themwere given between 100 and 150 questions related to national security and prepared by intelligence agencies (Chang, Chen, Mellers, &Tetlock, 2016). Their average age was forty, sixty-four percent of respondents had a bachelor's degree, and fifty-seven percent had completed post-graduate training. During all tournaments more than 1,800 participants (who submitted more than 25 answers), giving more than 888,000 forecasts in total (Friedman, Baker, Mellers, Tetlock, &Zeckhauser, 2017). Their background covered a diverse range of fields including mathematics, computer science, photography, law, pharmacy, biochemistry and others.. Diversity of topics in the tournaments was large enough that no one was an expert on all subject matters (B. A. Mellers, Baker, Chen, Mandel, &Tetlock, 2017).

Competition of this kind can be useful to the scientific community but also to the decision makers to test the methods in real conditions (Tetlock, Mellers, Rohrbaugh, & Chen, 2014).Some authors describe ideas and quality of geopolitical forecasting with "warranted tempered optimism" (Mandel & Barnes, 2018) and other found based on analysis of numerus geopolitical forecasts that foreign policy analysts can "consistently assess probability with greater precision" (Friedman et al., 2017). The goal was to define and test the best methods and technics for producing analysis and predictions which would be applicable in the work of intelligence agencies. The intention was also to with the participation of academic community representatives, private companies and participants-volunteers identify capabilities, technics and desirable forecasters' characteristics which contribute to forecasting accuracy. In the part of research related to producing geopolitics assessments, five teams answered different questions of interest for the USA politics. Teams answered these questions by giving numeric probability of specific development. During this competition several hundred questions were given and teams answers were analyzed and evaluated based on realized predictions. After the first year, team lead by professor Tetlock showed significantly better results in comparison to the other four teams. After the second year that gap was even bigger, hence it was decided to continue only with the monitoring of the Fetlock's team.

At the beginning of the research participants were divided in groups in order to define the level of correlation of the value of the assessment in relation to the type of preparation (probabilistic-reasoning, scenario training and group without additional preparation) and teamwork (individual work, control group and group additionally prepared for teamwork). During the competition, participants also got 199 questions prepared by IARPA (B. Mellers, Stone, Atanasov, et al., 2015). From these questions, 150 were yes or no questions, while for the rest they gave a choice of three - five answers. During the competition, participants were given feedback on their results in comparison to the others. Teams had the freedom to choose their members, as well as to develop their own technics and methods for producing individual and joint assessments. Winning team was composed of carefully chosen individuals who got best results in previous stages and are among 2% most successful participants.

Already at the beginning the differences were noticed in the quality of some answers, evaluated by Brier scoring rule. As the time passed this trend was more noticeable, which is seen in Figure 2.whichis representing results of 100 the worst and 100 the best participants after evaluating answers to first 25 questions. Although it could have been expected that by time this differences would reduce, this trend continued and differences grew which showed that initial results were no coincidence or statistical error (Mellers et al., 2015).

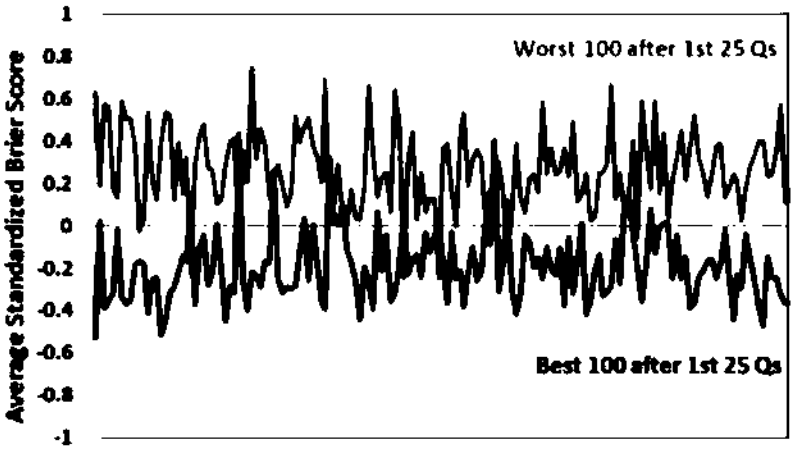

Figure 2: Quality ratio of answers given by the best and the worst participants

Result analysis related to some categories of participants show significant differences in the quality of answers. Figure 3. represents quality ratio of answers given by the group composed of the best participants which worked as a team on producing joint assessment (the best 2%), very good analysts (the best 3-5%) which individually produced assessments and a group composed of the remaining participants. Conclusion is that during the research differences grew in favor of the group of the best participants who prepared answers as a team, while the two other groups by time showed deterioration in answers (B. Mellers, Stone, Murray, et al., 2015a).

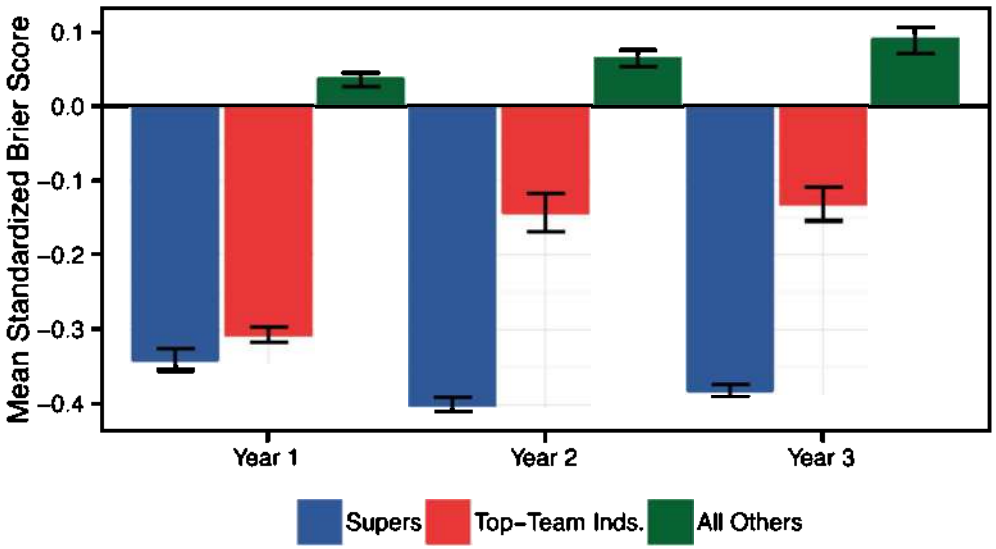

Figure 3: Quality ratio of answers given by groups of participants (B. Mellers, Stone, Murray, et al., 2015a)

Based on these indicators it can be concluded that some of the participants in the research under the same conditions recorded better results, as well as that by working in a team in a longer period of time these abilities could be further improved.

During the tournament training was organized for participants. Main topics were about statistical and mathematical models, probabilistic reasoning, calibration and resolution, Brier scoring, biases in probability judgment etc. (Chang et al., 2016). Training consisted of two modules: probabilistic reasoning and scenario training for the first year. Second year of tournament training was improved with graphics tools. Next year political science content module was added. In the fourth year participants were offered improved web platform with graphical elements and pictures. Analyses of results lead to a conclusion that a trained forecaster performs much better than control group (without training). Effect of training was shown in Figure 4.

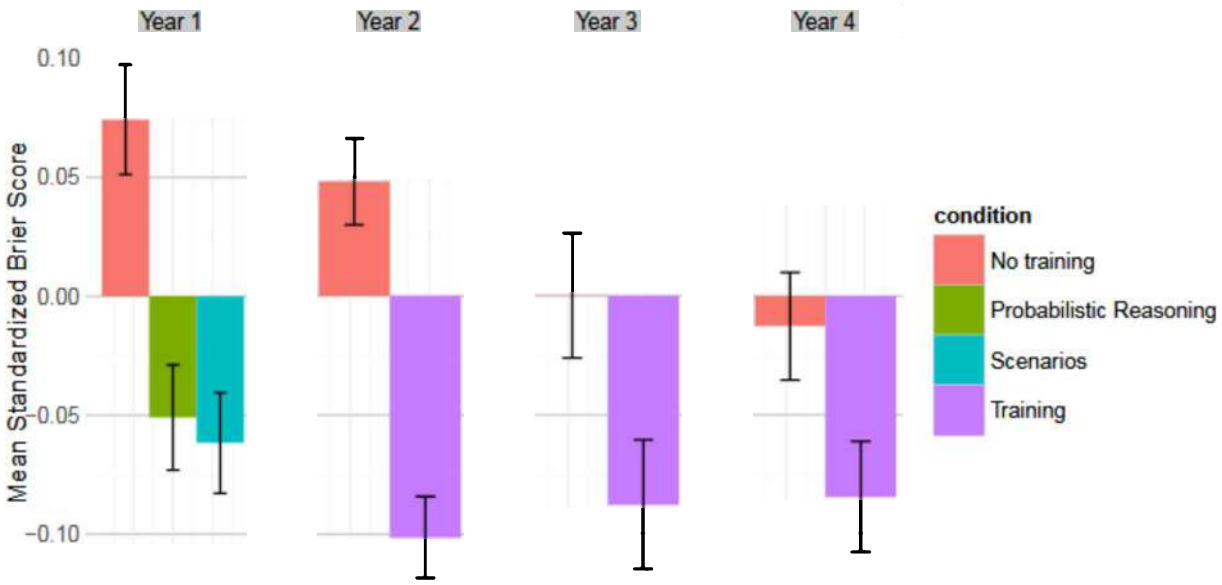

Figure 4: Training Effects (Chang et al., 2016)

That and similar scientific experiments can help state agencies and private companies in monitoring and improving their performance in objective analysis and precise and timely forecasting. Decision science and modern IT and analytical tools can help protect from negative consequences of wrong decisions based on incorrect information, analysis and/or forecast. Available quantitative methods for measurement and testing of cognition and behavior, theoretical models of human judgment and decision making can be used as tools in decision making process. That can be applied in intelligence and business community which are both dealing with uncertainty and problems inconveying assessments to end users typically using onlyverbal probabilities (Dhami, Mandel, Mellers, &Tetlock, 2015).

Some other authors support this kind of ideas. For example, prominent Richard Hauer wrote about methods and technics that can help in overcoming problems in intelligence analytics. He consider that it is very hard to find a good way for define adequate evaluation criteria for probability of the development, which led to a problem during creation of the complex assessment. Bearing that in mind, he points out the need to improve analytic technics and create new “analytic culture”, different from the current, with improved coordination among analysts, continued testing and questioning of the initial hypothesis, improved selection and training (Hauer, 2007).

4. GOOD CHARACTERISTICS OF THE FORECASTERS

Based on the previous experience and results of the research, Tetlok thinks that the most successful participants are not necessary high intelligence individuals, but with good education, and knowledge from different fields.Capability of making a good forecast depends on numerous factors, but is also correlated with intelligence. However, unlike some aspects of intelligence, forecasting can be learned, improved, and sharpened (B. A. Mellers et al., 2017). Conclusion is that those participants stand out from the others because of theirs commitment in resolving problems; ability to separate important from unimportant issues, as well as facts from assumptions. Theirs most important characteristics is an ability to divide problem into smaller parts, analyze validity of the available data and their impact on the problem solution.

Important characteristic of good forecasters is an ability to present problem in the way it is recognized in the past, as well as to determine principles that are repeated and could be used for resolving a concrete problem. Besides this, it is unnecessarily for the forecasters to be able to separate personal experience and opinion from the available facts. It is very important, that in the environment of growing changes, resulted by many different things, forecasters can explore different types of information, as well as not to seek only for the arguments that will support his opinion. Moreover, the participants who are ready to adjust their perspective of view due to surrounding changes and new knowledge have performed better results.

Participants of the research with the best scores were mostly pragmatic, open-minded, who carefully seek, select and check information. They were curious and able to analyze data from different fields and gained from different sources. Especially teamwork is important, and ability to express opinion without fear. They are able to listen and accept different, and opposite opinions if they contribute in better analyses of the situation and precision in assessment.

We can conclude that the most successful participant don't have a special "power" or ability. They actually use some common skills that result with a good understanding of the problem and making decision. Because of that, ordinary people who do the analysis can upgrade that skills, and by individual or teamwork make better quality of analyses and assessment.

It is especially important that forecasting accuracy could be reached through teamwork (Ungar, Mellers, Satopää, Tetlock, & Baron, 2012). With good team organization and quality interaction among motivated members, good result could be reached. But in case of lack of communication and slow dynamic, imposing opinion and unhealthy competition, results of the prediction and assessment could be wrong(B. Mellers et al., 2014). Bearing into mind all mentioned above, structure of the teams is very important as well as a good preparation, interaction and teamwork that will led to more quality conclusions.

Beside individual ability and characteristics of the forecasters, for better assessment it is important to improve a procedure for making analysis. For work that is more efficient, development and improvement of the quality of the assessment it is unnecessarily to monitor result of the assessment in the future in what level assumption will became reality. Even if the time shows that the assessment is not good enough, it is unnecessary to study initial data, recognize process and define reasons of the wrong assessment. Without additional analysis and conclusions, the process cannot be upgraded and reaching precision in assessment is impossible.

5. CONCLUSION

Analysis, assessment and forecasting in modern age requires the need for upgrading current methods and technics, as well as seeking for the new models that are adjustable for the modern times. Effect of the globalization and improved development of the technology (primarily telecommunication) make the information more accessible, it has shorten the time requested for making decision, in some level it has made it easier to do the assessment. However, managing this data became a problem, selection of the information became harder as well as assessment of their value and this has increased possibility for making mistakes in forecast.

Researches in this field contribute in finding solutions that are applicable in everyday life, but as well as during the complex assessment for the need of the private sector and government. This especially refers to a need for the careful selection of the individuals that do the analysis, their training and courses, continued improvement of their abilities and upgrading technics and methods that could follow up with fast changes in the environment.

In a modern business and intelligence environment characterized by rapid changes andabundant information, it is possible to create the conditions for analyses to contribute to making better decisions and creating new values, only with the appreciation of the increasing importance of the analytical process and the ability of analysts. Organizations that recognize this trend and adapt their business processes and procedures will be in a better position than those who do not accept the possibilities that new technologies bring with them. In a creative atmosphere, talented and motivated analysts, who have good knowledge of the field of analysis and who recognize the needs and expectations of the customers, can, using appropriate techniques, prepare timely and accuracy information and high quality forecasts.

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VIRTUAL IDENTITY ON SOCIAL NETWORKS – NEGATIVE ASPECTS

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Abstract: *This paperanalyzes the ways in which virtual identity is created on social networks as a form of virtual communities, as well as the problems that accompany such communications. Firstly, the relationships between social networks and virtual culture are presented, as well as the effects of social networks on users. The phenomenon of social networks has almost revolutionized the field of communication.A virtual reality is created which enables, first of all, faster exchange of information, but also satisfaction of a multitude of human needs.Through various forms of virtual communities, people around the world are connecting and networking,and a large number of users directly influence the growth of the popularity of such a community. In doing so, we are able, thanks to virtual identity, to build our "online" personality exactly the way we want, which can positively influence the development of interpersonal relationships, since a virtual personality often helps to solve some social problems, but on the other hand it can take us to another negative extreme.*

Keywords: *virtual identity, communication, social networks, Facebook, negative aspect*

1. INTRODUCTION

The meaning of the concept of communication using a computer can be double analyzed.At first glance, the Internet is a global networked computer worldwide systemthat has transformed the way communications systems work. Such speed of communication on the Internet has made it possible to access a variety of services, to overcome the great distances and the multicultural nature of the relationships that can arise on this network, which makes modern life considerably easier. However, it is necessary to mention more the other negative side of the medal, which is reflected in the fact that the virtualization of the communication mode minimizes the nature of communication and interpersonal relations are significantly diminished.People easily accept new technological inventions, regardless of negative connotations, so it can be said that human communication technology is moved to a virtual space.

This paper will try to examine the ways in which communication through social networks, and especially Facebook and I Instagram as the most popular social networks today, creates the virtual user identity.

First of all will be examined the occurance of virtual communities or social networks within virtual culture and communication,their development,their particularities,and especcialy thenegative impact of social networks on users.

2. VIRTUAL COMMUNICATION

Virtual communication introduced a lot of novelties into the traditional form of interpersonal communication, especcialy in the domain of interpersonal and group communication. It brings the possibility of communication people separated in space, real time, the ability to communicate with many, quickly get direct feedback, which traditional media do not have. New media give users many benefits to use, but remember that deficiencies have to be overcome, that is to find a way to avoid the set limits in this type of communication. For every technology that is intended to improve the living conditions it is also believed that it in some way also has a negative impact on life. (Jones, 2001)

Virtual communication is simple and direct. It contains many elements as well as face-to-face communication: more people communicate at the same time, using jargon, changing the topic, taking out the words. They differ exclusively in textual character. Communication through a video call also makes virtual communication, but most of the intemet communication is written communication.

Virtual communication is mainly a process of messaging, but in order to get closer to face-to-face communication, it must compensate those functions that are included in that communication, such as expressing emotions through body movements, tone of voice, displaying their own characteristics by arranging their outer appearance and way of dressing and other ways of non-verbal communication.

The fact is that people in virtual communication often behave more freely than in communication live,and the phenomenon of more free behavior in virtual than the "real" reality, known as the "effect of online

disinhibition" (Dr. John Suler) is one of the the reasons why people are losing their jobs, breaking links and falling into conflicts, although the extent of this effect is probably still not fully understood.

Many consider that virtual communication is suitable for overcoming social anxiety and shyness.They can favor the development of careers, friendly and loving relationships. On the other hand, it can lead to alienation in case of overuse.

2.1. Virtual communities

To be a member of the virtual community, we need to visit it regularly, because the continuity of members keeps the community existing. According to Steven Jones there is another visible difference between physical and virtual communities. Traditional communities impose obligations and rules, while virtual communities function on the principle of voluntariness, and we decide by ourselves to join the community.Various forms of virtual communities can be listed as social networks (so-called social networks), groups, forums, games, blogs, chat rooms. (Jones, 2001)

Chat Rooms or chat were popular before social networking, so they are now outdated. They had their greatest popularity in the period before the development of social networks.This form of virtual communication provided both closed and shy people the opportunity to express their views.The good side of this form of communication is that it gives enough time to come up with and shape our words, and it is allowed to the other side as well. The fact that we do not know the user, we do not know what it looks like, how it behaves and reacts gives us additional courage to open ourselves up and express. The covered information is providing us with the opportunity to be at the same time and what we are like and what we would like to be. (Milinković M, 2015)

Forums as a type of a virtual community are very similar to the chat rooms, but they are created with the goal of covering various topics that are grouped and organized so that the user can easily find whatinterests him. In forums user can comment, give answers,ssk questions and so actively influence the development of the forum, but also just read the topic and passively follow.Users of the forum are allowed to pose problems, so that they can help them in finding a solution, which is quite significant in relieving stress and negative feelings. (Milinković M, 2015)

Blog is one of the forms of a virtual community that is most often used to express different aspects of user creativity.It can also serve as a personal diary where public attitudes, thoughts, desires and ideas are publicly expressed. Bloggers are opposed to traditional media and censorship and have the need to influence the readers and audiences by blogging and thus reach people who are similarly thinking. Readers of these texts of bloggers are also referred to as followers, because they have come to the blog's text by leading their own interests, and are waiting for and following new texts and photos of the author of the blog. Blog keepers in this way become a very faithful audience, which does not easily change the source of information. The disadvantages of using the blog are that the authors are not completely protected and it often happens that their ideas are abused and imitated.(Milinković M, 2015)

Games on the Internet primarily serve as a means of entertainment, but it often happens that their users take so much time to represent another life or virtual lifestyle. The games are made so that virtual communities really resemble communities in the physical world and thus attract as many members as possible. (Milinković M, 2015)

2.2. Virtual identity

Virtual identity is one way we represent ourselves on the Internet in various virtual communities. This identity provides many opportunities to build our online personality the way we want it. We can be tall, blue, black, skinny, we can change the name and show everything we want, and hide everything we do not want, or all the flaws. However, for this reason sometimes there is too much reliance on this imaginary identity, so we forget who we are. For example, a virtual personality often helps to solve the problem of shyness.

Different virtual communities allow each of them to create their own identity in the way we want.For example, on social networks, we can post pictures of events from our lives, we can play games with our identity and experiment in games, while in forums we can freely express think and share experiences with others or demonstrate professional knowledge in some area. Everyone has sometimes wanted to be someone else, and the Internet provides a great deal of opportunities for doing so, with feedback from other people. There is also a bad side of identity hidden, such as not knowing who the person we communicate with, we can not even know if we can trust her. In the period of growing up, creating and finding our own identity acts as a challenge.Modern times and environment in which we live represent very important factors in creating

identity while technology and the virtual world mediate in it.This world represents an imaginary figure in a mirror in which friendships can be created, transfer information, organize socializing, contests, discussions. The advantage is that virtual space provides the ability to hide, change identity, anonymity, less control and censorship. These benefits can be at the same time shortcomings, but mostly allow the development of creativity and non-hierarchical communication with everyone. (Milinković, 2015)

There are recent studies that show that virtual identity is shaped and maintained in the real world, because if we belong to a virtual community, then we must respect the rules of its functioning, share the values of the community, participate in community attitudes, etc.

Virtual identity on social networks is a special area of behavior on the Internet, because it is mostly related to the actual personality and does not allow much anonymity and hiding of the real character. This leads to the tendency to idealize ourselves and present ourselves in the best possible light, which can further lead to some beginning of narcissistic behavior. On the other hand, while observing other people who also crave for perfection, we create a fake picture of them and we get the desire to pair them in some way.

3. SOCIAL NETWORKS

Social networks are a website where people talk, exchange ideas or interests, and make new friendships. (Social network, 2017). They have practically become an integral part of our lives.They serve us to entertain, educate and inform.The first modern social network was Friendster, which in a very short time of 3 months attracted a million users. After this social network appeared others, and today they are popular Facebook, Twitter, Linkedin, Instagram and others.

Social networks consist of various technical elements, and their most important part is the profile on which the contents and lists of friends are edited. Profiles are unique pages where each user can present himself / herself to friends with descriptions such as sex, age, interests, can share images and other multimedia content and applications. Even though social networks encourage true representation, this is not always what users choose. These services allow the individual to self-representation, write comments on the profiles of his friends, share pictures, music, create groups, building up in this way his own identity and socialization that involves communicating with other users through profile.

Some of the most popular social networks related to the appearance of narcissistic behavior are Facebook and Instagram. Facebook was launched in February 2004 in Harwardas some kind of alternative student database and his popularity rose in record time without any commercials. The decisive role in popularizing this social network had email marketing.

The number of users of the Internet and networks on it, and the amount of time users spend on intemational communication has grown sharply since 2006 when the social networks lead by *Facebook* moved to conquering the virtual space at the expense of the physical, the real one. Facebook is soon becoming the reason why many decide to provide themselves with permanent or as frequent as possible access to the Internet.

Users of this social network are able to check their notifications for hours, complement their profile, and check which photos were taken by their friends. It is very important for them to keep up with new developments. For supporters of this social platform, if you have not shared an event from your life on a social network, it's as if it did not happen. In normal communication, people dedicate 30-40% of talk about themselves, and this percentage increases in online communication up to 80%. When we make facebook profiles, we have unlimited time for self-representation. Mostly those aspects of one's own personality, which we think will be liked by others, are selectively shown. We actually create an ideal image of ourselves, the way we want others to see us.When we look at our own profile, the pupils are expanding, as well as pleasant feelings, which influence the increase in self-confidence. Also, pleasant emotions are causing positive reactions from other people to our posts. With each of the faces of a particular post, photos, services or products, a specific brand, we give information about ourselves. If we were to track all the activities of the average Facebook user, we could make a person's psychological profile. We might be able to meet his needs, interests, value systems, and even some character traits.

In addition to this social network that has become popular and attracted a lot of users recently, it is certainly Instagram. Instagram is specific in that it represents the network and application for publishing user photos. It was founded in 2010 by Mike Krieger and Kevin Systrom as a project first called Burbn. Instagram was created as a combination of the term "instant camera" and "telegram". The essence is photography with mobile phones and a very easy sharing of these pictures with followers.Instagram is an application for creating and sharing photos via the Internet. Users can take photos via Instagram and subject their photos to

various modifications (color, contrast, brightness). This application targets individuals who use mobile devices for social exchange; this targeting proved successful - in the first year of its existence, this application had 15 million users (Crnobrnja, 2014).

Instagram won the most popular iPhone app for 2011. Since its release date, Instagram has had around 100 million users worldwide. In 2012, it was bought by Facebook for a billion US dollars.

On the website of Ellecta digital (Đuričić, 2017) data are given that in the third quarter of 2015 in Serbia there were 360,000 open accounts on Instagram, and today there are about 1,200,000. Instagram is more commonly used by women (around 650,000) than men (about 560,000). When talking about location, Instagram is the most popular in Belgrade with 460,000 users.

4. NEGATIVE ASPECTS

In addition to the positive effects that social networks have on reducing loneliness, encouraging prosocial behavior, shared thoughts and interests, one should also point out those bad sides, because each social network can be viewed as a sword with two blades. Using social networks encourages mental activity, but at the same time it reduces time for socializing, sports and physical activities in nature and the like. Nothing can replace the live contact, the specific atmosphere, and the energy exchange in "non-electronic" communication.

The list of negative aspects is long and there are problems with the protection and theft of data, child abuse, the occurrence of addiction and alienation from the real world and people, the lack of censorship, the lack of technical support, the formation of user groups that support socially disastrous ideas and organizations or accelerate socially harmful behavior.

The magazine “Time”cites research findings that linked the use of Instagram with high levels of anxiety, depression, violence and fear of missing out. (Macmillan, 2017) Research has previously claimed that young people who spend more than two hours a day on social networks often report psychological problems. Royal Society for Public Health and Young Health Movement conducted a survey in the UK in early 2017. On a sample of 1,500 young people aged 14-24, they were researching the use of social networks. Respondents were asked how a social network affects 14 health-related items, including anxiety, depression, loneliness, sleep, online abuse, and so on(Macmillan, 2017).The results have shown that Instagram is the network that has the greatest negative impact on the mental health of young people, as it disturbs the perception of the body, increases the fear of leakage and has a detrimental effect on the dream. Second place was Snapchat, and third place went to Facebook.This does not mean, however, that Instagram is necessarily a negative social network. It has its positive sides, such as creative expression, identity, self-awareness and community (Macmillan, 2017).

A virtual environment allows a wide range of identity manipulation, in many cases it is about its complete distortion. As a special category should separate identity theft, which aims to dispose of the monetary and other material goods of the person whose identity is stolen.

In social networks the users privacy is the most drastic, most concrete, and most often violated.It runs through segments of which the user and application (technical) aspect is the most concrete. The most common users themselves place certain personal information, data and material that belongs to the private domain, and then share them with other users. In this way, they unconsciously and directly allow violation of their privacy, because they allow their personal data to be abused both by other users and by the social network itself (Đ.Klipa, R. Dragović).

In any case, privacy on social networks is certainly relativized whether by the users themselves who voluntarily provide certain information about themselves (access and use of the social network), or by the social network itself (collecting and filtering, and segmenting user data for targeted marketing campaigns).

There are several thousand organizations on the Internet dealing with some of the many ways of using children. A large number of these organizations are legally registered companies, humanitarian or non-governmental organizations with real legal identity. Their representation in the public unambiguously points to the services for providing various types of assistance, starting with humanitarian, material donations, through psychological assistance to endangered groups (children of divorced parents, children with poor material and social status, etc.), to business deals with good and secure earnings. However, under the "colorful mantle" of tempting opportunities for a better life, the goals of trafficking, prostitution, various types of theft and other ways of exploiting the victims are most often hidden. On the other hand, there are anonymous sites behind criminal groups that act completely illegally, while in the third group there are

individuals (psychiatric cases) who have direct access to the victim in order to achieve their goals, of which sexual abuse in the first place. The common trait of such "hunters" is their incredibly "honest" performance, full of emotion, understanding and compassion for the potential victim.

We will also mention a broader negative aspect as many people use networks to find the news and information and thus complement and shape their political identities and behaviors. In such a way, they become a suitable ground for manipulation and misleading, because the quality of such information can not be spoken in a positive light since social networks wanted it or not to become a site of sophisticated ways of political action.

Communication on the Internet also has a share in the reconstruction of cult and linguistic identity, both collective and individual (Tubella, 2004). The cultural model that reach us with the help of the Internet is the most natural of those from the English-speaking world, just as it did with other media: movies, music, television, video games over the last century (although only 29% of interactions on Intemet is in English (Castells M, 2010). English language, the speed of communication on the Internet and the new conventions in expression, have a synergistic influence on the quality of the Serbian language, which we meet not only in communication through social networks, but also in emails, letters andeveryday speech.

5. CONCLUSION

The personal characteristics and their development through social networks can be followed because the personality is a unique system of particular behavior. The personality itself over time is influenced by many factors as biologically, sociologically, and with the development of technologies today, a significant influence has a factor of socialization on social networks. The organization of emotional and cognitive characteristics represents the identity of a person who is characterized by attitudes, motives, needs and behavior, and which is relatively unchanged. The identity of a person in his/her real world can be quite different from the virtual identity, or the way people present themselves in virtual communication. To have a virtual identity and to use a social network means to have adventages for the education and personal development, however should be careful and keep a real image of themselves. It should be found the measures that social networks will look at so as to interest people for the useful things they offer and reduce the audience that encourages narcissistic behavior.

Young generations as the most serious users of social networks and the Internet in general growing up with modern technologies are losing in the field of learning the social skills they need in real life. They find it difficult to deal with life situations when they need to be quickly reacted, and when they can not imagine the right answer hidden behind the computer, which requires a real life experience.

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THE EFFICIENCY OF HIGHER EDUCATION STUDENT MOBILITY PROGRAMMES IN EUROPE IN 2015

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Abstract: *Student mobility has become an important policy instrument in the higher education and it is essential for students' development and development of higher education in general. The success of mobility leads to increased quality of education and the cooperation between institutions and countries. Therefore, it is crucial for countries to maintain the high number of students enrolled in mobility programmes in order to be efficient and successful from the aspect of student mobility. Data Envelopment Analysis (DEA), nonparametric method, is a very convenient tool for determining the efficiency rate. The ease with which DEA can handle multiple inputs and multiple outputs makes it an attractive choice of technique for measuring the efficiency of this problem. (Johnes, 2006). Therefore, in this paper, DEA models evaluate the efficiency rate of European countries from the aspect of student mobility programmes in year 2015.The study was conducted through two scenarios. The first scenario tells us more about the efficiency of higher education in Europe in generally, not only about the efficiency of student mobility, whereas the second scenario is focused completely on the efficiency of student mobility programme. Based on the results, this analysis determines which countries in Europe are efficient and which are not. For inefficient countries, comparing them to the efficient ones, DEA is giving us an information about what is each country required to do in order to become efficient. Based on the results, we can conclude that all the efficient countries are countries with high level of GDP and high number of students enrolled in mobility programmes. Countries that have higher percentage of mobile students, comparing to the number of students enrolled in tertiary education and the size of country, are the most efficient as well.*

Keywords*: Data Envelopment Analysis, efficiency, student mobility programmes, European countries, higher education.*

1. INTRODUCTION

Cross-border mobility among students is a key instrument in favouring peace between European countries: discovering that they share a common culture, common values, and, despite a history of wars and conflicts, knowing that they have much to gain by building a cooperative future together. For this reason, at least, cross-border mobility among students is politically desirable (Gérard and Sanna, 2017). Student mobility programmes are important for both students that are enrolled in the programmes, and for the countries and institutions that are sending and receiving students through mobility programmes. Student mobility has a positive impact on student's personal and professional development. Universities become more competitive and therefore the quality of studying increases.

DEA began as a new management science tool used for technical efficiency analysis of non-profit sector decision-making units (DMU). It is a linear programming model and specially designed technique used for evaluating relative performance of homogeneous DMUs where there is no known relationship between the transformation of inputs used by an organizational unit and the outputs that it would produce (Taylor and Harris, 2004). The efficiency frontier is therefore not known, but it can be estimated by using data on the actual performance of the DMUs under consideration, in terms of the outputs that they produce for the level of inputs that they use. The essential characteristic of DEA is the transformation of the multiple-input, multiple-output DMU into a single "virtual output" value for all DMUs. The ratio of this single virtual input to virtual output provides a measure of technical efficiency (Fernando & Cabanda, 2007). That ratio must not exceed the range from 0 to 1.

Student mobility was described in the first part of this paper, as well as its benefits. After introduction of student mobility programmes, the concept of efficiency and Data Envelopment Analysis is being described in the second part. In the third part of this paper, the efficiency analysis of student mobility programmes in Europe in 2015 is conducted and its results are being presented. And finally, the fourth part of this paper gives us the conclusions and closing discussion.

2. INTERNATIONAL STUDENT MOBILITY

Mobility has always been the objective of the Bologna Process, and it is a key instrument in developing the European Higher Education Area. Mobility of students and academic and administrative staff is seen as crucial for academic and cultural as well as political, social and economic spheres (Communiqué, 2003). In the Bologna process agreement, mobility of at least 20% of higher-level educated students is targeted by year 2020 (Barr et.al., 2009; Gvetadze, 2014).

UNESCO Institute for Statistics defines international (or internationally mobile) student as a student who has crossed a national or territorial border for the purpose of education and is now enrolled outside their country of origin (http://uis.unesco.org/en/glossary-term/international-or-internationally-mobile-students).

Student mobility programmes have been designed in order to provide students support in their education and professional development through opportunity to study in a new, international environment. Student mobility, especially studying abroad, is particularly important for student's personal development. It offers a unique opportunity to each candidate to gain new experience, to learn foreign language and develop interpersonal skills in a new and culturally diverse environment. Therefore, one of the most valuable results of mobility programmes is the increased number of young professionals who can make a positive impact on their local environment, thanks to their exposure to wider experiences through studying abroad (Đokvučić et.al., 2014). Other than new knowledge, students develop an ability to adapt to a different culture, they learn of cooperation and exchange experiences; they become more competitive on the market, get better wages, better social status and reduce chance of unemployment. Besides the students, both countries and institutions that are enrolled in mobility programmes also benefit from these programmes. Student mobility increases competition between universities through pressure for better and more courses in foreign languages, and more generally, pressure from more demanding students for improved quality of studies. It also contributes labor mobility and supports research and innovations (Gérard and Sanna, 2017).

There are various student mobility programmes in Europe, among which are the programmes Erasmus+, CEEPUS and summer school programmes. Students are able to choose the programme and type of their mobility that determines the duration of the programme (2-3 weeks, one semester or a full academic year). One of the main criteria for students in choosing countries of destination is the availability of studies in English or other popular European languages, such as German, French or Spanish (Gvetadze, 2014).

One of the indicators of student mobility programmes success is increased number of realized mobilities. Therefore, it is of a great importance to constantly work on improving the quality of programme and on increasing the number of students enrolled in programme. The key of increasing that number is in adequate promotion. Both receiving and sending countries and institutions must have different approaches in trying to reach the greater audience and raise the popularity of programmes.

It is vital that students know, before their exchange programme starts, that their study period and results will be recognized when they get back to their home institutions (https://www.uns.ac.rs/images/doc/medjunarodna/UNS_Guide_for_Mobility_Officers.pdf). The purpose of the Learning Agreement is to provide a transparent and efficient preparation of the exchange to make sure the student receives recognition for the activities successfully completed abroad and must be approved by the student, the sending and the receiving institution, organization or enterprise before the start of the exchange.(https://ec.europa.eu/programmes/erasmus-plus/resources/documents/applicants/learning-agreement_en).

3. DATA ENVELOPMENT ANALYSIS

Data Envelopment Analysis is specially designed nonparametric technique used for measuring the efficiency of complex entities with diverse inputs and outputs. (Charnes et.al., 1978). It is a linear programming model used to measure technical efficiency. Efficient units are those that:

- produce a certain amount of or more outputs while spending a given amount of inputs, or
- use the same amount of or less inputs to produce a given amount of outputs, as compared with other units in the population (Vincová, 2005).

Using the results of this analysis, we can determine how much is each decision-making unit inefficient comparing to units that are efficient. It also gives us an information on how much each unit must reduce its inputs and increase its outputs in order to become efficient unit. DEA determines the efficiency rate of each DMU, in the population of n decision-making units. Each unit produces s outputs, while consuming m inputs.

In that case, we can write an input matrix:

$$X = [x_{ij}, i = 1, 2, \dots, m; j = 1, 2, \dots k \dots, n], \tag{1}$$

and output matrix:

$$Y = [y_{rj}, r = 1, 2, \dots, s; j = 1, 2, \dots k \dots, n], \tag{2}$$

where x_{ij} represents the amount of i-th input of DMU_j, and y_{rj} the amount of r-th output of DMU_j. For k-th unit, X_k and Y_k shows the quantified inputs/outputs of unit DMU_k. The efficiency rate of such a unit can then be generally expressed as (Vincová, 2005):

$$\frac{weighted\ sum\ of\ outputs}{weighted\ sum\ of\ inputs} = \frac{\sum_{r=1}^{s} u_r y_{rk}}{\sum_{i=1}^{m} v_i x_{ik}} \tag{3}$$

Before conducting the analysis, it is crucial to determine the orientation of model that will be used. There is input and output orientation of DEA models. In purpose of this study, output-oriented DEA model will be used in order to determine the efficiency rate of each country, with constant returns-to-scale (CRS). Output-orientation is being used simply because the aim is to maximize the number of students enrolled in mobility programmes (outputs) with given amount of inputs. Model used in this study is the following:

$$\begin{gathered} \min h_k = \sum_{i=1}^{m} v_i\, x_{ik} \\ st \\ \sum_{r=1}^{s} u_r\, y_{rk} = 1 \\ \sum_{i=1}^{m} v_i\, x_{ij} - \sum_{r=1}^{s} u_r\, y_{rj} \geq 0;\ j = 1, 2, \dots k \dots, n \\ v_i \geq \varepsilon;\ i = 1, 2, \dots, m \\ u_r \geq \varepsilon;\ r = 1, 2, \dots, s \end{gathered} \tag{4}$$

where:

- v_i, $i = 1, 2, \dots, m$, are weights assigned to *i*-th input,
- u_r, $r = 1, 2, \dots, s$, are weights assigned to *r*-th output and
- h_k is relative efficiency rate of DMU_k.

Model above is called primary CCR model. It is more often that the number of units is much greater than number of inputs and outputs. Because of that, in practice, dual model is more commonly used. The dual model can be stated as follows:

$$\begin{gathered} max Z_k + \varepsilon \left(\sum_{r=1}^{s} s_r^+ + \sum_{i=1}^{m} s_i^- \right) \\ st \\ \sum_{j=1}^{n} \lambda_j\, x_{ij} + s_i^- = x_{ik};\ i = 1,2, \dots, m \\ -Z_k y_{rk} - \sum_{j=1}^{n} \lambda_j y_{rj} + s_r^+ = 0;\ r = 1, 2, \dots, s \\ \lambda_j \geq 0;\ j = 1, 2, \dots, n s_r^+ \geq 0; \qquad r = 1, 2, \dots, s s_i^- \geq 0;\ i = 1, 2, \dots, m. \end{gathered} \tag{5}$$

where $\lambda = (\lambda_1, \lambda_2, \dots, \lambda_n), \lambda \geq 0$ is a vector assigned to individual productive units, and s_r^+ and s_i^- are variables that show how much each individual unit must increase its outputs and reduce its inputs in order to become efficient unit. The variable Z_k indicates the need for increased output to achieve efficiency (Vincová, 2005).

DEA provides us information about units that are efficient and those that are not. However, this analysis also tells us what is it that each inefficient unit must do in order to become efficient. Variables s_r^+ and s_i^- are used for calculating target values: values of parameters that each inefficient DMU must achieve in favor of becoming efficient. Those values are possible to determine using equations (6):

$$X_k^* = X_k - s^-, \qquad Y_k^* = Z_k Y_k + s^+ \tag{6}$$

where X_k^* and Y_k^* are vectors of target values of input and output parameters for DMU_k. (Savić, 2012).

4. EMPIRICAL STUDY

The main objective of this study was to determine which country in Europe is efficient from the aspect of student mobility programmes. DMUs in analysis are members of European Union (EU-28) and partnered countries (Table 3).

The parameters used for analysis are shown in Table 1.

Table 1: The parameters used for efficiency analysis of European countries from the aspect of student mobility

Inputs	**Scenario 1**	**Scenario 2**
	▪ GDP per capita [$] ▪ Expenditure on tertiary education, as % of GDP ▪ Population	▪ GDP per capita [$] - I_1 ▪ Expenditure on tertiary education, as % of GDP – I_2 ▪ Population – I_3 ▪ Number of students enrolled in tertiary education – I_4
Outputs		
	▪ Number of students enrolled in tertiary education ▪ Number of incoming mobilities ▪ Number of outgoing mobilities	▪ Number of incoming mobilities – O_1 ▪ Number of outgoing mobilities – O_2

As seen in table 1, there are two scenarios of efficiency analysis of European countries from the aspect of student mobility. The only difference is that the parameter "number of students enrolled in tertiary education" is input into the model in the first scenario, and output from the model in the second scenario. The first scenario can be used to show us the efficiency of higher education in Europe in generally, not only the efficiency of student mobility, whereas the second scenario is focused completely on the efficiency of student mobility programme. The purpose of these two scenarios is to see how the change in parameters and the number of students enrolled in tertiary education, as an input, affects the efficiency of European countries.

The model used for the purpose of this study is output-oriented DEA model, since the goal is to increase the number of student of mobilities in Europe. The analysis is conducted using EMS software (Efficiency measurement system).

4.1. Analysis and results

Descriptive statistics of values parameters used in the analysis and correlation analysis are shown in table 2 and table 3. The tables for descriptive statistics and correlation analysis are the same for both scenarios.

Table 2: Descriptive statistics

	I_1	I_2	I_3	I_4	O_1	O_2
Mean	32,494.25	1.27	17,867,903.72	804,333.81	53,549.95	22,374.55
St. error	4,220.93	0.08	4,184,938.98	221,830.60	15,823.87	5,176.31
Median	24,453.35	1.27	7,544,249.50	305,103.50	22,390.00	9,555.50
Mode	-	-	-	-	821.00	-
St. dev.	23,877.19	0.43	23,673,589.88	1,254,863.35	89,513.33	29,281.66
Variance	570,120,219	0.18	560,438,857,799,473	1,574,682,017,701	8,012,636,685	857,415,417
Kurtosis	0.99	-0.07	1.15	9.42	10.40	5.38
Skewness	1.08	0.46	1.57	2.81	3.07	2.17
Range	99,631.97	1.80	82,138,104.00	6,055,990.00	430,012.00	129,075.00
Minimum	1,818.00	0.52	299,891.00	6,896.00	821.00	54.00
Maximum	101,449.97	2.32	82,437,995.00	6,062,886.00	430,833.00	129,129.00
Sum	1,039,816.11	40.76	571,772,919.00	25,738,682.00	1,713,598.35	715,985.50
Count	32	32	32	32	32	32

Table 3: Correlation analysis

Parameters	*GDP per capita [$]*	Expenditure on education (% of GDP)	Population	Number of students enrolled in tertiary education	Number of incoming mobilities	Number of outgoing mobilities
I1	1.000					
I2	0.290	1.000				
I3	**-0.085**	**-0.081**	1.000			
I4	**-0.127**	0.058	0.886	1.000		
O1	0.134	0.050	0.758	0.558	1.000	
O2	0.182	0.097	0.681	0.441	0.915	1.000

Based on results of correlation analysis, we can see that population and number of students enrolled in tertiary education positively affects number of students enrolled in mobility programmes.

Table 4 presents the results of the efficiency analysis for both scenarios.

Table 4: Efficiency analysis of student mobility in Europe

Scenario 1			Scenario 2		
DMU	**Efficiency rate**	**Rank**	***DMU***	**Efficiency rate**	**Rank**
Turkey	**19.97%**	**1**	**Luxembourg**	**34.58%**	**1**
Finland	**45.29%**	**2**	**United Kingdom**	**48.82%**	**2**
United Kingdom	**48.82%**	**3**	**Austria**	**59.59%**	**3**
Austria	**59.59%**	**4**	**Finland**	**72.24%**	**4**
Czech Republic	**92.20%**	**5**	**Czech Republic**	**88.06%**	**5**
Poland	**93.76%**	**6**	**Switzerland**	**97.31%**	**6**
Germany	103.14%	7	Poland	102.14%	7
Netherlands	112.04%	8	Cyprus	111.68%	8
Italy	114.54%	9	Turkey	122.95%	9
Switzerland	117.90%	10	Germany	126.38%	10
Luxembourg	121.40%	11	Netherlands	136.97%	11
Belgium	121.50%	12	Denmark	138.19%	12
France	124.92%	13	Belgium	144.50%	13
Denmark	124.94%	14	France	147.06%	14
Latvia	128.68%	15	Latvia	147.31%	15
Serbia	149.85%	16	Serbia	161.62%	16
Iceland	153.06%	17	Iceland	170.68%	17
Spain	157.40%	18	Romania	177.01%	18
Romania	173.36%	19	Italy	185.86%	19
Sweden	174.41%	20	Hungary	186.23%	20
Hungary	175.02%	21	Slovakia	223.48%	21
Ireland	177.00%	22	Ireland	230.60%	22
Bulgaria	180.14%	23	Bulgaria	254.91%	23
Norway	190.07%	24	Sweden	266.67%	24
Cyprus	198.07%	25	Malta	330.55%	25
Slovakia	200.53%	26	Estonia	332.86%	26
Lithuania	216.64%	27	Spain	333.38%	27
Portugal	235.00%	28	Portugal	370.90%	28
Croatia	248.44%	29	Norway	409.47%	29
Slovenia	256.84%	30	Lithuania	493.12%	30
Estonia	267.92%	31	Slovenia	526.25%	31
Malta	358.61%	32	Croatia	2935.24%	32

According to the results of analysis in first scenario, where number of students enrolled in tertiary education is output from model, we can see that the most efficient country is Turkey. DMU that produces big amount of outputs while consuming small amount of inputs is considered to be efficient. Turkey, as a country with amount of inputs, comparing to other countries, has a high number of students enrolled in tertiary education and therefore is most efficient. Comparing Czech Republic to Portugal, as countries with similar GDP per capita, expenditure on education and population, Czech Republic has a much greater number of students enrolled in mobility programmes than Portugal, thus is more efficient.

The results of analysis in second scenario is slightly different. Moving the number of students enrolled in tertiary education in 2015. from outputs to inputs affected some of the countries' efficiency rate. In the case of second scenario, Luxembourg and Switzerland (inefficient in first scenario) became efficient countries from the aspect of student mobility programmes, while Turkey and Poland are now inefficient. The reason why Turkey became inefficient, as a most efficient country in the first scenario, is because of the same reason it was efficient in the first one. Great number of students enrolled in tertiary education is now input in the model and thus it makes Turkey inefficient because it produces small amount of outputs with high number of inputs. Luxembourg becomes the most efficient because it is a really small country, but comparing to other countries, it has a great number of students enrolled in mobility programs for its size.

5. CONCLUSION

According to data published by UNESCO Institute for Statistics and Eurostat, and reports made by European Commission, the popularity of student mobility programmes is increasing each year. Both students and countries are aware of the benefits that those programmes carry. Comparing data of implementation of the programme Erasmus+ in 2014, first year of implementation of this programme, and in year 2015, we can see that the number of students enrolled is 4% greater. The first two years of the programme Erasmus+ are used for the purpose of evaluating the success of this programme at the beginning of its realization. This paper evaluates the efficiency of European countries from the aspect of student mobility programmes in year 2015. Although the research was conducted in year 2018, the data from year 2015. is being used because of unavailability of updated data in 2018. The most updated data for expenditure on higher education, for most of the countries, dates from year 2014, which can be used for analysis in year 2015, but not in the present.

In the analysis that was done in this paper, it is obvious that the most popular countries are Austria, Czech Republic, Finland, United Kingdom, countries efficient in both scenarios and Luxembourg, Poland, Switzerland and Turkey, countries that are efficient depending on the scenario. Using DEA, it was determined which countries are efficient. For other countries, that are inefficient, DEA calculates target values that indicates how much each country must increase its outputs - students enrolled in mobility programmes (and students enrolled in tertiary education, in the case of first scenario) in order to become efficient. For those countries, it is important to invest more in promoting student mobility programmes to their students, in order to increase the number of their students enrolled in the programme. Also, the adequate promotion of one country and its universities in other countries is equally, if not more important, for increasing number of students that are coming to that country in purpose of studying.

This study can be a significant contribute to improving the student mobility programmes in Europe considering that there hasn't been any paper published yet that uses DEA for the purpose of measuring the efficiency of European countries from the aspect of student mobility.

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DISPARITIES AMONG YOUTH LABOUR IN SERBIA

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Abstract: *It is evident that the unemployment rate among young people in Serbia is much higher than in developed countries. The latest statistical data have shown that about 32 % of young people aged from 15 to 24 are unemployed or work in the field of the grey economy which is by 15 percentage points higher than the average of the youth unemployment rate in EU countries. Furthermore, Serbia has been facing youth labour disparities indicating more chances of entering the labour market for the male population than female. The reasons for this could be various. The paper includes data of the Labour Market Survey 2017 that was conducted by the Statistical Office of Serbia, and descriptive statistics results in order to explain the main reason for disparities within the youth labour market in Serbia. It is also important to emphasize that respectable insight into youth labour market as well as results of the research, will provide a significant contribution to unemployment problem-solving in Serbia.*

Keywords*: Labour Market; Youth; Gender inequality; Disparities.*

1. INTRODUCTION

Although the Republic of Serbia has an obligation to provide better future for its young citizens, it has been obvious so far, that the Government has been facing a large number of issues within the youth labour market. According to statistical data from 2016, the youth unemployment rate was almost twice as high as the average unemployment rate of young people in EU countries (18%) (ILO, 2016). The women unemployment rate (aged from 15 to 24) is by seven percentage points higher than the men youth unemployment rate (Statistical Office of the Republic of Serbia, 2017).

However, the issue of employment among young people aged from 15 to 24, as well as the young population aged from 25 to 29, had excited in the Republic of Serbia even before the outbreak of the financial crisis in 2008. Accordingly, since 2007 the Ministry of Youth and Sports, at the initiative of the Government, has started to take some actions to improve the employment of young people (Pavlovic, Djukic, and Bodroza, 2017).

One of the current Strategies dealing with this issue is the National Youth Strategy. It was adopted in 2015, and since then it has been focused on young people within on and outside the labour market (aged from 15 to 30). The strategy points out that Serbia faces various issues such as young people leaving their country (males especially, which additionally impacts gender inequalities in the labour market), decline in the number of young people in the general population, high unemployment rate among young people as well as gender inequalities (Youth National Strategy, Ministry of Youth and Sports, 2017).

During the last few decades, a group of researchers has been trying to determine the reasons why young people in Serbia are significantly late in various aspects of their lives such as completing their education, leaving the parental home or finding permanent employment, comparing to the same indicators in developed European countries such as the Netherlands, Germany, and Denmark (Tomanovic and Ignjatovic, 2004). Most of young people in Serbia leave their parental home in their late 30s, and they are supported by their parents (93.3%), which is an important indicator that they definetly enter the labour market late. Furthermore, it is important to mention that some of them are beneficiaries of scholarships and student loans (Mrdja, 2011; Todorovic et al., 2016).

Besides the fact that the youngsters in Serbia start their families very late, it is also evident that many of male population look for their life and job opportunities abroad. On the other hand, the statistics show that a more significant share of females decides to deal with household and motherhood, which directly affects gender inequalities within the labour market (SILK, Statistical Office of the Republic of Serbia, 2004). Although the role of women has increased considerably in the education sector, during the last few decades, the number of women with a high level of education is higher than the number of men, especially in the countries of southern and south-eastern Europe. However, there is still a patriarchal stereotype, where men are in charge of the finances in the family (Beveridge and Velluti, 2016). According to the Kabeer and Natali (2013), there

is evidence that reducing inequality in education and raising the average level of education among women contribute to their better economic performance, as it was indicated by GDP per capita.

The issue of gender inequality was also recognized by the UN. Therefore, the UN adopted the Agenda 2030 for Sustainable Development (UN, 2015), dedicating a special attention to gender equality goal. Also, regarding this issue, the Republic of Serbia has been using the National Youth Strategy to reduce inequality between young male and female.

In this paper, we analyzed the core indicators which have profoundly influenced the issue of gender inequality in Serbia. The indicators that are carefully considered are the following:

- education
- wages
- regional differences
- demographic indicators

Data analysis is presented throughout descriptive statistics. The research results will be useful in the making of adequate strategies within the youth labour market, as well as in further researching within the field of youth labour market and solving gender inequalities in Serbia and other countries in the region that are facing the same problem.

The first part of the paper presents the subject of the study and the reasons why we focused primarily on the gender inequalities within the labour market. Moreover, the second part of the paper provides an overview of previous research, followed by an overview of the youth labour market and gender inequality. The fourth part of the paper covers the discussion, and finally, conclusions are presented by a review of labour market differences among men and women.

2. LITERATURE REVIEW

The idea of feminism and inequalities among women and men appeared for the first time in the 19th century, more precisely, after the end of the Second World War. Women started to fight for their social equality and received huge support by decision makers at the international level. According to this, UN Secretary-General suggested that “investing in women is not only the right thing” but also “the smart thing to do” (Kabeer and Natali, 2013). Since the 1960s, as a result of growing interest in the issue of inequality within the labour market, there has been a significant increase in a number of women involved in science and education as well. This fact gave rise to the development of new research field.

Firstly, women started to be a part of national economics because that was the win-win scenario. Moreover, gender inequality seemed to support economic growth and macroeconomic performance. This was evident in the research carried out by Seguino (2000), who analyzed how gender wage gaps can boost international competitiveness when women are disproportionately employed within labour-intensive export-oriented industries.

In the 1960s, neoclassical theory sought for the reasons of the participation of women within the labour market. Thus, Mincer (1962) implied that the presence of women in the labour market contributed to an increase in family income. Several years after Mincer's theory, the number of women in organizations increased. Moreover, the concern for gender equality gained ground across a wide range of organizations (state, bilateral and multilateral). The achievements of research, in the field of gender inequalities, as well as the impact of education and earnings on the employment of young men and women, led to the development of a large number of theories, such as the theory of capital and the expansion of institutional labour economics (Edwards et al, 1973), segmentation theory (Beneira 2003), etc. Institutionalists studied historical and contemporary segregation, segmentation and discrimination within the labour market and criticized the model of a competitive labour market. However, none of these theories and achievements answered the question why segmentation was present, only analyzed the position of women within the labour market.

A specific group of researchers was analysing over the time the factors that influenced the employment of women, as well as the differences in wages and race, ethnicity and sexuality, gender discrimination and segregation (Power, Rosenberg 1995; Rubery 2005; Strober, 1984; Rubery et al, 2006; Pavlovic et al., 2017).

Furthermore, women successfully occupied their positions within the labour market, in a way that some professions are only common for women such as public relations, systems analysis, bartending, advertising and insurance, depending on country of origin. For instance, women in Europe and North America have recently been involved in nursing, primary teaching, hairdressing and other ‘beauty work,’ as well as various

manufacturing (Bradley, 1989). Men are more represented in occupations such as jobs related to mining, driving, professional catering, plumbing and car sales. The researchers indicate this phenomenon as "job segregation by sex" or "sexual work segregation" (Wharton, 2012).

3. YOUTH LABOUR MARKET AND GENDER INEQUALITY IN SERBIA

Labour market of the Republic of Serbia has recorded a significantly low rate of women employment. Statistical data from 2016 displayed that the women employment rate was 38,1% which is almost 14,7 p.p less that men employment rate. The employment rate among women within the age box from 25 to 54 is by 11 p.p. less than the employment rate among men within the same age box.

The Figure 1 indicates that the women unemployment rate within the age box from 15 to 24 is extremely high. The unemployment rate reached the pick in 2014 with 50% which means that half of young women population couldn't have found the job. However, in the following period, the statistical data imply that the young women unemployment sharply dropped to 36, 3% in 2017. At the same time, the young men unemployment rate (29, 2%) is slightly lower than young women unemployment rate. Moreover, the women inactivity rate is by 6, two p.p. higher than men inactivity rate (63, 2 % and 69, 4% respectively).

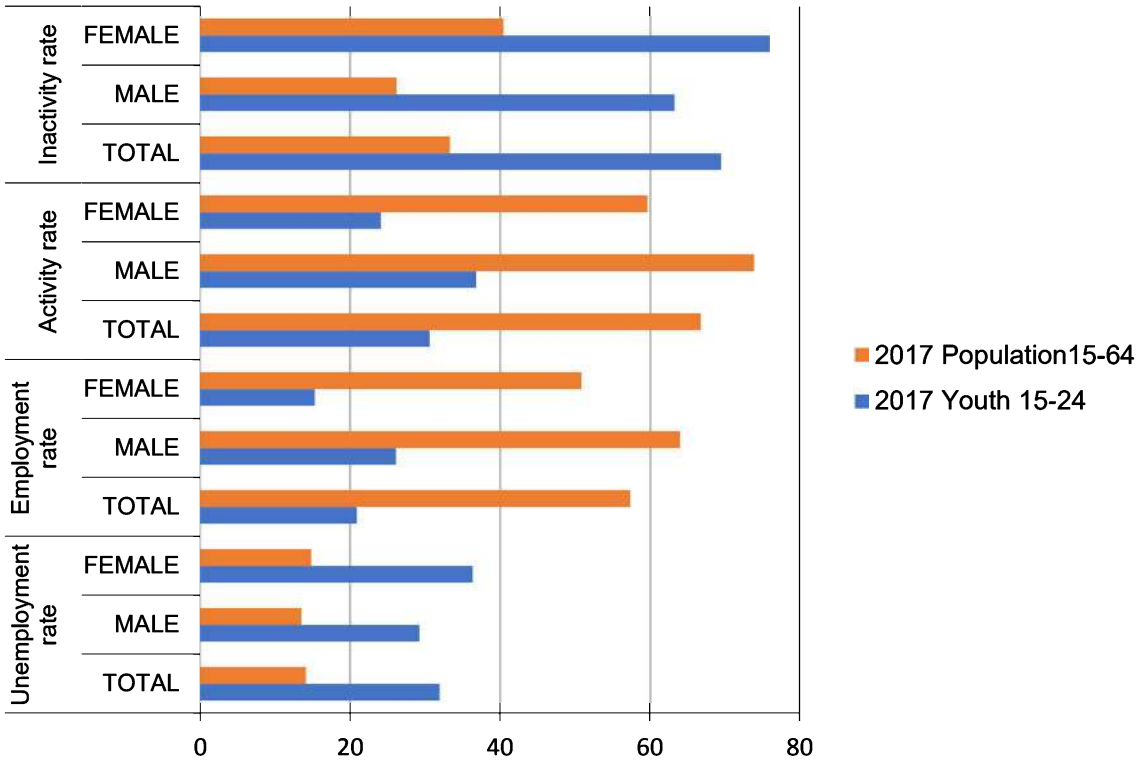

Figure 1: Labour Market in Serbia, 2017.
Source: Statistical Office of Republic of Serbia, 2017.

Considering the region, the worst women position at the labour market is evident in the region of South and East Serbia (43,6%), while the best position is in the region of Vojvodina (28%).

Comparing to the men unemployment rate aged from 15 to 24, the lowest rate is evident in Vojvodina (30%), while in the Belgrade region is 33,9%, in Sumadija and central Serbia is 33,8%, as well as East and South Serbia is 33,6% (Statistical Office of Serbia, 2016).

On the other hand, the women inactivity rate is much higher than the men inactivity rate. According to Statistical Office of the Republic of Serbia (2016), the women inactivity rate was 41,6% comparing to the men inactivity rate of only 26,9%.

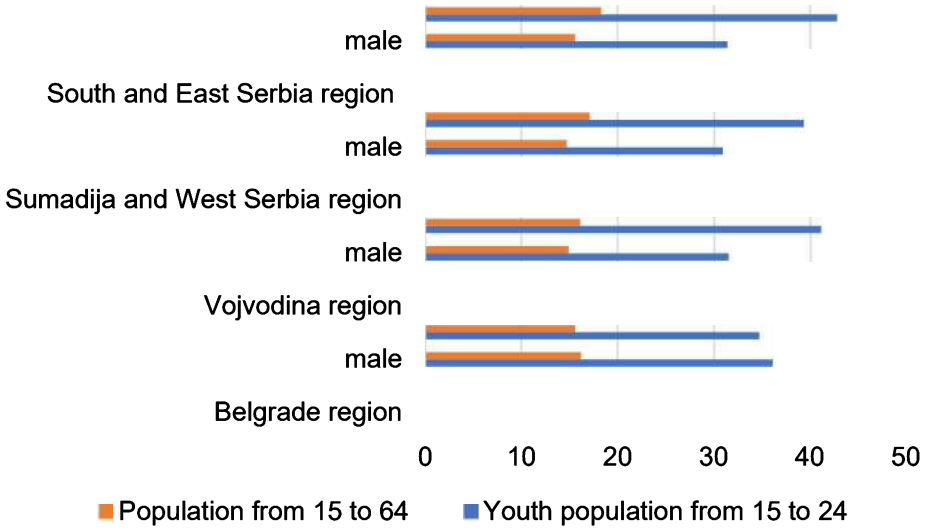

Figure 2: Unemployment rate Serbia, 2017.
Source: Statistical Office of Republic of Serbia, 2017.

If we take in consideration the women inactivity group according to the age, it can be noticed that the highest inactivity rate refers to the age groups over 55 (81,2%) as well as from 15 to 24 (76,7%). Furthermore, the lowest inactivity rate among women aged from 25 to 54 is 23,9% while the men inactivity rate is 12,3% at the same age.

Table 1:. Inactivity rate in Serbia, 2017

INACTIVITY RATE 2017			
AGE	**TOTAL**	**FEMALE**	**MALE**
15+	46, 7	54, 6	38, 2
15-64	34, 4	41, 9	26, 9
15-24	69, 7	76, 6	63, 2
25-54	18, 0	23, 9	12, 3
55+	73, 4	81, 3	63, 6

Source: Statistical Office of Serbia, 2017.

4. DISCUSSION

Investment in the youth should be more strategically planned because they are the creators of our future. Numerous scientists were aware of the inappropriate position of yang people of Serbia at the labor market (Obradovic and Pavlovic, 2015; Gorry, 2013; Flinn, 2006). By analyzing various factors, it can be concluded that different indicators influence on youth employment (Gorry, 2013; Zubovic, Zdravkovic and Pavlovic, 2015; Kelly and McGuinness, 2015) in that way additionally slowing down the employment of young women.

The reasons for the unfavorable position of young people in the labour market are many. A large number of economists believe that the financial crisis caused a considerable lack of available jobs, influenced the level of earnings, and on the other hand created a disagreement between supply and demand in the labour market, etc. (Arandarenko, 2011). On the other hand, some researchers believe that the unemployment rate was high and before the crisis (Vasile, 2012).

On the other hand, the number of population is in decline, and consequently, demographic trends significantly influence the labour market, and more precisely, the youth market. According to the 2011 census, the share of young people is 18% (considering young people aged from 15 to 29), while according to the 2002 census, the share of young people accounted for 20%, which means that the young population in Serbia is reducing. Serbia does not belong to countries with a high percentage of young people. Out of the total population, young people aged from 15-24 account for 11.7%. Taking into account a group of young people up to 30 years old, the most significant share of young people is aged from 25 to 29 (480,286). The

most substantial number of young people lives in the north of Serbia (413,765), while 183 848 young people aged between15 and 24 live in the south of Serbia (Census, Statistical Office of Republic of Serbia, 2011). Observing the population according to the gender structure, out of the total population in the Republic of Serbia, there are 3,499,176 males and 3,687,686 females, more precisely 51% of the total are women. Considering the last two Census, the women age rate has been decreasing from 50,8 to 49,5 as well as the men age rate from 45,3 to 43,1. Additionally, regarding the age, there are women within the old and middle age group and more men within the young age group.

In the last few years, due to the unstable political situation in the region, youth dissatisfaction is mostly present, and young people are leaving their country of birth. The Statistical Office of the Republic of Serbia announced that in the period from 1991 to 2001, about half a million young people, predominantly males, looked for a better future abroad. Furthermore, the highest trend of population movements is from the south of Serbia, where according to the 2011 population census, about 1,563,916 inhabitants live, while the most populated region is the South and East Serbia with 2,031,697 inhabitants.

Education significantly influences the employment of young women and men and education had the main impact on finding a job (Buha et al., 2014; Devjak and Devjak, 2009; Pavlovic et al., 2016). Research shows that education provides better jobs and higher earnings (Flinn, 2006; Heckman, Lechner and Taber, 1998), and on the other hand reduces chances for poverty. According to the SILK Survey (2014), out of 100 highly educated people, only one is poor. More recently, the statistical data shows that women attend faculties more than men (women attendance 56%/ men attendance 44%) (Table 1).

Table 2: Enrolled students at Faculties in Serbia

YEAR	TOTAL MALE	TOTAL FEMALE	% MALE	% FEMALE
2011	102441	129220	44	56
2012	105518	133427	44	56
2013	108400	134448	45	55
2014	106594	134460	44	56
2015	112191	138971	45	55
2016	115190	146899	44	56

Source: Statistical Office of Republic of Serbia, 2016.

Out of the total number of employees, there are more women who have completed a high degree of education. Therefore, out of the total number of employees with a high level of education, about 326 thousand are women, while 281.5 thousand are men. The most substantial amount of male population completed the secondary degree of education. According to the statistical data from 2016, the women constitute more than half of graduate students within a vast area of education while men are mostly present in the fields such as IT, engineering and construction sectors. Moreover, in 2016 there were more women with the Ph.D. (57%) than men (43%). On the other hand, there were more men in research sector as well as in SANU where 90% of the members are men.

Three-year high school education is finished three times more by male population while on the other side compared to women population that is more numerous at 4-year high school education. Accordingly, the data from 2016 indicates that the girl's share in grammar schools is 58%, comparing to the number of boys in 4 year high schools 53% (Women and men in Serbia, Statistical Office of Republic of Serbia, 2016).

When it comes to young people aged between 15-24, out of a total of 779,963 young people, more than half completed secondary education (431,032 young people with completed secondary school), while only 2,941 young people did not complete the primary education. Young women 15-24 are more interested in tertiary education than men. According to the data from 2015, there are 17,109 young highly educated women and 9,791 young highly educated men in Serbia (Statistical Office of Republic of Serbia, 2016).

5. CONCLUSION

According to the National Youth Strategy for the period from 2015 to 2025, using a large number of activities Republic of Serbia is trying to reduce the number of unemployed young people aged between 15 and 30. One of the aims is solving an issue about gender equalities. There are differences between the unemployment rate among man and women. Moreover, in some part of the country unemployment rate is much higher than for instance in Belgrade region. Regarding this, one of the reason is a traditional overview of the position of women is the fact that they are under the influence of their family patterns. The woman is more present in the household more than at the labour market. Additionally, male family members very often leave their families and go abroad searching for better job opportunities (Obradovic et al., 2017).

Dissatisfaction of young people, besides lack of job opportunities, is considered as an issue that additionally complicates the entrance to the labour market. It is important to say that the education presents for both sexes, an essential factor in their search for job opportunities. However, although women are very educated, they are still discriminated against in some ways and enter the labour market very hard.

Besides already mentioned Youth Strategy, Republic of Serbia implemented two laws with a tendency to regulate the problem of gender quality. According to this law, international standards within the area of equal men and women employment. To conclude with there is a massive tendency of protecting the position of women in the labour market and society as a whole.

In this paper, we have elaborately presented the differences at the labour market, including the particular focus on gender inequality. The review of the previous research, as well as the present situation, is made to help policymakers to find the most propriety solution in this area.

ACKNOWLEDGMENT

This paper is a result of the Projects No. 179001 - Organizational and information support to the system of quality management as a key factor to increase the competitiveness of national companies and their rapid entering the global and EU markets and No. 179081 - Researching Contemporary Tendencies of Strategic Management Using Specialized Management Disciplines in Function of Competitiveness of Serbian Economy funded by Ministry of Education and Science of the Republic of Serbia.

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VIRTUAL VERSUS TRADITIONAL TEAMS: TEAM DYNAMICS AND TEAM MEMBERS NEED SATISFACTION IN A LEARNING ENVIRONMENT

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Abstract: *A lot of researchers had discussed about team satisfaction and performance when team members working in virtual environment. In this study, our intention was to examine team satisfaction and performance in students' virtual teams, actually to compare students' group dynamic interaction, need satisfaction and academic performance when they are working in virtual and traditional teams. The research was conducted among students of the Faculty of Organizational Sciences, University of Belgrade, who attended the course Group Dynamics and Interpersonal Relations. The students were divided into four groups and all groups had the opportunity to follow both traditional and virtual practical classes, after which they were assigned a team task. Design of the study was quasi-experimental with repeated measures. Although we expected no difference between traditional and virtual student teams, since students replace many face-to-face activities with online activities and discussions, we found that working in traditional teams provide better understanding of the task, more quality communication and higher initial motivation. This research also indicate that there is a higher satisfaction of needs for autonomy and relatedness.*

Keywords*: virtual teams, traditional teams, e-learning, team dynamics, need satisfaction, academic performance*

1. INTRODUCTION

Nowadays, teams and teamwork are very popular topics, especially when it comes to teams in a business or learning environment. In many studies it is shown that teams in business can undertake more ambitious projects and their members can provide a greater variety of skills (Hansen, 2016). Teamwork, as every other filed, has been influenced by the growth of information technology, as business people often require more flexible access to learning, their work and business communication (Berger 1999; Bull, Kimball, Stansberry 1998). In business environment virtual teams becomes increasingly common, not only because business people require it, they are also linked with significant savings, due to reductions in travel expenses, meeting times, duplication costs, and other expenditures (Robbins, Judge, 2007). Purvanova (2014) in her paper highlighted the researches which shows that virtual teams make companies and organizations more flexible, allowing them to handle the pressures created by the increasing business globalization and competition (Avolio, Kahai, Dodge, 2000; Bell, Kozlowski, 2002; Driskell, Radtke, Salas, 2003; Dundis, Benson, 2003).

There are also many researches which consider the importance of the teams in learning environment and virtual learning environment. With changing student lifestyles and fast-developing technology, universities are increasingly offering more "flexible" learning environments (Kemp, Grieve, 2014). Educational institutions recognize the need and obligation to prepare students for work and teamwork in virtual environment. Examples are e-learning and virtual project student teams, and both can have positive influence: e-learning and virtual team in education provide an opportunity for students to learn interpersonal skills that are useful in a virtual environment (Kozlowski, Ilgen, 2006). Virtual learning provides flexibility and it may be best for students who require alternatives to formal educational arrangements.

Since students manage study, work, and family life, they often replace many face-to-face activities with online activities and discussions, and it is expected that they might prefer at least some aspects of online learning to traditional classes. As everyday communication and activities students perform equally well in both online and offline environments, the assumption is that the success in the learning process and the performance of team tasks is not influenced by the environment in which students learn and accomplish their assignments. The aim of this study is to compare undergraduates' group dynamic interaction, need satisfaction and academic performance when they are working in virtual and traditional teams.

2. THEORETICAL CONSIDERATIONS

The worldwide trend toward e-learning and virtual teams result with a lot of debate about how they affect group dynamics, connection between team members, and do they affect positive or negative team performance. In the process of e-learning, teacher-centered model of teaching (the lecturer transmits

knowledge to students (Harden and Crosby, 2000; Prosser et al., 2005)) is replaced with less traditional classes with a greater focus on more student-centered learning (Balluerka et al., 2008), where students get work materials through some of the online education platforms, and then independently or in teams organize their learning process.

Previous researchers have suggested that this way of learning can produce more in-depth discussions and to improve the quality of learning (Smith, Hardaker, 2000), the extra time available for online activities might allow students to think about course material more critically and reflectively, leading to deeper understanding of the course content (Robinson, Hullinger, 2008). Hobbs in his research (2002) has suggested that the less confrontational or personal nature of e-learning might encourage shyer students to engage more, or to feel less pressure than in face-to-face interactions (Hobbs, 2002). Perceptions and experiences of the students are very important in the process of e-learning (Holley and Oliver, 2010; Ituma, 2011). Hensen (2016) has studied student experience and he has shown in his research that online student teams exhibit more positive communication, participate more in team activities and team members are more satisfied with their team than traditional teams.

Much of the initial experience of e-learning failed to live up to learners' expectations (Imel, 2002).There are studies that have shown negative sides and potential problems in the e-learning team, partly because of technological constraints, and partly because of the teaching staff approaches (Anderson, Dron, 2011). Efficiency, content and delivery method that are applied by teaching staff, influence the learning process (O'Neill et al., 2004). Some teaching staff seems to perceive web-based platforms simply as an alternative method for presenting the traditional content, whereas others might look for more innovative ways of using such platforms to improve students' engagement (Holley, Oliver, 2010; Ituma, 2011).

Further, perceptions and experiences of the students themselves have been largely neglected. Otter et al. (2013) found that students in online-only classes felt more disconnected from their peers and lecturers, more obliged to be self-directed in their studies. We can find a rational explanation for this in the theory of self-determination, where the basic psychological needs are the needs for autonomy, competence and relatedness (Deci, Ryan, 2000). New virtual space as a learning and working context might lack some of potentials to satisfy those needs. From one point of view, lack of face-to face communication might diminish and restrain some aspects of interaction and relatedness with coworkers. The results of one study have exposed a tendency to greater satisfaction of needs for autonomy and relatedness when it comes to work in real team rather than when it comes to work in virtual team (Kovačević, Milinković, 2017). When observing the needs for autonomy and relatedness in real team, the need for relatedness is more satisfied than the need for autonomy, while in a virtual team there is the opposite tendency. On the other side, platforms for virtual learning and working provide possibility for constantly being in touch in real time.

It was noticed that there is a need for more research into what does and does not work in online learning, with a focus on the student experience.

2.1. Research problem

Many studies have so far highlighted the advantages of online teams in the learning process, as well as the positive dynamics that could be developed in online teams. Hensen (2016) has shown in his research that online student teams exhibit more positive communication, participate more in team activities and team members are more satisfied with their team than traditional teams.

Cristiana Cicei in her research (2012) discusses some negative aspects of e-learning and virtual student teams. She point out that learning and working in virtual settings being, from the students' perspective, less satisfying for team working than the traditional setting. She also claimed that team's problem solving process is considered to be less satisfying when learning and working online, than when interacting directly (Cicei, 2012).

Previous study mentioned above (Kovačević, Milinković, 2017), although provide interesting insight in the domain of need satisfaction, did not go beyond the subjective perception with the lack of the objective measure of task completion excellency. The current research was therefore designed to examine the satisfaction and performance while performing real task, in both traditional and virtual learning experiences, of students from the Faculty of organizational sciences, University of Belgrade, who were enrolled in the course Group dynamics and interpersonal relations.

On this course we had separated students in four teams with intention to compare undergraduates' group dynamic interaction, need satisfaction and academic performance when they are working in virtual and traditional teams.

2.2. Research goal and hypotheses

The main goal in current research is to compare students' communication, motivation and need satisfaction while working in traditional and virtual teams.

To accomplish this, through a qualitative analysis, we examined the student satisfaction with their work in traditional and virtual teams. Targets are related to the comprehensibility of materials and tasks when they are presented by the lecturer, face to face, and when they are placed on the platform through which team members communicate; to communication in the team, how much easier is for students to define and express their opinions when communicating face-to-face with colleagues, or communicating through the platform; and motivation for work, or do students take more initiative when working in the presence of other colleagues, and how willing are they to make an extra effort when sitting at home and working without time constraints and the presence of other people. Observing group dynamics through these three indicators, assuming there are no differences when students work in traditional teams and virtual teams, the following hypotheses have been defined:

Hypothesis 1*: There is no difference in the manner in performing task that includes understanding the task, quality of communication and motivation indicators:*

a) *There are no difference in students 'understanding the task while working in virtual and in traditional teams.*
b) *There are no difference in communicating actively while while working in virtual and in traditional teams.*
c) *There are no difference in the level of effort and determination while execution of the task in virtual and in traditional teams.*

Often, researches indicates that the social interaction of face-to-face meetings allow people to interact socially, verbally, physically as well as work together psychologically. There are reasons for which students might prefer more traditional, in-class activities. Although social connectedness can be derived online (Grieve et al., 2013), most students feel that face-to-face contact is essential for building a sense of community (Conole et al., 2008). We can find a rationale for this in the theory of self-determination, where the basic psychological needs are the needs for autonomy, competence and relatedness.

Assuming that in the student teams, both traditional and virtual, the need for competence is met, the target of this paper is also to check if there is a difference in meeting the needs for autonomy and relatedness in the context of work and learning in traditional and virtual student teams. We have come to the assumption that both contexts can have advantages and disadvantages in meeting needs. On the one hand, the absence of direct contact can limit some aspects of closeness among students, but it can enable constant communication in real time and possibly greater autonomy in work. If we provide the teams with the opportunity to get to know each other and do something together, before they start working in a virtual environment (as is most often case with student teams), all needs will be equally satisfied both in traditional and virtual teams.

Hypothesis 2: *There are no significant differences in need satisfaction while working in traditional compared with virtual teams:*

a) *There are no significant difference in meeting the need for relatedness while working in traditional compared with virtual teams.*
b) *There is no significant difference in meeting the need for autonomy while working in traditional compared with virtual teams.*

As the most important output from the learning process (in both modalities of learning) are the individual and group results that a student achieves, the aim of the paper is to prove that students' success does not depend on the way they are preparing for testing and passing the exam (either traditionally or virtually), so the last hypothesis relates to:

Hypothesis 3: *There is no significant difference in the results achieved by the students on the test and the group tasks, while working in traditional compared with virtual teams.*

2.3. Variables

Independent variable in this research is the environment of performing task: virtual/traditional

Dependent variables are:
1. Manner of performing, including understanding of task, quality of communication and effort and determination (level of motivation)
2. Need satisfaction (relatedness, autonomy)
3. Test results (group and individual)

Control variable: order of experience (two different orders)
Stimulus: concrete tasks to perform considering the cases in the domain of conflict and communication topics.

3. METHODS

As the main assumption in current research is that there is no difference between traditional and virtual student teams, both quantitative and qualitative methods of inquiry were used to capture the dynamic interaction in groups and satisfaction of basic psychological needs. Individual tests were used to show that academic performance does not depend on the environment in which students work. Design of the study is quasi-experimental with repeated measures.

3.1. Sample

The sample consisted of 20 students, from 22 to 23 years. All of them are students of Faculty of organizational sciences, University of Belgrade, fourth year at the department Quality management and standardization. All of them had experience of learning and working in the virtual and the traditional student teams.

3.2. Instruments

Since our intention was to investigate student satisfaction, using qualitative method, we create a questionnaire that had 15 questions, in two parallel versions, to examine whether there is a difference in:

1. Understanding the tasks,(a) when the teacher explains the task to the students, (b) when it is just placed on the online platform without any additional explanation;
2. The communication process, is it easier for students to express their thoughts and feelings (a) when communicating face-to-face with other colleagues, (b) when communicating electronically.
3. Motivation, or which environment influences more on students to make additional effort to accomplish the task.

Table 1: Example of items in Satisfaction questionnaire

Variables:	Example of items:
Understanding of task	1.a. When I work in a traditional team, I understand the task without any problems and what is expected of me.
	1.b. When I work in a virtual team, I understand the task without any problems and what is expected of me.
Quality of communication	2.a. When I work in a traditional team, I can more easily express my opinion.
	2.b. When I work in a virtual team, I can more easily express my opinion.
Effort and determination	3.a. When I am working in a traditional team, I can notice when other members making an extra effort, so I have the desire to do my best.
	3.b. When I am working in a virtual team, I can notice when other members making an extra effort, so I have the desire to do my best.

Students were asked to rate, on a scale of 1 (“completely disagree”) to 5 (“completely agree”), how they experienced work in a traditional and virtual environment.

Further, during the research, we used a modified questionnaire of basic psychological needs (Deci, Ryan, 2000), which was reduced to 15 questions of autonomy and relatedness in two parallel versions (for the traditional and virtual team).

Also, students were asked to rate, on a scale of 1 (“completely disagree”) to 5 (“completely agree”), how they felt when it comes to meeting their needs for autonomy and relatedness in a traditional student teams and virtual student teams.

Table 2: Example of items in questionnaire of basic psychological needs (Deci, Ryan, 2000)

Variables:	Example of items:
Autonomy	1.a. When I work in a traditional team, I usually feel that I can decide on how I will do my part of the job. 1.b. When I work in a virtual team, I usually feel that I can decide on how I will do my part of the job.
Relatedness	2.a. Members of the traditional team I work with, I consider as my friends. 2.b. Members of the virtual team I work with, I consider as my friends.

As we want to measure their academic performance too, we used knowledge test, where they had questions from parts that were learned either traditionally or virtually.

3.3. Procedure and data analysis plan

The research was conducted among students of the Faculty of Organizational Sciences, who attended the course Group Dynamics and Interpersonal Relations. The students were divided into four groups, each group had five students. All groups had the opportunity to follow both traditional and virtual practical classes, after which they were assigned a team task.

Team 1 and Team 2 the first part of the course (Topic: Team Dynamics and Conflict Resolution) were attending in traditional teams. After the lectures were completed, the teams got explanation what their task was. The first part of the task was to complete the part related to the simulation of the conflict situation, where through the discussion they should solve the problem. The second part of the task was related to the written part, where they got a case study, with the task to write as many conflict resolution strategies as possible. The same lecture and the same tasks were set up to Teams 3 and 4, for which we created the online environment for learning and team working (Microsoft Office 365 Education Platform - Teams).

The second part of the lesson (Topic: Interpersonal communication), Team 3 and Team 4, was followed in a traditional way, while Teams 1 and 2 were online. Classes were held by teacher who explained the material and the requirements that should be done through the tasks to teams 3 and 4. Teams again had a couple of exercises that required a discussion and after that a team task that was done in written form. For teams 1 and 2 the same lecture and the same tasks were set up on online platform.

After two weeks, students who now had experience both in traditional and online teams were given to fill in two questionnaires. The first one concerned to the satisfaction of team work in traditional and the virtual environment, and the questions were related to the comprehensibility of materials and tasks, communication with team members and motivation, actually their engagement in both the traditional and the virtual team. The second questionnaire referred to meeting the needs for autonomy and relatedness.

Additionally, students were given the test knowledge to check if the change in the environment had an impact on their academic performance.

In the data analyses we used descriptive statistics and t test for significance difference (with repeat groups).

4. RESULTS

The results which are related to Hypothesis 1, that there is no difference in the manner in performing task that includes understanding the task, quality of communication and motivation, are summarized in Table 3. Rezultes show that there is the difference, in process of understanding of task, communication and effort and determination, and all goes in favor of traditional team work.

Table 3: Results of students' satisfaction with process (virtual versus traditional teams)

		Mean			Significance of differences		
Satisfaction with process	**Environment**	**AS**	**SD**	**N**	**t**	**df**	**Sig.(2-tailed)**
Understanding of task	Traditional	4.7400	.05822	20	**6.666**	**19**	**.000**
	Virtual	3.6800	.16821	20			
Quality of communication	Traditional	4.3700	.09655	20	**4.160**	**19**	**.001**
	Virtual	3.6700	.15846	20			
Effort and determination	Traditional	3.3800	.24188	20	**4.186**	**19**	**.001**
	Virtual	2.7200	.21541	20			

When it comes to the resultes of need satisfaction, there is also a higher satisfaction for autonomy and relatedness in traditional then in virtual teams (on lower level of significance) (Table 4). T test for significance difference (with repeat groups) for the autonomy is t(20)=2.607, p<.05, while satisfying experience for relatedness show indicator t(20)=2.54, p<.05.

Table 4: Results of students' need satisfaction (virtual versus traditional teams)

		Mean			Significance of differences		
Need satisfaction	**Environment**	**AS**	**SD**	**N**	**t**	**df**	**Sig.(2-tailed)**
Autonomy	Traditional	4.036	.088	20	**2.607**	**19**	**.017**
	Virtual	3.728	.125	20			
Relatedness	Traditional	4.256	.100	20	**2.540**	**19**	**.020**
	Virtual	4.150	.121	20			

If we look at the results in Table 5, we can conclude that the results of student work depend on the environment in which students follow the lessons and do their tasks. Success on team assigments is better when students work in a traditional environment than when they work in virtual environment.

We did not take individual test results on knowlege test into consideration, as they depend on many other factors.

Table 5: Results of students' academic performance (virtual versus traditional teams)

		Mean			Significance of differences		
Academic performance	**Environment**	**AS**	**SD**	**N**	**t**	**df**	**Sig.(2-tailed)**
Group resultes	Traditional	29.50	.199	20	**4.745**	**19**	**.000**
	Virtual	25.50	.835	20			

5. DISCUSSION AND CONCLUSION

Although we expected no difference between groups, results goes in favor of traditional team work. We found that working in traditional teams provide better understanding of the task, more quality communication and higher initial motivation. There is also a higher satisfaction of needs for autonomy and relatedness (on lower level of significance), which is in the concordance with previous researches (Imel, 2002; Anderson, Dron, 2011; Kovačević, Milinković, 2017) indicating higher intrinsic motivation of team members. The most important founding is the significant difference in team performance clearly pointing toward the traditional team as the superior mean of finishing learning tasks.

These results are not in concordance with some other studies which that emphasized the positive effects of e-learning (Smith, Hardaker, 2000; Robinson, Hullinger, 2008), with numerous personal and performance related advantages of it, with some of them could be relevant for learning via teamwork platforms. It particularly referred to the domain of communication, participation and satisfaction, as some researches point out as the benefit of virtual teams (Hensen, 2016).

Our sample is limited, as well as the research design itself; nevertheless there is relatively strong evidence that in the specific context traditional teams might be superior over virtual providing more guidelines for students in face to face communication evoking higher motivational potential visible also in concrete results. It might not be the case in some other situations with different tasks and demands from team members, and one of the important factors might be the effect of randomly assigned order of experience for different teams. Also, we did not take into consideration individual differences of our participants, as some studies found benefits of virtual teams for more introverted students (Hobbs, 2002). For example, for some students environmental factors as well as the order of the experience might make a difference, and for some others it might be irrelevant while performing task.

Finally, the experimental design might be "responsible" for the resulting trend. The nature of the task and the way that learning demands are set could be more adjusted toward traditional team work, which goes in favor to several scholar`s conclusions that teaching approach and platform itself have influence on learning process (O'Neill et al., 2004; Anderson, Dron, 2011). Due to the fact that all team of students are working traditionally as well as virtually (only in different time), it is possible that they perceive these virtual experiences only as an additional learning tool, not the complete no way of performing activities. This problem was recognized in some researches (Holley, Oliver, 2010; Ituma, 2011) only considering the teacher`s side but it also could be the students point of view.

Even though this research show that students and teachers are not yet ready to accept the process of digitization and go into the virtual environment, it's unavoidable that this will step by step have to happen. Future researches should aim at the process of adapting students to e-learning, and the professors to look for more innovative ways of using online platforms to improve student engagement.

Activities that should be improved in the process of online working with students, as Kemp and Grieve (2014) emphasize in their research, are: to enforce more engagement (students feel more engaged when the activities are complete in the social environment, rather than online); to give and to ask for immediate feedback (students appreciate the fact that each comment they made in class directly provoke a comment from a peer, or a teaching staff. In online environment they have to wait hours for a response); to induce students to read comments (students have no wish to read the comments and to engage in an online discussion).

In this study, even though we started from the idea that students appreciate the flexibility of online studying, it is shown that they more appreciate explanation from the lecturer, they value face-to-face rather than face-to screen communication, and they are more engaged in traditional class environment. Still, there is a great opportunity for academic institutions to use the potential of online technology, not only as alternative modality for delivering academic content, but to inspire students' engagement and success at university and beyond.

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RELATIONSHIP BETWEEN WORK-LIFE BALANCE AND WORK ENGAGEMENT AMONG HIGHER EDUCATION LECTURERS

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Abstract: *Key research objectives of the study were to empirically test the relations between the construct of work-life balance and the three dimensions representing work engagement – vigor, dedication and absorption - by empirically testing a structural model linking these constructs and determining the relations. A six-country survey was conducted on a sample of higher education lecturers from Austria, Croatia, Czech Republic, Germany, Serbia and Slovenia with a sample size of 305. Findings showed that work-life balance is positively related vigor, whereas the relation to dedication can due to the lack of statistical significance be neither confirmed nor refuted and as a surprise came the relation between work-life balance and the third dimension of work engagement – absorption, which was negative. Results of this study can be used both for further research and in practice.*

Keywords*: work-life balance, work engagement, higher education lecturers, SEM*

1. INTRODUCTION

The two key spheres in the life of an adult are work and family, and both are important for the individual. We could say that they are the "two sides of the same coin". The conflict between work and life can lead to stress and other health problems, and on the other hand, a work-life balance affects quality and satisfaction in both private and working life.

The roles of an individual are often excluded. Greater involvement in one area or role can reduce attention in other areas, or with the other words, if an individual devotes more time to one area, it left less time for another (Adkins and Premeaux, 2012). Successful work-life balance also has an impact on the individual's work engagement (Bedarkar and Pandita, 2014). The perception of work-family balance is linked to the individual's sense of being supported by the organization and that he or she is meaningful value for an organization (Timms, Brough and Bauld, 2009). Another reason is that those employees who, in addition to their work, are also responsible for caring for their families, are limited in their availability to work, and if they fail to balance work and family, engagement in work can turn into burnout (Banihani, Lewis and Syed, 2013).

Various researches confirmed the connection between work-life balance and work engagement. Some studies (e.g. Caesens and Stinglhamber, 2014; Mache, Vitzthum, Klapp and Danzer, 2014; Taghipour and Dezfuli, 2013) have thus shown that family-friendly policies and practices of the organization has an impact on the individual's increased commitment to work. The Swanberg, McKechnie, Ojha and James (2011) survey showed that some family-friendly measures, such as leadership support and employee control over timetables, not only help to balance work and family, but also have a significant impact on the increased work engagement of employees. Similarly, the results of Kar and Misra (2013) research confirmed that employees who get the organization's support in work-family balance are more satisfied at the workplace and more closely related to organization. The research (Rothbard, 2001) also showed that the family does not negatively affect the individual's engagement at work, but in particular women are even more engaged at their work if they have family. These findings show that organizations should instead of restricting family responsibilities and participation in other roles, continue to promote these activities as they have a positive impact on the employees' behaviour at work.

The relationship sometimes also exists in the opposite direction, since not only the work-life balance influences the work engagement, also the work engagement can influence a work-life balance. The research (Siu et al., 2010) showed that the work engagement of an individual significantly contributed to perception of the work-life enrichment.

We therefore hypothesize, that work-life balance positively relates to work engagement on the dimensional level, where the three dimensions of work engagement are: vigor, dedication and absorption (as presented in Figure 1). First we begin with a theoretical review of work-life balance and work engagement, and continue with an empirical analysis using SEM to test the relations and discuss our findings.

2. THEORETICAL REVIEW

2.1. Work-life balance

The problem of the work-life balance is a broad concept and it can be analysed from several aspects: psychological, sociological, gender or aspect of the working environment culture (Sukalova, Ceniga and Janotova, 2015). The psychological aspect focuses on how problems with the work-life balance are connected with stress and work dissatisfaction as well as the psychological health of an individual. The sociological aspect focuses on work-life balance from the social state policy point of view, while the gender perspective focuses on the gender differences in the frame of the work-life balance.

The term work-life balance has three components - "work", "life" and "balance" (Suresh and Kodikal, 2017). “Work” is a paid work, or the employment (Guest, 2002), and "life" is all activities outside of work (Suresh and Kodikal, 2017), such as, household activities, friends, family and community (Skinner and Pocock, 2008). Thus, the work-life balance is in a broader sense, the work-life balance could be described as the satisfactory involvement or adaptation between several roles in an individual's life (Bedarkar and Pandita, 2014). Different people will value the work-life balance differently, according to their values and circumstances (Othman, Yusof and Osman, 2009).

There are several factors that influence the individual’s work-life balance. They are roughly divided into individual-level factors, organizational-level factors, and country-level factors. Factors at the individual level include the influence of personality traits on the work-life balance (Turliuc and Buliga, 2014), the impact of gender on the work-life balance (e.g. Southworth, 2014) as well as parenting and the partner's support in balancing work and personal life (e.g. Ferguson, Carlson, Zivnuska and Whitten, 2012).

Another set of factors are the organizational-level factors. For an individual, it is important to perceive the organization as family-friendly, since this significantly influences the reduction of work-family conflict (Lapierre et al., 2008). Organizations can help to reduce work-family conflicts with family-friendly programs that can help an employee to balance work and family or the obligations of working and family life (Boyar et al., 2008). In practice there are several work-life balance policies and practices. The most common are the flexible schedule, the use of overtime, part-time work, "pressed" working week, flexible working hours, work from home, holidays, etc. (Parakandi and Behery, 2016). Employees with access to work-life balance policies and practices often reported better psychological well-being, because the ability to use work-life balance practices enable them sufficient time also for a family and therefore they feel less stress with balancing work and family (Kashyap, Joseph and Deshmukh, 2016). But not only a work-life balance policies and practices are important for employees’ work-life balance, numerous studies evidence also an important role of the leader (e.g. Greenhaus, Ziegert and Allen, 2012; Maxwell, 2005). On the one hand, the leader contributes to the development of work-life balance policies and practices, and on the other hand plays a key role in the implementation and monitoring of the results of these policies (Maxwell, 2005).

In addition to the role of the individual and the work organization, researches (Stier et al., 2012, Roeters, 2011, Trefalt et al., 2013) show that the state also significantly influences on work-life balance. With its policies and measures, the state creates more or less favourable conditions for the work-life balance. The main initiatives of the state focus primarily on the field of child care, leave, which provides care for dependent family members, flexible forms of work and equal opportunities for women and men.

2.2. Work engagement

Employees’ engagement is one of the important topics in human resource management, among other things, because it is strongly associated with organizational productivity (Gujral and Jain, 2013). Organizations need employees who devote themselves energetically and committedly to their work, or in other words, organizations need engaged employees (Bakker and Schaufeli, 2008).

Gallup (2006) divides employees into three types: engaged, unengaged and actively unengaged. Engaged employees work with passion and feel deeply linked to their organization. They promote innovation and move the organization forward. Unengaged employees are essentially "disconnected". Time at work pass passively, they devote their time to work, but not energy or passion. The third, actively unengaged employees, are not only dissatisfied at the workplace, but they even create this dissatisfaction. These workers undermine what their co-workers make (Robertson-Smith and Markwick, 2009).

The two main concepts of work engagement definition exist. The first concept defines work engagement as the opposite of burnout, namely, work engagement is characterized by energy, co-operation and efficiency, which is contrary to exhaustion, cynicism and lack of efficiency, the three main components of burnout

(Maslach, Schaufeli and Leiter, 2001). The other concept defines work engagement as an independent concept, namely, as a positive, fulfilled, work-related state characterized by vigor, dedication and absorption (Schaufeli and Bakker, 2004, Schaufeli et al., 2002). Vigor means that an individual has a high level of energy during work and is mentally resistant. Dedication refers to the fact that the employee is strongly involved in his work and at the same time he experiences a sense of relevance, enthusiasm and challenge. Absorption means that the individual is fully concentrated and immersed in his work, his time at work runs fast and he is hardly misconduct (Schaufeli and Bakker, 2004, Schaufeli and Bakker, 2003). For the purposes of our research, we will use the latter definition, i.e. engagement as an independent concept.

The work engagement of employees is influenced by number of factors, roughly divided into institutional and personal factors (Mache et al., 2014). The institutional factors are working resources, and the individual factor is personality. The research (Chen, 2017) carried out among teachers has shown that working demands negative affect work engagement and on the other side working resources positive affect work engagement. Work engagement is therefore high when employees have good social and non-social resources at the employment level (Christian et al., 2011). On the other hand, the work requirements, such as overloading work, emotional demands or the work-home interference negative impact the work engagement (Schaufeli, Bakker and Van Rhenen, 2009; Chen, 2017).

The employee's work engagement has many positive outcomes. For example, work engagement plays an important role in promoting work ability (Airila et al., 2012) and greater work performance (Bakker, 2011; Christian et al., 2011); work engagement has also positive effects on an individual's work and life satisfaction (Mache et al., 2014). Work engagement also serves as a mediator between the effects of high work demands and organizational commitment (Hakanen, Bekker and Schaufeli, 2006) and plays an important role as a mediator between family-friendly organization policies and the work-family enrichment (Siu et al., 2010).

3. RESULTS

The full set of questionnaires was completed by a total of 305 online participants, all of which were higher education lecturers, which represent our sample, of whom 69 (22.6%) were men and 108 (35.4%) were women – 128 (42.0%) did not respond to this question. The average age of respondents was 45.26 years. On the average they had 18.91 years of work experience overall, of which 15.13 were in higher education. According to the marital status of respondents: 106 (34.8%) were married, 11 (3.6%) were divorced, 40 (13.1%) were in a committed relationship, 4 (1.3%) were engaged and 16 (5.2%) were single - 128 (42.0%) did not respond.

According to the educational level of respondents: 5 (1.6%) were with B.Sc. or B.A., 36 (11.8%) were with M.Sc. or MBA and 135 (44.3) had a Ph.D. - 129 (42.3%) did not respond to this question. According to their academic rank: 29 (9.5%) were teaching assistants, 16 (5.2%) were research assistants, 62 (20.3%) were assistant professors, 36 (11.8) were associate professors and 32 (10.5%) were full professors – others did not respond to this question. According to their work status: 150 (49.2%) had full time employment, 17 (5.6%) had part time employment, 8 (2.6%) worked per contract and 1 (0.3%) was self-employed – 129 did not respond.

Table 1: Means and standard deviations for the items of work-life balance

Item	*n*	M	SD
I currently have a good balance between the time I spend at work and the time I have available for non-work activities.	305	3,01	1,310
I have difficulty balancing my work and non-work activities.	305	3,19	1,307
I feel that the balance between my work demands and non-work activities is currently about right.	305	2,96	1,272
Overall, I believe that my work and non-work life are balanced.	305	3,11	1,306

Descriptive statistics for the variables constructing work-life balance (Brough et al., 2014) are presented in Table 1 and those constructing work engagement (Schaufeli and Bakker, 2004) by dimensions are presented in Table 2.

Table 2: Means and standard deviations for the items of work engagement by dimensions

Item	*n*	M	SD
Vigor			
At my work, I feel bursting with energy.	305	3,33	1,069
At my job, I feel strong and vigorous.	305	3,48	1,070
When I get up in the morning, I feel like going to work.	305	3,40	1,090
Dedication			
I am enthusiastic about my job.	305	4,04	0,981
I am proud on the work that I do.	305	4,25	0,863
My job inspires me.	305	4,15	0,962
Absorption			
I am immersed in my work.	305	3,85	0,973
I get carried away when I'm working.	305	3,82	0,960
I feel happy when I am working intensely.	305	4,02	0,923

Empirical research was performed by survey method. To obtain data, we designed an online questionnaire, which was sent via e-mail in winter 2018. We have used convenience sampling, which is the most common (Etikan, Abubakar Musa, and Sunusi Alkassim, 2016), where people from six countries were invited via e-mail to participate in our survey. After conducting online research, primary data was controlled and edited. For processing and analysing data, we have used IBM SPSS Statistics 24 and Lisrel Student Edition 9.30 software package.

In continuation, we present a method to test the model by applying structural equation modelling (SEM), which is used for testing structural relations between constructs. That operation was made by building a model in Lisrel Student Edition 9.30 software package, which is an analytical statistics program, which allows the testing of multiple structural relations at once (Prajogo & McDermott, 2005). It combines factor and regression analysis by which it tests the proposed model by which we can assess the significance of hypothesised cause-and-effect relations among the variables (Diamantopoulos & Siguaw, 2000). The standardized solutions and t-values for the hypotheses tested in the model are presented in Figure 1 and Figure 2.

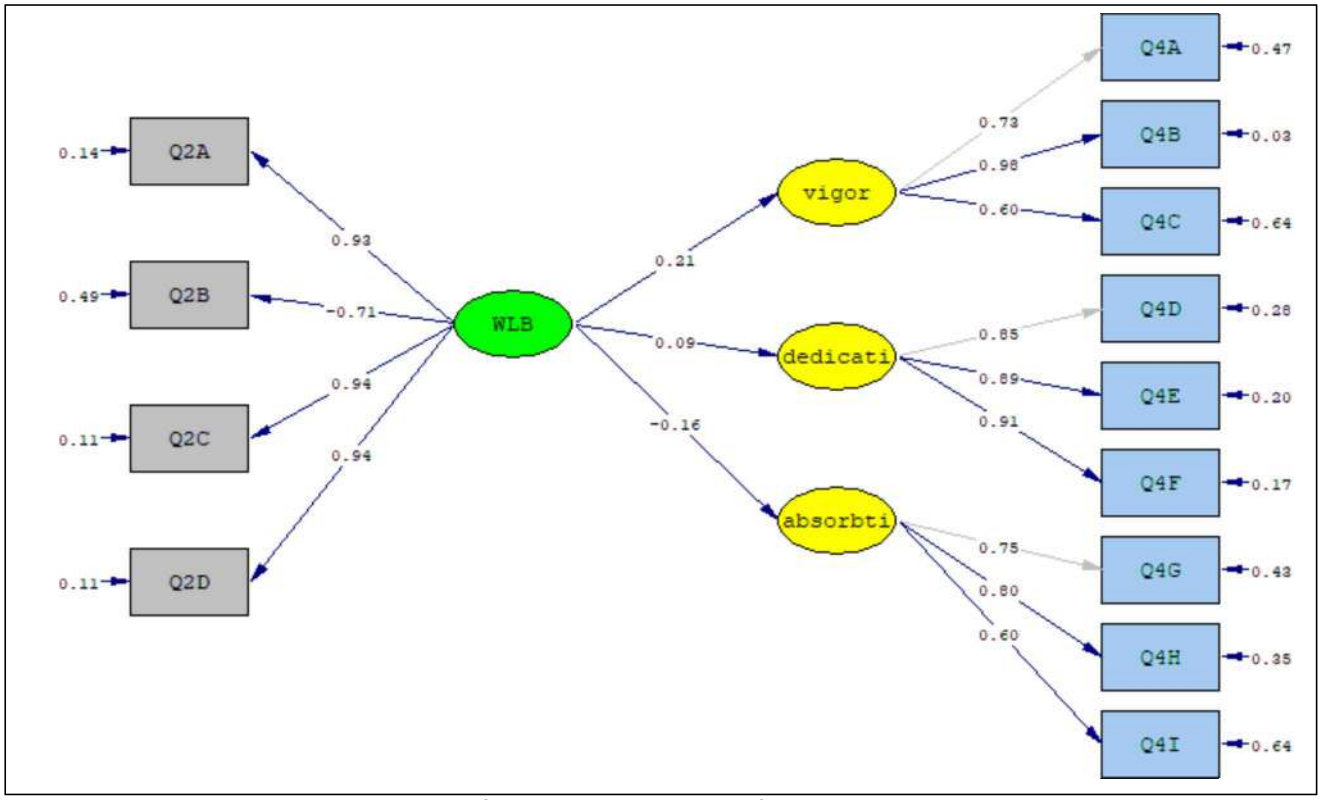

Figure 1: Standardized solution of the tested model

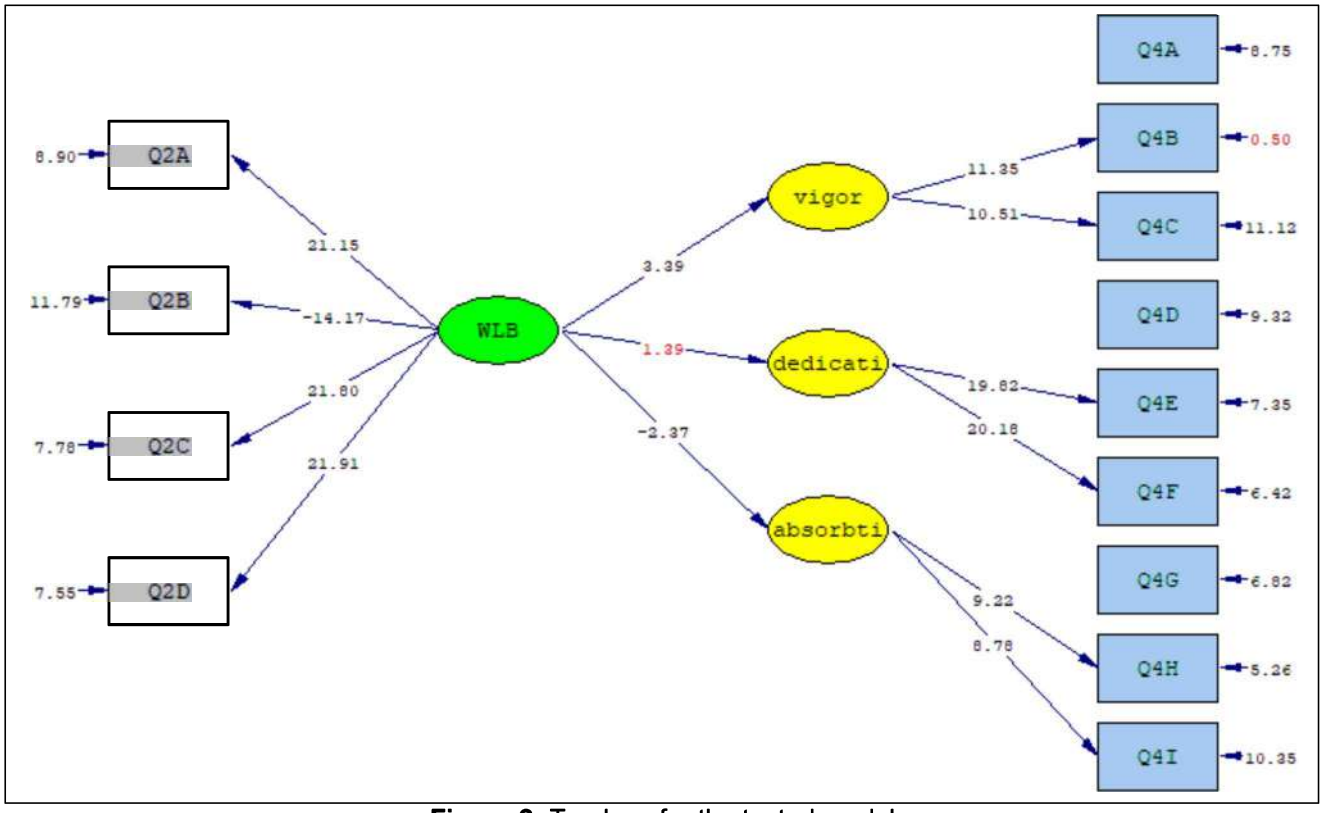

Figure 2: T-values for the tested model

4. DISCUSSION

Our research intended to test the structural relations between work-life balance and the three dimensions of work engagement among higher education lecturers. Our main aim was our hypothesized model in which *work-life balance positively relates to work engagement on the dimensional level, where the three dimensions of work engagement are: vigor, dedication and absorption* 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) are as follows: $\chi 2/df = 9.86$ and RMSEA=0.17, NFI = 0.799, CFI = 0.814, SRMR = 0.258, GFI = 0.775. We wanted to test the relations between the constructs in this model; two of which are statistically significant and one is not according to the t-test values. The whole model shows statistical significance of P-value=0.00000.

As seen from Figure 1 and Figure 2, work-life balance is positively and statistically significantly related to the first dimension of work engagement - vigor (Standardized solution = 0.21, t-test = 3.39), whereas we cannot confirm that with statistical significance regarding the relations between work-life balance and the second dimension of work engagement - dedication (Standardized solution = 0.09, t-test = 1.39), and we also add that the relation between work-life balance is negatively and statistically significantly related to the third dimension of work engagement - absorption (Standardized solution = -0.16, t-test = -2.37).

5. CONCLUSION

Due to research results we cannot confirm, that the relations between work-life balance and the three dimensions of work engagement among higher education lecturers are positive even if we hypothesised so based on the literature review. In fact, we have found only one positive relation, which is between work-life balance and the first dimension of work engagement – vigor, whereas the second was not statistically significant and we can therefore neither confirm nor refute it and the third relation between work-life balance and the third dimension of work engagement - absorption was negative.

For further research, we suggest investigating the effects of the determinants omitted or to put in other words not included in our study. In order to advance to the results interpretations, we should first analyze the limitations of this research. The study was focused mostly on how higher education lecturers' work-life balance relates to their work engagement, whereas other determinants were not considered, and there are also other factors involved in achieving work engagement.

The theoretical contribution of this study is to the existing research of work-life balance and work engagement in the aspect of advancing previous research by empirically examining the relations between both of them. The practical contribution is in the presented results that the relations are also present in the case of higher education lecturers.

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FACING INDUSTRY 4.0 COMPETENCES DEMAND: THE IMPORTANCE OF TRAINING OF TRAINERS

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Abstract: *In the era of digital transformation the theme of competences plays a crucial role. In the manufacturing sector, the diverse national initiatives that have been launched following the German Industrie 4.0 Plan try to identify, inter alia, the set of skills that are necessary to cope with the new requirements of the labour market. In this framework, significant researches are being carried out to build appropriate competency models whereas a minor attention seems to be paid to the aspect concerning the training of trainers. This paper intends to address this specific issue through a quick analysis of the existing competency models and the presentation of a project implemented by Università degli Studi Guglielmo Marconi (USGM) that aspires to become a good practice in the Italian context.*

Keywords*: Digital Transformation, Industry 4.0, Training of Trainers, Competences, Academia - Industry Cooperation*

1. INTRODUCTION

Digital Transformation is one of the most abused buzzword in the latest years. Behind those two words, a universe of potential definitions and interpretations open up and if on the one hand this feeds the general interest, on the other it increases the confusion that is often related to disruptive changes.

Technology is undoubtedly the main factor of change in the modern world. A change which happens with a rapidity never seen before, where nothing is evolutionary or linear but rather exponential. Thanks to the acceleration imposed by digital, business has to prepare to sustain diverse speeds balancing the requirements for stability of the most classical and governable processes with those of rapidity of innovative and not predictable processes. Those two speeds impose new organizational models but, above all, the re-discussion of the constituting values of the organizations themselves which have to rethink their own fundamental principles.

At a first sight, digitization is characterized by a series of disruptive changes which are very diverse form each other:

- Communication and replication free of charge, at a global scale and in real time of information expressed in bit (0,1)
- Collection, storage and analysis of data, related to all is moving on the web, with the possibility of profiling situations and people, making it statistically predictable their behavior
- Development of learning algorithms enabling to learn from experience, automatically facing problems of a certain degree of complexity
- Use of intelligent machines, which makes flexible works and are able to interact with other machines and people through sensors and data
- Distance interaction among people (and also machines) which can this way exchange ideas, projects and decisions, developing forms of shared intelligence and creativity

At the centre of those changes is the *economy of data* – which are different from products and services – and the *centrality of the individual*. On the basis of the changes enabled by digital transformation, organizations have to modify their business model and their approach to the market, not only by developing new products and/or services but also thinking and acting in a digital way, This is the concept of “Digital at the core”, which the new generation of leaders have to cope with. The rapidity of innovation grows exponentially but, above all, what grows is the need to rapidly build up new capacities enabling new Business Models and innovative work organization and processes.

The most important investment for the present and the future of organizations, and of economic systems to a broader extent, is the development of human capital that have to be endowed with new and transversal skills and competences.

Hence, the world is changing rapidly and the search for acquiring the required abilities has to come with that digital transformation which affects all economic domains but that has found in the manufacturing sector its first and most important stimulus to communication and development.

2. THE FOURTH INDUSTRIAL REVOLUTION: A MATTER OF COMPETENCES

Industry 4.0 is an expression which has become very popular in the political, social and economic debate in Europe (and beyond) which originated from the German manufacturing sector where the term was coined in 2011 within the HighTech-Strategy 2020 action plan launched by the Federal Government.

The term describes the organisation of production processes based on technology and devices autonomously communicating with each other along the value chain: a model of the 'smart' factory of the future where computer-driven systems monitor physical processes, create a virtual copy of the physical world and make decentralised decisions based on self-organisation mechanisms. As a result, "manufacturing systems are vertically networked with business processes within factories and enterprises and horizontally connected to spatially dispersed value networks that can be managed in real time – from the moment an order is placed right through to outbound logistics" (DG for Internal Policies, Policy Department A: Economic and Scientific Policy, 2016).

Generally speaking, Industry 4.0 identifies what is defined as the Fourth Industrial Revolution where the real innovation is characterized by the capacity of technologies of providing products and services through the interaction, in form of network, among machines, physical goods, virtual objects, systems of calculation and memorization, communication devices, energy containers.

Actually, the scope of the digital transformation justifies such a definition but it is important to underline that this Revolution presents specific features which, compared to similar situations in the past, delineate a diverse scenario since:

a. it is not characterized by new technologies but rather by existing technologies combining and operating in a joint way
b. the rapidity affecting the way in which technologies evolve and produce innovations has increased
c. it has a pervasive dimension involving the whole supply chain and the relationship among the different actors, including consumers
d. it is a transformation that does not affect manufacturing only but also other sectors of economy such as agriculture, services and tourism as well as public administration and education (Cervelli G., Pira S., Trivelli L., 2017).

In this framework, the theme of competencies is crucial and assumes a particular importance even in the light of the consequences of digitalization on employability which are still uncertain. Most occupations are indeed undergoing a fundamental transformation. While some jobs are threatened by redundancy and others grow rapidly, existing jobs are also going through a change in the skill sets required to perform them. The debate on these transformations is often polarized between those who foresee limitless new opportunities and those envisaging massive dislocation of jobs.

In many industries and countries, the most in-demand occupations or specialties did not exist 10 or even five years ago, and the pace of change is set to accelerate. By one popular estimation which is frequently cited, 65% of children entering primary school today will ultimately end up working in completely new job types that do not exist yet. In such a rapidly evolving employment landscape, the ability to anticipate and prepare for future skills requirements, job content and the aggregate effect on employment is increasingly critical for businesses, governments and individuals in order to fully seize the opportunities presented by these trends and mitigate undesirable outcomes (World Economic Forum, The Future of Jobs, 2016).

A study conducted in Italy in 2016 by a interuniversity consortium named CRISP together with TAbulaex, a spin-off created by Bicocca University of Milan, has analyzed 121000 job advertisements in the manufacturing sector over the last five years concerning the region of Milan identifying 65 new professional profiles that can be ascribed to the 4.0 technological revolution (Il Sole 24Ore, Nuove professioni da Industria 4.0, 2016). Moreover, even the existing jobs are going through a change in the set of competences needed. Tomorrow workers and employees will be requested to do more in terms of managing complexity, problem solving, acting autonomously, possessing communication skills and being able to organize work activities with their colleagues. Shortly, they will be asked to put in place more and more their own potentialities and abilities which appear necessary for improving the quality of their work, ensure a more interesting environment and facilitate their professional experience (Magone, Mazali 2016).

So, the implications of the technological innovation on the work in the factory are complex and significant. On the one hand we are witnessing to the birth of new very specialized profiles with high technical skills whilst on the other we notice that some professions are disappearing or getting impoverished. Surely, decision-making and digital skills will become essential.

Within an enterprise willing to adopt the Industry 4.0 model, the role of competences is therefore decisive. The use of enabling technologies requires specific technical skills whilst the new business models and the penetration of highly competitive markets need advanced managerial skills and the complexity of production processes and organizational models necessitate new transversal competences. All those needs require a proper management able to adopt a specific competency model contributing to define and classifying the professional profiles and their functions.

According to Prifti et al., Competency Model is a valid, observable, and measurable list of the knowledge, skills, and attributes demonstrated through behavior that results in outstanding performance in a particular work context (Prifti et al., 2017). The construction of a competency model requires techniques and tools which can vary depending on the company. For the purpose of this paper it is useful to report an example of model for industry 4.0 which does not refer to a specific company but that can be applied to whatever business intends to implement the principles of the new paradigm and adopt the main enabling technologies. The model suggests a scheme identifying eight big categories of skills referring to the main aspects of the work activity. Those big eights are in turn divided in twelve dimensions of competency which originate a bigger number (112) of specific competences, both transversal and technical divided into three standard training paths (information systems, computer sciences, engineering). On the base of those skills, it will be possible to detect the behaviors corresponding to a correct and performing execution of the competences, in line with the objectives and strategies of the company.

The model above, based on the SHL Universal Competency Framework developed by CEB Inc.1, is based on different competency approaches from research and practice. Other models are present in literature or are about to be published identifying the different competences and organizing them into diverse categories such as soft skills, hard skills, interdisciplinary skills and so on.

Of course, those models are quite exhaustive and this kind of research is extremely valuable but do not help replying (of course it is not its purpose) a crucial question: *who is going to teach those competencies? How and by whom trainers will be trained to convey those skills?*

Today the institutions which are responsible for the creation of new skills and knowledge like schools and universities are in a difficult position due the rapidity of transformation. Firstly what it is needed is “learning to learn”, i.e. to be open towards innovation and accept that the new knowledge may not have the time to be included and codified in a classic textbook but has to be considered like a liquid knowledge from which all concerned people can draw and to which all concerned people have to contribute for further development.

Schools, universities, public and private institutions have to combine the traditional capability to provide a basic cultural education with the ability to offer new contents with a rapidity of change which is unknown at the moment.

At present, apart from big companies, SMEs come into direct contact with the new technologies in a not structured way. Even universities, apart some excellences, do not have a systemic and unique approach. The public debate about a potential *training 4.0* has started but it has not been realized yet that the production of knowledge has a rapidity which is not consistent with the usual times of traditional training and with the generational replacement of teachers.

For this reason it is necessary that the development of competences becomes a central pillar of the government policies.

Big Eight	Competency Dimensions	Competencies		
		Information Systems (IS)	Computer Science	Engineering
Leading & Deciding	*Deciding and Initiating Action*		• Decision Making • Taking Responsibility	
	Leading and Supervising		• Leadership Skills	
Supporting and Cooperating	*Working with People*		• Teamwork • Collaborating with Others • Communicating with People	
	Adhering to Principles and Values		• Respecting Ethics • Environmental Awareness • Awareness for Ergonomics	
Interacting and Presenting	*Relating and Networking*		• Compromising • Creating Business Networks • Maintaining Customer Relationships	
	Persuading and Influencing		• Negotiating • Emotional Intelligence	
	Presenting and Communicating Information		• Presentation and Communication Ability	
Analyzing and Interpreting	*Writing and Reporting*		• Targeted/Technical Communication • Literacy	
	Applying Expertise and Technology		• IT and Technology Affinity • Economics • Extract Business Value from Social Media	
		• Service Orientation/ Product Service Offerings • Business Process Management • Business Change Management • Understand and Coordinate Workflows	• Network Security • IT Architectures • Machine Learning	
			• System Development • Integrating Heterogeneous Technologies • Mobile Technologies • Sensors/Embedded Systems • Network Technology /M2M Communication • Robotics/Artificial Intelligence • Predictive Maintenance	
		• Modelling and Programming • Big Data/Data Analysis and Interpretation • Cloud Computing /Architectures • In-Memory DBs • Statistics • Data Security		
	Analyzing		• Problem Solving • Optimization • Analytical Skills • Cognitive Ability	
Creating and Conceptualizing	*Learning and Researching*		• Life-long Learning • Knowledge Management	
	Creating and Innovating		• Innovating • Creativity • Critical Thinking • Change Management	
	Formulating Strategies and Concepts		• Business Strategy • Abstraction Ability • Managing Complexity	
Organizing and Executing	*Planning and Organizing*		• Project Management • Planning and Organizing Work • Management Ability	
	Delivering Results and Meeting Customer Expectations		• Customer Orientation • Customer Relationship Management	
	Following Instructions and Procedures		• Legislation Awareness • Safety Awareness • Individual Responsibility	

Big Eight	Competency Dimensions	Competencies		
		IS/Economics	IT/Computer Science	Engineering
Adapting and Coping	*Adapting and Responding to Change*		• Work in Interdisciplinary Environments • Intercultural Competency • Flexibility • Adaptability and Ability to Change Mind-set	
	Persuading and Influencing		• Work-Life Balance	
Enterprising and Performing	*Achieving Personal Work Goals and Objectives*		• Self-management and -organization	
	Entrepreneurial and Commercial Thinking		• Business Model Understanding • Entrepreneurship	

Figure 1: "Industry 4.0" Competency Model

3. THE CREATION OF NEW SKILLS: THE ITALIAN NATIONAL APPROACH TO INDUSTRY 4.0

Industry is one of the pillars of European economy since it involves more than 33 million people across more than two million companies in Europe. But it also accounts a strategic component which is much more important than its GDP may suggest. Indeed as Chrisophe Sirugue, the former French Secretary of State of Industry declared, industry accounts for 64% of European R&D, and economists estimate that each additional job in the industry creates between 0,5 and 2 jobs in other sectors.

That is why the evolution of the economic system towards the adoption of Industry 4.0 technologies is supported by diverse policies in many industrialized countries. Many governments have recognized the scope of the digital revolution and have designed specific programs for the development of Industry 4.0.

Obviously, the referential concept as well as the implementation modalities differ in each country reflecting the related industrial, cultural and economic diversities. Each nation has its own industrial tradition, its own way of doing business, its own approach to data privacy and so on.

More than 30 national and regional initiatives for digitizing industry have already been launched across Europe in recent years. Examples at national level are Plattform Industrie 4.0 in Germany, Industrie du Futur in France and Piano Nazionale Industria 4.0 in Italy.

Surely, all the national initiatives recognize the importance of identifying and developing the new skills required and have envisaged strategies on how to develop them. Certainly, it is very hard to predict and develop training contents and profiles for the population affected by present and future transformations and, above all, it is very difficult to prepare trainers able to transfer the new competences.
Italy, which is the second manufacturing country in Europe after Germany, has launched in 2016 the Piano Nazionale Industria 4.0, a plan allocating 13 billions of Euros aiming to:

1) reinforce innovative investments (by increasing money in research and development activities and by strengthening financial services supporting start-ups and innovative companies)
2) enhance the relevant public instruments (in order for example to strengthen and renew the international market penetration)
3) favour the development of the enabling infrastructures (through a plan for developing the ultra-wide band and the collaboration at a European level to defining standards and criteria of interoperability, especially in the expansion of IOT)
4) develop competences (through the creation of competence centers and digital innovation hubs, by increasing PhDs and disseminating a 4.0 culture even at a school level).

Figure 2: Italian National Plan pillars

A central theme of this initiative is to boost the competitiveness of Italian companies through the development of necessary skills at both vocational and university/school level.

In this respect, the initiative has set the following objectives by 2020:

- reach 200.000 new academic students and 3.000 managers qualified on Industry 4.0 topics by innovating study curricula to train student on new digital and Industry 4.0 skills
- have 1400 more industrial PhDs focused on Industry 4.0 topics
- increase from current 9,000 to about 20,000 the number of students enrolled in ITS (Advanced Technical Institutes)
- incentivize training 4.0 to protect and reinforce employment through 40% tax credit on labour costs of personnel following training courses in Industry 4.0 topics
- develop the National Network «Impresa 4.0» made by: a) «Punti Impresa Digitale» (Digital Enterprise Points) based on the national network of chambers of commerce and aiming at spreading awareness and basic knowledge of Industry 4.0 technologies b) *Innovation Hubs* aiming to provide advanced training to specific organizations and coordinate digital transformation and tech transfer structures c) *Competence Centres* that intend to provide advanced training and development of research projects on industrial research

According to Lombardi (2017), despite education is one of the main pillars of the national plan, it is still very hard to notice a real focus on the training process of the operators and the workforce that will be involved in Industry 4.0 for the years to come. He identified the cause in the following reasons:

- the lack of funds
- a "traditional" cultural approach of many stakeholders
- a lack of awareness of the importance to develop new competencies
- the extreme variability due to the rapid evolution of technology and the dynamics of the knowledge in many sectors which force to elaborate training strategies in conditions of high complexity and uncertainness

Actually, a further reason should be added to the list above, i.e. the poor *training of trainers*. The system created has its force and validity but it seems to lack on this specific aspect. Have academic professors the appropriate preparation to convey the new skills? Have teachers from school really understood the scope of digital transformation? Are innovation hubs and competence centres able to provide the proper training to companies?

4. THE USGM SUGGESTED MODEL

In order to face those questions and in the meanwhile the central government defines a roadmap even for the training of trainers, educational institutions have to adapt to the changed conditions and increasinlgy align their current model of pedagogy with the company requirements.

An example of this attempt is provided by the Università degli Studi Guglielmo Marconi which is closely working with important players from the industrial sector in order to create courses containing contents coming directly from the field. This does not mean that the university simply receive and follow the indications of companies but that both parties work together, side by side and in a concrete way, to the creation of the new competences through a real exchange of knowledge and methodologies. The first experimental project in this respect concerns the agreement signed by USGM and **Baker Hughes, a General Electric Company®** in October 2017 aiming at creating three new courses developed by a joint team formed by Marconi professors (in this case belonging to the Faculty of Applied Sciences and Technologies) and people from the company.

The new courses have the objective of training students on the new competences in line with the digital industrial strategy of BHGE which involves three different areas: Manufacturing, Engineering and Digital Technology. The aim is to create a new generation of professional profiles who are now absent in the labour market: the *engineers 4.0.*

The three study paths, that will offer students a complete overview of the processes and tools necessary to the definition of the product and of its re-use along the whole production chain, are:

- *Product definition for Industry 4.0*
- *Digital Models for Industry 4.0 applied to work stations*
- *Lean Manufacturing for Industry 4.0*

In the first module students will acquire competences especially linked to Industrial 3D Modelling, in the second they will cope with cloud platforms and data analysis (especially in IoT environment), in the third they will learn about lean manufacturing elements and robotics related to industrial applications. The three courses will be part of a new curriculum orientation to be included in the third year of the Bachelor's degree in Industrial Engineering. The choice of this specific study cycle (Bachelor's degree, 1st cycle) is to give

students a realistic chance to access the world of work after three years of study thanks to the acquisition of concrete competencies, in line with the objective of the Bologna Process Reform when launched. Moreover the contents, which will be provided in e-learning modality, will also be offered to all BGHE staff who will be trained directly within the company.

The advantages of this project are manifold since on the one hand the university will offer its students the chance to access fresh and innovative contents that are totally different from the traditional ones so overcoming the dramatic problem of skills mismatch which affects the industrial world, on the other the company will have material well prepared and revised from a didactic and pedagogical perspective to be provided to their resources.

Hence, the agreement represents an innovative model of building and acquisition of Industry 4.0 competences since it satisfies a twofold objective:

1. it provides a tool to qualify the existing workforce and prepare students for a world in rapid and continuing transformation
2. thanks to a reciprocal transfer of knowledge and method, it allows to ensure the training of trainers creating a virtuous circle which make it closer academia and industry in a more decisive way

The final release of the courses is envisaged for early June 2018 whilst the official presentation to students will be held in September 2018.

5. CONCLUSIONS

Before being technological, the Fourth Industrial Revolution is firstly cultural, since it concerns the way of thinking about the industrial goods, the system of working in the offices, the modality of operating in the factories. It affects the relationship and interaction between people and machines and the structures of factories that are increasingly flexible, sustainable and intelligent. It finally regards the relationship among companies since this transformation, born in the big industry, is also permeating the small and medium enterprises (which are the core of the European economic system), modifying the supply chain and the set of competences which are necessary to compete in the market. Surely, who is going to work in this innovative context will not have simply a technical preparation and, above all, will not refer to the traditional learning methodologies.

This will mean that education has to adapt to the changed conditions and has to re-think the current model of pedagogy aligning it with the potential of digitization. In this changing, dynamic and rapid context, a central role is played by universities, especially by those that, driven by the digital transformation, have understood the need to modify university teaching by integrating the traditional learning paths with a set of contents coming directly from the field.

In this respect USGM is trying to reinforce the synergy with companies with the aim to involve them in a direct way in the creation of new contents, in the modernization of its curricula and in the training of its professors though a flexible and agile approach which also allow to rapidly modify and include new inputs in case of new changes and further developments. The university has undertaken this new path in the field of engineering but intends to extend this methodology to other study domains even in the light of creating a community of teachers and company experts characterized by interdisciplinarity and open collaboration which are two further crucial features of the ongoing Industry 4.0 phenomenon.

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CHALLENGES FEMALE EXPATRIATES FACE ON INTERNATIONAL ASSIGNMENTS

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Abstract: *Multinational Companies (MNCs) are faced with many challenges due to globalization. That is why many MNCs are sending expatriates on international assignments in order to properly manage the subsidiary and to make sure that the implementation of the company policies, culture, mission and vision is adequate. Expatriates are a particular group of employees that face different challenges. Based on extensive literature review, this paper researches women expatriates and the challenges they are faced with on international assignments. Furthermore, it reviews the position of women on international assignments and the reasons why are they less likely to be found in the role of an expatriate than men. However, the evidence today shows overwhelmingly that women can and do succeed at working abroad. Having this in mind, MNCs should do their best to plan for international assignments more strategically in order to make sure not to exclude women from international assignments. On the other hand, women can themselves use different strategies to increase their participation in international assignments.*

Keywords*: women, expatriate, international assignment, multinational company, human resource*

1. INTRODUCTION

The Global Relocation Trends Survey (2010) discovered that 17 percent of the international assignees in 2010 were women while according to SHRM (2014) women comprise over 40 percent of the employable global workforce. The focus on expatriates in general and great amount of cross-cultural research arose with globalization and internationalization of business. Today, multinational companies (MNCs) are aware of the role that International Human Resource Management has regarding expatriates.

The purpose of this paper is to describe and explain the most common challenges women are faced with while on international assignments. Furthermore, it will review the position of women on international assignments and the reasons why are they less likely to be found in the role of an expatriate than men.

2. MANAGING EXPATRIATES

With the increase of globalization and internationalization of business expatriates have gained immense importance. With that being said, the role of Human Resource Management (HRM) has shifted to International Human Resource Management (IHRM) and has become of crucial importance to Multinational Companies (MNCs) when hiring expatriates. Stahl, Björkman and Morris (2012) define the field of IHRM broadly to cover all issues related to managing the global workforce and its contribution to firm outcomes. Dowling, Festing and Engle (2013) define the expatriate as an employee who is working and temporarily residing in a foreign country. Brewster, Sparrow and Vernon (2007) conclude that expatriates are used by MNCs as means to transfer the corporate culture and strategy to the foreign subsidiary and be there in the preliminary stages of the operations to transfer competence. In order to maintain integration and effective communication between the foreign subsidiary and headquarters, MNCs tend to relocate their experienced staff and executive managers to international assignments in their foreign subsidiaries (Tayeb, 2005).

2.1. Women and men expatriates

The typical expatriate is still a male figure. Even though studies have shown that there is an improvement in numbers of female expatriates the statistics are still in favor of men and indicate that women still make up a small percentage of expatriates (Feltes & Steinhaus, 1998).

According to White at al. (1992) if women were to work that would be considered as a secondary activity since women would have a job rather than career. The perception of a career has been reserved for men where a career is different than a job in a way that having a career would include repeated actions and behaviors associated to work-related activities where then a personal commitment is included.

Extensive existent literature on the topic of "the glass ceiling" comprises evidence from the USA, Europe as well as Australia and notes that women face challenges in their professional carriers that their male counterparts are not faced with. Furthermore, different reviews and cross-cultural studies have been published and have compared both male and female managers regarding their performance and efficiency. Moreover, the research conducted states that in general female expatriates are successful on their cross-border assignments (Caligiuri et al., 1999).

Selmer and Leung (2002) discovered that women had higher interactional and work-related adjustment than men when investigating the adjustment of both female and male expatriates.

Many studies have shown that women repeatedly have better scores then men when considering emotional intelligence (Schutte et al., 1998; Ciarrochi, Chan, & Bajgar, 2001; Ciarrochi, Chan, & Caputi, 2000). According to Deane at al. (2001), women were found to be more responsive to stressors than men while also willing to reach out to get help from others and use the emotions to their advantage. Thus, the conclusion can be made that generally speaking, women tend to be more emotionally intelligent than men and that can be one of the reasons why female expatriates consistently score better than male expatriates on international assignments (Adler, 1987; Caligiuri & Tung, 1998; Taylor & Napier, 1996).

2.2. Historical background featuring female expatriates

Women came to the spotlight during the late 1970's and early 1980's. Izraeli, Banai and Zeira (1980) confirm that substantial number of journals at the time did not reference women executives in international business. After Adler published her ground-breaking work more than three decades ago (1979, 1984a, 1984b, 1984c, 1987), women expatriates came to focus and many other scientists followed. It wasn't until after the mid-1980s that women were even mentioned regarding the management rankings of international business (Schwartz, 1989; Feltes & Steinhaus, 1998).

In her 1984 research, Adler (1984) reported that out of 13,338 expatriates only 3 percent were women. In 1998, Tung (1998) reported that 13.9 percent in her research were women. The Brookfield Global Relocation Trends Survey (2010) reported that 17 percent of all expatriates were women while the Brookfield Global Relocation Trends Survey (2012) discovered that 20 percent of the international assignees in 2012 were women. The most recent Brookfield Global Relocation Trends Survey (2016) reports that 32 percent of international assignees were women in the consumer products industry. As it can be seen from the existing research made so far, the number of female expatriates in the expatriate arena has been rising. However, women are still underrepresented on international assignments and their participation within international assignments remains significantly lower than men's (Florkowski & Fogel, 1999; Altman & Shortland, 2008).

Even though an increasing number of women seeking managerial positions and women that were successfully pursuing executive carriers, the executive suite was still highly resistant to women's access according to the extensive review of female managers in the global economy performed by Adler and Izraeli (1994). Comparable, a more recent research conducted by Linehan at al. (2003) suggested that even though MNCs might be willing to promote female managerial positions domestically in the hierarchy, very few were ready to allow female managers to take their successful carriers on a higher level, international assignments.

3. BARRIERS FEMALE EXPATRIATES FACE ON INTERNATIONAL ASSIGNMENTS

According to Linehan & Scullion (2004) the specific problems that women expatriates are faced with include: 1) burdens of coping with the role of the "token woman"; 2) being a test case for other women; 3) lack of role models and feelings of isolation; 4) strains with coping with prejudice and sex stereotyping; 5) indirect discrimination from fellow employees and employers; 6) the organizational structure and climate.

Other barriers include lack of mentors and role models – especially women mentors (Linehan & Scullion, 2001), lack of female networking (Varma, Stroh, & Schmitt, 2001) as well as lack of social support (Caligiuri & Lazarova, 2002).

In their research, Vinnicombe and Colwill (1995) discovered that both women and men when asked to describe their model mentors, they choose people very similar to themselves. The same authors also suggest that there are few top-level executives that are women, which further suggests that both female and male managers on lower positions will be most likely mentored by a male figure.

According to Linehan (2001), Linehan and Scullion, (2001b), Linehan et al., (2001) and Westwood and Leung (1994) women do not have access to networks and therefore they have less expatriate opportunities. Linehan and Scullion (2004) state that women expatriates should use their networking capabilities to make themselves visible. However, that is not an easy task since women are not as included in the organizational

networks as men and debate is that exactly these networks that can contribute to acceptance and career advancement.

The “old boys club” is very strong in many different organizations and women are excluded because of the traditions, male customs and the negative perception towards women expatriates, according to Linehan and Scullion (2000). They also differentiate barriers due to female exclusion from the “old boys club”, such as: 1) blocked promotion; 2) blocked career development; 3) discrimination; 4) occupational stress; and 5) lower salaries. Breaking into the “boys club” for women is also proven as difficult resulting in women’s inability to reach policy information, opportunities, business contacts, social support, etc.

However, operating within these (male) networks and making relationships is crucial to women’s breaking of the glass ceiling. Furthermore, networking is shown to reduce bias against disadvantaged groups (Kalev at al., 2006), such as women expatriates in this particular case.

As concluded by Linehan and Scullion (2004) the majority of women managers in Europe are not married, meaning that they’re either single, divorced or widowed, or if they are married they do not have children. They state that according to many studies conducted it is usually women who aren’t married and don’t have children while on the other hand men are married and have children.

According to IRC/ORC Worldwide (2007) and ORC/CBI (1992) women expatriates tend to be single. That adds pressure to women expatriates and they feel they must make friendships in order to minimize social isolation as a part of their adjustment process. Some establishments even operate a double standard for marriage, where a male manager is considered an asset while on the other hand a female manager is considered a liability. It is considered that a male figure has stable home support while a female figure will likely abandon her responsibilities due to prioritizing family over work as suggested by Vinnicombe and Sturges (1995).

According to Linehan (2001) women must put in a lot of work to become accepted but also have less time to do so, especially if they have a family to take care of. Therefore, according to Metz (2005), women who are mothers at the same time would have smaller and less close circles than women who do not have children.

Additionally, it has been recorded that women still experience difficulties with different complex laws regarding women employment especially throughout Europe even though European Union has made an effort to standardize employment legislation (Linehan and Scullion, 2004).

There are also many barriers that often prevent women to climb the senior management ladder such as cultural, legislative, corporate, attitudinal, educational and many other constraints. Of course, these differ from culture to culture. Likewise, the role of an ideal manager differs across societies as well, however in all cultures the role is associated with a male figure rather than a female.

4. CONCLUSION

The purpose of this paper was to examine women as expatriates on international assignments. From summarizing the data gathered from various sources such as journals, reports, articles, studies and researches, a conclusion can be made that the expatriate arena is definitely more accepting of women expatriates but barriers for entry as well as bias are still existent.

There is still a big gap between women and men expatriates. Women expatriates have historically been mentioned in the literature around 1980’s for the first time. Since then, many authors have discussed the characteristics, skills, willingness, barriers as well as the satisfaction of female expatriates.

From everything stated in this paper it can be concluded that women are not less competent, capable and knowledgeable than their male colleagues. They seem as ready as they can be to conquer expatriation issues connected with international assignments. As Adler (2002) states, both genders have weaknesses and strengths that are either instinctive or socially conditioned. Therefore, the approach used when investigating this matter should be an optimistic approach - stating that the differences and complementarities of both genders strengths should be celebrated.

Furthermore, Harris (2004) suggests that MNCs need to plan for international assignments more strategically, MNCs need to make the criteria for selection effective for the expatriates and need to carefully review when they are making their selection and make sure not to exclude any groups of employees, such as in this case women while also making sure that the compensation packages are adapted in the way of encouraging women in international assignments. On the other hand, Fischlmayr (2002) adds that women

can themselves use different strategies to increase their participation in international assignments while also using the networks as much possible to their advantage and make sure they let the MNC now they are willing to go on international assignments (Harris, 2004; Linehan, 2000). Women should, according to Adler (2002), also make sure they are at the right place at the right time to make themselves visible when a good international opportunity comes up.

The evidence today shows overwhelmingly that women can and do succeed at working abroad (e.g. Caligiuri and Cascio, 1998; Napier and Taylor, 1995; Stroh *et al.,* 2000). Taking into consideration all aspects and explanations covered with this paper, women must be acknowledged for their constant battle in the expatriate arena while trying to climb the ladder.

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THE USE OF LEARNERS ENGAGEMENT DATA FOR REPORTING: CLUSTER ANALYSIS

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Abstract: *This study consists of learning engagement data analysis using a clustering data-mining technique, with a goal to report the results to an instructor. Clustering is performed based on engagement indicators, which are extracted from log files, attendance data, and the formative evaluation results. Four clusters formed as a result: Enthusiasts, Traditionals, Theorists and The Self-Reliant. The results are presented in a report which can be useful to an instructor who would then be able to orient himself in a virtual setting, form a clearer picture of the student's engagement and develop a distinct approach to the members of each cluster.*

Keywords*: data driven learning, e-learning, learning management, training and development, learning analytics*

1. INTRODUCTION

A "data explosion" in the educational context was recognized even in 1979 when the long-distance learning research was conducted on student success. This research was faced with huge amount of data and lack of adequate data processing tools to cope with (McIntosh, 1979). The quantity of data kept rising over time and this tendency drove the interest for the question at the core of data driven learning (DDL) - what can one reveal about *learning* by analyzing such data? The increase in popularity of the data driven approach in the corporate sector lead to the development of data saving formats, the power of computers and analytical tools also rose (Baker, Inventado, 2014), thus making the technical difficulties of data analysis absolute.

E-learning can lead to an advanced tracking of learner's activities (Welsh, Wanberg, Brown, Simmering, 2003). This tracking is one of the results of the advancement of technology such as web 2.0 (Ferguson, 2012), which can be used to record the interaction of the user with the learning environment. This makes it easier to collect data about the number of sessions in the system, their length, quiz results and time taken to use each learning resource, etc. This "explosion of data" is not complete, as there needs to be a connection between the user and their demographic characteristics. Moreover, adequate sensors can be used to track a person's facial expression, posture, breathing and eye movement (Scheuer, McLaren, 2012). These data sources can give us an opportunity to use a data-driven approach to learning.

Despite the fact that DDL is easier to comprehend in a virtual environment, it is not limited to e-learning. It is possible to turn off the computer and rely solely on traditional learning materials to collect data and make use of DDL. For an example foreign language learning can be done in a traditional setting, relying on traditional materials and still lead to DDL (Boulton, 2010). For a detailed review of research done in data-driven traditional learning, the reader should refer to (Romero, Ventura, 2010).

The literature explored mentions *Learning Analytics* (LA) and *Educational Data Mining (EDM).* LA is used to understand and improve the learning process and setting through quantifying and collecting data which come from learning, as well as the analysis of this data and reporting to the stakeholders (Ferguson, 2012). EDM consists of automatic pattern-finding and structures in big data-bases. (Romero, Ventura, 2007). The difference between these approaches can be summed into three points (Baker, Inventado, 2014):

- The EDM approach is based on automated methods, while the LA relies on a human operator in data analysis.
- The EDM helps understand the relationship between different structural elements, the LA is characterized by a holistic approach.
- The EDM tends to partially or fully automate processes (e.g. personalized student guidance through a learning environment), the LA focuses on strengthening and informing all participants to take further action.

Clustering is one of the data mining tasks that can help to group objects (in this study learners). Learners in the same cluster share similar characteristics, compared to those in other clusters. In this study, we attempt to find how clustering students according to learning persistence data can be used to improve the management of the learning process. There is an assumption that the report about student engagement can help the instructor (by instructor we mean the one who is in charge of the learning process) adapt learning methods to specific characteristics of each cluster. Moreover, this report can be used to enhance the training and learning process in the HR department. The main limitation of our work is that we did not consider the length of the session, but its frequency.

2. THEORETICAL BACKGROUND

Learners tend to drop out the most when switching between traditional and virtual learning environments. Literature suggests that students attending e-learning courses drop out at higher rates than their on-campus counterparts (Levy, 2007). There is a need for studying learner engagement, whether this behavior is linked to a lack of motivation or disorientation in a virtual environment. The instructors might want to know which learning group would pay more attention to learning resources, quizzes, or whether the group is inactive. The instructor could therefore himself administer the learning process, or it could be automatized.

The analysis we conducted according to the EDM categorization belongs to the instructor's reporting based on learners' behavior and is known as one of the most common tasks in literature (Castro, Vellido, Nebot, Mugica, 2007). The goal of reporting is to overcome some of the flaws of e-learning, which can include feelings of isolation among learners (Mazza, Dimitrova, 2004), or instructor's perplexion (Dringus, Ellis, 2005) who can lose any sense of how their learners gain new knowledge. The reports designed for professors contain relevant information such as: the estimated risk of failure to which the students are exposed to during the course (Arnold, Pistilli, 2012), a cluster to which the student belongs to regarding their interaction with each other (Romero, Ventura, Garcia, 2008), timely alerts of detected critical learning patterns (Singley, Lam, 2005) etc.

In DDL clustering which we used in our analysis, belongs to the most common tasks, following the classification. According to the field review that analyzed 242 works, clustering was carried out in 65. (Pena-Ayala, 2014) The problems that are most commonly solved using one of the clustering algorithms (independently or in combination with other techniques) are: identifying important variables that influence the performance, analysis of the surfing behaviour during the interaction with an e-learning environment, to analyze the web log data files of a learning management system (LMS), how to teach a basic computer skills course to students from rural and urban background etc (Dutt, Aghabozrgi, Ismail, 2015).

Log files in DDL appear as a typical source of data (Romero, Ventura, 2010) when it comes to monitoring students (Mazza, Bettoni, Fare, Mazzola, 2012) or predicting their performances (Romero, Ventura, De Bra, De Castro, 2003, Zacharis, 2015). There are examples of their use to analyze students' engagement. Students at the Tel Aviv University were divided into five groups based on their interaction with the Moodle system, which describe their persistence in a virtual setting (Hershkovitz, Nachmias, 2011). A similar approach was applied to a programming language (HTML) electronic learning system to find the disengaged learners. The goal of this study was to create the preconditions that would adapt the learning environment to their needs, meaning to re-engage them (Cocea, Weibelzahl, 2009).

Log files are not the only source of data for learning engagement analysis. With appropriate sensors, one can track the user's pulse, posture, eye movement and so on. An example can be found in the intelligent tutoring system (ITS) which recognizes disengagement and boredom based on the user's eye movement in an attempt to re-engage the student using virtual assistants (D'Mello, Olney, Williams, Hays, 2012).

3. METHODOLOGY

3.1. Research field and population

This study examined log files, attendance data and formative evaluation results of 62 students. The students at the Faculty of Organizational Sciences, University of Belgrade attended two separate courses: e-Education (39 students) and Training and Development (23 students). Two week-long assignments were given so that they were relevant to students from both courses. Their completion, along with the instructor's feedback, lead to a successful completion of the final project. We used the evaluation data of these assignments in our analysis.

Both groups were given a chance to use the same Moodle course on learning during the 2017/18 winter semester to achieve a part (10%) of their final grade. The instructor intended to give the students a chance to

understand the basics of learning in order to understand more specific concepts such as e-Education and Training and Development. This course was available during two weeks and all students completed it. It contained four learning resources and four quiz evaluations, where each resource was dedicated to a specific quiz and contained all the necessary information for completing the quizzes successfully. The students could access each resource and quiz as many times as they wanted, since the goal of the online course was that all students understand general learning concepts. As a result, we gained a diverse student-quiz, student-resource and student-learning-system interactions data.

3.2. Log files

Moodle's log files consist of user actions taken within the course. For an example, actions might consist of viewing the resources and quizzes. Each row in the log file consists of a triplet describing the user, action and time. In total, 4 844 records of 62 students were logged.

3.3. Variables

We extracted multiple variables that show a level of student engagement during learning based on the log files, attendance data and formative evaluations. The System Interaction (INT) consists of the number of times a student has accessed the system, which includes the number of logins, the use of resources and course navigations. The Resource Interaction (RI) consists of the number of times that a student has accessed the learning resources. There are two variables that describe the student interaction with the quizzes: the Quiz Interaction (QI) which shows how many times a student accessed the quiz, looked at the questions and changed their answers, and the Quiz Submissions (QS), which is the number of submissions by which the user confirms that they are satisfied with their answers and asks for the number of points. We extracted the two variables to show differing behaviors during the studying process. There were students who submitted the quiz multiple times and chose random answers to maximize the number of points in one of these attempts. This assumption is supported by past analysis, which recognized such behavior as well and called it cheating the system (Baker, Corbett, Koedinger, 2004). However, some students characterized by a high level of quiz interaction do not always intend to check their answers by submitting them. They might want to navigate through the quiz in order to find the right answer or because they keep changing their minds.

Three more variables were extracted from a traditional learning setting: Attendance (ATT), Formative Evaluation 1 (FE1) and Formative Evaluation 2 (FE2). The first assignment was theoretical (an essay), the second was more practical (making e-learning materials). We made the assumption that the instructor could use the report if they knew which student engaged with which assignment better.

3.4. Data preparation and modeling

During the preparation phase and modeling we assumed that the results of the analysis should be dedicated to the instructor. This means that the report has to be understandable *and* informative to them. We used the RapidMiner Studio, a data-mining software platform, for data processing. Using the log files, we measured the frequency of the interaction with the learning environment, learning resources, quizzes and quiz submissions. These variables, in combination with variables collected from a traditional environment (attendance and weekly results), make up all variables used for this study. The data was discretized by frequency to adapt the report to the instructor's needs. The numerical values were transferred into nominal values by putting each of the numerical values into a finite number of groups (in our case three: below average, average and above average). The discretization of formative evaluation was performed separately for the group that attended the e-Education and the Training and Development course.

Then, the nominal values were turned into numerical values for the needs of clustering. The learner who attended the class below the average value of their peers would be labeled with a 0 in that variable. If their attendance is around the average they would get a 1 and a 2 if it is above the average. The k-Means algorithm was used for clustering. We chose 4 clusters, based on the average cluster distance. The number of max runs was set to 10 and the measure types on numerical measures. At the end, the intra-cluster distance is checked by using Cluster Density Performance operator.

3.5. Ethics

Ethical issues are considered during this research. The de-identification of data was done in data preparation process. Students were informed that data will be used in purpose of knowledge discovery. The both groups had an opportunity to attend the lecture on data driven learning and present students were called to take a role in the discussion about ethical aspects of this field. After all we considered the students' consents as well informed.

4. RESULTS

We extracted four clusters that represent structures that had specific characteristic so that they would be useful for the instructor. The clusters were named based on the centroids characteristics (shown in Figure 1): Enthusiasts, Traditionals, Theorists and The Self-Reliant. The report should not be used to evaluate learners but to create adapted learning environments and approaches to learning.

The most numerous clusters are Enthusiasts and Traditionals. They both contain 21 students each. Theorists have 15 and the Self-Reliant 5 students. The Self-Reliant cluster is significantly smaller than the others, but is kept in this analysis due to the specific behavior that it describes. A further analysis showed that this group of students was derived from the *Theorists* cluster, meaning that if there were 3 clusters, these students would belong to Theorists. The characteristics of each cluster can be found in Figure 1, in a form that is easily read and dedicated to the instructor. The average within cluster distance is -34.14 while intra-cluster distance for each cluster can be found in Table 1.

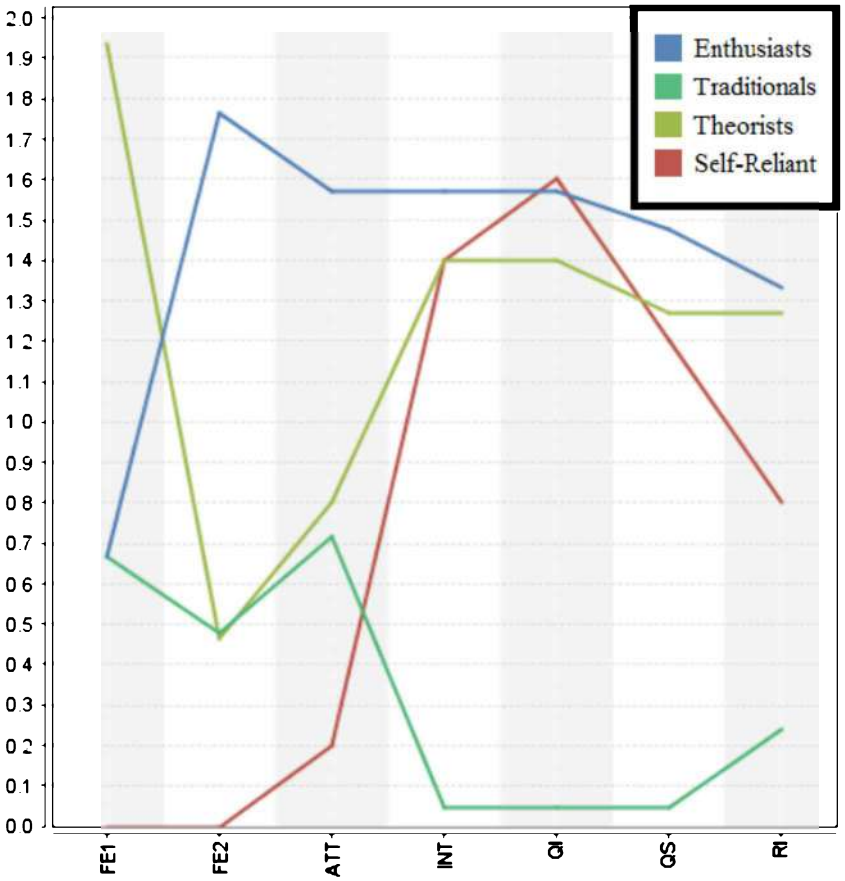

Figure 1: Centroid chart

Table 1: Average within cluster distance

Enthusiasts	-41.426
Traditionals	-38.366
Theorists	-26.996
The Self-Reliant	-7.221

Enthusiasts are characterized by high values in all engagement indicators except for the first week's assignment. The enthusiasts were highly engaged, whether they learned in a virtual or traditional environment. They have better results in a traditional setting on the second assignment and attendance than other clusters, but have worse results in the first formative evaluation. This deviation from engagement in this indicator can be interpreted as an inclination to practical assignments (the first one was more theoretical) or a tendency to estimate the situation before engaging (the first assignment was at the beginning of the semester). The Enthusiasts had the highest scores on the virtual environment variables, except the Quiz Interaction variable. This shows that they might have been well-prepared for the quiz, since they had a high learning resource interaction.

Theorists are similar to enthusiasts in that they are active in a virtual environment. They have a highest score on the *theoretical* assignment, but the lowest score on the *practical* assignment. Since e-learning was based

on reading theoretical texts in a virtual environment in this course, we assume that this shows a tendency for thorough reading and writing. Moreover, their interaction with the resources is not much different than the Enthusiasts'.

The Self-Reliant, the students who belong to the third cluster, have a rich interaction with the system. However, their interaction focuses on the quizzes and they decided to ignore the given resources. Their attendance was below the average value and they did not complete the weekly assignments. An instructor who has no access to a report on the students' performance might label this behavior as disengagement. Based on the findings in the Self-Reliant cluster, we can conclude that they might be autonomous, meaning that they do not rely on provided learning resources. As the number of submitted quizzes is not high, these students did not simply guess their answers hoping that they would get the right answers, but put effort into finding their own, to us unfamiliar, learning resources.

We found a group of students who were the most active in a traditional learning setting, in contrast to other clusters. *Traditionals* have low scores in all indicators including the lowest score in learning in an e-learning setting. They have low scores on formative evaluations, but are present during lectures, meaning the instructor can approach them in the classroom.

5. CONCLUSION

The report about learners' engagement based on the data about their activity can be useful to the instructor to gain new information about the learner, that can be hardly noticed in the classroom. Contrary to what is shown in the literature (Levy, 2007) some learners were more active in a virtual environment, the instructor without this report might consider the members of the *Self-Reliant* cluster as disengaged based on their behavior in a traditional setting. A more detailed description of these learners might lead to designing a better learning approach, which might aid these students.

The instructor can provide guidelines on how to use scientific search engines to self-reliant students to maximize their learning outcome, instead of just providing a final list of learning resources. Members of this cluster could work with Traditionals, who are a complementary cluster with contrasting weaknesses and strengths. Other than a partner who feels comfortable in an electronic environment, the instructor could also aid Traditionals by giving them traditional learning materials. The instructor should at least provide basic concepts this way in order to increase possibilities to learn.

Enthusiasts and Theorists could also benefit from group learning, since they belong to complimentary clusters. While the first group is good at solving hands-on assignments, the other achieves great results in theoretical ones, thus increasing the chances of successfully completing a course for members of both clusters. For Theorists, who are typically not very attentive in class, the instructor can use a virtual environment to assure the acquisition of key concepts. The report gives the instructor freedom to act however they seem fit with the Enthusiasts, since they show above-average scores in almost all categories.

The mentioned actions are suggestions for the instructor, who can decide how to use the report to benefit the class. A complete list of all the possibilities to adapt the learning process is by no means given in this study. The instructor could justify challenging or supporting members of certain clusters depending on the pedagogical/andragogical paradigm and a context in which the learning occurs to achieve the desired results.

The DDL approach stands as one of the tools that the instructor could use to manage the learning process. The instructor could gain insights into the classroom that is in line with the literature, but can also see that the group (or cluster) is governed by different rules. A special advantage is that learning management that is supported by evidence gains a quantified ground, which can be used in justifying decisions, for an example to manage the business organization. This approach calls for interdisciplinarity to supplement the knowledge gained from data by using differing sources such as the instructor's experience and the learning sciences.

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DIGITAL PUBLIC ADMINISTRATION 915

Sašo Matas
EFFECTS OF THE USE OF ELECTRONIC AUCTIONS ON PUBLIC PROCUREMENT EFFICIENCY: CASE OF SLOVENIA 916

István Hoffman, Kristóf Balázs Cseh, Andrea Jugovics
E-ADMINISTRATION AND THE MUNICIPAL AUTHORITIES: THE CASE OF THE HUNGARIAN LARGE MUNICIPALITIES 924

Mária Murray Svidroňová, Nikoleta Muthová, Nikola Štefanišinová
INNOVATIVE WAYS OF CITIZEN PARTICIPATION IN SOLVING MARKET FAILURE 932

David Póč
PUBLIC POLICIES STRATEGIC MANAGEMENT AT THE REGIONAL LEVEL – MYTH OR REALITY? 941

Ivan Todorović, Stefan Komazec, Đorđe Krivokapić
KNOWLEDGE OF THE EUROPEAN UNION REGULATIONS ON PUBLIC PROCUREMENT AT THE LOCAL LEVEL IN SERBIA 949

Slađana Benković, Dejan Stanković
FINANCIAL MANAGEMENT CAPACITY BUILDING IN PUBLIC ADMINISTRATION BY UPGRADING KNOWLEDGE OF EMPLOYEES IN AREA OF INFORMATION-COMMUNICATION TECHNOLOGIES 956

Ernad Kahrović, Veljko Dmitrović, Zenaida Šabotić
PUBLIC MANAGEMENT: COMPARATIVE ANALYSIS OF THE APPLICATION OF THE PARTICIPATIVE BUDGET CONCEPT IN THE COUNTRIES OF THE FORMER YUGOSLAVIA 964

Miloš Milosavljević, Kristina Đurić, Jasmina Dlačić
THE EFFICIENCY OF ONLINE CONTENT IN POLITICAL CAMPAIGNS 973

Tatjana Stojadinović, Ilija Antović
DIGITAL TRANSFORMATION IN PHARMA INDUSTRY 980

Rajko Ković
THE ROLE OF OUTSOURCING IN IMPLEMENTATION OF PUBLIC-PRIVATE PARTNERSHIP CONCEPTS 988

EFFECTS OF THE USE OF ELECTRONIC AUCTIONS ON PUBLIC PROCUREMENT EFFICIENCY: CASE OF SLOVENIA

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Abstract:*In the late 1990s online auctions were developed and oftenused to getan advantage inevolving internet technology and software tools. Not much later, in the 2000s, public procurement procedures were enhanced with non-mandatory usage electronic tools, and one of the mostrenownwas the useof electronic auctions. Sinceelectronic auctions are marketed and favoured for their efficiency, we searched for data fromelectronic auctions in public procurement procedures in the Slovenian government. We discoveredthat some parameters, such as competition, can influence the efficiency of procurement procedures, but some others, such as the procurement size,donot.*

Keywords: *electronic auctions, public procurement, efficiency, Symposium, SymOrg2018*

1. INTRODUCTION

In 193 A.D., after killing Emperor Pertinax, Praetorian Guards have sold off the entire Roman Empire by means of an auction. The winning bid was the promise of 25.000 sesterces per man to the Praetorians. DidiusJulianus, who won the auctions, was declared emperor, but lasted only two months before he was beheaded. In the history of auctions since 500 B.C. this is most known auction, and probablyalso the worst example of the winner's curse (Cassady, 1967, Krishna, 2009).

Public procurement plays an important role in satisfying the needs of the public sector. Public procurement is a procedure for satisfying the needs of the public sector and representsan important part of public expenditure asashare of the gross domestic product. In certain EU member states, that share represents 20% of the entire GDP; in 2015 the average in the member states amounted to 14% (EC, 2016). The aim of the public sector is to satisfy the public interest and is in this part thereforesignificantly different from the private sector. This fundamental characteristic characterises the basis for the operation of public markets, where maximising profits substitutes the public interest (Bovis, 2015, pg. 1). Nevertheless, the economic efficiency of public procurement represents an important element of the public interest and one of the core principles of public procurement enabling the contracting authorities to achieve their interest of maximising the benefits of procurement, the latter being summed up in the catchphrase "more value for money".

Notwithstanding the fact that public procurement legislation for the European Unionsingle market, which is regulated identically for all member states by European Directive 2014/24/EU on public procurement (*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, UL L no. 94 dated 28 March 2014 pg. 65*), is based on the equal, non-discriminatory and transparent (trans-border) processing of tenderers. Through the recent EU policy making push in procurement, there has been a growing emphasis on secondary policies of public procurement and a greater focus on economic efficiency, taking into consideration both of the changes in the procurement directives of 2004 (*Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts, UL L 134, dated 30 April 2004, pg. 114*) and 2014. The Directives highlight economic efficiency through an increased opportunity to applyvarious criteria and by stressing the importance of quality as well as by expanding the scope of the electronic tools available in public procurement procedures. Furthermore, after mid-2018, the only permitted method of communication in the procedures (submitting offers) in all the member states will be communication through available information systems.

Another tool for improvingthe economic efficiency of the public procurement process is thedigitalisationof procedures, the electronic public procurement. The European Commission (2014) assessed that implementing electronic procurement may result in potential savings of between 5 and 20 percent. Electronic procurement comprises various cornerstones or components, from the electronic submission of offers tothe electronic verification of evidence and electronic catalogues, with electronic auctions being one of the most important ones. Electronic auctions are not a new developmentin the European public procurement process,

sincetheir use was already permitted by Directive 2004/18/EC. These Directives recognised the benefits of using electronic auctions as tools for allocating contractual relationships more efficiently and transparently, by establishing specific rules of procedure, regulating this technique of public procurement (Soudry, 2004, pg. 341).

Electronic auctions represent a computerised method of purchasing goods, services and works where various tenderers simultaneously bargain with the contracting authorities through the electronic platform and thus compete for winning the contract by transparently quoting lower prices or offering more favourable terms (criteria). Electronic auctions in public procurement play a significant role for the tenderers due to the high level of transparency and ensuring efficient equal treatment of tenderers while simultaneously offering an efficient negotiation tool to the contracting authorities, since negotiations are otherwise prohibited in the transparent proceedings. When speaking of using the computerised tool of the electronic auction in public procurement, this means a reverse electronic auction, leaving regular e-auctions in the public sector to be used as a tool for disposing of or selling-off of tangible property (Bastaet al, 2016, pg. 263).

2. AUCTIONEERING AND ELECTRONIC REVERSE AUTIONS

Auctions have been used for over 2500 years, but they entered the economics literature only relatively recently. Vickrey (1961) was one of the first to recognize the game-theoretic aspect of a problem, and he made enormous progress in terms ofanalysing it and developing the Revenue Equivalence Theorem, and his papers of 1961 and 1962 were a major factor in receiving his 1996 Nobel prize (Klemperer, 2004, pg. 15).

One should not be confused by theterminology and different auctions inauction theory. There are four basic types of auctions, the ascending-bid auction (also called the English auction), the descending-bid auction (also called the Dutch auction), the first-price sealed bid auction and the second-price sealed bid auction (also called Vickrey auction). In public procurement, market goods are sold and so we refer here to reverse auctioning. When using internet auctions in public procurement, we used the English-type of auction, also known as the reverse version. There is no formal distinction between normal auctions in which the auctioneer is the seller and the bidders are buyers and public procurement auctions, where the auctioneer is a buyer (Klemperer, 2004, pg. 15).

Electronic auctions entered public procurement domain relatively quicklyafter they were used in B2B and B2C. In Directive 2004/18/EC electronic auctions were introduced '*since use of the technique of electronic auctions is likely to increase, such auctions should be given a Community definition and governed by specific rules in order to ensure that they operate in full accordance with the principles of equal treatment, non-discrimination and transparency*' (recital 14). The European Parliament and Council acknowledged that electronic tools in public procurement are ameans of information and communication that can greatly simplify and increase the efficiency of procurement processes (recital 52 od Directive 2014/24/EU).

The economic theory emphasises that auctions, when used properly, have the potential to increase value for money, represent an efficient allocation of resources and increase the transparency in the proceedings of submitting public procurements (Soudry, 2004, pg. 342). Electronic auctions may thereforesignificantly affectthe efficient operation of the public sector and contribute to an (improved) allocation of resources. The use of computerised tools, including but not limited to, the use of electronic auctions in the public procurement proceedings, plays one of the more important roles. Several authors (Stein et al, 2003, Shalev and Asbjornsen, 2010, Tassabehji, 2010) emphasise the importance of electronic auctions in the procedures forreducing costs in the public sector.

This paper focuses on the effects of the auctions on direct savings that arise from the use of electronic auctions and the impacts of several factors on the efficiency of public procurement auctions. We shall examine whether the savings arising from the use of the application e-Dražba*[e-Auction]* of the Slovenian government aresimilar to the savings that were presumably found and noted in other research studies. We shall further examine whether the noted savings are different for the different subjects of procurement and the different types of contracting authoritiesand how individual factors influence the savings. We presume that the savings resultingfrom the use of the e-Dražba application are similar to the savings in other research studies, that they do not differ from one another in terms of the subject and that the savings are affected by both the number of tenderers (offers) as well as the amount of the public procurement.

3. EFFICIENCY OF REVERSE AUCTIONING

Many governments and private businesses have been using electronic auctioning to improve their performance. In 2010 The UK Office of Government Commerce (today Crowns' Commercial Service) reported savings of GBP 50 million in IT hardware using e-Auction over a period of four years, while General

Electric claimed to have saved USD 600 million, or 8 percent of their spending, through e-Auctions (Shalev and Asbjornsen, 2010).

Several studies (Stein et al, 2003, Shalev and Asbjornsen, 2010, Tassabehji, 2010, Hawkins, Coyne and Hudgens, 2010) emphasise the importance of savings in terms of an effective use of computerised tools in public procurement procedures. One of the advantages of the electronic reverse auction is achieving the lowest possible price (Pavel and Sičakova-Beblava 2013), in other words, achieving higher savings than in classic procedures of public procurement, where computerised tools are not used. Savings can be substantial, but some authors caution that the actual effects may be considerably milder and the savings substantially lower (Emiliani and Stec, 2002).

Notwithstanding the various information on the amount of savings, which are based on empirical findings, the conclusion can be reached that there is sufficient evidence to demonstrate that properly used auctions generate potential for the improvement of economic performance or the results of the public procurement procedures (Soudry, 2004, pg. 364).The success of the auctions (meaning the amount of discount) is also affected by the number of tenders submitted. Since the tenderers look for opportunities, among other reasons, in order to compensate for lower profits caused by lower prices, higher contract values attract a higher number of tenderers. Studies have shown that the size (scope) of the public procurement affects the number of tenderers, which affects the success (savings) of a public procurement (Shalev and Asbjorensen, 2010, pg. 433).

The literature emphasises the importance of the number of tenderers in procedures as a factor, guaranteeing the success of the auctions. Classic procurement, which may in a broader sense be understood also as a first-price sealed bid and used in open procedure public procurement format, the tenderer only has one option. The fundamental difference when using electronic auctions is that the tenderers dynamically change (lower) the price only when someone offers more favourable terms. Therefore, a higher number of tenderers must be present in order for the auction to be successful (Shalev and Asbjorensen, 2010, pg. 432). Number of tenderers also plays a significant role in terms of success of the electronic auction, Pavel and Sičakova-Beblava (2013, pg. 122) have found, among other, that the number of tenders in the public procurement procedures, where electronic auction is used, is higher when compared to the classic procedures. Shalev and Asbjorensen (2010, pg. 432) have studied the relation between success of electronic auctions and the size of the auction volume and established that there is no relation between the two.

Electronic auctions should mostly be intended for the procurement of goods and services (save for intellectual services where offers may not be sorted by using the methods of automatic evaluation). Auctions are mostly used for purchasing goods, however, as literature explains, auction is also suitable for purchasing complex services (Tassabehji, 2010, Schoenherr andMabert, 2007), hence, there is no (major) difference between the use for purchasing goods and the use for purchasing services.

Savings in electronic auctions are measured as the difference between the expected price and the contractual amountor the last starting price in the bidding system. This may differ significantly; the usual savings fluctuate somewhere between 5 and 30 percent (Shalev and Asbjornsen, 2010), between 10 and 40 percent (Tassabehji, 2010). Sashi and O'Leary (2002) explain that typical savings in auctions fluctuate between 10 and 15 percent or 15 percent, according to Beall (Beall et al, 2003, pg. 54). Although the savings may be significant, some authors caution that the actual effects may be considerably milder and the savings substantially lower (Emiliani and Stec, 2002). Smeltzer and Carr (2003) state that the savings amount to 5-12 percent. Pavel and Sičakova-Beblava (2013) assess that the savings estimate expressed in two-digit percentage is not realistic. They established that the savings are significantly lower and amounts to no more than 2.4 percent, whereas Singeret all (2009) assessed the savings to be just 3.03 percent.
The success of the auctions is allegedly affected by the number of tenders. Several studies have shown that the value must be large enough to attract a larger number of tenderers and that this compensates the additional costs of the contracting authorities (implementing the system and the expenses related to the management of the system) (Shalev and Asbjorensen, 2010, pg. 433). The higher the value of the public procurement, the higher the potential of savings (NSW Government, 2006. pg. 5). Nevertheless, literature gives examples where even low values attract tenderers, e.g. the American Department of Defense received tenders through auctions where the values were very low, i.e. procurement under USD 10,000 (Turley, 2002, pg.36). Nonetheless, the author further states that auctions bring greater success when the value is significantly higher (over USD 500,000).

The literature stresses the importance of the number of tenderers therefore, in order for an auction to be successful, at least two tenderers should be present; if greater success is intended, more tenderers should be present (Shalev and Asbjorensen, 2010, pg. 432). Authors state that the number of tenders is important for the success of the electronic auction however, these differ significantly across member states. The data

by the European Commission indicate that the number of tenders in procedures in the Eastern-European countries is significantly lower than the average of EU (European Commission, 2011). Pavel and Sičakova-Beblava (2013, pg. 122) establish that procedures, using electronic auction, generate moretenders, namely by 0.7 percent.

The findings of the authors (Singer et al, 2009, pg. 73) stating that electronic auctions with only one tenderers may have negative savings (higher prices), with the savings increasing with the increase of the number of suppliers, are not unusual. With two tenderers (and a small market) there is a high probability that the auctions shall not stay anonymous (which may not necessarily be negative per se; rivalry among the known competitors may even lead to greater savings) however, the likelihood of concerted practices (cartels) is increased. Most researchers thereforesuggest at least three to five suppliers in order to achieve a successful electronic auction (Mabert and Skeels, 2002, Beall, 2003, Major, 2007, Kaufman and Carter, 2004). The relationship between the success (amount of savings) of the auction and the number of suppliers was further recognised by Pavel and Sičakova-Beblava (2013), who both found that each additional bid decreases the costs by 3.4 percent. To the contrary, certain authors e.g. Shalev and Asbjornsen (2010, pg. 441) did not identify a relationshipbetween the success and the number of tenderers. Similarly, Wagner and Schwab (2004, pg. 21) did not.However,Shalev in Asbjornsen (2010, pg. 442) did not identify a relation between the success and the value of the procurement (r=-0.0034). In their research, they established that there is no relation.

4. FINDINGS OF USAGE OF ELECTRONIC AUTCIONS ON EFFICIENCY

4.1 Methodology

We have gathered data derived from application for eAuctions (*eDražbe*) of the Ministry of Public Administration (http://ejn.gov.si/edrazbe), we have analysed several factors influencing efficiency of electronic auctions in public procurement. Findings are based on data form SQL database, on parameters of estimated value, lowest price, contracting authority status (central – non-central), procurement item and number of received bids. In analyse were included auctions from 1.1.2015 to 31.12.2016. There were 198 auctions conducted in period of two-year from central and non-central contracting authorities. Procurements were proceeded for services and goods, for cleaning services, maintenance, IT equipment such as computers, laptops and LAN equipment and stationary material.

Table 1: Descriptive statistics

	N	Minimum	Maximum	Mean	Std. deviation
SAVINGS	198	-0.56	0.75	0.1737	0.19798
NUMBERS OF BIDS	198	1	7	3,35	1.423
STATUS*	198	0	1		
AMOUNT	198	30.74	3767220.00	151949.2010	389045.74640
ITEM*	198	0	1		

* *dummy*

Data was examined through statistical regression analysis, to analyse which of these factors influenced and derived efficient usage of public procurement reverse auctions, where dependent variable is savings and explanatory variables are the number of bids, status (of contracting authorities, amount (value) and group of items (services or goods). In the regression model, we will be using the method of least squares.

4.2. Findings

In this paper we will focus on efficiency of public procurement procedures when using electronic tools, in our case reverse electronic auctions. Our main question is related to the amount of savings, are those savings such as proclaimed in literature and well above 10 or even 20 percent? Furthermore, we are interested in variables that are determining savings, so does number of bids, status of contracting authorities, value of procurement and different groups of procurements influencing savings?

Therefore, we will first check the impact of usage of electronic auction on efficiency or 'savings'. Due to difficulties of measuring the additional costs of conducting the electronic auctions against efficiency gains, the variable success is mostly limited to difference between expected and actual cost of order (Shalev and Asbjorsen, 2010). We have compared estimated value, which by Slovenian law is furthermorea difference between average market prices and price of winning bid. Notwithstanding, expected cost can vary and be subjective estimation, but due to Slovenian law contracting authority need to derive it from and average market price. Therefore,computed savings were of 17.37 percent or 0.1737 of the estimated value of procurement. This finding is aligned with findings of some other authors. But, to realize the exact amount of

savings of usage of an electronic tool, we need to compare it to estimated savings of whole set of (other) procurement procedures. For 2015 and 2016 in Slovenia the difference between estimated value and wining contract, due to yearly statistical reports of Ministry of Public Administration (2015, 2016) was 14.36 percent. Meaning that using eAuctions savings computed for using an electronic tool is 3.01 percent, and this finding confirmed similar findings of Pavel and Sičakova-Beblava (2013) and Singer et al (2009).An electronic auction module was used by 17 contracting authorities, governmental and non-governmental. We have computed the difference between using electronic auction by state contracting authorities and other (non-government). 33 electronic auctions were conducted by non-government contracting authorities, and 165 by governmental authorities. We discovered that the procurement of state contracting authorities are more efficient than non-governmental for 9.6percent (t=2.663, p=0.008). We have used dummies with values 0= governmental contracting authorities and 1=non-governmental contracting authorities. This difference we can probably attribute more not to the experience of different contracting authority but rather to size (quantity) of different procurements, as governmental procurements are, on average bigger than non-governmental. Nevertheless, because of lack of data we don't know the influence of quantities on savings.

The eDražbe module was used for procuring different services and goods. It was not used for procuring works. Is there any difference? We calculatedthe difference in savings between different items, services and goods,and found that there is no statistically significant difference (t=0.525, p=0.600).Average number of bids received per procedure when using electronicauctions is 3.35. In procurement procedures in Slovenia for past three years (2014-2016) was 3.30, so there is no significant difference in average number of bids between classical and electronic procedures.

After first regression analysis (F=5.882, p<0.0001) we found that two independent variables, amount (value) of procurement and items (explained above) are not determining the dependable variable ((t=0.001, p=0.999 and t=-1.181, p=0.239, respectively).Someone would expect that bigger values would attract more competition and thus lowering the price, but we found no effect. This can be due to absolute effect on relative, percentage saving –the bigger the amount of procurement value, more money bidder is losing within the same rabat and exponentially more when lowering it.

Aswe concluded that value of procurement is not determining the savings when using reverse electronic auctions, also, there is no significant difference between auctioning using electronic tools services or goods, so these variables were removed from the model.

After adjusting the model, we included number of bids and status of contracting authorities,

$$y= \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \varepsilon \quad \text{oz.} \tag{1}$$

$$y_{(savings)}= \beta_0 + \beta_{(bids)} x_{(bids)} + \beta_{(status)} x_{(status)} + \varepsilon \tag{2}$$

where we have computed values

$$y_{(savings)}= 0.077+0.034x_{(bids)} -0.096x_{(status)} + \varepsilon \tag{3}$$

with adjusted determination coefficient of model of r2=0.093.

We found, statisticallysignificant (t=3.541, p<0.0001), that each additional bid, on average, lowers the cost by 0.034 units or 3.4 percent, which is similar to findings of Pavel and Sičakova-Beblava (2013). Also, Bulow and Klemperer (1996) show that when bidders are symmetric, an additional bidder is worth more to the seller in an (ascending) auction than setting a ceiling price. They have found that asimple competitive auction with N + 1 bidders will yield a seller more expected revenue than she could expect to earn by fully exploiting her monopoly selling position against N bidders (pg. 190). Meaning that, in public procurement terms and layman quite the opposite claim, it is usually better to have a competition in open procedure (using reverse descending auction) with N+1 bidder then conducting negotiating procedure without publication with limited, N bidders.Meaning that when a contracting authority is to expect one extra serious bidder to appear in a procedure, then it should generally not negotiate and should have an open procedure and use an auction (also, procurement procedures usually does not allow it). As we have seen in our case of an electronic auction on average every additional bidder is lowering cost of procurement by 3.4 percent.

5. CONCLUSION

Electronic commerceis seen as one of the most important tool for increasing procurement transparency and efficiency. Auctions have the potential to increase value for money and represent an efficient allocation of resources and increase the transparency in the proceedings forsubmitting public procurements (Soudry,

2004). Electronic auctions may thereforesignificantly impact the efficient operation of the public sector and contribute to an (improved) allocation of resources. The European Commission (2014) assessed that the implementation ofelectronic procurement may result in potential savings of between 5 and 20 percent,withelectronic auctions being one of the most important ones. Therefore, online (reverse) auctions have become a popular method for reducing prices in public procurement too. Many governments around the world, including Australia, Canada, France, South Korea, Portugal, the United Kingdom, Chile, Colombia, Estonia and many others, as well as thousands of private sector entities, make extensive use of electronic auctionsin order to conductbusiness more efficiently.

As we have noted, savings merely using an electronic tool was not as expected or claimed by many authors. An average, saving of a slightly more than 3% in electronic auction should put, consideringmanydrawbacks, questions marks as often as straightforward decision of using it. Electronic auction can't be panacea and most important answer for seeking an efficient public procurement, governments should also be aware of wider impact. A lack of competition can drive prices up and risk-averse bidders will seek other opportunities. In smaller procurement markets, electronic auctions can drive to more collusion and one should be careful auctioning complex project. In tense competitions, prone to social dumping in some sectors, care should be focused on theside effects of using auctions, especially in work-intensity services. An old saying goes that you can squeeze a lemon only once. Maybe there will be some for a second time, but for the third there will be nothing to squeeze.

We have seen that the size of the procurement didnot influenceefficiency. However,in general we noticed that somecontracting authorities were more efficient than others. A plausible answer would be that the central government contracting authorities are procuring bigger quantities that non-government authorities. There is also no significant difference between theaverage bid received per procurement in theclassical and electronic procedures.

Using e-Auctions as efficiency driver is an important, but minor factor. It is far more important to attract more competition, which is a confirmation of the Bulow and Klemperer (1996) competitionclaim. It is far more important than usinge-Auctions to boost competitiveness in public procurement procedures. Every additional bid, on average, reduces prices by 3.4%. Basic procurement principles should thus be respected, not only for the rule of law, but also for promoting economic efficiency. A procurement process that demonstrates transparency, equal treatment and non-discriminationshould be the cornerstone of every public procurement procedure. Lowering the entering cost of economic operators in public procurement markets and assessing the wider competition should be one of the most important policiesfora government. Moreover,full electronic procurement with more automated and re-usable tools, with easier and faster inclusion delivery and lowering operational costs should be one of the most importantfactors.

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APPENDIX

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,320[a]	,102	,093	,18855

a. Predictors: (Constant), STATUS, BIDS

ANOVA[a]

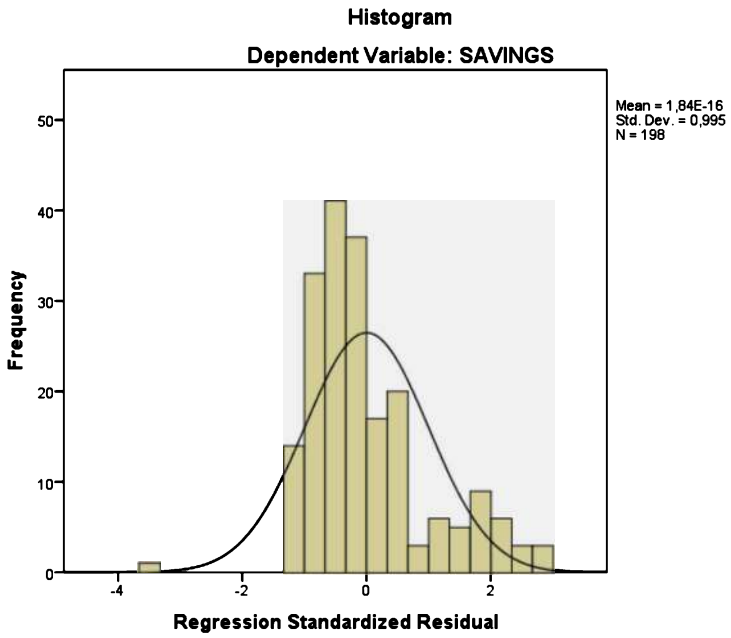
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,789	2	,395	11,101	,000[b]
	Residual	6,932	195	,036		
	Total	7,722	197			

a. Dependent Variable: SAVINGS
b. Predictors: (Constant), STATUS, BIDS

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	,077	,036		2,158	,032		
	BIDS	,034	,010	,242	3,541	,000	,986	1,014
	STATUS	-,096	,036	-,182	-2,663	,008	,986	1,014

a. Dependent Variable: SAVINGS



E-ADMINISTRATION AND THE MUNICIPAL AUTHORITIES: THE CASE OF THE HUNGARIAN LARGE MUNICIPALITIES*

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Abstract: *Digitalisation could be interpreted as one of the tools for the economic development. In this article the regulation on the e-administration services and the practice of the large Hungarian municipalities (the municipalities with more than 100 000 inhabitant – except Budapest capital city) will be analysed. If we look at the regulation it was focused on the development a horizontally integrated e-administration. Although the acts on this system have been passed in the last years, and the former restrictions of the electronic administration have been eliminated, but the practice of the Hungarian e-administration is partly different. The municipal e-administration systems have been built by the largest municipalities, but their operation could be further developed. Although these local interfaces could be developed and the accessibility of these pages are not always perfect, but the e-administration have been extended after the reforms of 2014/2015. These services focuses on those sectors which have direct links to the local economic development. The main fields of the municipal e-administration are the administration of the local taxation, the construction administration and the administration of the commerce.*

Keywords*: digitalization, e-administration, Hungary, urban areas, digitalization of municipal authorities, economic development, municipal administration*

1. INTRODUCTION

Today, the digital revolution has also caught up with the administration. E-governance has many advantages. For example, clients are not tied to office hours, do not have to meet with officers, they can access information more easily, and many tools are available to help them make decisions (Bowman & Kearney, 2016: 223). The *e-government* is an umbrella term: in the literature it covers the government innovation and the government information and services. The concept of *e-democracy* is distinguished by the literature: it covers the topics on the e-participation and e-voting issues (Paskaleva-Shapira, 2009: 71). The aim of e-government is often referred as the paperless office, which means that electronic administration converts paper processes into electronic processes. E-government creates a lot of ways that in governments and citizens can communicate with each other. As a result, clients become the actors of the administrative system (Wohlers, 2010: 89-90). Therefore the e-government is interpreted as a tool of the economic development. The simplified procedure, the automatization of the decision making could accelerate the procedure. This could result reduction of the administrative cost. Therefore the investment in e-government is considered by the literature as an investment in the economic development (Joseph & Kitlan, 2008: 2-4).
Our presentation is based on the research project of *Territorial aspects of the economic development* co-funded by the European Union. The focus of the research is the role of the Hungarian urban areas and urban governments in the economic development. Our team – which is based on the Department of Administrative Law of the Eötvös Loránd University (Budapest), Faculty of Law – does the researches on the role of the municipal administration of the large Hungarian towns in the field of economic development. This research is a part of a complex analysis. As we have mentioned earlier, the digitalisation and the innovation in e-Government could be a tool of the economic development.
As we have mentioned, our research and presentation focuses on the role of the municipal administration in the field of the economic development, especially the role of the municipalities as authorities. Thus the analysis of the digitalisation of the municipal authorities will be reviewed by this presentation. Therefore the central elements of our review are the analysis of the legal regulation on (municipal) e-Government and e-Administration and secondly the review of the digitalisation of the Hungarian urban authorities and especially the accessibility to these e-tools.

2. METHODS

In our research, we examined Hungarian towns with over the population of 100 000 (which could be considered as large Hungarian municipalities)* – excluded the capital municipality, Budapest, which has

* The research has been founded by the research project "Territorial aspects of economic development" – founded by the KÖFOP-2.1.2-VEKOP-15-2016-00001 (project leaders: Prof. Dr. János Rechnitzer and Györgyi Nyikos PhD).

special status and a two-tier municipal model – to find out in which cases and in what way they provide electronic administration services. First of all, our analysis is based on the methods of the *jurisprudence*. Therefore firstly the concept and the legal regulation on the digitalisation of the administrative services will be reviewed, especially the services provided by the Hungarian urban municipalities. As part of this analysis the basic elements of the concept of the e-administrative services will be shortly shown.
The presentation contents an empirical analysis, as well. Thus we have visited the websites of these towns. On the websites, we visited the electronic administration interfaces to examine what types of administration opportunities are provided by them to the clients. The accessibility to these services has been reviewed, as well. If it was allowed, we tried to enter the electronic administration interface with the official government portal (*Ügyfélkapu* literally translated: 'customer gate').[†] In other cases, we looked at what electronic forms and e-papers are available on the website. We also investigated whether information on electronic management opportunities could be available. After that the results of the tests have been compared to find out which typical cases were the possibilities of electronic administration at the local government level.
Thus the expectations – the legal regulation – and the reality could be compared. Not only the legal regulation have been analysed but we tried to examine the reality of the e-administration of the large Hungarian municipalities.

3. THE ANALYSIS OF THE REGULATION ON THE EGOVERNMENT IN HUNGARY

Firstly, we would like to examine the analysis of the regulation on eGovernment, especially on the e-tools of the authorities in Hungary. After this analysis we would like to review the actual situation of the e-administration in the large Hungarian municipalities. But as a preliminary issue, we would like to analyse the interpretation of the e-services, especially the e-services of the Hungarian municipal administration.

3.1. Municipal e-administrative services

The e-services are different and the different stages of e-administration is distinguished. Four main stages of the e-government development are distinguished. This classification is based on the integration of the different services and on the complexity of the structures and technology. The first stage is the *catalogue,* in which the online presence of the government is provided, the main tasks are catalogued and the several forms could be downloaded. The second stage is the *transaction,* in which the services and forms are online and the online transactions are supported by several working databases. The third stage is the *vertical integration,* in which the local systems are linked to higher systems (within similar functionalities). The fourth stage is the *horizontal integration,* in which the systems with different functions are integrated and a real one-stop-shop is provided (Layne & Lee, 2001: 124-125).
It is highlighted by the literature, that significant investments are required to fulfil these aims (Heeks, 2006: 107). But the e-government technologies have several prerequisites. After Layne and Lee three vital condition should be fulfilled to implement a successful e-government reform: universal access to the e-government tools, the defence of privacy and confidentiality and – last but not least – the citizen focus in government management (Layne & Lee, 2001: 134).
The accessibility to these services is an important element of the characterisation of the systems. The international standard is based on different indicators. One of them is the *number of the clicks* to access the given service. Formally a hidden information could fulfil the accessibility, but the growth of the number of the required clicks could reduce significantly the accessibility to the services. Therefore the *clearness of the link* to the services is an important element of the analysis (Garson, 2006: 440-441). These elements are mainly tested by the international researches, and in our methodology we tried to – at least partly – examine them.
As we have mentioned earlier, the several issues are covered by the concept of eGovernment. Thus the services and decision making of the authorities and its automatization and the improvement of the electronic accessibility of the different procedures are interpreted as a part of the eGovernment. But this concept has a broader interpretation: the e-Democracy and the citizen's participation are defined as an important element of the eGovernment, as well. Both sides of e-government are focused by the literature on local e-government and both sides have a significant role in the field of the recent administrative reforms (Pollitt & Bouckaert, 2017: 125-127). As we have mentioned, the central element of our research are the administrative activities of the municipalities, especially the municipal authorities. Therefore in this presentation a narrow interpretation of e-administration will be used: the e-services – especially the accessibility and the automatization of the decisions of the municipal authorities – will be reviewed by this presentation and the citizen's participation and the access to the public information will be analysed just tangentially.

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[*] Hungary had 3152 municipalities in 2010. Budapest, the capital municipality has more than 1 000 000 inhabitant (circa 1 700 000 inhabitant). 8 municipality have a population between 100 000 and 1 000 000 inhabitant (practically, the 2nd largest town of Hungary, Debrecen has ca. 200 000 inhabitant). Thus 0,28% of the municipalities have more than 100 000 inhabitant (including Budapest) (Szigeti, 2013: 282-283).
[†] The homepage of the official government portal is: https://ugyfelkapu.magyarorszag.hu/ (downloaded March 27th 2018).

3.2. Municipal e-administration in Hungary – a short review

The Hungarian public administrative system was a highly decentralised one before the reforms of 2011/2013. After the Democratic Transition a very fragmented and very autonomous municipal system evolved.

Table 1: Population of the Hungarian municipalities (1990-2010)

Year	0-499	500-999	1,000-1,999	2,000-4,999	5,000-9,999	10,000-19,999	20,000-49,999	50,000-99,999	100,000-	All
						Inhabitants				
1990	965	709	646	479	130	80	40	12	9	3,070
2000	1,033	688	657	483	138	76	39	12	9	3,135
2010	1,086	672	635	482	133	83	41	11	9	3,152

Source: Szigeti 2013: 282

The majority of the tasks of the local authorities belonged to the competences of the local bodies especially as delegated administrative tasks of the officers of the Hungarian municipalities. Therefore the general first instance body of the Hungarian public administration was the municipal clerk before 2010 (Fábián – Hoffman, 2014: 330). Therefore the eGovernment issue of the Hungarian local government system became a significant element of the Hungarian strategies and service provision.

In Hungary the development of the municipal e-administration was partly a 'from bottom to top' initiatives, especially in the large municipalities, but it is highlighted, that primarily the local e-administration was a top-bottom initiative (Budai & Tózsa, 2007: 52-55). As it will be shown in the point 3.2. the Hungarian legislation is now tried to realise the 4th stage: a unified government portal has been organised and the local (municipal) systems are integrated in it.

The evolvement of the municipal eGovernment system begun at the end of the 20th century. Several problems have been occurred: firstly, the general administrative knowledge of the citizens and the accessibility to the e-tools were limited (Budai & Tózsa, 2007: 52-55). Therefore – and because of the limited form a bottom to the top approach – the online presence of the larger municipalities were provided in the early 21st century. As it will be reviewed later, the Act XC of 2005 on the freedom of electronic information was a turning point: the first stage and second stage of the eGovernment model should be realised by the Hungarian municipalities. New platforms were developed in this time, firstly in several sectors (for example in the municipal finances, later in the field of construction administration). An integrated national system has been developed after the Millennia, the www.magyarorszag.hu site and the Government Portal and its Client Gate. Originally the municipalities were not fully integrated, but the tendency of integration has been strengthened. After the reforms of 2010 the integration of the local and central was an important reforms issue (Budai, 2013: 134). A new model of the municipal e-administration was evolved after the amendment of the administrative and tax procedural acts, because the municipalities should provide fully electronic administrative platform in the field of local taxes. These transformation impacted the municipal e-services.

3.3. The legal framework of eGovernment in Hungary

It is a main strategic goal for Hungary to modernize its public administration. The goal is to increase the use of modern information and communication technologies in the communication between state institutions themselves and between state institutions and citizens. During the last few years, considerable measures have been taken by the Hungarian government to reform the public administration of the country. The most important results of these reforms include the reduction of administrative burdens and the simplification of administrative procedures.

From October of 2009 (with Act CXI of 2008) the general administrative procedure rules were amended. Electronic communication between clients and authority became available through the use of an online citizen portal dedicated to this end, called Client Gateway. In April 2012, with the amendment of the Act CXL of 2004 on the General Rules of Administrative Procedures and Services by the Act CLXXIV of 2011, and the introduction of the so-called regulated electronic administration services, the legal preconditions for eGovernment services were established (Baranyi, 2013: 222-225). In addition to this, in July 2015 a new law on the Hungarian eID card has been adopted. As the scope of the Hungarian eGovernment developments continuously grew, the need for a separate eGovernment law appeared. Act CCXXII of 2015 on the General Rules for Trust Services and Electronic Transactions (hereinafter referred to as ET Act) kept the achievements of the 2012 reform and further extended the possibilities of electronization of processes.

As of January 2018, a new act regulating administrative procedure entered into force (Act CL of 2016 on General Public Administration Procedures). In Section 26, the new act also regulates the communication of the authorities with clients and utilise the electronic communication means provided by the ET Act as a form of written communication. (It is also allowing electronic communication not in accordance with the ET Act, but that is regarded as oral communication.) The new Procedure Act, according to its general concept, is not containing detailed rules of this form of communication but rely entirely on the ET Act. There is also an option

to deliver the decision by the ET Act, in place of an official document, regulated in Subsection 3 of Section 85 (Baranyi, 2017: 317-319).

According to the ET Act, it is mandatory for municipal governments to provide the option for electronic communication for clients. To be precise, it is mandatory for almost all governmental bodies to provide this option. There are only few exception to this rule: when an act or government decree adopted in a vested legislative capacity creates an obligation for the physical presence of the client, or for the submission of documents that may not be obtained in any other way; where it is not applicable; when it contains classified information or when it is excluded by an international treaty or a directly applicable Community legislation that is binding in its entirety.*

Clients shall have the option to make statements, take procedural steps and fulfil other obligations either through a single, personalized communication interface or through e-governance services platform if it is provided.†

The ET Act contains the general rules of the electronic connection between the body providing e-governance services and the client, as well as the provisions on the IT cooperation between the body providing e-governance services and other bodies. An important provision for local authorities is provided in ET Act. According to Section 1 17. b), local authorities are bodies providing e-governance services which are obliged to ensure electronic administration services as specified in the ET Act from 1 January 2018. ET Act Section 9 (1) paragraph a) and b) also states that electronic communication is mandatory for economic operators acting as clients and for the legal counsels of clients from 1 January 2018. There is an obligation to maintain electronic communication, then any statement not in compliance with this regulation shall be deemed invalid. The only exception under this regulation is when the client can't maintain electronic communication due to a failure of the system on behalf of the authority, when the electronic administration service cannot be accessed or when the required forms can't be reached because of it wasn't provided.

For clients, ET Act does not make electronic communication mandatory but it gives them the opportunity to use this form of communication.

In general, it can be said that in any type of cases local authorities provide the electronic administration services for their clients via electronic form services on their websites or in other cases through e-Paper services. In cases in which it is not possible to use electronic forms, clients are required to use the e-Paper services. In most cases, the electronic form services can be used through Client Gateway, which is the most widely used and most essential eGovernment application in Hungary.

E-Paper is a general purpose electronic application form, a free, authenticated messaging application that connects clients electronically with the institutions and bodies connected to the service via the Internet. The purpose of the e-Paper service is to enable the client to submit a complaint to the authority electronically for those procedures or simple matters which are not supported by a system of expertise for their frequency or other reasons. The e-Paper service is available through Central Identification Agent, at https://epapir.gov.hu.

As we have mentioned earlier, this process requires significant human and financial resources. The digitalisation and the eGovernment investments and reforms in Hungary– as an element of the economic and regional development – is co-funded by the European Union. The support of the digital and e-administration is an important objective of the operational programme supporting the development of the Hungarian public administration and public services (Közigazgatás-és Közszolgáltatás-fejlesztési Operatív Program – KÖFOP). The municipal e-administration projects are funded by this programme, as well (Hoffman, 2017: 105-106).

3.4. Transformation of the legal framework of the municipal e-administration

There is also an online system, called The Local Government Office Portal (hereafter referred to as Portal) which is the location of the e-government administration in the local ASP system. The Portal provides municipalities with a local government ASP system for both natural persons and legal entities, providing the opportunity to use electronically available services for specialist applications.

Through the Portal, the clients can query for a local tax balance, the status of local government affairs electronically initiated by the Portal. They can also initiate an administrative action using it. At present, the local government's tax, industrial, commercial, estate inventory, estate protection, birth and social affairs are supported by system development through the local ASP system. The application provides customers with the opportunity to track the process of their administrative procedures over the Internet. The Portal is mostly used by smaller municipalities, bigger cities both with and without county rights (which are the scope of this paper) normally use their own websites.

Thus, a modern stage 4 e-Government system begun to evolved in Hungary: a horizontal integration of the local, central and sectoral systems is required, as well several administrative services are available only online. These are the expectations, but these expectations are – at least partially – checked by our empirical research. We analysed how this system works in those municipalities which have significant resources.

* See the section 8 of ET Act.

† See section 10 of the ET Act

4. EMPIRICAL ANALYSIS OF THE E-ADMINISTRATION OF THE LARGEST HUNGARIAN MUNICIPALITIES

4.1. The electronic municipal administration – in general

Most of the settlements in Hungary has its own website. Their development differs depending on the financial resources of their local governments. Local governments comply with their statutory obligations in connection with e-governance services on these websites. While the cities which are fall under the scope of this paper have mostly up-to-date and modern websites, the general state of the local government websites is quite unfavourable. Hungary has a fragmented spatial system, and the maintenance of the website is not a priority of the smaller municipalities (Budai 2018: 5-6). The larger municipalities like the ones below usually maintain websites both for administration and for representation purposes too.
In the following we would like to analyse the e-administrative services of the large municipalities. Our analysis *focused on accessibility,* as we have mentioned earlier, and we analysed the possibilities of the digitalisation and automatization, as well.

4.2. Electronic e-administration in the large Hungarian municipalities – an empirical analysis

Debrecen is Hungary's second largest town after Budapest. It is the regional centre of the Northern Great Plain region and the seat of Hajdú-Bihar county. Debrecen is a city with county rights. Debrecen's web page is available via www.debrecen.hu. The website has a page for administration within we can find an electronic administration page and another page for electronic forms. We can access the electronic administration page through client page. For security reasons, it is necessary to register personally at the Mayor's Office Customer Support Center. Only then can the first case be initiated on the online interface. As far as available services are concerned, the only option is the electronic local tax query.1
The situation is different with electronic forms. The page has 10 categories for the electronic forms: e-tax, e-finance forms, e-technical forms, e-administration forms, e-culture forms, e-public educational forms, e-social forms, e-property management forms, e-urban management forms and e-Papers. On each page, we can find information on the legislative reforms of 2018 in connection with the mandatory electronic communication.
E-tax and e-administration pages contain most of the available forms. There are 49 different forms in the e-tax category. We can find forms with these types of taxation: building tax, property tax, community tax, local business tax, municipal tax. The municipal authorities are responsible for the taxation of the vehicle tax, however 60% of the income from this tax belong to the incomes of the central government (Kecső, 2016: 377). They are mainly general notification forms or tax and fee concession forms. The other major category is e-administration. There are very different kinds of forms within e-administration, 46 varieties in total. Most of them are applications for some kind of activity authorisation or activity notifications for example notifications on commercial activity or applications for operating licenses.
Szeged is a city with county rights, the third largest city of Hungary, the largest city and regional centre of the Southern Great Plain and the county seat of Csongrád county. Szeged's website is available via www.szegedvaros.hu. E-services are available via https://eservices.szeged.eu. It contains an information page and a page with all of the available electronic forms. This page contains all the forms, without any category, listed in alphabetical order, making it difficult to navigate. On the side of the page, we can find links to the page of the offices such as Tax Office or Development Office, and on these pages, you can find the forms within the competence of the offices. The main problem is that some of the pages are empty or contains only an information file about the prices for example.
Szeged also has an electronic tax system, in which we can find the electronic forms and we can inquiry our electronic account balance.
Miskolc is the fourth largest city in Hungary behind Budapest, Debrecen, and Szeged. It is also the county capital of Borsod-Abaúj-Zemplén and the regional centre of Northern Hungary. The administration page is available via http://miskolc.hu/varoshaza/ugyintezes. Online forms and online services are hard to find on this website. Also, the search engine does not work properly on the interface created for these.2 For example, this search engine will not drop hits on electronic forms. Electronic forms are therefore difficult to find. There is a longer description for each case type on separate pages. At the end of these, you can find the links to the forms. The main problem is that you can not see exactly that in what kind cases there is available online e-service. Like Szeged, Miskolc also has an electronic tax system, but in this more options are available. For example, you can review the tax declarations and the taxpayer's data, and you can also query the account balance
Hungary's fifth largest city is **Pécs**, which is the administrative and economic centre of Baranya County. Pécs has two main websites, one of them is dedicated to administration (http://gov.pecs.hu/). The other site is mostly dedicated for tourism and it could be reached easier. For electronic communication, there is a dedicated subpage with general information in PDF format (http://gov.pecs.hu/download/e_ugy/altalanos_ugyfeltajekoztato_1_1.pdf). According to this page, clients can initiate their procedures through E-Paper for which a link is provided but there is also information about each

category of action under their subsection. On paper, a client can start a whole plethora of actions in many categories, such as tourism and construction, industrial and environmental administration, agriculture and veterinary matters, social administration and more. It is not easily accessible, there is a necessary authentication but the client interface is not intuitive, and only informational material is available mostly for non-electronic purposes. There are dedicated subpages for local tax with fillable forms and for a status report on ongoing procedures. Amongst the numerous (almost 40) tax-form there is a majority of outdated ones, for previous years.

Westernmost of the surveyed cities, **Győr** is the seat of Győr-Moson-Sopron County and Western Transdanubia region with almost 130 000 citizens. Like all others, Győr has a dedicated page for administration purposes (http://ekozig.gyor.eu/kezdolap). The page contains information and promotes the use of E-Paper for administrative procedures. It also promises downloadable and fillable forms for a couple of categories. Most of them only PDF format forms, only to make non-electronic communication easier. There are some which only can be filled with the use of ÁNYK (*Általános Nyomtatványkitöltő* – General Form Filler Application, mostly used by governmental bodies). For these, there are links and help provided to download and use this software. There is also local tax form both in PDF and ÁNYK format. For construction issues, there is information to use yet another central system designed to specifically for this purpose, called ÉTDR. The website is functional and transparent but there some subpages with a confusing design.

On the opposite side of the country than Győr, there is **Nyíregyháza**, the county seat of Szabolcs-Szatmár-Bereg. With a population of 118,000, it is the seventh-largest city in Hungary and is one of the leading cities of Northern Hungary and of the northern part of the Great Hungarian Plain (Alföld). The city's website (https://www.nyiregyhaza.hu) has a subpage dedicated to eGovernment. Administrative action categorised by the organisational structure of the municipal government – a viable solution for categorisation but can be deceiving for clients. Under each category, there is some general information on administration actions and forms both fillable and non-fillable. The forms which are fillable can be used for E-Paper or ÁNYK documents, there is help for each step of the process of electronic communications. Most of the main types of administrative action are available through the website, under one of the subpages but the site is not easily navigable and there were a couple category and form not working at the time of the survey. There is also a local tax interface. It contains information about each local tax but the forms are on another subpage which makes the navigation unnecessarily difficult.

The county seat of Bács-Kiskun, **Kecskemét** is also a city with county rights over 100 thousand citizens. Its eGovernment page (http://www.ekecskemet.hu/ismerteto) contains accessible information on electronic communication and administrative procedure. It has a clear connection to the Client Gateway website and the E-Paper service. The downloadable forms structured by the organisational system, like in the case of Nyíregyháza and they are not organised after that. You can find the forms for the previous years too. The forms are mostly not fillable PDF files. There are also fillable online forms for local tax, social, environmental and service procedures amongst others. These are given in category groups, in alphabetical order. In every form, the version number and the date of the last update are clearly indicated which make it tremendously easier for clients to inform themselves about the up-to-dateness of them. Moreover, there is information on the judicial electronic procedure, which can also be highly useful for the client. There three available form for the ÁNYK system, these are the most used judicial forms concerning local municipalities.

The city of **Székesfehérvár** located in central Hungary is the ninth largest city in the country; regional capital of Central Transdanubia; and the centre of Fejér county. It is also the last city to qualify for the scope of this paper. The accessibility of the administration website of Székesfehérvár (https://ekozig.szekesfehervar.hu) has several problematic elements (for example there are no easily reached list of fillable form, the client needs to start searching for his necessary files - while it is not a major fault but it is inconvenient). After finding the forms, there is ample help to fill it, most of them can be filled online after authentication with Client Gate. For the local tax procedures, there is another website available (https://eado.szekesfehervar.hu/), but the clearness of the link from the main webpage could be interpreted as a problematic one, it is hardly reachable. The page contains just limited information on the tax issues, the link to the forms are partly broken.

4.3. Discussion of the result of the empirical analysis

The surveyed cities use their website for complex purposes and electronic communication is one of them. They normally make available auxiliary information which is needed for administration. The local regulations are accessible. The websites also used for communication with citizens generally, local news and general (sometimes political) information is the main profile for them. All of the municipal governments surveyed here are maintaining some form of eGovernment websites. Most of them give general information on and the basic means of electronic communication and e-procedure. Generally speaking, the website of the local governments unreasonably difficult to navigate, and they are not answering the challenges of e-government. Almost all of them need some form of authentication to use the online procedures, as a minimum the use of a Client Gate account. The most common development is when some official forms can be downloaded from the home page in non-fillable forms. Some of them have easily used online forms available but in general,

they promote the use of the E-Paper website. We have found on several websites that the information is no longer in line with the legal environment, they refer to legislation no longer in force. In other cases, such information material was not available for clients. Another thing we have been aware of is that these websites are very different from each other, there is nothing common in the information surfaces created by the local authorities the structure is very different for each of the websites. This only makes it more difficult for them to be transparent. To date, there has been no technical solution that would allow effective communication between the client and the civil servant at the office. The general solution is to give information of email addresses and telephone numbers on the website, but these are mostly higher level information, and no direct link between the civil servant and the client.

5. CONCLUSION

The digitalisation and the e-administration are important issues of the public administration reforms of the last decades. The challenges of the new, digital ages resulted the transformation of the traditional administration. These changes could reduce the administrative costs and could accelerate the administrative procedures. Therefore the digitalisation of the (public) administration has strong links to the economic development. Digitalisation could be interpreted as one of the tools for the economic development.
As we reviewed, the Hungarian regulation on eGovernment and on the digitalisation of the public administration transformed significantly. The regulation was focused on the development a horizontally integrated e-administration. Although the acts on this system have been passed in the last years, and the former restrictions of the electronic administration – especially in the field of the administration of the human services (for example in the field of the administration of the children protection) – have been eliminated (Mattenheim et al. 2017: 683-684), but the practice of the Hungarian e-administration is partly different. The municipal e-administration systems have been built by the largest municipalities, but their operation could be developed. If we examine the issues of the e-administration services of the municipal authorities, it is clear, that these systems focuses on those sectors which have direct links to the local economic development. Thus the main fields of the municipal e-administration are the administration of the local taxation, the construction administration and the administration of the commerce. Although these local interfaces could be developed and the accessibility of these pages are not always perfect, but the e-administration have been extended after the reforms of 2014/2015. The reforms of 2016/2017 transformed the regulation but the scope of the electronic administration of the human services in these municipalities is limited. It is clear, that the digitalisation of the administrative procedures and the e-administration services are interpreted by the largest Hungarian municipalities as special tools of the economic development.

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INNOVATIVE WAYS OF CITIZEN PARTICIPATION IN SOLVING MARKET FAILURE

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Abstract:*The development of information and communication technologies (ICT) enables, inter alia, to address the problem of ineffective provisionof publicgoods (free-riderproblem) and emerging externalities. This degree of inefficiency can be reduced by introducing alternative ways of securing public goods on a voluntary basissuch as crowdsourcing. Crowdsourcing taps into a largepoolo find ividuals, primarily online through socialmedia and crowd sourcing platforms, and leverages their networks for greater financial support and advocacy initiatives with a social impact. The aim ofthis paper is to introduce crowdsourcing as a tool for solving public sector failure in the delivery of public goods by demonstrating the factors influencing the achievement of desirable results. This illustrates these effects, we use the method of case study to demonstrate the provision of public goods through crowdsourcing in the environmental policy sector. In the analysis we look at the comparison of selected projects using crowdsourcing. The paper suggests that using a network of crowdsourcing for social impacth a sits externalities, e.g. positive network externalities existifthe benefits are an increasing function of the number of other users.*

Keywords*: public goods, crowdsourcing, crowdfunding, public services*

1. INTRODUCTION

The works of many authors, e.g. Cullis& Jones (1987, 1992), Osborne &Gaebler (1993), Osborne & Brown (2011), Nemec& Wright (1997), MikušováMeričková& Stejskal (2014) discuss the two basic questions of public economics:
1) How can public goods be produced?
2) How can public goods be funded?

An economically rational reason why public goods are to be realized on the political market is that consumers do not take express their preferences whilst consuming it, i.e. the willingness to provide a counter-value for meeting their needs, or simply put the willingness to pay (Arrow, 1962). Individuals are aware that regardless of whether they pay or not, they will not be excluded from the consumption of public goods. This phenomenon is called the free-rider problem in public economics (Bailey, 1999; Jackson and Brown, 2003, Cullis and Jones, 1998, Groves and Ledyard, 1977, Stiglitz, 1997). The lack of expression of consumer preferences in the consumption of public goods (e.g. environmental protection) means that there is no information on the expected ex-ante benefit from the consumption of these goods as would be the case with private goods (e.g. a hamburger). The problem is that if the strategy of the free-rider is applied by all members of a given society, there will be no production of public goods and the strategy itself becomes ineffective.

Table 1: Payoffs from public goods: voluntary contribution versus free-riding

		Outcomes
Strategies	Other contribute (goods provided)	Other free-ride (goods not provided)
Individual contributes	(€10 - €5) = €5	-€5
Individual free-riders	€10	€0

Source: Cullis, Jones, 2009, p. 66

Buchanan (1968) assumes that an individual is one of many who would benefit to an amount of €10 if a level of public goods were provided, whereby the contribution of the individual would only be €5 (Cullis& Jones, 2009). Therefore, if the individual contributes (and others also contribute), the goods may be provided and the individual's net return is €5 (Cullis& Jones, 2009). In the event that other individuals decide to choose the free-rider's strategy, the individual loss to the individual would be €5, without recourse to a refund. The net profit of an individual who became a free-rider is €10. Their outlay is zero, as they are paid by other members of society. Therefore, each individual faced with the decision to contribute voluntarily to public

goods chooses the best "payoff" and attempts to free-ride even though everyone would earn €5 if everyone contributed (Cullis& Jones, 2009).

This assumption leads to the conclusion that the private provision of public goods will be less efficientwhencompared to public and state provision (Špalek, 2011, p. 27). At the same time, however, it must be borne in mind that in the case of a society with hundreds or several million people, the state cannot decide correctly about the types and quantities of public goods provided. The reason is very simple, the state does not know the value of the goods or, they do not recognize the benefits of those citizens who have utilised the goods and do not know the loss (cost) of those citizens who contribute their taxes to the goods but do not use them (Hayek, 1994).

Innovative answers how to solve this public-sector failure, i.e. how to produce and finance public goods, intended to enhance public values such as effectiveness, efficiency, and legitimacy, can be found through collaboration with different stakeholders, delivering interesting social innovations (Voorberg et al., 2015). This approach to the production of public goods can also be defined by the term "public private civil sector mix", which is dealt with by Nemec (in Medveď et al., 2005). According to the author, in the area of increasing public sector efficiency, it is desirable to create situations where individual forms of ownership (public, private profit and private non-profit organizations) compete equally for public contracts, where appropriate, while others are directly involved in meeting the public interest. Also, Horak et al. (2013) argues that the nature of the public-private mix of social service delivery is affected by the processes of centralization of decision making, marketization and contractualisation of service delivery, the growing use of new public management methods, organizational innovation al., 2016), and the increasing networking between state and non-governmental organizations (Vaceková et al., 2017).

Crowdsourcing is a new concept of realising and funding projects with the help of crowds via the Internet. It has been a significant growth trend in the world and whose application and benefits are also noticeable in the public sector. The largest boom in crowdfunding servers occurred worldwide after 2006 and in Slovakia even later (the first crowdfunding portal was established in 2013). Any scientific research on crowdfunding in the CEE region is very scarce, especially when used for funding public services. There was a study conducted in the Czech Republic by Makýšová&Vaceková in 2017, on the sample of the 617 funded projects via the "Hithit" Czech crowdfunding platform, of which 212 were created by non-governmental organizations that also provide public or publicly beneficial services. Based on this knowledge, it is necessary to research crowdfunding more in depth for sourcing public services or services that are beneficial to the community. This was the motivation for the preparation of this paper with the objective of presenting the factors of crowdsourcing for achieving positive changes in environmental protection and demonstrating case studies on the provision of public goods through crowdsourcing as an innovative way with the participation of citizens.

2. INNOVATIVE WAYS OF PARTICIPATORY SOLUTION FOR PUBLIC SECTOR FAILURES: CROWDSOURCING AND WHY IT WORKS

In innovations, information and communication technologies (ICT) have an ever more vital role. ICT have enabled the creation of tools to organize, transmit, store and act on information in digital form in new ways (Atkinson - McKay, 2007). Combined with the reforms of government and public administration in the spirit of the abovementioned public private civil sector mix, many innovations are driven by ICT in the public sector.Wymer (2006) presents the significance of the Internet for non-profit organizations, both public and private. As the limiting factors he sees the availability of ICT equipment and the creativity and knowledge of managers and employeesof public organizations. The Internet is an environment conducive for the development of new trends, e.g. Web 2.0 type applications, and also the use of social media, crowdsourcing (an open appeal to society to get engaged in the preparation and development of a product/service), and a subset of crowdsourcing - crowdfunding (group or community funding), also known as crowdsourced capital.

2.1 Crowdsourcing

Crowdsourcing is connected to the Internet and social networks, creating effective advertising for the project, accessible to a wide range of people from around the world, and can be followed and shared by the support of the relevant person, project, event or campaign. By building social networks, crowdsourcing creates a new dimension to help projects that reflect the interest, passion, attitudes of people to certain problems or situations (Dresner, 2014). Belleflamme, et al. (2013) describes crowdsourcing as a new tool that has not been addressed in scientific literature yet and that we are only now beginning to gain knowledge of it. Crowdsourcing can be understood as a practice of engaging a 'crowd' or group through the Internet for a common goal - often innovation, problem solving, or efficiency. The subset of crowdsourcing, the crowdfunding, is better defined by several scholars. Thus, we define the crowdfunding and we bear in mind that crowdsourcing is a broader term encompassing crowdfunding. According to Sullivan (in Castrataro,

2011), crowdfunding is based on reciprocity, transparency, shared interests and, above all, funding from the crowd. Kleeman et al. (2008) define crowdsourcing as an open call, essentially through the internet, for the provision of financial resources either in the form of a donation or in exchange for some form of reward and / or voting rights, in order to support initiatives for specific purposes. Crowdfunding is a process that takes place on the Internet and helps to increase the volume of capital of organizations through a relatively large number of small quasi-investors. It is a way of meeting the needs not only of non-profit organizations but can also be used by ordinary people or public-sector organizations (Cunningham, 2012). Liu (2015) pointed out that crowdfunding makes not only financial assets more accessible but that distribution of money is more democratic and supports community development. Younkin and Kashkooli (2016) added an interesting view that collecting money through a crowdfunding platform enables finance seekers to gain access to new networks. In the context of this paper, we work with the definition that crowdfunding is an emerging source of funding involving open calls to the public, generally via the Internet and ICT, to finance projects through donations and monetary contributions in exchange for a reward, product pre-ordering, lending, or investment. Crowdsourcing is then also receiving a non-monetary contribution (e.g., information or input) into a task or project by using the services of a large number of people, typically via the Internet.Crowdsourcing has been used for various projects in the profit and non-profit sectors; in this paper, we focus on its use in the public sector to solve the public-sector failures in the field of environment. Therefore, we define several factors that influence the human behaviour and decision-making, as well as can be seen as the principles which crowdsourcing builds on.

2.2 Why crowdsourcing works

In addressing public sector failures in the field of environmental protection, climate change, it is necessary to change the behaviour of individuals, households, companies and public organizations. If we do not perceive the individual as purely rational (homo economicus), i.e. a person who is driven exclusively by "economic" motives in order to achieve the greatest possible material or monetary gain who would choose thefree-rider strategy, but perceive their bounded rationality, bounded willpower and bounded self-interest, then it is possible to achieve desirable the results by means of suitable settings of the conditions in which an individual decides.

According to Mullainathan &Thaler (2000) bounded rationality reflects the limited cognitive abilities that constrain human problem solving. Within bounded rationality, we identified several determinants acting on individuals:

1. **Framing effect**, respectively, the way individuals are presented with individual choices (decisions) that depend on a number of other influences: rational choice (Kagel& Roth, 1995; Špalek, 2011); collective decision-making (Mises, 2006), information asymmetry (Musgrave & Musgrave, 1994; Camerer, 2003; Tullock, 1967; Mueller, 2003), a fiscal illusion (Buchanan, 1998, Fehr and Fischbacher, 2003, Gintis et al, 2003). This means that when making decisions, individuals make certain calculations, taking a number of factors into account - human, social and emotional factors associated with inaccuracies in predicting the outcome of the procedure. The situation where we can encounter the effects of a framing effect is, for example, when contributing to a "charity" collection. For example, if a given NGO has the setting for, respectively the default monthly amount of voluntary contributions, it may happen that individuals will not increase their contributions retrospectively (Dolan et al., 2009). Crowdsourcing and especially crowdfunding determine different support options and varying amounts of financial contributions to eliminate the framing effect.
2. **Incentives,**where the individual's goal is to avoid any loss resulting from the processing and evaluation of that information. For example, if the situation is presented as a loss, individuals may act as risk takers, while in a situation presented as winning, individuals display an aversion to risk-taking (Kahneman, Tversky, 1979). According to Kahneman and Tversky (1979), people have a subversive resistance to a loss that is greater than satisfaction from profit. For this reason, crowdsourcing is focused on presenting a solution that individuals gain from implementing the project rather than what they could lose / be threatened by. Crowdsourcing uses positively tuned instructions, which, as it were, force the "altruism" or highlight the benefits of collaboration on the individual and thus achieve a higher degree of voluntary engagement, as well as public policy-making experiments with negatively tunedinstructionsby means of sanctions. Dolan et al. (2009), regarding the perception of risk, also suggest that it is important for individuals to have an overview or, know what their money was used for, or when their money was used. Individuals want to know what they can do rather than what prevents them from doing so. Campaigns set through crowdsourcing are time-limited, and those involved are always informed about the results.
3. **Priming,** the actions of an individual are influenced by subconscious impulses, that is, if the individual is affected by a particular message (e.g. advertising) before the final decision, the resulting decision may be different. For example, not removing graffiti or illegal landfills may cause the same behaviour in other individuals (Keizer et al., 2008). According to Dolan et al. (2009), whether an individual is ultimately influenced by a particular behaviour depends on the environment (Aarts, Dijksterhuis, 2003;

Greitemeyer, 2009), where the individual is, from what the individual sees, hears or feels when it comes to spreading the message or, in the sense that an individual imitates what they see or hear (Dijksterhuis, Bargh, 2001). The reason for this behavior, imitation, is that the individual has a "need to belong" (Baumeister, Leary, 2000; Caporael et al., 1989; Leary, Baumeister, 2000), i.e. does not want to be alone, wants to be accepted by society. Social networks make this largely possible, crowdsourcing also contributes to community building.

Individuals often make decisions that are not beneficial to them in the long run (bounded willpower (Mullainathan &Thaler, 2000) and may be influenced by news (messenger), i.e. who provided them with the information (Dolan et al., 2009). In practice, this means that individuals are more likely to respond to the news if an expert (e.g. a nutrition counsellor, research assistant) provides them with the information than from a "layman" from the given field (e.g., an article in a magazine) (Webb, Sheen, 2006). Similarly, if there is a certain demographic and character similarity between the expert and the respondent, the efficiency of the relevant intercession is increased, resulting in a desirable behaviour by the respondents (Durantini et al., 2006). An increased willingness to help occurs even if the individual is directly exposed to the victim's suffering (victim effect), e.g. is confronted with a photograph of a suffering individual (Batson, 1987 in Hladká, 2015, p. 57). Crowdsourcing uses video and photo campaigns, e.g. of illegal landfills, and attempts to get people to do something about it, that this problem also affects them. The faces of charismatic personalities are frequently used as the bearers of ideas for such campaigns.

Individual behaviour is also limited by selfish interests. Bounded self-interest incorporates the comforting fact that people are often willing to sacrifice their own interests to help others (Mullainathan &Thaler, 2000). The individual acts in order to have the best possible feeling. If an individual or group in which an individual is present and succeeds, their success is attributable to their skilfulness, but if an individual or group in which the individual is present does not succeed, then their mistakes or deficiencies are considered to be mistakes of others, or mistakes due to other factors determined by a particular situation (Hewston et al., 2002, Miller, Ross, 1975; Ross, 1977). Dolan et al. (2009) recommend that states, respectively, organizations have used this perception of the individual in creating new goods and services. Asking individuals first about something "small and easy", for example, filling in a short questionnaire may result in something "big" (e.g. buying a new product or service). By completing the questionnaire, the individual has expressed their preference and feels the need to buy the given product or service (Bem, 1967; Festinger, 1957 in Dolan et al., 2009). In the hypothesis of crowdsourcing, "something small" is to take a photograph of the illegal landfill, "something big" is to help in its removal.

The way a state or an organization can intervene and influence (change) the behaviour of an individual is, according to Dolan et al. (2009), presenting how many individuals do it in the required way. For example, the Most of Us Wear Seatbelts media campaign to increase the use of seatbelts (Linkenbach, Perkins, 2003) helped increase the use of seat belts by presenting the survey results where only 85% of respondents use safety belts, whereby only 60 % of them are adult respondents. Another example is the repeated use of hotel towels where the hotel informs guests about the behaviour of other hotel visitors and their "recycling", respectively, the repeated use of towels (Cialdini, 2003). Likewise, the repetition and suitability of the information also has an effect on individuals (Allkot, 2011; Golman, 2016), furthermore, the method and forms of dissemination of information, e.g. use of social networks (Christakis, Fowler, 2007, 2008). Social networks also work with crowdsourcing and take advantage of the group's strength to achieve positive externalities.

3. MATERIAL AND METHODS

Private production or consumption can generate costs (negative externalities) or benefits (positive externalities) that are not being internalized, and producers or consumers, therefore, do not pay for the costs or benefits. As a result, these costs are not charged, companies are left behind, and the activities that generate these costs usually have a huge range (Musgrave & Musgrave, 1994). Whilst subsidies can be applied in the case of positive externalities, negative externalities require sanctioning that responds in a certain way to problems associated with a social "ill", such as environmental pollution or the creation of illegal landfills.

In the previous section, we pointed out the need to apply the political process in the case of public goods, because as long as there is no exclusion from consumption there are no voluntary payments and therefore no expression of preferences. However, we are dealing with a problem where neither the state is able to address any negative externalities arising in society. For example, climate change as a consequence of environmental pollution is now an urgent challenge and a potentially irreversible threat to future economic development and well-being (OECD, 2015). The carbon intensity of energy used in human activities has hardly changed since the summit in Rio de Janeiro in 1992, and fossil fuels continue to dominate energy

supply (OECD, 2015). This is why innovative solutions that engage citizens, for example through crowdsourcing, come to the fore.

Various initiatives are underway in the world to tackle climate change (OECD, 2017). These include, for example, projects aiming at encouraging energy conservation and private investment in energy efficiency, promoting the purchase of more fuel-efficient cars, encouraging water conservation, incentivising more sustainable food consumption, preventing waste and promoting resource efficiency, promoting environmental compliance and participation in voluntary scheme and the solution of illegal landfills. Whether an individual will or will not participate in tackling climate change depends on a number of factors that affect their rationality, willpower and self-interest.

From our point of view, the greatest degree of citizen participation in the field of environmental protection as a public good is possible in dealing with illegal landfills in terms of their reporting and the economical use of water resources. To illustrate these effects, we analyse the characterization of selected projects in order to point to crowdsourcing as an innovative way of public goods provision with the participation of citizens.
The method we applied in the analysis is a case study, whereby the case being observed had to meet the following criteria:

- The case study is from the environmental protection sector where the public sector fails to deliver the public service.
- Citizens are involved in solving the issues through crowdsourcing / crowdfunding.
- Possibility of specifying the outcomes of crowdsourcing / crowdfunding use - in order to draw some conclusions about these outcomes, the selected cases need to involve crowdsourcing / crowdfunding initiatives that are no longer in their initial phase but have actually delivered some results.

4. CASE STUDIES: CROWDSOURCING IN WATER SAVINGS AND INTHE SOLUTION OF ILLEGAL LANDFILLS

4.1. Water saving

The case of Columbia: In 2015, Colombia suffered the worst droughts and forest fires in the history of the country due to the climatic phenomenon El Niño. This climate phenomenon influences a large area of climate on the Earth, with the most striking impact on the atmosphere in the tropical and subtropical regions in the Eastern Pacific Ocean. El Niño causes extreme weather fluctuations; in some areas there is a significant increase in precipitation, whilst in others, as a result of drought, a number of fires occur. The Colombian Government has therefore introduced measures to deal with water savings. They introduced incentives for protective measures and penalties for water wastage to reduce water consumption in certain regions. The first was a communication campaign that encouraged citizens to save water. It warned that if citizens did not start water saving, 70% of the city's inhabitants would be left without water. The campaign resulted in increased water consumption because the citizens did not know how to save water. Due to the failure of the communication strategy, the government came up with three simultaneous intercessions. Firstly, they changed the physical environment (distribution of stickers to be placed next to water faucets in order to make the need to conserve water salient at the point of use – OECD, 2017), secondly, by publicly rewarding households that saved more water and publicizing how they had done so, by punishing those who wasted water, and also by making the public aware of an efficient water consumption limitation strategy (OECD, 2017, World Bank, 2015). By using social standards, local government was able to influence the behaviour of individuals, households and businesses, and after eight weeks of campaigning, it was able to reduce water consumption by 13.8% by also making effective use of crowdsourcing. Even though these measures were adopted to address the emergency, they have been reflected in the long-term behaviour of individuals.

The case of Spain: Projects focusing on water conservation include the Esferic "WaterDrop: Don't Feel Guilty About Wasting Water" crowdfunding project, published on the Kickstarter website, which focuses on water capture. The average amount of water that drains away while we wait for the hot water is 3 to 6 litres. The Esferic solution is a thermoplastic polyurethane tote bag that can be hung on a shower and filled with cold water while waiting. The water captured in the bag can be further utilized e.g. for polishing, cleaning, flushing. The goal of the project is not only to sell bags that capture water but change the behaviour of individuals. Esferic is a project of 4 individuals who want to create a huge water-saving community and social movement built on common sense. With people who value important things. Esferic launched the project in December 2015, setting a target amount of €15,000. By January 4, 2016, thanks to 314 contributors, they managed to reach this amount and even exceeded it by €1,680.

Other projects that try to save water include various shower systems. Thanks to dispersing water into atoms, respectively, the atomisation of water can save from 28% to 92% of water. Many similar projects (Altered: Nozzle, e-Shower, Nebia Shower, Methven Rua - Power shower) are published on the

websitewww.kickstarter.com. Thanks to crowdfunding, these projects managed to collect €2,669,471.73 from 16,288 contributors.

4.2. Solution of illegal landfills

In addition to water saving, citizens can also participate in the area of waste management. The continued increase in population raises a dramatic increase in waste production.

The case Sweden: Through an inclusive nationwide recycling strategy, Sweden has been able to transform high-cost waste disposal into a profitable business. Not only can Sweden save fossil energy from renewable energy based on waste recycling, but at the same time it can generate millions in revenue annually by recycling waste from countries such as the UK, Norway, Ireland and Italy. One of the reasons why Sweden is successful in recycling 99% of the waste is (52% of the waste is converted to energy, 47% is recycled and 1% is landfilled) that in the middle of the 20th century Sweden adopted a coherent national policy (Kim & Mauborgne, 2017), which has increased the recycling of waste. The second reason for successful recycling is to educate individuals from an early age. In Sweden, there is even a national day during which children around the country gather together to clean up their surroundings. Teachers, thanks to special training, engage children in practical activities such as creating their own documents, respectively, implementation of a waste policy in schools. By making recycling simple, affordable and comfortable (a recycling station is up to 300m away), Sweden has been able to involve everyone in recycling. Sweden also uses material incentives in the form of discount vouchers as a reward for the use of nearby recycling machines. In new urban areas, it is even possible to use the waste shafts leading to the power generation converters. This means that the waste produced by the inhabitants of a given building is directly transformed into energy that can be used by individual households (Kim & Mauborgne, 2017).

The case Slovakia: projects targeting illegal landfills include the environmental TrashOut project initiated by a group of enthusiasts. The goal of TrashOut is to involve people from around the world in tackling environmental problems by locating illegal landfills while developing an effective solution to fight them. As can be seen from the results of the experiment (Dijksterhuis& Van Baaren, Tabula Rasa and IPR Normag, 2010 in OECD, 2017), the cleanliness around waste bins is a necessity for the population. The problem is not only the generation of waste around the waste bins, but also the creation of illegal landfills. Illegal landfills have multiple negative impacts on the landscape, economy and human health. Illegal landfills can increase the threat of floods due to the narrowing of water flow profiles by landfilling but can also contaminate soil and air. The aim of each country should therefore be to raise their citizens' awareness of illegal landfills and activities that can be developed to deal with illegal landfills by educating people in schools and various projects.

The TrashOut project works on a crowdsourcing platform where individuals use the application to report the type of waste (automotive, building, dangerous, animal skeletons, electronics, communal, liquid, metal, organic, plastic or glass), landfill size (can fit into a bag, wheelbarrow or need to be removed by a vehicle), GPS position, accessibility of the landfill (accessible by car, located in a cave, under water, not for normal cleaning), method of dispatch (anonymously) and a photograph of the landfill. TrashOut, in addition to announcing the existence of a landfill, makes it possible to create a social event for landfill cleaning. Thanks to this application, 42,678 landfills were reported, of which 3,381 managed to be cleaned (Trash Out, 2018).

5. CONCLUSION

Crowdsourcing can be successful only on condition that the activities the project/campaign offers are beneficial for the community and thus contribute to society's sustainable development.Another condition for success is to build a community and/or create a networkofcontributors who are willing to contribute in monetary or non-monetary form so the campaign would be fulfilled and the project realised. Crowdsourcing works with network externalities, which are the effects on the user of a product or service of others using the same or compatible products or services. Positive network externalities exist if the benefits (or, more technically, marginal utility) are an increasing function of the number of other users. Negative network externalities exist if the benefits are a decreasing function of the number of other users. For example, social media likely confers positive network externalities since it is more useful to a user if more people are using it as well.

Crowdsourcing builds on many principles used in creating effective public policies, there are several joint factors discussed in this paper (framing effect, incentives, priming). Yet, crowdsourcing uses the power of a crowdand thus has more effective results than just implementing public policy. The impact of crowdsourcing is also in the education of citizens and changing their behaviour in environment protection. The further research could focus on the crowdfunding part and analyse the amount of public budgets saved, as well as how to manage public project on crowdfunding platforms.

ACKNOWLEDGEMENT

This paper is supported by the FINAC project (FINancial management, Accounting and Controlling for capacity building of public administration), funded with support from the European Commission.

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PUBLIC POLICIES STRATEGIC MANAGEMENT AT THE REGIONAL LEVEL – MYTH OR REALITY?

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Abstract: *The use of the public policies strategic management concept in the new member states is a relatively new experience where we are witnessing implementation of certain strategic goals in one electoral term and its complete abandonment in the very next period. On the regional level the problem is even more eminent, because of the exogenous factors directly influencing possibilities of local governments to take full advantage of the strategic management concept. Even though there has been a significant strengthening of the regional strategic management dimension in the last decade in the Central European region, still there are numerous procedural, ideological or historical obstacles causing inefficiencies within regional public policies. The key problem here is the underestimation of strategic management structural concept and real implications of its implementation on the regional or local level (Mintzberg, 1994). On regional level we can see that there are strategic documents aimed on different public policies – in paper is an example of human resources development area in the Czech Republic regions – are frequently created (like primary and secondary education), but nevertheless there are strong signals that real implementation is questionable. The paper focuses on issues limiting full implementation of a strategic management concept on the regional level, specifically on inability to implement strategic planning on the regional level (Mintzberg, 1994; Kooiman, 1993).*

Key words: *strategic management, human resources development at the regional level, strategic planning, three level strategic management conception, human capital*

1. INTRODUCTION

The possibility of proving a relation between the socio-economic development of a region and the development of human resources is based on the assumed application of certain controlling elements or tools given by legislative, economic, and social conditions of a certain region related to the national or supranational level.[1] Regions in the Czech Republic have only been established recently, their legislative basis is still being developed and their purpose is under ongoing discussion.[2] It is, however, indisputable that **legislation provides them with opportunities to apply certain financial or coordinating tools to influence human resources on "their" territories**.

Given the definition, the author of the paper will be using the term *„strategic management"* which expresses **long-term continuity of certain activities and tools, at least in the medium term (i.e. 8 – 10 years).** Long-term activities projected at the level of states or the European Union is a domain in which first comprehensive treatises based on empirical data of the past decades have not been written until recently. These treatises primarily aim to **identify the correlation between changes of political parties (or the system) related to meeting long-term priorities set by strategic documents (e.g. the Lisbon strategy)[3], or rather the inability to meet them.** For example the publication by Potůček, M. and col. (2007) uses the term *„strategic governance"* defined by many recently published studies (Kooiman 2005, Dror 2001 etc.). With regard to the content of the paper, however, a more suitable term *„strategic management"* will be used which can be, to a certain extent, **differentiated from the former by being defined as a term dealing with a practical realization framework, or the**

[1] The assumption is confirmed for example in Belanger, J.: *From Human Capital to Organizational Learning*. In *Canadian Public Policy.* Toronto: University of Toronto Press, 2002. Volume 28, number 1, p. 143 – 148, where the positive correlation is proved between the necessity of an institutional frame at the state level and the potential of "positive" development in human resources.

[2] The paper will reflect the current wording of Act on regions No. 129/2000 Coll., and Act on regional development No. 248/2000 Coll.

[3] See probably the most comprehensive publication available in the Czech Republic: Potůček, M. and col. *Strategické vládnutí a Česká republika* (Strategic governance and the Czech Republic). Prague: Grada Publishing, 2007. ISBN 978-80-247-2126-2., which also defines a set of indicators to measure the level of strategic governance.

implementation of strategic documents rather than with a general concept of approach to creating certain policies or activities of institutions.

2. STRATEGIC MANAGEMENT AT THE REGIONAL LEVEL

Potůček, M. and col. (2007) distinguishes three main levels in strategic governance, the concept of „strategic management" being tied to the second of them – in simplified version it is the following three levels:

- Mechanisms for creation of strategic documents including their long-term validation in various public policies linked to political systems and their constituents;
- Mechanisms for creation and implementation of particular strategic documents including definition of the set organizational units that will carry out the process, evaluation tool, budgetary planning etc.;
- Mechanisms defining the involvement of or impact on target groups which are subject to the activities and tools defined in the strategic document (including measurement, benchmark activities etc.)[4]

Some conceptions that could be found in the European Union use different approach within the public sector' strategic management concept based on the so called *strategic triangle* or three main *"management dimensions":* political, cooperation and operation (McBain, Smith 2010; Moore 1995). The political factor reflects the need to have political support for any activities in the public sector management. Cooperation principle is based on the new public management paradigm where is a strong stress put on the cooperation and networking between social actors. And thus operation dimension derives from general concepts of efficiency and effectiveness. For this paper and further research would be used simplified conception (derived from Potůček 2007), because latter mentioned concept requires among some other methodological issues extensive research in political science etc., while concentration should put especially on the system and process conception.

The core of the problem-oriented concept of „strategic management" at the regional level in the Czech Republic (for regions will be further used term *"district"*) is the process of implementation of the strategic document connected to the long-term general socio-economic development of a district. In general the strategic management on the local level' issue is being perceived in the literature ambivalently, where we could find several authors that have detailed some difficulties for "strategic management" or "strategic planning" concept on local level[5] (like Streib 1992; Backoff, Wechsler and Crew 1993) and on the other hand there are numerous authors seeing local level strategic management as promising and effective tool for public administration, because on local level there are being "delivered" more concrete products and services compared to central governmental units (Moore 1995; Lax, Sebenius 1986; Alford 2001). One of the classical definitions[6] for strategic management and strategic planning is that it's "a disciplined effort to produce fundamental decisions and actions that shape and guide what organization is, what it does, and why it does it" (Bryson 1995). Also it has to be said that any form of a strategic management that is being performed on the local public administration' level should be also methodologically based on the understanding of differences from the private sector.[7]

The key term „strategic management" is, at the moment, not often associated with human resources development at the state or district level, or it is often reduced and perceived by the expert public as a term "only" associated with specific activities of a particular employer from both private and public sectors aimed at employees. **The term „strategic management ", in relation to the above definition of human resources development, is a term defined by the author himself with regard**

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[4] For comparison model for strategic planning developed by Vinzant and Vinzant (1996) that is based on four levels: 1. Completion of a full-fledged strategic planning process, 2. Production of a strategic planning document, 3. Changes in resource allocation to support the accomplishment of strategies, 4. Changes in control and evaluation processes to provide feedback on the implementation of strategic plan.

[5] Among the main reasons could be stated variety of stakeholders influencing whole process, difficulties with measurement of the given targets/goals etc.

[6] More could be found in the Poister, T.H. & Streib, G. Elements of Strategic Planning and Management in Municipal Governenment: Status after Two Decades. In: *Public Administration Review.* January/February 2005, Vol. 65, No. 1, pp. 45-56.

[7] Summarization could be found for example in the Nutt and Backoff (1992) model where they had identified three main factors distinguish public sector organizations from private ones – environmental factors (influence of the political settings, projected and also expected results from key stakeholders etc.), transactional factors (scope of impact that is much wider than in a private sector companies, public assessment of all transactions leading to need of collective accountability etc.) and internal processes/factors of organization (not feasible measurement by profit only, difficult incentives for employees etc.).

to the theoretical definition of „strategic governance ", a detailed analysis of which was carried out by Potůček, M. and col. (2007).

3. OPTIONS FOR RESEARCH IN THE HUMAN RESOURCES DEVELOPMENT ARE STRATEGIC MANAGEMENT AT THE REGIONAL LEVEL

The possibility to carry out research in strategic management (a model example in the human resources development area) is defined by several factors: the existence of empiric statistic data of long-term validity, existence of tools in districts for „influencing" processes in a particular domain (e.g. human resources) and a theoretical basis given by a relevant economic theory (here strategic governance, or management and for example the theory of human capital).

Generally speaking, the incentive to launch research of any kind is very often an effort to bring information on a certain phenomenon which has not yet been elaborated sufficiently or at all. This holds true even in this particular case in which, with regard to the aforesaid defined subject and basic terminology, we can say that strategic management in the selected field of human resources at the district level is not systematically covered in the available literature. The only existing materials are general theses and manuals for example for district authorities claiming the necessity to apply strategic management in the human resources area[8] but, in principle, there is no systematic publication bringing a summary of current knowledge of key tools and mechanisms in human resources and evidence of a positive correlation between use of strategic management and the socio-economic development of a district. Another reason for research is also the fact that the concept of strategic management in human resources in correlation with defined economic indicators was not used in the Czech Republic until recently[9] and at the district level such activities are only beginning.[10] Yet another reason is the establishment of a set of new financial tools available for human resources development in districts after entering the European Union – above all, the allocation of so called structural funds.

It is obvious that human resources play a key role in the development of districts in today's global economy, associated with terms such as knowledge or information society. Strategic management in this field should become a priority carried out both in transferred and in independent competence of district municipalities. Nevertheless, according to the described theories, the concept of strategic management must be understood not as a process carried out by one subject only (e.g. the government) over an exactly defined period (e.g. electoral period) when precisely quantifiable results will be available, but rather as **a long-term process involving a lot of participants (including for example non-profit-making sector) where both quantifiable results and medium-term and long-term trend are continuously monitored and evaluated**. Processes of strategic management at the district level feature a number of various participants acting both directly (e.g. public administration subjects or allowance organizations) and indirectly (e.g. non-governmental non-profit organizations) and pursuing their own goals when deciding on their involvement in a particular process. Public administration bodies on regional/local level have thus also strong role of coordinator that has to be taken into account within strategic management.

It sounds trivial to state that another trouble spot in the strategic management research at the district level is the necessity to accept exogenous factors such as for example the influence of supreme bodies of public administration or even supranational subjects such as the European Union. It is therefore necessary to specify key priorities within the Czech Republic which can be identified in the strategic management of human resource (RLZ) and which are broad enough to satisfy the wide spectrum of participants engaged in the process. Related to the aforesaid phenomena of global economy, building the "knowledge capital" in a society may be mentioned.[11]

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[8] E.g. *Regionální hospodářská konkurenceschopnost (Příručka pro představitele veřejné správy) [Regional economic competitiveness (A Manual for public administration representatives)].* [online]. Prague: Czechinvest, 2006. Available on: <http://www.czechinvest.org/data/files/prirucka-verejna-sprava-208.pdf>, 20th May 2011, one charter deals with this matter.

[9] Strategy of human resources development for the Czech Republic was not published until 2003.

[10] Above all it is launching the process of creating documents mostly referred to as „Strategy of human resources development" related to for example a Regional Development Program.

[11] Building knowledge capital related to the process of so-called life-long learning of employees is briefly dealt with in for example Škorpil, P.: Current trends in human resources management in the Czech Republic: strategic foundations and implementation in an institution's activities. In *Strategie rozvoje lidských zdrojů v České republice*

4. LINKAGES TO THE NATIONAL AND SUPRANATIONAL LEVEL

At the level of European Union, however, some principles of strategic management in human resources development are implemented in the long-term (mainly continuous updating and monitoring of implementation of long-term priorities).[12] We can say that in view of the division proposed by Potůček, M. and col. (2007) the European Union strives to assert concepts of strategic governance, which are further strengthened by other integration trends (e.g. the Lisbon Treaty).

Czech Republic did not start dealing with **strategic management in human resources development until after 2000;** the endeavour was culminated by publishing studies of the National Educational Fund and the Ministry of Labour and Social Affairs.[13] Key trends in management of human resources development in the Czech Republic were summarized in the **document Strategy of Human Resources Development for the Czech Republic**, 2003 (hereinafter SRLZ CR). **In view of primary needs of the Czech economy and society, the following goals were set out:**

Goal 1 – Establish life-long learning as common practice

Goal 2 – Teach human resources in the Czech Republic to face challenges brought by information and knowledge society, global economy, the necessity of sustainable development, and membership in the European Union

Goal 3 – To boost international competitiveness of the Czech economy and its attraction for investors

Goal 4 – Enhance workforce employability and thus contribute to higher employment

Goal 5- Improve the use of limited resources and mobilisation of essential means for human resources development

The key question, first mentioned by the document, is **not only the top priorities in human resources development but also the most efficient allocation of both public and private financial means**. Put simply, most comments listed in the SRLZ CR reflect the conclusions of the theory of human capital (mainly related to original works by Becker, Schultz) and unambiguously **prefer maximization of investment in education** in this field**.** According to SRLZ CR investment in education is the highest priority in the medium term and this priority will be also reflected in the system of public budgets. In accordance with the theory of human capital, SRLZ CR deals also with the need of engaging private capital in education.

The adoption of SRLZ CR positively shows that the Czech Republic has made the first key step in the concept of strategic governance in human resources development including the specification of the coordination participant – in this case it is the Office of the Government alongside the Ministry of Labour and Social Affairs. Unfortunately, the process of strategic management connected with the implementation of the document is currently suspended and the Council of the Human Resources Development of the Czech Republic[14] does not meet regularly any longer.

The incentive to create and adopt a strategic document at the state level was, in accordance with trends in other European countries, reflected at the district level.[15] In about 2005 first strategic documents dealing with human resources development in the districts of Czech Republic started to be adopted.[16] It has become common practice for the structure of district strategic documents dealing with human resources to contain an analytic part (disparities in human resources or a SWOT analysis), a proposal (containing particular measures including participants and their

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a v Evropě. Sborník příspěvků z konference. Prague: Magistrát hlavního města Prahy, 2005. ISBN 80-239-766-4. s. 29 – 33.

[12] The trouble spot of European strategic documents regarding human resources remains to be their implementation, i.e. carrying out the tasks in cooperation with differentiated participants. The main factor is that the goals are defined too broadly and their achievement is difficult to coordinate (be it financial or administrative aspect) or some member countries are not able or willing to implement certain changes in relation to their own development priorities. These trends are shown for example in so-called Kok's report critically reviewing implementation of the so called Lisbon strategy. [online]. Available on: <http://ec.europa.eu/growthandjobs/pdf/kok_report_en.pdf>, 20th May 2011.

[13] Before the document was published, systematic development of human resources in the Czech Republic was dealt with by the project in the so-called Phare pre-entry fund called „Strategy of Hunan Resources Development for the Czech Republic " which was terminated in 2000.

[14] Established by the ruling of the Government of the Czech Republic No. 210/2003 Coll. of 3rd March 2010.

[15] An example of fulfilment of strategic management for human resources development in a district an at sub-district administrative units can be Finland which regularly adopts documents valid for the period of four years together with all evaluation and monitoring mechanisms. A presentation can be found for example in the article Kaartinen, L. Strategy of regional human resources in municipalities of the Helsinky district 2004 – 2007. In *Strategie rozvoje lidských zdrojů v České republice a v Evropě. Sborník příspěvků z konference.* Prague: Magistrát hlavního města Prahy, 2005. ISBN 80-239-766-4. s. 34 – 37.

[16] The South Moravian strategic document dealing with human resources was the first to be created in 2005 within the project Common regional operational program, measure 3.3.

involvement), a financial part (allocation of particular financial sources – e.g. for district budgets or financial means from structural funds), and a communication part (tools and processes for informing both direct and indirect participants). **Compared to the national level the process of strategic management of human resources development is fulfilled to a relatively larger degree**. By 2009 most districts in the Czech Republic had adopted their own strategic documents, coordination units had been established (e.g. the Council for the Human Resources Development) and the allocation of parts of district budgets on particular projects related to the strategic document for human resources management was also under discussion.

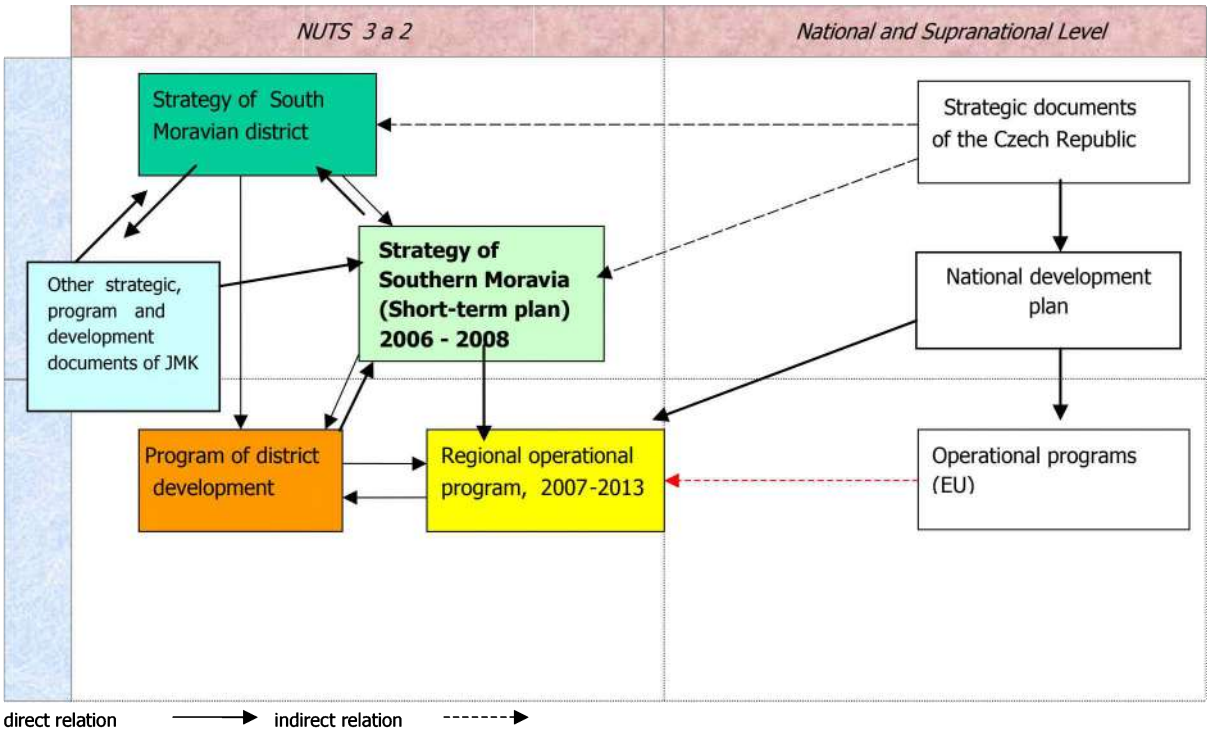
Strategic management of human resources development at the district level are currently being fulfilled to the extent that strategic documents are regularly created and updated, particular key projects are defined, budget framework is defined including the estimated investment from public finance and private sources, and controlling bodies have been established.[17] **However**, **unfortunately, the implementation and the concept of strategic management are far from being complete or fulfilled, the main reasons being the following:**

1) Non-existing feedback on the efficiency of human resources projects carried out in accordance with the strategic documents
2) Problematic communication among various participants in human resources management, in other words the non-existing communication platforms integrating various types of participants (e.g. representatives of public administration, non-profit non-governmental organizations or employers)
3) Budget frameworks are only approximate and, except for pricing of concrete projects, the relation to strategic documents is not monitored
4) Inability to take rational decisions on carrying out particular projects (i.e. investment opportunities) which are not taken until the strategic document has been adopted (unlike projects which are chosen by the coordinating subjects while the document is being prepared and adopted)[18]
5) Problem of strategic governance in districts where a change in political orientation of district municipalities results in scaling down activities and projects connected with the strategic document adopted in the previous period (the problem at the national level was pointed out by Potůček, M. and col., 2007; in his opinion, strategic governance in the Czech Republic is very problematic issue).
6)

[17] See strategic management in human resources development at the state level – e.g. Míkovcová, L. Program of implementation of the Strategy of human resources developemnt. In *Lidský kapitál a investice do vzdělání (sborník z 8. ročníku mezinárodní vědecké konference).* Praha: VŠFS, 2005. ISBN 80-86754-50-2. s. 51 – 53.

[18] The issue of taking rational decisions concerning investment opportunities in human resources is dealt with in Valenčík, R. Efficiency of investment in human capital: Information on project solution GA ČR 402/03/0128. In *Lidský kapitál a investice do vzdělání (sborník z 8. ročníku mezinárodní vědecké konference).* Praha: VŠFS, 2005. ISBN 80-86754-50-2. s. 65 – 79.

Scheme No. 1 An example of a relation of strategic and program documents of South Moravian district (JMK) to the district and national level



Source: *The Main Strategic Trends and Recommendations of the Strategy of Human Resources Development of the South Moravian District, p.13. Available on: <http://www.kr-jihomoravsky.cz/Default.aspx?PubID=51443&TypeID=2>, 5 December 2009.*

Putting plans into the action (implementation process) is generally perceived as a problem across all levels of public administration where usually a strategic plan/document is not directly linked to implementation, because of for example budgetary issues, resistance of employees who felt threaten by change or by endangerment of more control mechanisms that would be put on an organization.[19] Pregnant summarization of issues connected with implementation process was given by Mintzberg (1994), according whose opinion the criticism is base precisely on fact that organization's planning activities are too often completely divorced from performance measurement and resource allocation.

5. FURTHER RESEARCH OPTIONS

It follows, from the aforesaid analysis of current state of strategic management of human resources development, that some steps have been taken in the Czech Republic towards implementation of this concept, but they are considerably reduced at the national level. **The key factor for the research is that the incentive from the level of the European Union and the Czech Republic has brought about first strategic documents in human resources development in the districts of the Czech Republic.** In terms of the research we can say that the process of strategic management in human resources development can be analyzed at the district level where, in accordance with the theory of human capital, unambiguously specified indicators can be used. The research should primarily focus on full application of the concept of strategic management in the trouble spots mentioned above. The crucial problem will be **the efficiency of public expenditure including an analysis of application of so-called multi-source financing, as financial means from structural funds nowadays represent a fundamental tool (in terms of money supply) for the implementation of strategic management in human resources development** at the Czech Republic regional/local level.

[19] Among major sources could be named Franklin 2000; Donald, Lyons and Tribbey 2001; Mintzberg 1994; Streib, Slotkin and Rivera 2001.

The aforesaid findings are postulated as a summary of key terms as well as of important theoretical constituents which, used as complements, could **prove the validity of research into strategic management of human resources development at the district level of the Czech Republic**. Currently, „only " so-called strategic documents are available, **but they have not yet been appraised and neither has the efficiency of public spending been analyzed in relation to growth indicators such as labour productivity.**

6. CONCLUSIONS

It follows, undoubtedly, that **human resources development is a field which the districts in the Czech Republic must deal with, be it in terms of legislation (see Act on Districts No. 129/2000 Coll., or the Act on regional development No. 248/2000 Coll.) or in terms of political sciences.** During further research the approach of district/regional self-government to strategic management of human resources development could be more specified in relation not only to legislation but, in accordance with the concept of strategic management outlines above, alto to the implementation process including establishment of appropriate institutional elements (e.g. establishment of the Council for Human Resources Development). According to major survey performed in 2004 among more than 1200 municipality officials in the US (Poister, Streib 2005) the results showed that a substantial number of local governments – though well under a majority – have used or using strategic planning to establish long-term direction, determine priorities and guide decision making and from survey also came out that is a growing number of local governments that are linking strategic planning to a mix of approaches that would suggest the beginning of a comprehensive strategic management process.

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KNOWLEDGE OF THE EUROPEAN UNION REGULATIONS ON PUBLIC PROCUREMENT AT THE LOCAL LEVEL IN SERBIA

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Abstract:*Countries that are candidates for membership in the European Union (EU) need to harmonize their legislation with the EU regulations during the integration process. Republic of Serbia is has been undertaking this process since 2013, when the Stabilisation and association agreement between the European communities and their member states of the one part, and the Republic of Serbia, of the other part, came into power by the Council and Commission Decision. Public procurement is just one of the fields covered by this agreement. Serbian Law on public procurement from 2013 was reformed in 2015, implementing the changed EU directives on public procurement. Full compliance with the EU regulations in this area is expected to be reached in 2018, after the new Low that is currently in the preparation is adopted. Existing Serbian legislation on public procurement already contains most of the EU directives, demands and standards. As successful implementation of new regulations demands the participation of all levels of authority, it is of extreme importance that the representatives of local self-governments know and understand European public procurement regulations. The purpose of this research is to examine the knowledge of the EU regulations on public procurement at the local level in Serbia.*

Keywords*:Public Procurement, Directive, Regulation, Compliance, EU Harmonization,EU Integration, Local Government, European Union*

1. INTRODUCTION

The countries of the Western Balkans are preparing for EU membership. This process has to start long before accession and has to be well advanced when the country eventually becomes a full Member State and an important part of this process concerns the reform of the public procurement laws of the accession countries (Trybus, 2005) The term public procurement refers to a situation in which a public body procures necessary goods and services by entering into contracts with other entities (Arrowsmith, Linarelli& Wallace, 2000). The European Union is the largest market for public procurement in the world today, with a total value of public procurement contracts of around 1.4 billion Euros per year, and the countries that are part of the enlargement process of the EU have to harmonize their laws with the European treaties and secondary Community legislation (Trybus, 2005), in this area, as well as in all others. The directives on public procurement are adopted in order to provide transparency and equal treatment in public procurement, one of the most important issues in establishing the single market (Soudry, 2004).

Regarding the situation in Serbia, as one of accession countries, the first step in harmonization with EU legislation in area of public procurement was adopting the new Law on Public Procurement on January 6th, 2013. At the time, the Joint report to the European parliament and the Council on Serbia's progress in achieving the necessary degree of compliance with the membership criteria, published on April 22nd, 2013, stated that this Law further aligns the Serbian legislation with the acquis and generally improves the efficiency of public procurement procedures (Komazec, Todorović, Krivokapić, & Jaško, 2013). There was one more change in Serbian legislation in 2015, so during this study Serbia's public procurement legislation was already highly harmonized with the acquis in the area of public procurement. But the following year (2018) is seen as the most important, in a sense that by the end 2018 Serbia's legislation related to public procurement, as well as on concessions, has to be fully aligned with the acquis (Blagojevic, 2017).
The main focus of this paper will be on public procurement at the level of local self-government. Significance of public procurements at local level can be illustrated by assessment that the share of public procurements in the local government budgets in Serbia, amounted an average 20-25% in 2011. (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).

At the bottom line, the procurement function in operations and core knowledge of public procurement professionals is the critical and complicated element of the public procurement system (Thai, 2001). In one of the previous studies, we have concluded that improvement of personnel capacities is required at local level

in Serbia. Also, the study showed that for the implementation of the public procurement rules of the EU, rather expertise of employees in public procurement than their number is crucial (Komazec, Todorović, Krivokapić, Jaško, 2013). Those findings are in line with stand that there is no transparent and efficient public procurement system without appropriate personnel (Sakane, 2009).

Regarding the compliance with the EU directives for public procurement, which should lead to efficient public procurement system, the empirical findings indicate that both purchaser's familiarity and organizational incentives have a positive, statistically significant impact on the compliance (Gelderman, Ghijsen, &Brugman, 2006). Those findings had been confirmed not only for familiarity with EU regulation, but also for procurement regulation in general, and it justified to expect that that the more procurement personnel are familiar with the regulations, the more compliant they will be (Eyaa & Oluka, 2011). So the purpose of this paper is to examine familiarity to with EU directives and standards among public procurement officers at local level in Serbia, as one of main precondition of efficiency of public procurement system.

2. METHODOLOGY

The questionnaire that was used for data collection was designed as an online survey and contained closed-ended and open-ended questions. The answers were provided by 72 respondents from 63 different municipalities, which is more than 40% of local self-governments in Serbia. Accorting to the Regulation on Establishing the Uniform Development List of Regions and Local Self-Governments (2014), local self-governments in Serbia are categorized by the level of development into four groups, while the municipalities from group IV that are below 50% of the average development level are proclaimed as devastated areas and placed in a separate group. The respondents covered all the groups from this classification, as shown on Figure 1 and Figure 2.

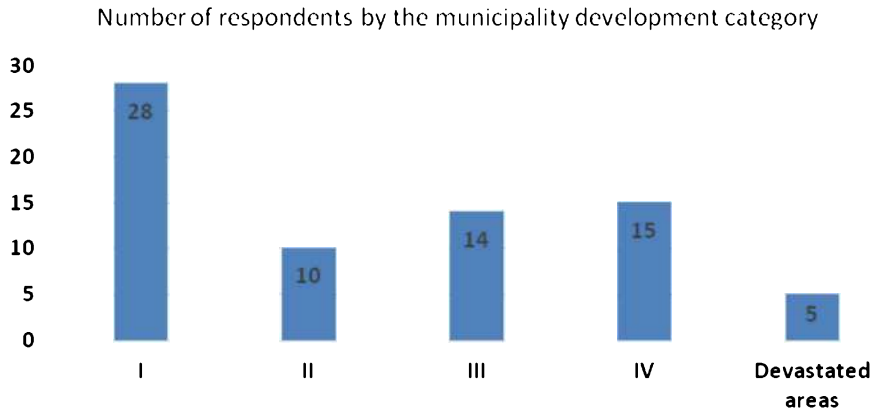

Figure 1: Number of respondents by municipality category

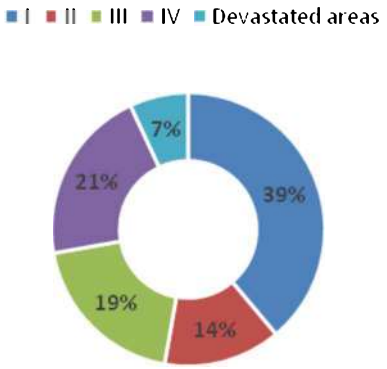

Figure 2: Sample distribution

This survey was conducted by the Standing Conference of Towns and Municipalities (SCTM) – National Association of Local Authorities in Serbia as part of the program "Support to Serbian Municipalities on the Road to EU Accession: Enabling High-Quality Services, Stakeholder Dialogue and Efficient Local Administration" that is financed by the Government of Sweden and implemented by the SCTM. The authors

of this paper were hired as the experts for the purpose of analyzing the results and providing the recommendations for further development of Serbian local self-governments in the area of public procurement.

3. RESULTS AND DISCUSSION

During the research, it was examined whether representatives of local self-governments were familiar with the three basic directives of the European Union in the field of public procurement. These questions included:

1) Knowledge of Directive 2014/24/EU on public procurement (''classic'' or ''traditional directive'');
2) Knowledge of Directive 2014/25/EU on procurement by entities in the water, energy, transport and postal services sectors (''communal'' directive);
3) Knowledge of Regulation (EC) No 2195/2002 of the European Parliament and of the on the Common Procurement Vocabulary which establishes a classification for goods, works and services that the contracting authorities have to use.

The results showed that only 1/3 of the total number of respondents knew all three directives, as presented on Figure 3.

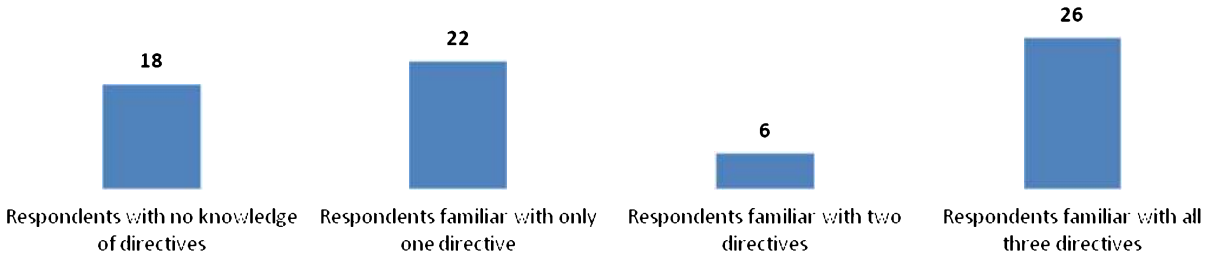

Figure 3: Knowledge of key EU directives on public procurement

Respondents who knew two regulations of the three which are subject of analysis are generally not familiar with the Directive that harmonizes the public procurement procedures of entities in the water, energy, transport and postal services sector ("communal" directive), while they are familiar with remaining two. On the basis of the results, it can also be noted that none of regulation that is subject of analysis is known to all local self-government units examined. Most of respondents, 74% of the total number of those who completed the questionnaire, are familiar with the Regulationthe on the Common Procurement Vocabulary. The "classic" or "traditional" directive is familiar to 43% of the total number of questioned, and the "communal" directive to 39% of them.

Almost all respondents who are familiar with only one of the analyzed Directives are familiar with the Regulationthe on the Common Procurement Vocabulary, which establishes a classification for goods, works and services that the contracting authorities have to use. Considering how questions were formulated in the questionnaire, and when comparing the original titles of regulations which are subject of analysis and the way they are translated and incorporated in domestic regulations, it can be noticed that only Regulationthe on the Common Procurement Vocabulary is literally translated, i.e. that its title is same in the applicable regulations and in the questionnaire distributed. The term "Common Procurement Vocabulary" is widely used in the Republic of Serbia among public procurement employees, and as this question contained a very similar formulation, the respondents were likely to immediately conclude that the respective Regulation relates directly to it. Therefore, it can be assumed that representatives of local self-governments may also be familiar with the remaining two directives, but that they were not able to link them with provisions from the domestic legal framework that relate to them.

It has already been noted that every third respondent is familiar with all of analyzed regulations. When clustering is made according to the level of development, it is concluded that this percentage in three most developed groups of local self-governments is somewhat higher and that it increases to 40%, and in devastated areas it significantly decreases to 20%, as shown on Figure 4.

Based on the research results, it can be concluded that the level of knowledge of European Union regulations in the area of public procurement among representatives of local self-governments is decreasing with the degree of development of the municipality. The research also showed that more than 60% of respondents were not familiar with the influence of EU regulations on local self-government.

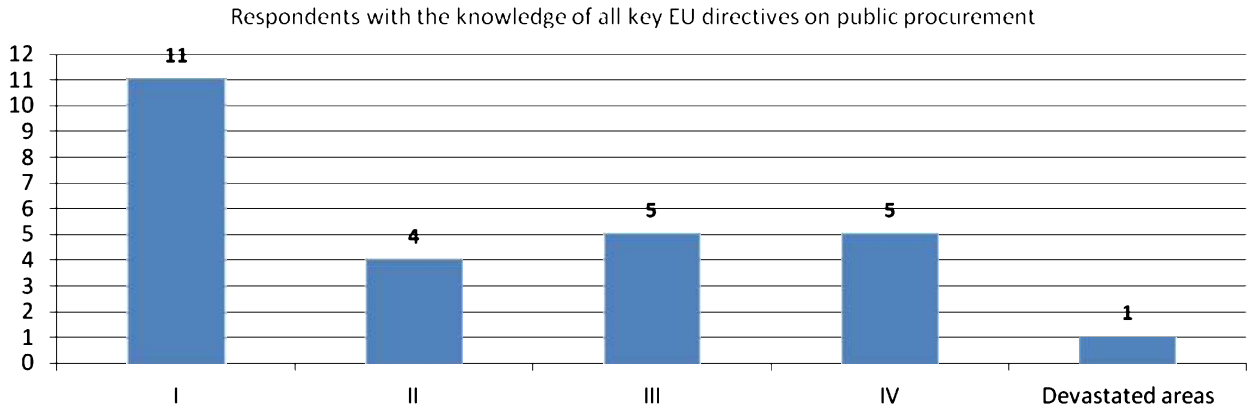

Figure 4: Distribution of respondents who are familiar with all EU directives on public procurement by municipality category

When it comes to the general knowledge of the requirements of European Union in the area of public procurement requirements regarding the process of accession of the Republic of Serbia to the European Union, two thirds of the respondents said they were not familiar with them. The situation is the worst in least-developed municipalities, where as many as 80% of respondents are not familiar with these requirements, which can be seen on Figure 5.

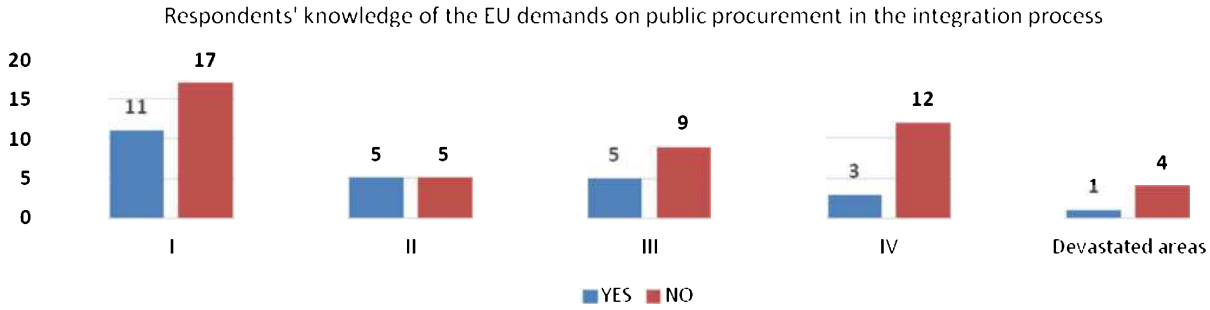

Figure 5: Distribution of respondents by their knowledge of the EU demands on procurement and by municipality category.

The respondents were further asked to indicate in an open-ended format what requirements of the European Union in the field of public procurement regarding the process of accession of the Republic of Serbia to the European Union are known to them. The results are presented on Figure 6. Respondents' answers presented on the graph show that the representatives of local self-governments in Serbia mostly recognize *harmonization of public procurement regulations with the EU, implementation of electronic procurements, strengthening competitiveness, greater transparency and enhanced supervision* and *reduction of corruption* as Serbia's demands related to public procurement in the process of EU integration.

The survey also contained a set of questions to determine the extent to which representatives of local self-governments are familiar to four basic principles of European Union in the field of public procurement, according to the Article 18 of Directive 2014/24/EU on public procurement:

1) The principle of ensuring competition;
2) Principle of equality of bidders;
3) The principle of transparency of the procedure;
4) The principle of environmental protection and ensuring energy efficiency.

The results showed that respondents are much better acquainted with EU public procurement principles than with European directives, regulations and requirements in the accession process related to the same area, as the first three principles are familiar to 89% of respondents, while with the last is familiar to 87% of them. Interestingly, the respondents are mostly familiar with all EU public procurement standards, or they are not familiar with any of them. As many as 86% of respondents are familiar with all key EU public procurement principles, while 10% of respondents are familiar with none of the key principles that are important for local self-government.

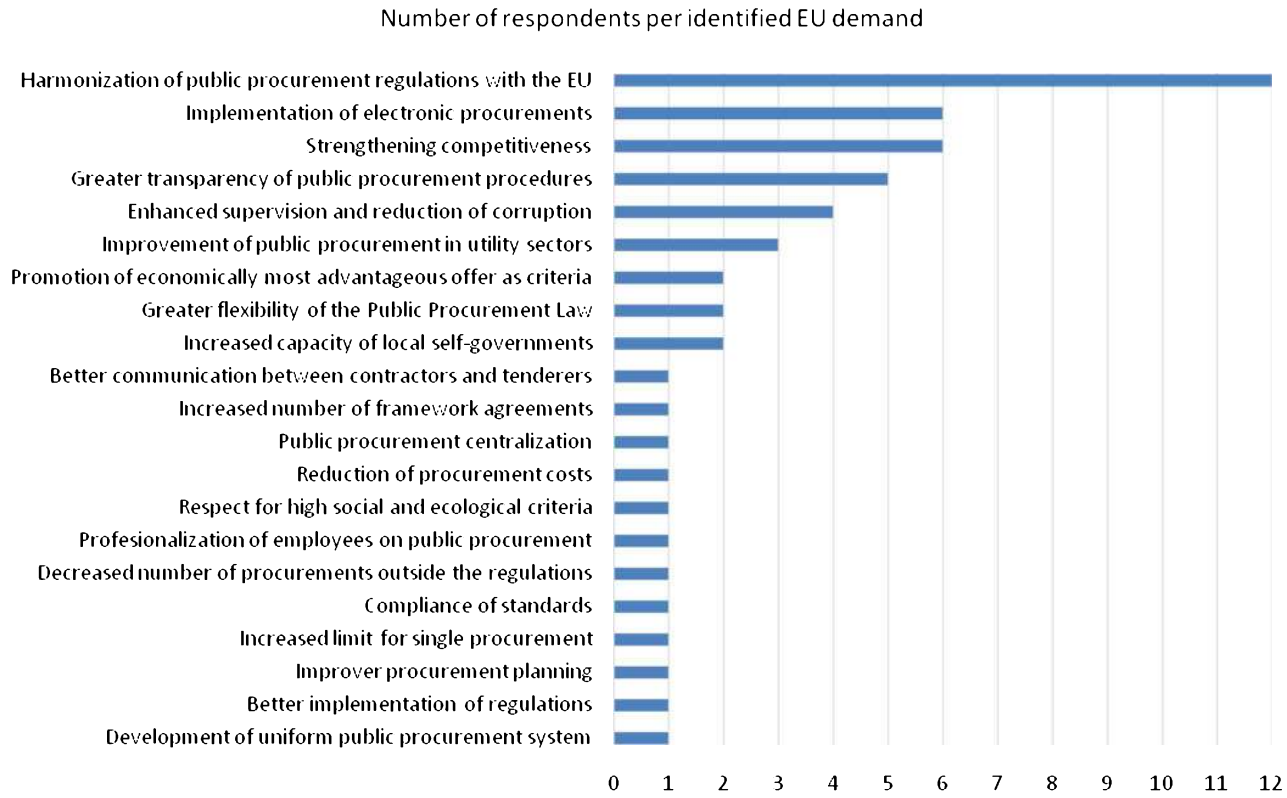

Figure 6: EU demands on public procurement in the integration process according to the respondents

Although most respondents are familiar with EU public procurement standards, only 17% of respondents consider that they are fully implemented in their municipalities. More than 70% of respondents consider that in their municipalities EU standards in the field of public procurement are applied to a large extent or completely, while in the least developed municipalities this percentage drops to around 50%. Figure 7 shows the extent to which local self-governments apply EU public procurement standards, according to their representatives who were involved in this survey. It can be noted that 30% of the respondents feel that in their local self-governments the standards are not being implemented enough or at all, while 80% of them believe that there is room for improvement in this domain.

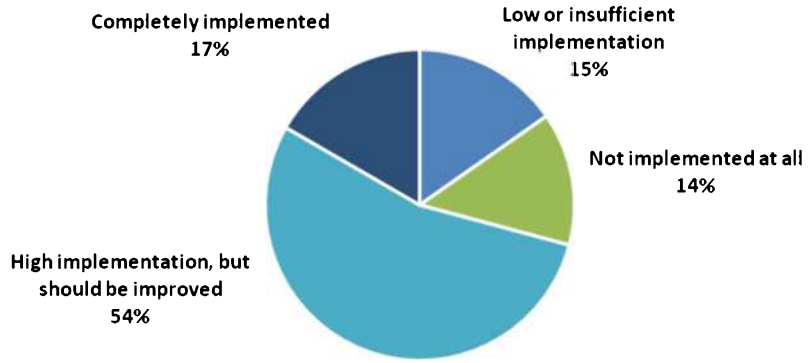

Figure 7: EU demands on public procurement in the integration process, according to the respondents

Deeper investigation has identified two basic reasons due to which the respondents believe that the EU standards in the public procurement area are implemented insufficiently, or not applied at all:

1) Insufficient information;
2) Lack of need, i.e. suitable requests in the local regulative.

However, the analysis has shown that Serbian legal framework in the field of public procurement is mostly aligned with the acquis communautaire, and that in previous years Serbia has made significant progress in regard to reforms in area of public procurement. This implies that representatives of local self-governments

may not even be aware of the need to apply EU procurement standards, or are unable to recognize these standards in the domestic legislative framework. This further emphasizes insufficient knowledge as a key problem in the domain of (non) implementation of European standards in the field of public procurement at the municipal level, which leads to the conclusion that additional education in this area is necessary.

4. CONCLUSION

Adequate application of the EU procurement rules affects local self-governments, purchaser of goods, services or works, as significant factor which is often underestimated. These rules aim to increase competition, fairness and transparency, which certainly lead to more bids, and consequently result in lower prices and higher quality.

On the other hand, these rules often require additional training and engagement of external experts, which increase the costs of public procurement. Also, a large number of procedures and rules can often lead to errors, whereby dissatisfied bidders have a greater likelihood of complaining, which can often lead to the delay of the process, even the annulment of the public procurement agreement. It is precisely these issues that need to be addressed, since the Republic of Serbia faces major challenges in the process of harmonization of public procurement regulations with EU rules. By signing the Stabilization and Association Agreement with the EU, Serbia undertook obligation to harmonize national legislation in this area with the acquis communautaire, as well as the obligation to implement them. Therefore, it is extremely important that local self-government representatives are familiar and understand EU procurement regulations. It is necessary to make a full harmonization of public procurement regulations with the applicable directives, and special attention should be paid to the implementation of the legal framework in practice at all levels of government, both central and local level.

The conclusions of this research can be of benefit to public authorities in Serbia and the in EU, in order to review the current situation in the field of public procurement regarding the integration process, as well to institutions that works on capacity building in field of public procurement and education of employees in these jobs, and to researchers dealing with this topic. Further research in this area should focus on assessing the compliance of the Serbian legal framework with EU regulations after the adoption of the new Public Procurement Law that is currently being drafted, as well as examining the capacity of local governments to apply its provisions.

ACKNOWLEDGEMENT

Authors' engagement on this research was partially supported by the Ministry of Education and Science of the Republic of Serbia through the Project No. 179081: Researching Contemporary Tendencies of Strategic Management Using Specialized Management Disciplines in Function of Competitiveness of Serbian Economy.

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FINANCIAL MANAGEMENT CAPACITY BUILDING IN PUBLIC ADMINISTRATION BY UPGRADING KNOWLEDGE OF EMPLOYEES IN AREA OF ICT

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Abstract: *Public administration contributes to the government's ability to ensure high-quality public services from the standpoint of competitiveness and progress. By taking in account importance of digitalisation and therefore role of information and communication technologies the paper presents some of research results conducted for the purpose of mapping current level of knowledge employees in public administration gained throughout ERASMUS+ project entitled Financial Management, Accounting and Controlling curricula development for capacity building of public administration during spring 2017 year. The paper aims to highlight how knowledge and competence of employees in public administration can be upgraded by involvement of information and communication technologies of Albania and Serbia in order of strengthening their capacities.*

Keywords*: public administration, digital age, information-communication technologies, Albania, Serbia*

1. INTRODUCTION

Public administration is the basis of the functioning of a state, as it contributes to the government's ability to ensure high-quality public services from the standpoint of competitiveness and progress. In addition, it plays a key role in the European Union (EU) integration process, by contributing to the dialogue about the reforms implemented as part of the integration process and alignment with the standards of good governance of EU countries. It is frequently pointed out that "good governance and the right to good governance represent relatively recent important concerns both for the national and the European governmental authorities (Mateia L. et al., 2016, pp. 335)".

The concept of "good governance" was defined by EU countries and included in the Charter of Fundamental Rights of the European Union (The Independent Commission for Good Governance in Public Services, 2004). The notion of a "European administrative space" was set out by SIGMA (Support for Improvement in Governance and Management) principles. SIGMA is a joint initiative of the OECD and the EU. Its key objective is to strengthen the foundations for improving public governance, by improving elements including reliability, predictability, accountability and transparency, as well as technical and managerial competence, organizational capacities, financial sustainability and citizens' participation in public administration.

Although good governance criteria are universal, these principles are primarily intended for countries which aspire to join the EU and which receive assistance via the Instrument for *Pre*-accession Assistance (IPA). Based on the principles of good governance, accepted by most European states, ICGGPS (2004) presents "the good governance standard for public policies", which comprises the focus on outcomes for citizens, transparency of decision, risk management, development of the capacity and capability for efficient governance, real accountability etc. (Mateia L. et al., 2016, pp. 335).

Regional countries Albania and Serbia belong to Western Balkan countries that are making a great effort in order to reaching EU membership. That process implies set of activities considering policies harmonization and improving quality of services to citizens. Additionally, those reforms include changes both in applicant countries as well as in candidate countries. All European country may apply for European Union membership if they are embracing democratic values and if they are committed to further improvements together with other EU family members.

First step for every country in reaching EU membership is to fulfil main criteria that basically where defined in Copenhagen 1993, on the EU Council meeting and those are called "Copenhagen criteria". EU accession process helps candidate countries to build capacities for adopting and implement EU laws as well as EU and international standards. Motives for countries to apply for EU memberships lies in the fact that they gain partnerships with EU countries that offers trade privileges, economic and financial help, assistance for reconstruction and development, stabilization and association process. In order to fulfil its commitments from

The Stabilisation and Association Agreement, every candidate country is getting closer to EU membership step by step. European Commission appraises achieved progress with countries reports of progression that are published every year (Benković et al. 2018. pp. 1).

European Council granted Serbia status of candidate country in March 2012, and from September 2013 Serbia has started process of monitoring of application legal attainment of EU through screening The Community *acquis*. At the same time Albania is expecting during 2018 getting a status of candidate country which means that it will start and a Screening of *acquis* in order of opening Chapter 23 - Judiciary and fundamental rights and Chapter 24 - Justice, freedom and security. Opening a chapters is a process structured in 35 steps or 35 chapters that are helping to candidate countries in build their capacity to adopt and implement EU law, as well as European and international standards. Chapter 23 and chapter 24 are ground chapters that are opening room for implementation of all other values structured in other chapters during process of accession to EU.

Serbia as a candidate country in November 2015 has opened Chapter 32 - Financial management and control. Ministry responsible for implementation of this Chapter values are Ministry of Finance and Ministry of Public Administration and Local Self-Government. Albania, as a regional country is still waiting for opening this chapter but it makes significant efforts in process of upgrading their capacities of public administration, particularly in area of financial management and control.

ERASMUS program entitled *Financial Management, Accounting and Controlling curricula development for capacity building of public administration (FINAC)*, financed by European Commission, part of witch results from one of the work activities are presented in this paper, aims to point available capacities of knowledge and employees competences in public administration. The paper is particularly aims to highlight how knowledge and competence of employees in public administration can be upgraded by involvement of information and communication technologies. Or, precisely speaking, do the employees in public administration od Albania and Serbia that are dealing with management and finance perceive the need for additional trainings in the field of information and communication technologies in order of strengthening their capacities.

By taking in account importance of digitalisation and therefore role of information and communication technologies, in this paper are presented some of research results conducted for the purpose of mapping current level of knowledge employees in public administration for the purpose FINAC project. The research findings presented in the paper are just small segment of primary research findings collected within the work package 1 of the ERASMUS+ project during spring 2017. The paper is divided in several parts. The introductory part is followed by the second chapter that provides overview of digitalisation of public administration. The third chapter presents the methodology of research, more specifically, the research sample, while the fourth chapter lays out the research findings. The fifth chapter summarizes the conclusions based on the research findings and gives recommendations for improving the public finance segment of the Serbian public administration. The final chapter provides concluding remarks.

2. DIGITALISATION OF PUBLIC ADMINISTRATION

Delivery of the services has been broadly defined by SIGMA (2017):*"as all contacts with the public administration during which customers, i.e. citizens, residents and enterprises (hereafter referred to collectively as citizens) seek data, handle their affairs or pay taxes. In this context, orientation towards citizens needs to be understood as encompassing all contacts and all tasks performed by the public administration that affect citizens. This broad definition encompasses not only contacts between the public administration and customers, but also the rules regulating those contacts (i.e. the administrative procedures).*" In order of modernization of public services the main priorities is the elimination of physical service windows, where documentation is generated and administered by the state itself, and, consequently, simplification and facilitation of the whole process thanks to the digital infrastructure.

For a last 4 years the Government of Albania has dedicated to implementation of a breaking reforms that should reinvents the way that public administration delivers services to the citizens. The reform relies heavily on innovation and the use of information technology in order of improving standards, procedures and the organization of service delivery. Some of results are particularly visible in combat of corruption due to fostering a customer-care culture, enhancing a public access, and increasing efficiency in the Albanian public administration.

Additionally, adoption of crucial documents like the Albanian Digital Agenda 2015-2020 and the Cross-cutting Strategy for Public Administration 2015-2020 should contribute to higher level of information and communication technologies services. The process of documents implementation is planned to be reached

by enhancing of the interconnection of information technology systems with each other and the exchange of real-time data between them through Government Interoperability Platform in order of simplifying services and reducing of a number of documents required for citizens or businesses in the service windows. Additionally, those steps will contribute to reduction of licenses, permits and authorizations needed to carry out activities, as well as to reduction of maximum deadlines for implementation.

Up to now 47 information systems in Albania are interconnected to the interoperability framework, including all basic registers, about 1400 services of 134 central government agencies have been classified and coded to support digitization and ensure efficient IT interaction. On a number of those activities that concern introducing and upgrading information and communication technology services of public administration in Albania is engaged the National Agency for Information Services (NAIS). These activities are including IT system development, Digitization, Interoperability, E-Albania platform and E-signature. The NAIS also co-ordinates integration with the interoperability technical solution to enable data exchange among registers. More importantly, the NAIS has strong leverage to push authorities to integrate their new systems with the common interoperability solution.

At the same time the IT sector is one of the key priorities of the government of Serbia that has set as a goal to be the centre of an electronic administration. During summer 2017, the Serbian government passed a decree on the establishment of the Office for Information Technology and Electronic Governance, that task is to consolidate state IT resources, ensure connectivity of various information systems, provide strong support and establish the basis for the development of Serbia's e-governance.

The Office for IT and e-Government deals with the development and implementation of standards in the introduction of information and communication technologies (ICTs) in state administration bodies and government services, while providing support in the application of information and communication technologies in state administration bodies and government services through the design, development, construction, maintenance and improvement of the computer network of republic authorities. The Office also coordinates the work of the National Center for Security of the ICT System (national CERT) that provides services of designing, developing and functioning of Internet access, Internet services and other centralized electronic services, and it is responsible for all ICT equipment procurement needs of state administration bodies and the government services.

Opening of the first National Data Center is a key for placement of information and communication infrastructure in order of upgrading efficiency of the state administration. The National Data Center has two teams: one for IT and one for e-Government and the centralization of state infrastructure will help streamline the budget, both in terms of using state-of-the-art hardware and software, but also for the future investment.

3. METHODOLOGY

Described trends in financial management and control and digitalization of public administration in Albania and Serbia generate a number of new and challenging practices for public administration employees. These practices require specific competencies which need to be acquired or further developed by many employees and it is presumed that this fact is recognized by many employees. Therefore, the main hypothesis that was investigated through this paper is the following:

- Majority of public administration employees in Albania and Serbia who have responsibilities in financial management and control (FMC) feel the need for additional professional improvement in usage of information and communication technologies (ICT) in order of building up capacities in sphere of financial management and control.

The overall research was designed as a mixed-method research. However, the part of the results that are reported in this text come from a quantitative segment that had a form of an on-line survey – participants were provided with a link to on-line questionnaires. Questionnaires were in a form of Likert scale and were designed for the purpose of this research. Each item described a specific practice for which respondents had a task to asses:

1) the extent to which they are taking part in the given practice (whether they actually perform it, organize it or manage/supervise it) - respondents could choose one out of four answers: Yes, to a greater extent; Yes, to a lesser extent; No, and This is not relevant for my job.

2) the extent to which they think they need further professional development in order to perform each of the practices more effectively - respondents could choose one out of five answers: High level of need; Moderate level of need; Low level of need; No need at all, and This is not relevant for my job position.

In other words respondents were ask provide information on their work and on their needed professional development. The self-assessment approach was deemed as suitable for civil servants as target group for several reasons. Moreover, this approach provides more direct information needed for the project as a whole – what is that for what civil servants think they need more of professional development, for what they would appreciate more education and training. The questionnaire was developed by the Centre for Educational Policy (CEP), in cooperation with partners from the Ministry of Public Administration and Local Self-Government in Serbia, and with partners from the European University of Tirana in Albania.

The target population for this research were civil servants from state administration authorities - from ministries, integrated authorities within ministries, special organizations and government offices. Three main sub-samples were defined: general managers (individuals who are responsible for meeting organizational objectives in a specific functional area or line of business, disregarding their position in command hierarchy (raging from, for instance in a ministry, assistant minister to a manager of the smallest organizational unit)), finance departments' staff (heads of units and subordinate staff), and internal auditors. Accordingly, there was four different versions of on-line questionnaires consisting of a different combination of topics covered, corresponding to the responsibilities of a given type of job.

In both countries, recruitment of participants was a two stage process - finding a contact person in participating organization that distributed link to a questionnaire to other civil servants who satisfy the conditions for being part of a sample. Finding organizational contact persons was task of Serbian Ministry of Public Administration and Local-Self Government and Human Resource Management Service of the Government in Serbia and European University of Tirana in Albania.

Having this two-step recruitment process as a consequence had a fact that final number of civil servants who actually get an invitation e-mail is unknown and thus the response rate could not be calculated. Therefore, realized sample of civil servants cannot be considered as representative for the given populations, so the findings should be understood as indications of certain patterns with limited generalizability. However, qualitative part of the research (which will not be reported here) strongly validated many of the findings of the quantitative survey, thus providing an argument that survey findings can be regarded as valid. Table 1 presents realized research sample.

Table 1: Sample characteristics

Subsample (realization)	Albania Number of respondents	Serbia Number of respondents
General line managers	46	152
Finance department managers	27	58
Internal auditors	98	21
Total	172	231

On the base of presented results it is important to notice that more than half of sample in Albania are internal auditors, while in Serbia two third of respondents are general line managers.

The survey was conducted from April to mid June 2017. The questionnaires were anonymous and it took respondents 45 minutes to fill it. The language used in questionnaires were Serbian and Albanian. Data were gathered via known platform for on-line surveys, cleaned and analysed in the Statistical Package for Social Scientists program (SPSS) version 17.0.

4. RESEARCH FINDINGS

For the purpose of this paper, we are presenting the most interesting results in terms of how much civil servants in Albania and Serbia recognize the need to improve their competencies in information and communication technologies in sphere of financial management and control.

First results are concerning general managers and their practice and perceived need for professional development in the area of developing ICT system that will provide employees with clear and precise directives and instructions on their role and responsibilities concerning FMC.

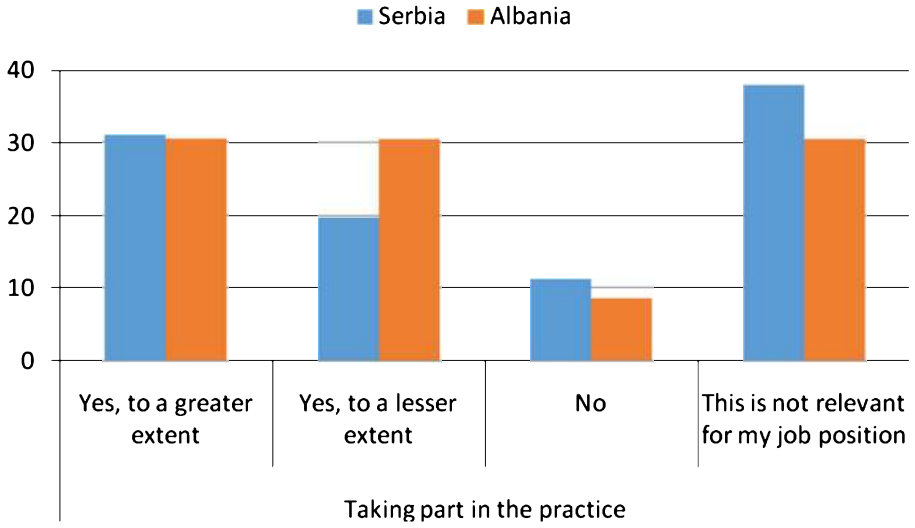

Figure 1: General managers - Developing information and communication system concerning financial management and control

Results presented in the Figure 1 show similar pattern for respondents across two countries. In both Serbia and Albania, a considerable portion of general managers do not take part in this type of practice (around one third of them). On the other hand, about 30% of them is taking part in this task to a great extent (whether they actually perform it, organize it or manage/supervise it) in both countries.

In relation to perceived needs for further professional development, out of those who see this practice to be relevant for their work, every fifth general manager in Serbia indicates high level of need in this area, and twice as much in Albania (Table 2). On the other hand, much bigger percentage of respondents in Serbia indicates no need at all for professional development in this area than what is the case in Albania. In sum, distribution of answers show that managers in Serbia less perceive they have a need for further training than their counterparts in Albania.

Table 2: General managers - Perception of need for professional development

Developing information and communication system that will provide employees with clear and precise directives and instructions on their role and responsibilities concerning financial management and control				
	High level of need	**Moderate level of need**	**Low level of need**	**No need at all**
Albania	38,5	23,1	23,1	15,4
Serbia	20,8	29,9	13,0	36,4

When it comes to managers of finance departments, results presented in Figure 2 suggests that these managers are much more involved in developing ICT systems concerning FMC than the line managers are (especially in Albania). When comparing two countries, all finance managers in Albania are dealing with the task (and majority to a greater extent), while in Serbia a quarter of the sample believes that this is not relevant for their job position.

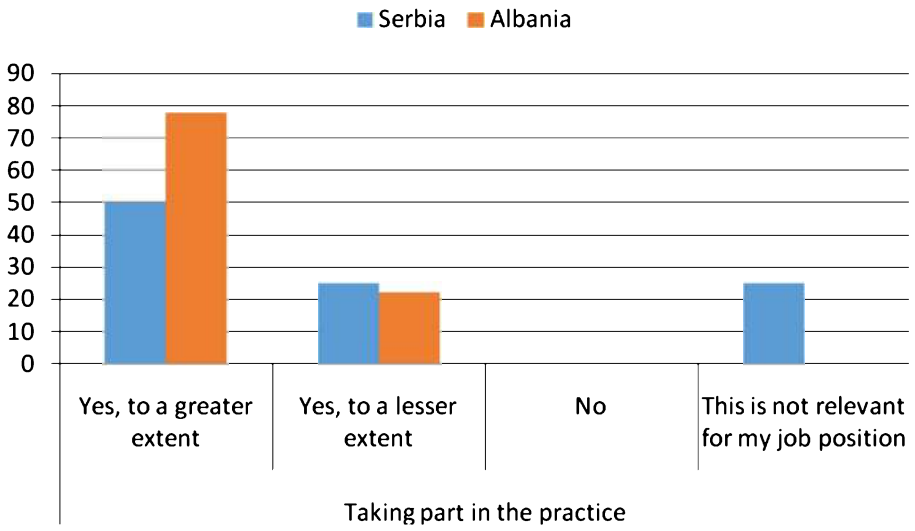

Figure 2: Managers of finance departments - Developing information and communication system concerning financial management and control

Out of those who see this practice to be relevant for their job, almost three quarters of finance managers in Serbia stated that they have a need for further professional development (whether it is high or moderate need). Interestingly, not one manager from Albania indicated high level of need, but more than half of them specified that they have moderate level of need. In sum, respondents from Albania appear to feel less need for trainings in this area than their peers in Serbia.

Table 3: Managers of finance departments - Perception of need for professional development

Developing information and communication system that will provide employees with clear and precise directives and instructions on their role and responsibilities concerning financial management and control				
	High level of need	**Moderate level of need**	**Low level of need**	**No need at all**
Albania	0,0	57,1	14,3	28,6
Serbia	47,4	26,3	10,5	15,8

Internal auditors were asked about perceived need for professional development only. Table 4 presents the results for two types of audit: information system audit and financial audit. Financial audit was taken here for the purpose of comparison with information system audit. Results suggest that in both countries need for information system audit is perceived at high level, much higher than further training in financial audit. More than three quarters of internal auditors in Serbia indicates high level of need in this area.

Table 4: Perception of need for professional development in information system audit and financial audit

	Serbia		**Albania**	
Need for professional development	**Performing information system audit**	**Performing financial audit**	**Performing information system audit**	**Performing financial audit**
High level of need	76,5	43,8	58,8	29,9
Moderate level of need	17,6	31,3	31,3	36,4
Low level of need	5,9	18,8	8,8	26
No need at all	0	6,3	1,3	7,8
This is not relevant for my job position	5,6	5,9	1,2	2,5

Auditors were also asked how much they feel a need for development in one of the aspects of information system audit - assessing whether the information technology governance of the organisation supports the organisation's strategies and objectives. As it can be seen in the Figure 3, vast majority of respondents asserted high or moderate level of need.

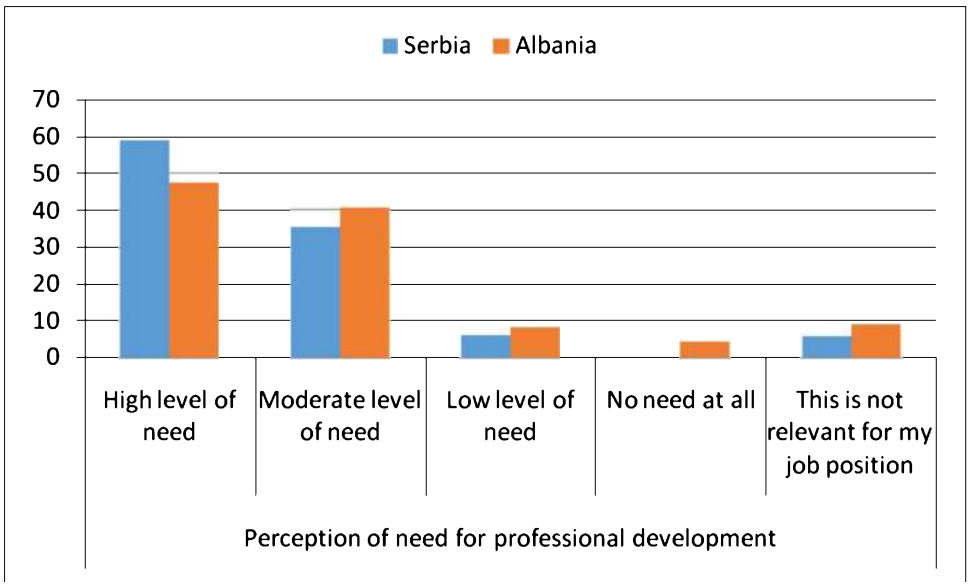

Figure 3: Perception of need for professional development in assessing the information technology governance

Overall, most unambiguous data are found with internal auditors in both countries. They strongly recognize the need to further develop in the area of information system audit. Situation with finance department managers is also mainly straightforward (more so in Albania) - dealing with information and communication system concerning financial management and control is generally seen to be their duty and they perceive the need to further improve in the area. In respect to general managers, results show that many of the do not see this be relevant for their position. We cannot say to what this can be attributed - to seeing financial management and control as not relevant for them or information and communication technologies. In the context of results of the main FINAC study, we are inclined to first explanation - many general managers do not see financial management and control to be their responsibilities. One reason for this is wrong perception that this is exclusive responsibility of finance departments.

These findings, as we see it, partly prove our initial hypothesis that the majority of public administration employees in Albania and Serbia who have responsibilities in financial management and control feel the need for additional professional improvement in usage of information and communication technologies in order of building up capacities in sphere of financial management and control. Aside of providing additional trainings in connecting ICT and FMC, what is still needed is raising awareness of general managers of importance and their role in financial management and control.

5. CONCLUSION

The European Union is committed to assist Albania and Serbia to create a more efficient modern public administration to meet the challenges the country faces in its bids to improve public administration. Till 2017 had already given 32 million euros (36.5 million U.S. dollars) for capacity building in Albanian administration. In order to guide implementation of Financial Management and Control, Albania has established the Public Finance Management Strategy 2014-2020 (PFM Strategy), where Pillar 5 of which seeks to establish effective internal control through a wide range of deliverables, covering issues such as information systems needed for effective Financial Management and Control (SIGMA, 2017, pp. 146).

Then again, Serbia is one of the European countries with the smallest number of public administration employees, when measured by the ratio of public employment per 100 inhabitants. Currently, this ratio equals 6.4 employees per 100 inhabitants, while the average for EU countries is 8.5. In the future period Serbia should strengthen the capacities of public administration employees, in order to reach the level of knowledge and competence of employees and efficiency and effectiveness of their performance similar to that of the public administration of EU countries. Digitalization should provide to citizens and companies to have a more practical, efficient and transparent approach to public administration, particularly financial management and control sector of public administration.

The rationale behind research conducted within ERASMUS + FINAC project was to get information about professional competencies of employees in public administration in management, financial management and audit positions, as well to get a picture do they recognise urge for improvement of their knowledge in field of information and communication technologies towards increasing process of digitalisation regional countries.

Although digitalisation and the digital transformation are processes that are widely discussed, and which will be among main topics in a period ahead, they actually present a topic-process that is not fully defined. In a broader sense we are talking about adequate and skilful introducing of process in public administration that will improve operations and provide to citizens and companies service on the quality level and fast and efficient enough for which they are paying.

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PUBLIC MANAGEMENT: COMPARATIVE ANALYSIS OF THE APPLICATION OF PARTICIPATIVE BUDGET CONCEPT IN THE COUNTRIES OF FORMER YUGOSLAVIA

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Abstract:*Participatory budgeting (PB) is a process that enables citizens to participate in decision-making related to local governments, i.e. improving the quality of life on a micro level.This paper takes an example of the former republics of the Socialist Federal Republic of Yugoslavia, which do not have such a developed system of PB, but the process has certainly begun, with the likely tendency of expansion and development. The aim of this paper is to provide a comparative analysis of the use and role of PB in Serbia, Croatia, Macedonia, Bosnia and Herzegovina, Slovenia and Montenegro.*

Keywords*:participatory budgeting, public investment decision, former republics of the SFRY, citizens' decisions*

1. INTRODUCTION

Participatory Budgeting (PB) is a relatively new concept in the countries of the former Yugoslavia, although it has been applied worldwide since 1989, when it was first used in Porto Alegre, a city that has faced serious financial problems. There is no single definition of participatory budgeting, because the scope of the concept differs depending on the city in which it is applied. Nevertheless, what is common in all attempts to define this concept is that *it is the process by which the local population is involved in the decision-making process on the distribution of all or part of the available public sources*. The fact that this type of budgeting was implemented in Porto Alegre (Brazil), at a time of democratic challenges and following a change in the political regime with the support of the working class and the poorer segments of society, when local governments faced a major budget deficit, infrastructure problems, insufficient financial resources and managed to change the image in a relatively short period of time, indicates the effectiveness of this mechanism. The basic principles underlying this mechanism are the strengthening of democracy, social equity and civic control.

Although the definition of PB emphasizes the participation of unelected citizens in the creation and distribution of public finances, important additional criteria are related to: discussion of the financial (budget) dimension, participation of municipal bodies, repetition of the process, the existence of some form of public debate and responsibility for the achieved result (Joan Font et al., 2014).

PB is a way of investing public money according to citizens' decision, ie, public. In any case, this is a limited amount of money that is different from the budget to the budgets of individual municipalities. It represents support to the civil sector, which is also a challenge for citizens to be involved in the decision-making process for the allocation of a certain part of the budget funds. PB is the process of the most direct possible involvement of citizens in decision-making, and can be called the most democratic way of decision-making. In a word, citizens are asked what they want to finance their (public) funds. Suggestions are submitted to local administrations.

2. CONCEPTUAL DEFINITION OF PARTICIPATORY BUDGETING

It is an innovative way of involving all members of a community, and connecting them with common goals and interests, regardless of party or any other affiliation. In this lies the secret of the success of this method of distributing budgets, because individual interests are subordinate to the common good. Participatory budgeting contains the basic settings of a democratic process that is truely applied in practice, and not only serves as a dead letter on paper. Thanks to the success and results achieved in Brazil, PB is rapidly expanding in Latin America (Argentina, Chile, Uruguay, Peru, Colombia), in many African countries as well as in neighbouring countries (Albania). OECD member countries adhere to so-called The principle of information, consultation and active participation of citizens in order to create an open and inclusive public administration since 2001, with an annual evaluation of the fulfillment of these principles. Nowadays, it is used in some form in over 2,500 municipalities around the world.

The main advantages of PB can be synthesised by giving priority to the needs and goals of the most vulnerable and impoverished members of the community, strengthening social cohesion, improving the services provided, increasing the transparency and accountability of local authorities, strengthening the credibility of local authorities. Transparency of the whole process is something that makes PB attractive to all actors, and especially to citizens. The amount of the public budget itself allocated in PB varies from city (municipality) to city. Usually, these are small amounts of the city's annual budget, where citizens discuss the proposed investment projects, and make a decision on the use of available funds, but they are not legally defined costs.

Nevertheless, PB in itself carries certain risks, and practice and literature identify several limitations (Wampler, 2007), which still depend on the form of PB:

- Focus on public works / projects, which require additional learning and engagement of citizens on rights, fiscal responsibility of the government or wider social policies. The way to overcome this constraint is fairly clear - the local community should evaluate the time and invested energy of the participants through the implementation of particular projects specific to the particular current problems of the local population;
- The process depends to a large extent on local government (organisation, availability of information, implementation) and therefore requires the will and support of the mayor who appears as the main actor in the whole process. So far, there have been poor experiences with the boycott of "hostile" citizens and selective "listening";
- Citizens mainly focus on short-term plans and projects that fulfill social goals, but often it is done to the detriment of economic feasibility of projects. It is necessary, during the process of PB, to develop an understanding of the complexity of the proposed allocation decisions;
- Similarly, the focus is on local problems, ignoring the general economic and social situation in the country, because although participants dedicate their ideas to ensuring changes in local public policies, the main problems faced by communities are often related to unemployment, violence or lack of educational opportunities;
- There is a risk of abuse of the entire process, such as the use of PB to achieve its own political goals, with the concealment of information on the size and structure of the budget, the weakening of the implementation function and monitoring of the entire process.

3. PARTICIPATORY BUDGETING PROCESS

The process of PB involves the active participation of citizens in the creation and implementation of all stages of the budget cycle, starting from identifying the crucial local issues for which projects will be drawn up, through the preparation of feasibility studies and submission of proposals to local authorities, analysis, discussion and selection of a project whose implementation will be approached in the upcoming period, to monitoring and evaluating the execution of public works. Part of these activities can be all members of the community, who want to participate in the decision-making about the allocation of budget funds. In this way, local authorities and the population cease to be two separate segments of the community, and unite their efforts to contribute to the prosperity of their municipality. Local government representatives have got (or should have got) skills and knowledge that citizens may lack, while the citizens themselves, for their part, know best to identify the problems they face on a daily basis.

PB is a process consisting of several repetitive phases. As already pointed out, the participants are the local self-government and the Mayor, and citizens (with special emphasis placed on the incorporation of the most vulnerable categories of population), civil society organisations, the business community. All of them participate voluntarily, which means that the first precondition for the application of PB is the existence of the will of the mentioned participants, primarily local self-governments.

PB is a model by which citizens are given an opportunity to propose the purpose of investing public money, which is later included in the budget. The amount of funds available for this kind of decision-making and the management of funds depends on the municipality to the municipality. Concerning the legal framework, participatory budgeting or citizens' rights are supported by several laws at the international and national levels: the Law on the Budget, the Law on Financing Local Self-Government, the Law on Free Access to Information, the Budget Law, the Law on Local Self-Government, the Law on Local Self-Government the ratification of the Convention on the availability of information, the European Charter of Local Self-Government, public participation in decision-making and the right to legal protection in environmental matters (the Archives Convention), it is also possible to refer to the statutes of cities and municipalities. (https://www.cdtmn.org/wp-content/uploads/2017/02/brosura-za-participative-bud%C5%BEetiranje-2-ver.pdf)

In practical terms, the PB process differs from the local community to the local community. In the global process, it begins with an assessment of the situation, and determining the amount of available resources,

and prioritizing after identification of needs. An important role is the process of improving the mechanisms for collecting proposals, opinions and feedback. It is necessary to ensure the smooth running of all stages of the process. Then follows the analysis of the proposal, and the democratic gradation of the proposal. The final step is the realization of selected proposals.

Good democratic practice in a regulated society can facilitate the governance process, and also increase the level of citizen satisfaction. Citizens, when voting in elections, entrust their trust to representatives, but through participatory budgeting and they alone or individually can influence the improvement of the development of local communities. The model of participatory budgeting allows citizens to express their ideas and to vote for the proposals they support. In this process, several principles should be respected: responsibility, participation, transparency, tolerance, fairness, competitiveness, efficiency and effectiveness, respect for the agreements reached, equality and predictability. Also, the participatory budgeting phases should include information, consultation, inclusion, cooperation and empowerment.

PB is not a complex process, but it differs from municipality to municipality depending on the projects that enable this system and the policy of local governments.As noted above, the process came to life at the end of the last century, and more recently, the initiators of this way of allocating local financial resources are represented by non-governmental organizations, and they also contribute to the spread of this kind of decision-making.

In order to implement this procedure, it is necessary to reach an agreement with the local self-governments, whereby political organizations / parties can contribute to the process of participatory budgeting being implemented. In this process, political parties can gain on their popularization because of a democratic idea, if citizens consider that such a form of management is adequate. Mostly this process is carried out through numerous international projects.

After the local government decision has been taken that part of the budget will be entrusted to the citizens for decision-making, the process begins. Regarding the amount of money in the absolute amount or the percentage of the budget that is entrusted to the citizens for decision making, it depends on the municipality to the municipality, and also from the project to the project, i.e. source of funding.

The first premise is the available resources. After that, citizens give project proposals that can be like building or restoring children's playgrounds, sports fields, increasing the quality of life of children, or the third generation, building bicycle paths, improving lighting, paving the streets etc. It is necessary that every proposed plan should be in its package contains a sufficiently elaborated business plan, which clearly shows the effects, the value of the investment, and the projected design period.

Proposed within the agreed time, projects are considered and publicly announced according to the procedures and decisions of local governments. Project proposals can be available on local government websites, can be printed and distributed in the form of leaflets, or inserted into the most popular local newspapers. It is also possible to promote through local radio and television stations. Basically, the point is to inform as many percent of the population as possible. The interested parties are definitely responding because the process is neither demanding nor complicated.Again, depending on the local self-government, a number of days are proposed projects for insights, and after the expiration of the given period, voting is allowed.

In principle, all interested citizens can vote. In some settings, this is an adult's life, while some high school students are involved in the process of participatory budgeting somewhere. Voting can be done publicly or secretly, and the voting period may last fifteen business days, again in line with local decisions. After the voting is conducted, the most sustainable projects are selected, up to a certain amount of budgetary funds. If projects require a smaller amount of funds, more projects can be implemented during a budget year.

The process in practice takes several months. Usually begins at the end of the calendar year, when a budget is proposed and approved, and then a clear amount is dedicated to participatory budgeting. After that, project proposals and proposals are accepted, included in the selection, and publicly disclosed. Then follows the voting of the population, which is a key step in democratic decision-making on the use of public funds. Lastly, the holders of selected projects receive funds through which proposals are put into operation within the agreed time.

The PB process could be presented in the following phases:
1. Determination of the amount of funds that will be incorporated into the budget of the local community;
2. Public call for submission of project proposals;
3. Matching with projects that contain a business plan;

4. Adoption of projects, and their promotion to the citizens through various information agendas - the period for the adoption of a pardon;
5. Citizens' voting, and selection of the most attractive projects, according to the number of votes.
6. Assigning budget funds and putting them into practice.
These phases must be respected, the process must inevitably be carried out in a transparent atmosphere. After that, projects selected by the citizens within a reasonable time have been put into operation.

4. MODELSOF PARTICIPATORY BUDGETING

Sintomer, Herzberg and Röcke (2008)distinguish six basic models of participatory budgeting,based on a set of criteria:

1. "Porto Alegre adapted for Europe"
2. "Participation of organized interests"
3. "Community funds at the local and city level"
4. "The public/private negotiating table"
5. "Proximity participation"
6. "Consultations on public finance ".

4.1. "Porto Alegre adapted for Europe" and "Participation of organized interests"

In some European experiments where the influence of the anti-globalization movement has been particular importance, the Porto Alegre model directly influenced the setting up of a completely new procedure. For example, in the Cordoba, the participatory budget (introduced in 2001) can be considered as an ideal example of "Porto Alegre adapted for Europe". However, in other cities, the influence of the Brazilian case was more indirect in character, as is the case where participation is not directed at individuals. In the second ideal case, secondary organizations, NGOs, trade unions and other organizational groups are the main actors. This model is based on neo-corporate logic, and is called "Participation of organized interests". Very often, it develops in places where the previous tradition of participation is based on contributions from associations by stakeholders to define the policies of certain sectors. Although there have not been direct examples of models of organized interests in Europe, some experiments are moving in that direction. The budget for the participation in Albacete can be considered as a hybrid of Porto Alegre and a model of "organized interests" (Sintomer et al, 2008).

The content of discussion represents the second difference between the two types. In the "Porto Alegre Adapted for Europe" model, discussions primarily refer to specific investments and projects, while the discussion of broader policy orientations is at the heart of the process of "Participating interests" (ie, general orientation of population, education, environment or local policies related to for traffic). The subsequent difference is in the way people's proposals are treated. In the "Porto Alegre adapted for Europe" model, there is a high pressure for the implementation of proposals that arise during the process of budgeting participation, because the local self-government has to comply with the undertaken obligations to accept them. Although the municipal council is technically still responsible for the final decision on the budget, citizens are those that can be deemed to have a de facto possibility of (joint) decision-making. As in the Brazilian case, this model contains the formula for the redistribution of investments. However, the criteria are not necessarily the same as in the Brazilian context. Other factors can be used, such as the number of beneficiaries of social benefits in the district, participation in meetings or the degree to which citizens themselves implement the proposed projects. In the "Participation of Organized Interests" model, the rules can be more informal than in the Porto Alegre model, and this can lead only to a consultative process.

One advantage of both models is the potential for making quality decisions. Participants not only discuss topics in a larger space, but can do the same in smaller forums, committees or councils of representatives. In these circumstances, a fundamental discussion, which allows the development of detailed proposals for problem solving and clarification of important topics, becomes possible. This may even mean that students develop expert reports on equipment in schools or better integration of minorities. One challenge for both models, however, consists of merging procedures with extensive modernization of the entire administration. Another challenge is to address potential conflicts between individuals' participation and the participation of organized interests. In some experiments that are closer to the Porto Alegre model, this proved to be problematic, for example, when associations were already being set up afraid of adversity regarding their promotion.

4.2. "Community funds at the local and city level" and "The public/private negotiating table"

The models of "community funds" and "public/private negotiating table" have only played a marginal role in European participatory budgeting so far. Regardless, they represent a potentially strong basis for the future

development of participatory budgeting, most notably in the UK and Eastern Europe. In both cases, there is a fund for investments or projects for society, the environment or culture. Such a fund existed, for example, in the British city of Bredfordand the Polish city of Płock. Another specificity of these models is that they are relatively independent of the municipal budget, since the money in question does not come, or comes only partially, from the local self-government. Accordingly, the municipal council has no last word on the acceptance of the proposal. It is already a committee, a commission or assembly of representatives that sets priorities. Organized groups, such as local associations or communities, and NGOs are in the center of both processes, but the work is excluded from one of them and is central to others. The possibility of a meeting can be considered fair, as several meetings with a sustainable group of participants take place.

In the case of a "public/private negotiating table," private firms and perhaps international organizations are collecting some money. Oil company ORLEN S.A. for example contributes 50% of Płock funds with a total of 300,000 euros, in addition to the municipality and the UN development program. This financial involvement allows the private sector to influence the design of the procedure, so that citizens who do not give money but apply for it play only a secondary role. This model can be developed when international actors try to involve civic groups or NGOs in public / private partnerships. The UN program Habitat officially adopted a participatory budgeting (Sintomer et al., 2013b), but shortly thereafter, it largely moved away from the Porto Alegre model while defining this instrument "an innovative mechanism that tends to promote the involvement of local self-governments, the private sector and civil society in process of remediation of municipal finances". The impact on Rio Grande do Sul's capital is therefore indirect.

On the contrary, the combination of a strong participative tradition with the ideas of Porto Alegre has led to the extension of the local model funded by the community to the city level. In this model, the participants decide on the rules of the joint fund independently, while the business is exempted. Funding is provided through specific policy programs, for example, for urban renewal. In this model, the promotion of socially vulnerable groups is a key feature. In 2004, for example, the fund for participatory budgeting of the British city of Bredford of more than EUR 875 000 was reserved exclusively for groups from vulnerable zones. Moreover, participants of "joint funds" ideal type realize the projects themselves. While this is also possible for a public / private negotiating table, it is not a necessary condition.

These two models have advantages and disadvantages. The connection of a local political structure, for example, is weak or non-existent, even when the municipal council retains some influence as it collects a portion of the money. At the public / private negotiating table, the influence of private investors depends on the size of their contribution, but radical reorientation towards greater social justice is unlikely. Similarly, the "common fund" model presents new opportunities for participatory budgeting. National and European programs for the promotion of cities and infrastructures can, for example, be connected at the local level with the budget of participation and promote vulnerable settlements or groups of residents. Both models have the same advantage that they enable a diverse citizen participation, as participants also implement projects.

4.3. "Proximity participation" and "Consultation on public finances"

While examples of the model of participation in proximity are mostly found in France, the model"Consultation on public finances" is a feature of the budget for participation in Germany. Both have in common that involve only consultative processes. This means that the results of the discussion were summarized by the local self-government, not by the citizens of the participants. Unlike the models that have been presented so far, participants do not vote here or develop project priorities. This is more about the process of "selective listening", that is, the local self-government can freely (and at its sole discretion) integrate some of the proposals in its public policies after the process of participation (Sintomer, 2012). What's more, civil society has only a slight influence on the design of the procedure. It has to be underlined that these models are not looking for any specific goals, and that there are no distribution criteria in this process. Another common feature is that associations can barely play any role within the procedure. Participation takes place through open-source councils where citizens are called upon to publish in media, letter or direct contact. In Germany and in some French experiments, participants were (additionally) mobilized on the basis of a random selection from the register of the right holder to vote. These persons receive a personal invitation from the Mayor to attend a civic forum. This method, among others, was applied to Emsdetten of Hilden, Vlotho and the Berlin districts (Sintomer et al., 2010).
The two procedures differ in their roots. The proximity model usually relies on pre-participant instruments, such as funds or district councils, which tend to link together with a preparatory budget together to a single instrument. This development takes place after the ideological impact of Porto Alegre, but the real resemblance to Treptow-Köpenick remains very limited. The model of "Public Finances Consultation" can keep some influence from Porto Alegre, but de facto is more similar to the trends in the participation of New Public Management strategies. In Germany, it was imported from the New Zealand City of Christchurch and the Brazilian experiment had an impact only later, which led to the emergence of mixed models. The

"proximity" model generally involves districts and refers to investments at that level. At the city level as a whole, this model no longer deals with investments, but with general political goals ("a nice city") (Sintomer et al., 2013a).

In general, the term "proximity" has two meanings. On the one hand, it refers to geographical proximity, in the sense of, for example, the organization of several meetings with quarters and not just one meeting in the city council; on the other hand, the term refers to close contact between municipal management or between administration and citizens. According to this model, Mayor Bobigny organizes open gatherings twice a year in order to respond to citizens' concerns. The model of "Public Finances Consulting" first deals with the establishment of transparency of the financial situation of the city. Information on the general budget is disclosed through brochures, the Internet, and press releases. There are two versions of the model. In a more widespread variant, public services and municipal accountability zones are presented, for example, in the form of revenue and expenditure for libraries, swimming pools and preschools and street cleaning, wastewater treatment and waste disposal, etc. Citizens can submit their proposals in an open session or in a specific forum. The second option aims to balance the budget deficit. In the city of North Rhine-Westphalia, Emsdetten, for example, the budgeting process for 2002. It is based on five options for a balanced budget: reducing personnel costs and operating costs, reducing voluntary liabilities and accountability, withdrawing from the reserve or increasing taxes and fees. Through the survey, each participant was asked to develop his or her proposal, which is based on the combination mentioned.

At the end of the event, the general recommendation of the civil forum was calculated on the basis of individual opinions. Generally speaking, the modeling aspect of the model is poor, because in most cases there is very little time for more intense discussion. Through the model of "Participation by neighborhood," contrary to the nature of considerations, can be herbs, as citizens sometimes work in small groups that meet more often over a longer period of time. The model of "Public Finance Consulting" is interesting in the sense that it is part of the general modernization of local bureaucracy, even if the promotion, limited to one or two sessions a year, can hardly produce tremendous effects. Moreover, civic participation is only a "supplement" of this modernization process, without a direct link with social problems and for the renewal of politics. The Model of "Proximity Participation" can trigger a discussion between citizens and administrations / council members, but it can hardly produce the effects of modernization at the city level. In both models, accountability is low on the implementation of the proposal and the autonomy of civil society is weak.

5. RESEARCH RESULTS

5.1. Serbia

The Municipality of Ruma recognized the importance of participatory budgeting and for the second year in a row enabled all interested citizens to get involved in budget planning for 2017. The Project Implementation Team "Participatory Budgeting" of the Municipality of Ruma carried out research among the citizens within the project activities and defined the List of Project Proposals, ie candidates to become part of the annual budget for 2017.

On June 30, 2016, Ruma adopted a Decision on including citizens in the budget decision-making process and preparing a budget guide through the budget. This Decision defines that the involvement of citizens in the budget process is carried out through the following activities of the municipal administration services: 1. Regularly informing the public about all steps in preparing the budget, such as: announcing citizen surveys, providing information to the media, setting information on the official website of the municipality (and on social networks); 2. prepares questionnaires and organizes citizens' surveys on budget priorities at the moment when the budget process starts; 3. the organization of the Local Budget Forum where the results of the survey and the Draft Budget Decisions are presented and conducts a public debate on the topic of budget revenues and local economic development and other topics of the overall development of the municipality; 4. Conclusions from the Local Budget Forum, as well as the results of the questionnaire / survey analysis, are an integral part of the explanation of the draft / proposal of the Decision on the municipal budget.

5.2. Croatia

An analysis conducted in Croatia shows that participatory budgeting (PB) of Croatian local units is not well developed. Several cities have had experience with involving citizens in the preparation of the local budget, but in most cases it is a process of "shallow consultation" without the real commitment of citizens to the decision-making process for specific financial amounts. Therefore, the types of engagement vary from a simple call for proposals to transfer the decision-making process by directing the priorities of sub-municipal projects.

Since most of the civic participation initiatives in the preparation of the local budget in Croatia have not been developed and are still elaborated, it is difficult to talk about PB and it is even more difficult to talk about specific PB models in local units of Croatia. The predominant part of the analyzed local units is primarily oriented towards making the local budget transparent and understandable to citizens, and thus only includes information in the form of one-way communication between administration and citizens. However, some of them have implemented non-binding consultation practices (in most cases e-consultation) that can be considered as one type of PB model, which Sintomer et al. (2008, 172 - 173) called "Public Finances Consultation". Half of the cities organized public sessions and discussions on local needs and necessary projects at the sub-municipal level and in cooperation with local government, which is a feature of "Participation by neighborhood". However, the model implemented in Pazin is the most developed. Since it involves the direct participation of individual citizens who decide on concrete investments and projects with a larger share of acceptance of proposals, this model is closest to the original PB model, or "Porto Alegre adapted for Europe" (Sintomer et al., 2008, 170). As the most developed local unit in PB practice in Croatia, the city of Pazin, or its PB model, is presented in Table 1. Other forms of citizen involvement in the local budget should not (still) be characterized as a developed PB practice.

5.3. Macedonia

Participatory budgeting in Macedonia is in its initial implementation phase. As a model recognised as successful by cities / municipalities around the world, representatives of some local authorities in Macedonia have decided to give a chance to this type of budget allocation, and to decide, together with citizens, about priority investment projects for the coming period of time. The PB project in Macedonia, supported by the USAID Civic Engagement Project through the East West Management Institute, is in progress (May 2017-2020). The overall objective of the project is to improve the practice and participation of local actors in the local budgeting process, as well as to increase the efficiency of spending municipal money. The specific objectives defined within the project include:

- Increasing the participation of local actors - civil society, business community, citizens, local media, in the local budgeting process;
- Increasing the awareness of the local population about how the endeavor of the local budget affects the quality of their lives;
- Increasing the credibility and efficiency of local government decisions related to the spending of public money and raising awareness of the necessary transparency in this respect.

The realisation of the project is organised so that six members of the FISCAST network (this is an acronym of FISCal Accountability, Sustainability and Transparency) plus Financial Think (independent non-profit institute for economic research founded in 2012) represent the core of the entire network. The selection of members was carried out carefully, bearing in mind their previous experience with certain municipalities, as well as the level of successful cooperation with Financial Think in the previous period.
The municipalities covered by this project are:
Kvantum Prima - Kavadarci, includes: Kavadarci, Negotino
Institute Zip - Skopje, which includes: Saraj, GjorcePetrov
Egri Civic Center for Sustainable Development - KrivaPalanka, covering two or three of: KrivaPalanka, Kumanovo, StaroNagoricane
InicijalniGlas (Initial Voice) - Prilep, which includes: Prilep, Krivogastani
Institute IMAPKT - Skopje, which includes: Strumica
Center for Change Management (MCP) - Skopje, which includes: Center, GjorcePetrov (together with Zip)
Financial Thinking: Krusevo, Centar (together with TsUP).
What is expected after the implementation of this project is more efficient allocation of budget funds, improvement of the quality of life of residents in these municipalities, as well as the expansion of PB in other cities / municipalities in Macedonia.

5.4. Bosnia and Herzegovina

Also, in Bosnia and Herzegovina (BiH), some municipalities have decided to introduce the PB process into their practice and use all its benefits. Among the innovators, and we hope for examples of successful practice, there are the municipalities of Breza, Istočnallidža and the municipality of Kreševo.
The Municipality of Breza is one of the municipalities in BiH which, according to the population census in 2014, has got 13,787 inhabitants. When it comes to the level of development, this municipality notes the tendency of economic growth and development measured by gross domestic product (GDP) per capita. Namely, in the period 2007-2013, according to the data of the Center for Social Research, GDP per capita is almost doubled (from 4,917.50 to 8,344.83). Data for 2014 show a GDP per capita of 13787 km, which is by 1.7% higher than the average GDP per capita in the Federation of BiH. (Federal Bureau of Development Program BiH, Macroeconomic Indicators by Cantons 2014). The implementation of the project in Breza municipality is expected in 2018, although it started with preparatory phases in April 2017. A sum of 9,000

euros (18,000 KM) is available to citizens. To date, 8 projects have been presented, with the selection and implementation of ideas for allocating separate funds.

The municipality of Istočnallidža, according to the 2013 census, has got 15223 inhabitants. GDP per capita in 2017 was 4,651.27, and in 2013 almost unchanged (4,668.47). The same available funds are available to residents of the Municipality of Istočnallidža (18,000 KM). Also, the time frame for project planning and implementation is the same (April 2017 - November 2018), but for now, residents of the Municipality of Ilidža have submitted 6 proposals.

The municipality of Kreševo is a smaller municipality by population (according to data in 2014, the number of inhabitants was 5456). GDP per capita in 2007 was 5,325.00, and in 2013 6,217.64 (Center for Social Research). However, according to the Federal Institute for Development Programming, GDP per capita in 2014 amounted to 629 KM, which is by 14.3% less than the average of the Federation of BiH. In the Kreševo municipality, the launch of the participatory budgeting process has very similar baseline settings in terms of the available funds and the time span of the implementation and completion of the project. The same amount of available resources (18,000KM), the number of received proposals, for now is 8, and the period of planning and implementation also from April 2017 to November 2018.

5.5. Slovenia

In Slovenian experience, the municipality of Ankaran can be mentioned, whose plan was reflected in sending a letter of invitation to all households, so that all inhabitants regardless of their age, sex or other belongings participate in the active decision-making on the development of the municipality. In 2016 they received suggestions of around 20% of the total population, while the following year an increase in participation of about 30% was recorded. Principals are also included.

Informal learning in the PB process was developed by self-organized local and district community assemblies in Maribor in 2013 (Gregorčić, &JelencKrašovec, 2016). Negative effects of the global financial crisis in correlation with local specific problems motivated the inhabitants of Maribor to protest. By the end of 2012, the residents of Maribor started a struggle for social change in order to initiate changes. After these protests, the results have already become visible.

5.6. Montenegro

In Montenegro, the process of participatory budgeting was first started in the capital - Podgorica, where almost half of the proposals were implemented. Then the municipality of Nikšić started implementing through the project "Your city, your money, your choice". For example, in the municipality of Niksic, participatory budgeting is carried out in the following way: the draft budget by the local self-government units for the next calendar year is being prepared from July to November of the current year. After that, the draft budget is subject to a public hearing, and the adopted budget proposal is directed to the Municipal Assembly. The Municipal Assembly adopts the budget in December of the current year for the next calendar year.

Project in Nikšić"Your city, your money, your choice" is specifically based on a healthy environment and the creation of an efficient local self-government and lasts from 2014 to 2019. The project is in line with the Local Action Plan for Youth (2011-2016) where the main goal is to increase the participation of young people in the decision-making process.Also, the Ozone Environmental Movement, in cooperation with the Center for Democratic Transition, aims to motivate the younger population to get involved in decision-making and the creation of a local budget in order to increase trust. (https://www.cdtmn.org/wp-content/uploads/2017/02/brosura-za-participativno-bud%C5%BEetiranje-2-ver.pdf)

6. CONCLUSION

The point of participatory budgeting is that citizens are not only passive observers (although they could vote in favor of the electionof a political representative, perhaps he-she not voted/elected), but to actively participate in the adoption of certain decisions related to the work of local self-government.

Participatory budgeting can be included as one of the criteria (in the program) for certification of municipalities with a favorable business environment. This budgeting system is still unknown to citizens, and it does not enjoy enough confidence in terms of a potential model for improving the quality of life of citizens at the local level.

The aim of this model is to encourage the population to actively participate in deciding on the development of the local community, in particular in the process of deciding on the importance of certain investments, and

thus the allocation of public funds and the control of use. In any case, the implementation of the project leads to increasing the confidence of the population towards local institutions. The ability to create a budget represents an important step in improving democratization, and simplifying and accelerating implementation into the work of citizens' ideas.

Benefits for the local population would be reflected in freedom and the ability to express opinions and needs, i.e. influencing decision-making, clarification of the functioning of local self-government, full use of civil rights, involvement in decision-making, and sense of ownership ofp ublic funds, responsibility for the functioning of the local community, as well as the provision of timely and adequate information.

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THE EFFICIENCY OF ONLINE CONTENT IN POLITICAL CAMPAIGNS

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Abstract:*In recent years, social media has become an indispensable part of political campaigns, enabling political parties to have a strategic approach to creating digital campaigns. This paper deals with the identification of indicators that show the engagement of the online voter body. The first is the concept of political marketing, as well as the presentation of the modernization of political campaigns and funds through the stages of development. Then, the role of social media in political campaigns has been defined. By identifying the importance of monitoring political campaigns on social media, the paper reviews the existing developed and applied methodologies that determine the effects of political campaigns on the online voter body. Existing research has set a framework for the proposal of new methodologies for measuring the efficiency of engaging the online voter body on social media Facebook and Twitter. The proposed methodology defined in this paper will be a quantitative analysis of the published content of political parties in Serbia as well as the basis for a strategic approach in creating digital campaigns.*

Keywords*:political marketing, social media, real engagement, efficiency*

1. INTRODUCTION

The beginning of the 1990s has marked a growth in use of Internet. The number of social media users in 2010 was 0.97 billion users, and in 2018, 2.62 billion users show the trend of population growth (Statista, 2018b). For this reason, social media has become a fact of life for civil society around the world. As the communication landscape becomes more complex, and more participatory, the networked population is becoming more important and gaining more power since social media gives people the opportunity to access information much more easily. (Okan,et al., 2014). Additionally, social media has also made a significant contribution to the democratization of communications because of the possibility of free sharing of attitudes, opinions and other types of content. As a new space for targeting a specific target audience, it became an indispensable tool in both corporate advertising and political marketing.

Karlsen (2010) argues that the digital era, the era in which communication is established with voters, and that social media is an indispensable part of every political campaign. In addition, Stieglitz & Dang-Xuan (2012) argue that social media is increasingly being used in a political context, and that Twitter and Facebook have the potential to continuously increase political participation, confirming the importance of continuously monitoring the engagement of social media users in the course of political campaigns to adjust messages campaign to the electorate.

But if one looks at the field of political marketing, there is a group of authors who argue that despite the growing popularity of social media and the efforts of civil and political organizations to adopt these services, there is limited empirical research on the effects of using these services on citizens' political attitudes and civic behaviours (Gil de Zúñiga, et al., 2012). The extant body of knowledge is enlarging with the studies covering topics such as the effects of fake news in political campaigns (Allcot&Gentzkow, 2017), the use of specific media, such as Twitter, for a particular campaign (Enli, 2017) or the intermedia agenda in the social media age (Harder, Sevenans& Van Aelst, 2017).Although there are studies dealing with the effect of political campaigns on the electorate and suggesting methodologies that can predict the results of the election (Williams & Gulati, 2008; Tumasjan, et al., 2010; Sang &Bos, 2012; O'Connor, et al., 2010; Barclay, et al., 2014), in Serbia, the field of political marketing has been insufficiently explored and leaves room for further research and monitoring of political campaigns. Empirical studies confirmed that political authorities in Serbia lack of transparency, responsiveness and interactivity with citizens (Milosavljevic, Milanovic&Benkovic, 2017). The confirmation of the Share Foundation's research on the use of social media as a channel for the communication of political parties with the electorate, and at the same time the existence of an online voter body, it is possible to plan better published content and improve the overall strategy of communication of political parties on social networks- media.

The paucity of the studies on the real effects of online political capmpaigns could partially be attributed to the lack of substantial matrices of indicators for the measurement of the effects of political campaigns in the

online arena. The aim of this paper was to identify the key indicators of the engagement of the online voter body by researching existing methodologies. The additional aim of the paper is to propose a new indicator of the efficiency of the engagement of an online voting body that would use political parties in Serbia as a feedback for the formulation of digital communication strategies.

The remainder of the paper is organized as follows. Section 2 delineates current body of knowledge related to the conpcepts of political marketing, and the online channels for communicating political programs, aims and ideologies. Section 3 depicts on the main matrices used to indicate the relevancz of online presence in the sphere of political marketing. Section 4 is reserved for concluding remarks.

2. RELATED WORKS

The concept political marketing, although relatively new, has grown rapidly over the last decade. According to certain authors, while business marketing manages the market of customers, political marketing is governed by the voter market. In this case, the element of the market implies a political market, which further relates to the political public or, more specifically, the citizens as decision makers. Essential determinants of classical marketing, such as needs, desires and demands, have their own substitutes in political marketing. The needs can be replaced by interests, preferences of voters or the political market, while demandsrepresent the interest of the political market for a political program (Škaro, 1999; Rocco, 1993). Nowadays, it attracts scholars from a number of disciplines outside the mainstream marketing field.

Political marketing includes political parties' influence on voters and focuses on influencing individuals in terms of political candidates to reach the maximum number of votes (Okan, et al., 2014; Bongard, et al., 1998; Slavujević, 2007). Political parties started to use marketing tools as part of their election campaign activities (Okan,et al., 2014). Karlsen (2010) claims that the recent decades of new information and communication technologies have influenced the creation of election campaigns. The same author, through three phases of campaign modernization, explains the instruments used in communication with voters. The first journalistic era (pre-modern campaign) is characterized by communication through newspapers, mass meetings and surveys whose main goal was to mobilize voters. The second television era (modern campaign) marks the use of television in campaigns that have been carefully prepared long before the election. Then there is a need of political parties to define the strategy of the election campaign. The third period is the digital era (post-modern campaign) in which communication is established with voters as well as the need for return information in order to adjust the message of the campaign to the audience. In the two-way communication, which marks post-modern campaigns, the possibility of a new type of engagement of the digital polling entity opens up feedback to political parties, thus adapting campaign messages to the digital voter body.

2.1. Social media as a channel in political campaings

One of the marketing channels that political parties use to reach the voters is the social media (Shehata&Strömbäck, 2018). Since the rise of the Internet in the early 1990s, the world's networked population has grown from the low millions to the low billions (Okan, wt al., 2014). The global popularity of social media can be seen by comparing the acceptance of different media by users - the radio took 38 years for 50 million users, 13 for television, for the Internet 4 years, while Facebook had the same number of users in 10 months (Filipović&KostićStanković, 2017). Kaplan and Haenlein define social media as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0 that allow the creation and exchange of user-generated content" (Stieglitz & Dang-Xuan, 2012).

Marketing on social media can be defined as monitoring and facilitating interaction between customers, participation and exchange through digital media to encourage positive engagement with the company and its brands leading to a commercialized value (Chaffey & Smith, 2013). If a social media strategy is properly applied, marketing on social media can contribute to the success of achieving the goals of the organization. This is supported by facts about the number of social media users with whom it communicates with the implementation of the marketing strategy. Facebook has 2.167 billion users worldwide, Instagram has 800 billion active users and Twitter has 330 billion (Statista, 2018a).

Social media is considered to have made a significant contribution to the democratization of communications, the free sharing of attitudes, opinions and other types of content, through which editorial power is transferred from owners and editors of traditional media to users. Also, social media is a completely new space for the target audience to be targeted, making them an indispensable tool both in corporate advertising and in political marketing. The successful use of social media in US presidential campaign Barack Obama has established Twitter, Facebook, MySpace and other social media as an integral part of the political campaign toolbox (Tumasjan, et al., 2010). Obama used fifteen social media sites to run his

campaign. He understood the power of complementing offline work with an online campaign. He systematically linked the online community to offline activities such as fundraising (Effing, et al., 2011). Another positive case was the online campaign of Ségolène Royal during the French elections in 2007. She managed to connect with a massive online crowd (Effing,et al., 2011). One characteristic of this primary election was that their members were highly mobilized (Montero, 2009). On the other hand (Okan, et al. 2014) talked about political communication with voters through online campaigns in Turkey. The results of an analysis of the activities of Turkish political parties in local elections show that social media platforms used in local politics in 2014 - the first three were Youtube, Facebook and Twitter (Okan, et al., 2014).

The first significant use of the Facebook and Twitter platform for communication with the electorate in Serbia occurs during the presidential elections in 2008, when the first forms of planned digital content in political campaigns appear. It was then clear that the main actors in Serbia's political scene understood the notion of democratization as a chance to freely distribute a large amount of content, without using enough opportunity for strategic positioning of parties, promotion of their own ideas and political programs. Although the success of political parties in the elections is influenced by a number of other factors, the role of social media has become increasingly important in recent years. The empirical data (Statista, 2018c) show that the number of social media users in Serbia is constantly increasing and even predicts that the number of social media users will reach 3.5 million individuals by 2022. However, the use of social media as an instrument in political campaigns is an area that has not been sufficiently explored in Serbia, especially from the point of planning, creating and managing content, measuring the effectiveness of recruiting a voter body on social media and influencing election results.

In the continuation of work, a review is made of previous research and studies that were done by measuring the engagement of the online voter body, predicting the election results and identifying users who support a particular political option.

2.2. Measuring the engagement of the electorate on social media

Publication of online content is displayed as an important part of communication with the online business marketing community, which encourages the community to a certain type of activity. One of the early definitions of engagement within brand communities refers to it as " consumer intrinsic motivation to interact and cooperate with members of the community " (Baldus, et al., 2015). This term has been increasingly used in marketing literature. The results of the Ashley &Tuten study (2014) showed a high correlation of the used channels of social media by brands and consumer engagement. The same authors suggest continuous focus of marketing on maintaining social presence through social media in order to encourage consumer engagement. This is supported by research conducted by Cvijikj&Michahelles (2013), analyzing online engagement factors on Facebook brand pages. The results of their research have shown that published content encourages engagement on Facebook pages. These authors especially emphasize the impact of the media type and content type, as well as the time of publication to increase or decrease the level of engagement. The results of their research should help Facebook's moderators in implementing digital communication strategies.

But if one looks at the field of political marketing, there is a group of authors who argues that despite the growing popularity of social media and the efforts of civil and political organizations to adopt these services, there is limited empirical research on the effects of using these services on citizens' political attitudes and civic behaviours (Gil de Zúñiga, et al., 2012). However, there are studies dealing with the effect of political campaigns on the electorate and suggesting the application of methodologies that can predict the results of the election. For example, Williams and Gulati (2008) have found that the number of Facebook supporters can be considered a valid indicator of electoral success. Tumasjan, et al (2010) have created a methodology for monitoring the containing of the names of German political parties and prominent politicians in tweets, as well as analyzing the sentiments of the published content. The results of their research have shown that Twitter is a platform for political deliberation, and as such can be a reflection of the political mood of the electorate, as well as a predictor of the election result. The application of this methodology is also found in the research of Sang &Bos (2012), who, with some adjustments, tried to predict the elections for the Dutch Senate Election 2011. O'Connor, et al. (2010) developed the text analysis of the twitter publication, showing that the publications show the confidence of the electorate and their political opinion, as well as that the text of the analysis can foresee future election results. Chung &Mustafaraj (2011) tested these methodologies (Tumasjan, et al.,2010; O'Connor, et al., 2010) on a new set of data (tweets) from the 2010 US Senate special election in Massachusetts. The same authors found that just counting tweets is not enough to obtain good predictions and measure the effect of sentiment analysis and spam filtering. Barclay, et al. (2014) analyzed content on social media in the run-up to the 2012 US presidential elections and found a correlation between the number of Facebook 'likes' that Obama and Romney recorded on their official Facebook fan pages and the number of votes they secured. Barclay, et al. (2015) asked whether the number of likes onthe

Facebook page of the party in the Indian environment could predict the results of the election. The results of the study found a positive correlation of the number of odds the party or leader had on the official Facebook page and the election results.

Analyzing political campaigns in Serbia and the digital content published by political parties, the Share Foundation, during the parliamentary and presidential elections in 2016 and 2017, monitored the activities of political actors on social networks. Monitoring was about measuring the involvement of the online political community in the course of political campaigns, and the aim of the research was to show in which official account the voters were most involved in interaction. This way, it was necessary to identify online users who clearly support a particular political option. The starting point in the research was to identify individual users who interacted with Facebook by announcing political actors, as well as the number of their interactions (likes and comments) from week to week during the campaign. Also, the posts on Facebook were explored, which during the election campaign largely caused the engagement of users. The research found great disproportion between the number of likes and comments. Twitter analysis took into account the relationship between tweets from the official orders of the parties, as well as the interaction of users with them. Their "social network analysis - SNA" method analyzed the links between actors and community structures by following the popular hashtag #izbori2016.

Previous studies show that in certain political systems, social media has become one of the key factors in political campaigns and that it is possible to predict the results of the election by using certain methodologies (Tumasjan, et al.,2010; O'Connor, et al., 2010; Barclay, et al., 2014; Barclay, et al., 2015). Also, studies show that using of the same methodologies in other circumstances and political systems does not have to prove effective for anticipating the effects of political campaigns or engaging in social media (Cvijikj&Michahelles, 2013). A survey by the SHARE Foundation found that publishing content on social media in Serbia contributed to communication between political parties and the digital voting body, but did not show how political parties should plan, create and publish content. The orientation to two-way communication on social networks, the influence on the engagement of the "digital" voter body, and the measurement of the efficiency of engagement, is possible to plan better content and improve the overall strategy of communication of political parties on social networks.

For this reason, the focus of this paper is on analyzing existing indicators of efficiency, as well as on the introduction of new ones that would be used by political parties as feedback for the formulation of digital communication strategies. In this regard, in the continuation of the work, the measurement of the engagement of the digital community as a reaction to the published content by the political parties is explained in greater detail.

3. REAL ENGAGEMENT OF ONLINE COMMUNITY

Marketers recognize the increasing importance of Internet and consumers who are active in online communities (Felix, Rauschnabel&Hinsch, 2017; Dahl, 2018). The survey, which served as a framework for setting up a new methodology and indicators of the effectiveness of published content in political campaigns, takes into account the factors of Online Engagement on Facebook brand pages (Cvijikj&Michahelles 2013). The study analyzes the influencing factors in terms of the characteristics of the content communicated by the company, such as type of media, content type, posting day and time, over the level of online customer engagement measured by the number of likes, comments and shares, and interaction duration for the domain of a Facebook brand page (Cvijikj&Michahelles 2013). In their online engagement model, which relates to the analysis of the number of clicks that represent the reactions, the number of comments and shares of the online community, they are dependent variables.

The specified dependent variables were used as the basis for creating a new indicator of efficiency of the online content in this paper. Given the similarity in the way the online voter body reacts to the published content, the new indicator of online content efficiency refers to Twitter and Facebook.

Efficiency on social networks Facebook and Twitter can be measured by reactions to content, or by engaging online audiences gathered around specific lists and candidates. For the purposes of fully monitoring the flow of campaigns and engagement, the following indicators are required:
1. Total and average daily number of posts,
2. Number of reactions to the posted post / content (facebook reactions, comments and shares, while on Twitter were reactions, comments and retweets), and
3. Average number of followers on a daily basis.

Taking into account the different ways of responding to the published content, a survey was conducted regarding the various levels of engagement on social media. In the opinion of experts, for each type of reaction (reactions, comments and shares/retweets), weight coefficients were identified (0.2, 0.3, 0.5). Reactions Like, Comment and Share on Facebook's social network have been assigned with weightings 0.2, 0.3 and 0.5, respectively. Also, the same weights are assigned for reactions on Twitter, but with the greatest weighting attributed to the "Comment" reaction. In this way, the basis for defining a new indicator of efficiency, real engagement of the auditorium was obtained. The real engagement of the auditorium was calculated for each list according to the formulas:

$$ReF = \sum \text{reacions} \times 0{,}2 + \sum \text{comments} \times 0{,}3 + \sum \text{shares} \times 0{,}5 \text{[Facebook]} \quad (1)$$

$$ReT = \sum \text{reacions} \times 0{,}2 + \sum \text{retweets} \times 0{,}3 + \sum \text{comments} \times 0{,}5 \text{[Twitter]} \quad (2)$$

The final indicator for which all lists are reduced to a single measure of comparability, shows the Real engagement of the auditorium by one post (ReA / P), by placing the value of Real engagement of the audiorium in relation to the total number of announcements in the observed period

$$Re1f = \frac{\sum \text{reactions} \times 0{,}2 + \sum \text{comments} \times 0{,}3 + \sum \text{shares} \times 0{,}5}{\sum \text{posts}} \text{[Facebook]} \quad (3)$$

$$Re1t = \frac{\sum \text{reactions} \times 0{,}2 + \sum \text{retweets} \times 0{,}3 + \sum \text{comments} \times 0{,}5}{\sum \text{posts}} \text{[Twitter]} \quad (4)$$

One of the important goals of publishing content on social networks is the growth of the online community that follows a certain list (auditorium), but also the inclusion in promoting different reactions (engagement). Depending on the electoral list and candidates, the size of the auditorium is different, but also the reaction to the published content. By using this methodology, the results of the basic set indicators would be available: the total and average number of posts of the observed political party / list, the number of reactions on the published post / content (in the case of Facebook, social networks would be followed: reactions, comments and shares; followed by reactions, comments and retweets) and number of followers on a daily basis. If analysis were to be further elaborated, it would be possible to answer the question about the impact of increasing social networking as well as the online community. Additionally, it would be possible to identify which posts caused the greatest real engagement, with the identification of the exact date / time of publication of the post, whether the volume of announcements influenced the increase of social networkers as well as the presentation of real engagement by published posts according to the number of followers on each individual social network.

4. CONCLUSION

Existing data on the current number, as well as the constant increase in the number of social media users, are indicative of the importance of monitoring the engagement of the online community. Social media as an indispensable part of political campaigns have become the topic of various studies. The aim of this paper is to explore the existing methodologies by identifying the indicators of the engagement of the online voter body as well as the ways in which the engagement is measured. By proposing a new indicator of efficiency of the recruitment of the electorate in Serbia, political parties would be enabled to monitor political campaigns that would serve as feedback for the formulation of digital communication strategies.

The proposed methodology defined in this paper will be a quantitative analysis of the published content of political parties in Serbia on social media such as Twitter and Facebook. Due to the similarity in the way the online voting body can respond to publications, the methodology can be applied to data collected on the available profiles of political parties on social media Twitter and Facebook. The results of testing and application of the methodology would generate data that would represent a comprehensive monitoring of digital campaigns of political parties and actors, as well as the possibility for strategic planning of campaigns.

It suggests further quantitative analysis of content on other social media, Instagram and Youtube and the development of a methodology that would apply to these two platforms

ACKNOWLEDGEMENTS

This paper has been financially supported by the University of Rijeka for project ZP UNIRI 9/17.

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DIGITAL TRANSFORMATION IN PHARMA INDUSTRY

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Abstract:*The purpose of this article is to explore the digital transformation in pharma industry, as a development of e-submission request for license for placing medicinal product on market (marketing authorization), as a subsystem of e-government. The goal of this paper is to introduce the relationship of e-business in the medicines regulation with other segments of e-government and e-pharmacy in order to improve public health. The methodology for the development of e-services, methods for modeling and analysis of business processes, the reference model of e-business in the medicines regulation are the main scientific contributions of this work. This paper shows a case study which refers to e-services development in the marketing authorization, as one subsystem of the e-government implemented in Medicines and Medical Devices Agency of Serbia, which is a major professional contribution of this work. This research is based and implements on a qualitative case study on the 2015-2017 project "E-Submission in medicines regulation".*

Keywords*:e-pharmacy; e-submission; medicines regulatory authority; e-services e-health;*

1. INTRODUCTION

Electronic business (E-business) is a modern form of business for an organization. The concept of e-business is represented and applicable in all activities and areas (Ivkovic M., Radenkovic B., 1998).

Medicines regulation is a process encompassing various activities that aim to ensure the safety, efficacy and quality of medicines, as well as the appropriateness and accuracy of product information. Medicines regulation is public policy that restricts private sector activities to attain social goal set by a given country (Pejovic G, Filipovic J, TasicLj, Marinskovic V., 2016)

The development of e-business in the medicines regulation, as one segment of e-government, envisages interactive electronic services tailored to the needs of citizens, government units, state administration, regulatory and educational institutions and businesses. Methodology for the development of e-services on the e-government portal and demonstration a study of the application of this method in the part of medicines and medical devices is very important for e-health and e-government development (Stojadinovic T, Radonjic V, Radenkovic, 2010).

The purpose of the research is analysis that encompasses application of e-business in medicines and medical devices regulation and the application of the method in development of e-services and e-submission in medicines regulatory authorities. This testing of e-readiness of the pharmaceutical industry for the project of e-submission that was implemented in November 2016 is the beginning of improvement e-services as the base of e-pharmacy development in Republic of Serbia (RS).The significance of this paper is that it is one of the first on e-services initiatives in RS.

This chapter will show previous the definitions of e-business, e-health, e-pharmacy and e-government, too.

E-business is based on more modern work organization adapted to the use of information communication technologies (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, thus we can distinguish between the different business models.

E-Government uses the application of information technology to improve: efficiency, productivity, transparency and accountability of the Government in dealing with: citizens, businesses, industry, 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(Gonnet P, 2001).

E-pharmacy as a segment of e-health is the application of electronic commerce in the pharmaceutical industry, which encompasses on the one hand the business of companies in the pharmaceutical industry and pharmacies. Increased use of information technologies and the Internet provides powerful tools and makes them available to citizens, government agencies, and pharmaceutical industry around the world. As a result, there are changes in organizations, as well as in relationships between businesses, citizens and state authorities.

2. METHODS

This chapter will show the methodology of developing software in e-government and previous research on e-services.Software design methods 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 D, 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). These methods of the life cycle 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 (Rational Unified Process) methodology and agile methodologies, business intelligence (BI) with the principles of data mining and data warehousing, BPML (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. Software Life Cycle Processes (SLCP) can be perceived through its processes, i.e. activities that make this process as well as through its models, methods and strategies. SLCP are defined by a number of reasons, including increasing product quality, facilitating human understanding and communication, support process improvement, and support management processes. Methods for SLCP can be said to describe the process of software development through its individual operations or processes.

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 (Quinn Kevin, 2007). In SOA programming is based on the process approach and represents a higher step in the development of software engineering. SOA describes the concepts, architecture and procedural framework to ensure cost effective development, integration and maintenance of IS. SOA does not represent a radically new architecture, but rather the evolution of the well-known distributed architecture and integration methods.

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.

3. A CASE STUDY – TESTING THE METHODS OF DEVELOPING SOFTWARE IN E-GOVERNMENT ON EUROPEAN MEDICINES REGULATORY AUTHORITIES'

This research is based on a qualitative case study on the 2015-2017 project "E-Submission in medicines regulation". The project holder is the Medicines and Medical Devices Agency of Serbia (ALIMS). The project includes several actors: project team of Agency, a project manager, manager of Agency as a member of team, Office of Information Technology and Electronic Government in RS in the Prime Minister's Office formed 27.07.2017 (Directorate of Electronic Government until 27.07.2017). The results of the research can be applied in any European medicines regulatory authority.

3.1. Research Approach

The aim of the research is to develop a national platform in RS for the development of e-pharmacy, which enables the integration of regulatory bodies in the medicines and medical devices regulation and institutions of the pharmaceutical industry.The data studied in this paper are focused on the data of the institutions that first began using the e-services of the Agency on the government portal of RS. Among the various roles and interviewed respondents are the directors of the pharmaceutical industry institutions, information technology

directors in the institutions of the pharmaceutical industry, responsible persons for submitting requests for obtaining a license for medicinal products and medical devices in the institutions of the industry, civil servants, and directors of state institutions. At the national level, the Project Electronic Application Submission of Client Support supports the development of the government portal in RS, which will enable the improvement of services to the pharmaceutical industry and citizens and contribute to the economic development of the country. The project is in line with the Electronic Administration Development Strategy and the Action Plan for the implementation of the Open Access Initiative. The project contributes to better implementation of the Public Administration and Public Health Reform Strategy and provides closer approximation to the best European and global practice in the field of good governance.

This chapter will show analysis and application of e-business in the medicines and medical devices regulation and the application of the method in development of e-services and e-submission in ALIMS from the previous chapter.

3.2. Analysis and application methods for E-business development in the medicines and medical devices regulation

This subchapter shows analysis that encompasses application of e-business in the medicines and medical devices regulation and the application in RS. For medicines and medical devices regulation, 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 the medicines regulation, as one segment of e-government of RS provides interactive e-services tailored to the needs of citizens, public authorities, regulatory and educational institutions and industry (producers, importers, representations, health care and pharmaceutical institutions). The goal of this approach is the integration of e-government and the segment relating to the medicines regulation, ensuring the efficiency of process of modeling and model implementation, which should result in models that must be explicit, understandable, modular and can be effectively amended and supplemented, distributed and placed on a variety of computing platforms and operating systems in e-government (Stojadinovic T, Vanevski I, RadovanovicLj, 2016).

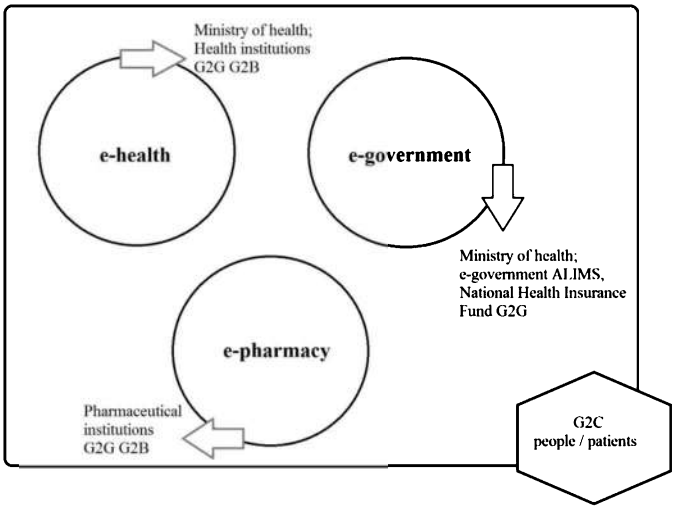

Figure 1: Models of e-business between eHealth, eGovernment and ePharmacy

E-business in the medicines regulation is one of the segments of the development of e-government in RS. Without e-business in the medicines regulation it is impossible to develop e-health and e-pharmacy. Providing information on medicines is one of the e-services in the medicines regulation. 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. Integration of business in the medicines and medical devices regulation, government, health and ePharmacy in RS (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 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.

4. RESULTS AND DISCUSSION

In this chapter, the results of the case study will be presented, as well as the preparatory phase of launching e-services development initiative in RS. This chapter will show concluding analysis and finding that encompasses application of e-business in the medicines and medical devices regulation and the application of the method in development of e-services and e-submission in ALIMS from the previous chapters.

4.1. Resultsofthepreparatoryphase – Applicationofthemethods

ALIMS is a public agency in RS, authorized (among other) to issue marketing authorizations, decide on their variations, renewals 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. 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 medical devices for which the ALIMS issued a marketing authorization, 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 RS.

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.

Data on medicines and medical devices that ALIMS handed over to the state institution and legal entities on the eGovernmentportal 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, once logged in by using a digital certificate, displays information about the owner of the digital certificate that 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 2016 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 i.e. customer requirements and deliver them electronically with all the accompanying documentation. The project titled "eSubmission" began in the middle of 2016, with the plan to be completed by the end of August 2016. The project includes the development of about 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 RS. For the future of e-government and e-business in the medicines regulation in RS it is important to use the experience of other countries, with consideration of their successes and failures, as well as adapting these knowledge characteristics of socio-economic environment in RS. Equally important is the cooperation with the Ministry of Health and the Government of RS, because in this way there is a solution that information subsystem of e-business in the medicines regulation 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. Figure 2 shows model and life cycle of the process. SOA is implemented using WS as follows:

- WS thatenablesthe transfer ofallcustomerrequirementswiththeappropriateelectronicservices from eGovernment portal to theinternal ALIMS network (externaleGovernment portal to DMZ at ALIMS),
- WS thatenablesthetransmissionofthe same clientrequestsandintegrationwithelectronicdocumentmanagementsystemof ALIMS (DMZ at ALIMS to internal, production EDMS at ALIMS).

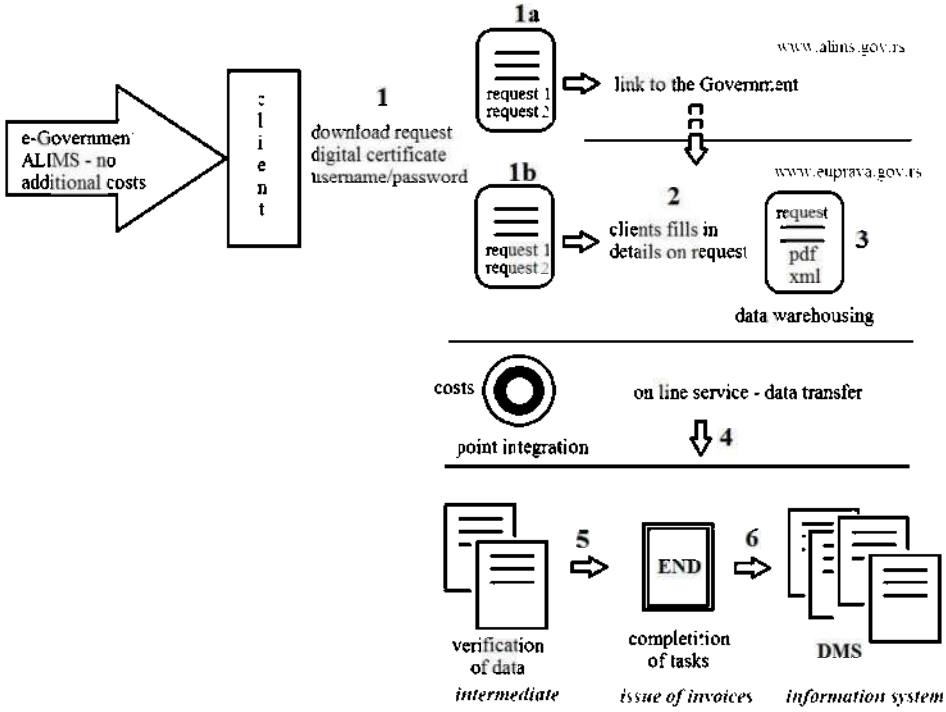

Figure 2: Model andlifecycleprocess

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 automatically 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 ALIMS IS-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 (Table 1). There are 23 e-services for human medicines, 25 e-services for veterinary medicines and 14 e-services for medical devices.

A good example of application of this project is open data about medicines and medical devices in human and veterinary medicine registred by the agency, whose mainactivity is the control of medicine sand the placing of medicines on the market. ALIMS was among the first to adopt the concept of open data and thus contribute to the achievement of benefits for the economy in general, economic entities, state authorities, scientific community and other segments of the society in RS. The registers of human and veterinary medicine and medical devices are presented in the forms of structured, open data formats and are presented as electronic services on thenational portal of eGovernment. This data, which ALIMS made open additional enhanced through services such as the search for registered medicines and medical devices and issued certificates that exist from before, help monitor and respond to anadverse reaction to drugs and medical devices and identify fake medical products, and significantly make it easier for businesses in this area to doall this in order to achieve better health of thecitizen sof RS. Based on open data sets for medicine sand medical devices, some web applications and mobile applications have already been developed as Mediately databases of medicines.

Table 1. List of e-services in medicines and medical devices regulation

Medical product/Name of eServices	Human medicines (23)	Veterinary medicines (25)	Medical devices (14)
	Application for marketing authorization (6)	Application for marketing authorization (6)	Application for registering in the Register of med. devices (1)
	Application for the import of unregistered medicines (2)	Application for the import of unregistered medicines (4)	Application for import of unregistered medical (2)
	Application for the approval of clinical trials (4),	Application for the approval of clinical trials (4),	Application for authorization or notification of clinical test(1)
	Application for the SPC, PIL and Labeling (3)	Application for the SPC, PIL and Labeling (3)	Application for promotional material (1)
	Application for approval of promotional materials for the medicines (1)	Application for approval of promotional materials for the medicines (1)	Application for issuing an expert opinion (1)
	Application for issuing the technical opinion (1)	Application for issuing the technical opinion (1)	Application for the categorization (1)
	Application for reporting doubts about the quality (1)	Application for reporting doubts about the quality (1)	Application for reporting adverse reactions (5)
	Application for the quality control (1),	Application for the quality control (1),	Application for reporting doubts about the quality or deviations from the standard qualuty (1)
	Application for supplementary documentation (1)	Application for supplementary documentation (1)	Application for quality control (1)
	Application for the suspension of request (1)	Application for the suspension of request (1)	
	Application For partial suspension of the request or changes the marketing authorization grouped variation request (1)	Application For partial suspension of the request or changes the marketing authorization grouped variation request (1)	

4.2. Performamceanalysisandresults

The survey relating to the testing of e-readiness of the pharmaceutical industry for the project of e-submission was implemented in November 2016 before the beginning of the project. 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 52% 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 questions and the results of that survey.

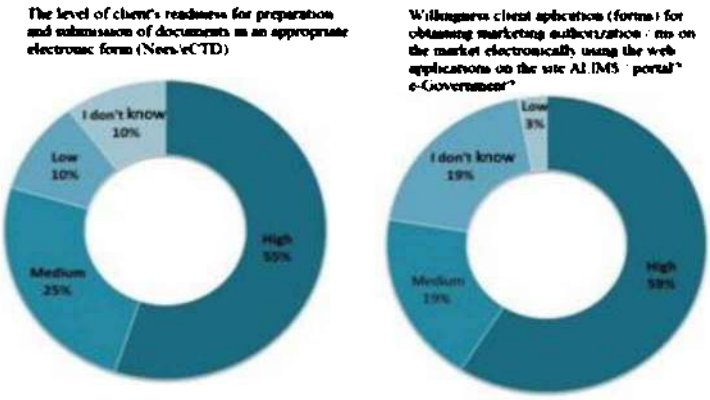

Figure 3: The testing of e-readiness of the pharmaceutical industry in RS

5. CONCLUSION

This study confirms several benefits and challenges described in previous studies regarding e-services as described above.

This is interesting, because at this moment there are few studies on e-services initiatives, especially in Serbia, where initiative e-government development has been launched and in its infancy. What this study highlights and contributes to, in addition to confirming the above studies, are the main lessons in terms of: The importance of actors who drive and realize initiatives, and the ability to overcome challenges, as well as the issue of private and public actors, together with the way a certain division of work is made when e-services or applications based are developed as part of a channel strategy.

The methodology for the development of e-services, methods for modeling and analysis of business processes and reference model of e-business in the medicines regulation as one of the subsystems of e-government process met model in the context of e-government, life cycle business system design on the e-government network web portal and e-business in the medicines regulation, are the main scientific contributions of this work. Developing web software for e-business development in the medicines regulation, as subsystem of the e-government implemented in ALIMS are the main professional contributions of this paper. Improving e-business in the medicines regulation, 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 modelling standards, integration of e-business in the medicines regulation, the e-government, e-health and e-pharmacy in RS, 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 and questions, thus achieving significant savings for ALIMS as for the pharmaceutical industry in the RS. In this way ALIMS fulfils 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 the medicines regulation, as a subsystem of e-government of RS, 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.

Based on the research in this paper, it can be concluded that e-services guarantees greater transparency of the work of state bodies, stimulates efficiency in government and beyond, and enables citizens, companies and organizations to use public information several times for different purposes. E-services strengthen entrepreneurship, influencing the development of innovative products and services, providing alternatives for decision-making in management, planning and science, and contributing to the creation of a knowledge-based economy.

Analysis and research conducted in the case study described in this paper point to the conclusion that the goal of the state should be that e-services of state farmers receive a useful value through the mixing of datasets in related institutions, the data of which are of great importance.

The useful value of the data has been increased during the combination of data, which leads to the direct benefit of the public, the economy and the institutions themselves, State bodies of RS. In all the above ways, the state fulfils its mission - to promote and improve the business of all sectors, as well as to contribute to the achievement of the basic human right to access quality, accurate and efficient information.

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THE ROLE OF OUTSOURCING IN IMPLEMENTATION OF PUBLIC-PRIVATE PARTNERSHIP CONCEPTS

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Abstract:*This paper aims to point out the potential of outsourcing as an organizational form in the implementation of concepts related to public-private partnership in business financing. This type of connection between processes of outsourcing and public-private partnership enables, within a frame of a unique business strategy of restructuring of largebusiness systems, public-private partnerships a further development of independent entities, according to the regulations of project financing. This connection showcases outsourcing as a model of change of organizational structure, and public-private partnership as a model of business optimization and a path to sustainable development of large business systems.Business partnership in the economy sector of public services presents an important direction of sustainable growth strategy, which, at least as a model, synthesizes and reconciles the goals of profit and welfare. With that in mind, it can be said that the goal of this paper is to indicate that a business result is always a synthetic expression of business efficiency, and in public business systems it is also reflected in the quality of public services.*

Keywords*:outsourcing, public-private partnership, restructuring*

1. INTRODUCTION

In the current processes of corporatization of large business systems in Serbia, favorable organizational preconditionsare emerging in regards to the implementation of public-private partnership, as an important opportunity for narrowing the gap between exponentially growing needs for system modernization and the lacking financial resources for the said modernization processes. Public business systems cannot be financed only from the state budged anymore, especially considering that the current condition of public finances in Serbia is characterized by a long-term struggle of Government with budget deficit and high external debt, with the help and control from the World Bank (WB) and International Monetary Fund (IMF). Annual budget expenses of Serbia only for subsidies of the current business operations of state railways are 120 million euro, which covers only about 40% of the current annual business expenses of the Railways. Besides that, the state, as a bondsman, is constantly settling the arriving annuities in repayment of credits taken by the Railways which amount to no less than 800 million euros. Additionally, the state considerably helps with the Railways' debt repayment which amount to about 600 million euro. And, above all, the state is undertaking large direct investments in the current projects of technical modernization of railway infrastructure, which 5-7 billion euro.

The reform of state railways in Serbia has begone as a reform of its organizational structure. With that purpose, in 2015, a status change of *allocation and establishment* has been performed, which is a unique case in the current economic practice. Through this type of outsourcing, *Serbian Railways AD* have transformed from a united, functionally organized joint-stock company (with the state being the single shareholder) into three legally and economically independent, but technologically connected railway companies (railway infrastructure management, cargo transport, and passenger transport). The intention is to make the new railway entities more economically efficient and competitive. This would be achieved by increasing their service quality and market share, which would lead to companies being able to cover their current annual expenses through their own income.

The processes of outsourcing in Serbian Railways are far from complete. The current corporate restructuring can be realized as a series of outsourcing processes in many of the core and non-core activities of the Railways. The existing and the expected processes of outsourcing are extremely suitable for the application of the concept of public-private partnership which allows that partner projects a further development of independent entities, according to the regulations of project financing (Benković, 2014). In outsourcing processes, which should commence in the immediate future, favorable conditions are being made with the goal of securing considerable financial resources from the private sector. The processes will be carried out through public-private partnerships and aim to lesser the burden on the state budget and, therefore, lower the credit debt of the state.

If we begin with the notion that the processes of outsourcing in large business systems like railways are an important precondition for the development and implementation of public-private partnership projects, it is necessary to identify and plan for the possibilities of outsourcing and public-private partnerships in the next phases of organizational reform of the Railways. It would be interesting to see which areas of the Railways are suitable for the partnership between public and private sectors, what is the scope of financial resources which would come out from this partnership, and what are the results of public-private partnership model usage in developed European countries, in the region, and especially in railway companies. The expected effects are suggesting that these processes should be the reason and the goal of every current and future corporatization of each of the 200 public and public-communal companies in Serbia.

Beginning with the above mentioned, there is a need to theoretically define and round off the characteristics of outsourcing and public-private partnership, especially in regards to their economic essence.

2. THEORETICAL CONTEXT OF IMPLEMENTATION OF PUBLIC-PRIVATE PARTNERSHIP

Theoretical explanation behind the usage of public-private partnership concept is derived from setting up a *make or buy* dilemma, which is in its essence a question of outsourcing. Specifically, it is a question of business specialization and it leads to public-private partnership as the most complex known expression of business specialization.

Reactions to demand and opportunities which come from business surrounding of an organization can no longer come down to increased production or lowered prices, because those factors are not effective enough. Instead, organizations need to invest their complete resources. Reactions need to be quick, complete, and, most importantly, faster than competition. In addition to faster changes, this leads to another, by now unrecognized characteristic of modern business – organization flexibility. The need for a permanent reallocation of resources leads to permanent changes in organizational structures, and other way around. The modern literature which explores the phenomenon calls it the *outsourcing process.* The ability of organizations to change their structure (resource-wise and management-wise) is a showcase of their success in adapting to demands of the environment. The authors of strategic outsourcing claim that organization flexibility is becoming an indication of business success, and organizational structure is emerging as the most important strategic resource in modern business.

Outsourcing is an economic-legal process in which an organization, by reallocating activities and processes outside of its organizational boundaries, (1) secures additional external resources to make the mentioned activity more economical and efficient externally than internally, and (2) creates a possibility to reallocate the freed resources into organization's core competence. Therefore, the usage of external resources is immanent to market economy, it begins with the inception of the concept of a market and develops alongside civilization. With that in mind, outsourcing is the result and the cause of specialization in production and business, and it has been developing throughout history into infinite forms. The essence of outsourcing process is in the transfer of responsibility and risk for the outsourced work to another business-legal entity, which implies that outsourcing organization takes over the job of organization and financing of the outsourced process and the risk that comes with it.

Flexibility of an organization is imposed as a measure of success especially in endeavors of large public business systems, such as railways. Their conglomerate structure with many different in-house processes and a functional system of vertical management represent a challenge in achieving competitive abilities in conditions of open transport market in European Union. The changes to the organization structure of large business systems are a necessary precondition to their business efficiency and existence. It is possible to conduct these changes by reallocating processes from a business system structure to another, preexisting or new, business entities, which would perform these activities more efficiently. Outsourcing processes in large business systems are, therefore, the processes of change to their organizational structure in direction of increasing organizational flexibility. By taking this direction, the organization also increase their competitive ability. The last two sentences sublime the essence of the current restructuring of large business systems in Serbia and the region. Beginning with the early '90, all major European railway companies have entered this process.

Changes to the organizational structures of large public systems through outsourcing of majority of business processes (BPO) have lead to changes in structure and efficiency of their always-limited business resources. The especially important changes are made to financial structure, because of the increase in personal resources as the share of overall business resources of a public system. Additionally, dedicated external expenditures from the budget are decreasing. By focusing the personal financial resources, as well as dedicated budget resources, an important change is being made to the quality of financial streams and to the

efficiency of usage of the limited financial resources. This proves the direct effect of changes to organizational structures of large business systems on changes to structures and quality of used financial resources in the direction of increasing the level of their efficiency.

In modern conditions, outsourcing is a permanent process which is characterized by the long-term relations of the organization and the external supplier. By time, this long-term relationship can transform into a partnership, where the partners can make mutual strategic plans, co-finance specific projects and share the risks. This is not possible to achieve through short and occasional business relations with the supplier. If the outsourcing is short-term and one-time, it is basically relegated to a simple market transaction with limited effects. Long-term relationship is the main difference between outsourcing and regular procurement.(Drljača, 2010; Popović, Jaško & Prokić, 2010, Larsson & Malmquist). Procurement is a short-term market transaction, while outsourcing is a long-term business arrangement based on partnership which is characterized by risk-sharing between an organization and its outsourcing partner. Even though every outsourcing endeavor leads to some changes to organizational structure, the short-term outsourcing is directed towards solving the expenses of a single business or function, while the long-term outsourcing is, at the same time, an important instrument of restructuring. In other words, it is primarily strategically directed towards reconfiguration of the complete business process.

On the other hand, outsourcing neither equivalent to the sale of a part of the organization, but a process of reallocation of activities which are still of vital importance to the organization. Their conduction is redirected to an external supplier, based on the estimate that the supplier can conduct the activities more efficient and economical. Even if an organization is allocating functions and activities to another company, there is no typical sales transfer, which implies that outsourcing is not a sale (Popović N, Jaško O, Prokić S., 2010, according Larsson & Malmquist).

Beginning with the linguistic meaning of the English term *out source – external source,* some authors do not look at outsourcing as separation of processes and activities from an organization. On the contrary, it is an endeavor in which an organization searches, occasionally or long-term, an additional engagement of lacking resources from other, external sources.(Paravastu, 2007; Cheon,1995)Modern business theories are recommending outsourcing of all non-core business activities. All of the modern theories are based on economic theory of competitiveness and transfer pricing theory. (Paravastu, 2007).

From the point of outsourcing process in large business systems, the important resource theories are those which emphasize the importance of business environment for procurement and maintenance of resources. This is caused by the sensibility of public systems to business environment and the large number of stakeholders, where the main actors are the state and its institutions, international financial organizations which monitor the development of public infrastructure, as well as the users of the public services. This makes the research of business environment based on stakeholder interests and possibilities of special importance to organization. In that sense, large business systems are directed toward defining the strategies for procurement of critical business resources from the environment, which also influences the decisions about outsourcing. These theories conclude that the outsourcing strategy is a good instrument for procurement of external resources.

A special branch of research could be the research of optimal resource reallocation in public sector, especially in large business systems. This is of great importance, because the transition of public sector, which comprises a huge economic and developmental potential, represents a general movement direction in all of the world's countries. These transitional processes are not focused on property, but on efficiency, as the integral expression of quality in economic, productional, financial, social, and cultural sphere of society, which can be quantified through the level of user satisfaction, risk lowering, the height of profits or loss lowering, market share increase, and other parameters. In that sense, orientation towards efficiency represents a general civilizational trend, which is characterized by outsourcing, as one of the best tools for its optimization in business practice (Bendor-Samuel, 2010).

Orientation towards efficiency in public sector is not so much a question of ownership, so the transition of public companies in not so much a question of privatization (Ković, 2018). Where and when is privatization the most important can only testify of rudimentary transition processes. Large business systems in the ownership sphere should certainly transition towards becoming stock companies with many shareholders, which leads to lower risks to all stakeholders (state, shareholders, company, users). These factors make this model of organization the carrier of economic success in the most developed countries in the world. Therefore, the transition of public systems is focused on the measures of change of their slow and rigid organizational structures to increased flexibility, which is achieved through outsourcing as a method of change of the organizational structure.

These changes in the organization of public companies not only lead to reallocation of their limited resources, but also to creation of the conditions for procurement of external resources, primarily from the private sector, including the banks. When it comes to the large business systems, outsourcing is not just a strategic measure of change in their organizational structure, nor just a tool for reallocation of their existing resources, but also what is perhaps the most important precondition for the procurement free external resources. This third dimension of outsourcing process in the public sector is a precondition for the usage of different models of public-private partnership (Ković, 2018).

3. THE ROLE OF OUTSOURCING IN IMPLEMENTATION OF PUBLIC-PRIVATE PARTNERSHIP

Outsourcing of processes always means the clearing a part of organization's own resources, and the efficiency of usage of these resources is achieved by focusing on the core competences. However, the realization of outsourcing projects also includes the engagement of external resources, which makes the choice of the outsourcing partner a key decision, especially from the aspect of risk management. Business and financial ratings of outsourcing partners guarantee not only the safety in the delivery of the outsourced components, but also showcase their ability in financing the outsourcing projects. This leads to creation of public-private partnerships on a long-term basis, as a form of project financing. Restructuring strategy of large business systems is directed toward public-private partnership as the strategy of sustainable development of many outsourced business processes which contribute to the quality of the public service.

Public-private partnership can be an interesting model of public sector transition specifically because of the risk distribution on the basis of the best management (Yescomb, 2010).That is caused by public companies measuring their business success through the level of user satisfaction, and not through the accomplished margin of profit. In realistic business practices this is achieved through increased quality of services, which includes longevity and reliability, which is possible to achieve in conditions of good risk security. In that sense, public-private partnership can perhaps be a model which enables risk optimization, as well as competitiveness maintenance, presented through satisfaction cased by getting value for money. (Sredojević, 2010; Juričić, 2011).

If outsourcing can be interpreted as a business strategy, then public-private partnership can be used as one of the specific business models for procurement of additional financial resources from external sources. Outsourcing relationship can encompass nearly all businesses and business processes in nearly any activity, and public-private partnership is achieved mostly in the domain of public services. Outsourcing is certainly a wider concept, and encompasses long-term or short-term relationship of business entities, regardless whether they belong to public or private sector. From that angle, outsourcing can be presented as a mutual relationship between private and private, public and public, as well as public and private subject.

Outsourcing does not necessarily imply public-private partnership, but public-private partnership does imply outsourcing (Ković, 2018). Outsourcing of public services usually, but not explicitly, implies a relationship between public and private entity. Accordingly, outsourcing of public services represents an economic basis and a structural precondition for the set-up of models of public-private project. Based on the previous discussion, it can be defined that the public-private partnership is a practical model of a long-term outsourcing relationship, in which the outsourcing supplier and the outsourcing subject are specific (Ković, 2018).

Therefore, the model of public-private partnership is based on the long-term outsourcing of a basic activity of public sector (Ković, 2018). Unusual complexity and multidisciplinary characteristics of the public-private partnership model, from the economic aspect (costs and benefit analysis), financial aspect (financing and risks), commercial aspect (procurement and delivery), organizational aspect (management and interorganizational relationships), legal aspect (contracting, procedures), and social aspect (social and economic sensibility, control), requires for the past studies and decisions regarding outsourcing to include the complete public-private partnership project, which besides infrastructure development also encompasses public service activities.

Public-private partnerships can emerge through two types of outsourcing as a consequence of dual attribute of public business systems (Ković, 2018).

First, the large systems as market entities have motives for outsourcing of different non-core activities which they perform inefficiently or which are performed more efficiently by other companies. Two methods of procurement of additional resources of external financing are possible, and they can emerge through

outsourcing of businesses and processes which are performed internally in modern public systems (Ković, 2018):

1) Business system management, aiming to lower costs, can decide upon reallocating various supporting and mutual standardized activities, which are not public services (accounting, security, cleaning, object maintenance, marketing, PR, and others). Alongside, most of these jobs are not in direct connection to the quality of public service. Considering the large number of these activities and as a consequence of economy of scope, a considerable resource freeing is possible. Today, Serbian Railways spend 20 million euros annually on these mutual activities, which is, for example, the estimated cost of development of main Logistics center in Batajnica.

2) Aiming to increase the efficiency in conducting important logistical activities which affect the quality of public service, but are not public services themselves, like railroad maintenance, train and locomotives maintenance, procurement of specific railroad materials, management of a railway company can decide to outsource these activities to specialized organizations. Through these outsourcing projects, a considerable amount of financial resources can be freed, because Serbian Railways spend more than 50 million euros annually on public procurement of maintenance services.

These projects can be considered as public-private partnership projects, even though the subject of outsourcing is not a public service.

Second, large systems as public services providers can, through public-private partnership projects, conduct outsourcing of basic activities or specific parts of basic activities (i.e. urban and suburban railway passenger transport, cargo transport, and others). Since the current annual incomes which arise from public services are used as a "cover" for financing in the scope public-private partnership project, the scope of these project can roughly define the scope of public-private partnership project. Considering the annual income from cargo transport in Serbia amounts to around 100 million euro, and that the duration of public-private partnership project is around 20 years, it can be derived that the complete guarantee potential of the Railways can be around two billion euros, counting only the income from cargo transport in the project period. This rough statistic showcases that it is possible to raise interest of private partners for public-private partnership projects in railways.

4. CONCLUSION

From restructuring processes of large business systems arises a number of projects suitable for various forms of public and private partnerships. This is in relation both to projects which emerged from organizational outsourcing and to project of financing of transport and other infrastructure development. This situation opens a space for research of public-private partnership project portfolio management in large business systems, from the aspect of finances optimization.

It would not be pretentious to say that the financial optimization of public-private partnership portfolio projects is a separate economic and multi-aspect discipline. It can be claimed considering the scope and the uniqueness of the subject, as well as its huge influence on society, because the economic and societal development depend on the success of transition of large business systems. Therefore, it is not a coincidence that the most developed countries of Western Europe have been putting business and research emphasis on restructuring of large systems in the last three decades.

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OPERATIONS MANAGEMENT FOR A DIGITAL WORLD 995

Bojan Lalić, Darija Medvecki, Uglješa Marjanović
SERVICE MANAGEMENT IN MANUFACTURING: EVIDENCE FROM SERBIA 996

Dragan D. Milanović, Ilija Tabašević, Mirjana Misita
THE MANAGING OF THE TEMPERATURE MAPPING PROCESS OF THE WAREHOUSE 1002

Slobodan Morača, Marko Milosavljević, Angela Fajsi
VIRTUAL TEAMS: CONSTRAINS AND CHALLENGES 1010

Biljana Cvetić, Miloš Danilović, Oliver Ilić
AN APPROACH TO EVALUATING GOODNESS OF HEURISTIC SOLUTIONS IN MANUFACTURING CELL FORMATION 1014

Miljan Kalem, Danica Lečić-Cvetković
APPLICATION OF TYPIZATION AND STANDARDIZATION IN ACOMPANY FOR THE PRODUCTION OF PANEL FURNITURE 1021

Milena Stojković, Teodora Rajković, Danica Lečić-Cvetković
SAP APO APPLICATION IN THE PRODUCTION PROCESS FROM AUTOMOTIVE INDUSTRY 1029

Ivan Tomašević, Dragoslav Slović, Dragana Stojanović
EXPLORING THE LIMITS OF LEAN IMPLEMENTATION IN ENGINEER-TO-ORDER ENVIRONMENT: CASE STUDY 1036

Ivona Jovanović, Ivan Tomašević, Barbara Simeunović
WASTE ELIMINATION IN CONTEXT OF WORKPLACE CLOSURE AND STABILIZATION AND LEAN PRODUCTION 1043

Danica Savičić, Teodora Rajković, Slađan Babarogić
INFORMATION AND COMMUNICATION TECHNOLOGIES AS SUPPORT FOR INVENTORY CONTROL IN THE AUTOMOTIVE INDUSTRY 1051

Lena Đorđević, Uroš Jeremić, Slobodan Antić
SPREADSHEET APPLICATION AND ALTERNATIVE DEVELOPMENT DIRECTIONS FOR A DIGITAL AGE 1059

Zoran Rakićević
THE S&OP: PRACTICAL AND ADVANCED MID-TERM PRODUCTION PLANNING 1066

Marija Unterberger, Dragana Šarac, Spasenija Ožegović
DEVELOPMENT OF A MODEL FOR DETERMINING THE NUMBER AND PLACEMENT OF ACCESS POINTS TOTHE PUBLIC POSTAL OPERATOR NETWORK 1074

SERVICE MANAGEMENT IN MANUFACTURING: EVIDENCE FROM SERBIA

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Abstract: *In nowadays economy, the service sector has increasingly significant role in every country or region. Following the trends and competing in globalized market, services are not only offered by service companies today, but also by manufacturers. Those services are referred as product-related services and the phenomenon is well-known as the servitization. With the Serbian dataset from the European Manufacturing Survey (EMS), presented paper analyzes the importance and the influence of product-related services on company's performance. Furthermore, using a regression model, it provides the insights and guidelines about the services that have the highest positive effect on company's turnover. It is shown that different types of product-related services have diverse impact on financial success of companies, depending on the way how they are invoiced, directly or indirectly. The results could be useful for companies to improve their customer value and gives the fundamentals for future research.*

Keywords*: Servitization, Manufacturing, EMS, Serbia, Product-related services*

1. INTRODUCTION

The structure of economic output (i.e. product, service) has significantly changed over the last 35 years in whole Europe(Dachs et al., 2014).Almost all developed countries have large service sectors. According to Central Intelligence Agency (2018), in the United Kingdom, for example, the share of services in GDP in 2015 was 79.6% and in 2017 it rose to 80.4%. Also, in 2017 France had the share of service sector in GDP 78.9%, Belgium 77.5% and Denmark 75.2%. Moreover, labor force engaged in service sector in European Union in 2012 was 70.1% (Eurostat, 2018) and in 2014 was 73.1% (Central Intelligence Agency, 2018). However, it is important to note that services are not only provided by service companies. Manufacturing firms also provide a wide range of different types of services (product-related services) in order to give better offer to the customers on the competitive market (Kinkel et al., 2011).

As service sector seems to play an increasingly significant role for all countries on today's global market, services in the Republic of Serbia might be a topic of great interest for success of both types of companies, service and manufacturing. Since there is a lack of the literature and empirical research which addresses this problem in developing countries, the possible effect of services on company's success could be missed. On the other hand, if the manufacturing companies in Serbia decide to offer product-related services, the way of charging for the provided service could be under question for them.

Although the significant contribution of product-related services to financial performance of manufacturing companiesis proven in general(Vandermerwe & Rada, 1988), it is not sufficient acknowledged how specific types of services could influence the company's sales (Kinkel et al., 2011). According to this, it is important for companies to have information and guidelines not only for use of specific product-related services, but for making the strategic approach which includes the appropriate way of charging customers for provided services.

This paper aimed to give insights into the importance and the effects of different types of product-related services on company's turnover in developing countries such as Serbia. Moreover, it contributed to existing literature providing the empirical results on the relevance and differences between two ways of invoicing the given product-related service, separately or calculated in product's price.

2. LITERATURE REVIEW

2.1. Servitization

Servitization as a term was firstly defined and discussed by Vandermerwe and Rada (1988). Servitization refers to the "fuller market packages or bundles of customer-focused combinations of goods, services,

support, self-service and knowledge" (Vandermerwe & Rada, 1988, p.1). Up to now, a variety of definitions has been formed to describe the phenomenon of manufacturers turning into service providers (Cvetković et al., 2017). Baines et al. (2009) defining the manufacturing servitization as a migration process wherein product companies embrace a service orientation and/or develop more and better services, with the aim to offer total client solutions. According to Tellus Institute (1999) this term is defined as "servicing" which represents the emergence of product-based services which blur the distinction between manufacturing and traditional service sector activities. Since there are different terms for the output of servitization depending on different academic disciplines, in the context of this article, the term servitization is used in the sense of product-related services to explicitly cover the whole range of definitions. Product-related services can be defined as services in the manufacturing industry which are offered to customers together with the main products as an integrated solution (Dachs et al., 2014). Product-related services can serve as a differentiating characteristic which distinguishes firms within the same market. The distinctive strategy pattern is the ability of these firms to offer their customers unique problem solutions, integrating professional services and innovative products (Kinkel et al., 2011).

Nowadays, attention and interest for servitization has grown in academia (Dachs et al., 2014; Lightfoot, Baines, & Smart, 2013; Szász, Demeter, Boer, & Cheng, 2017). Most of the research has been conducted in the fields of manufacturing (Baines et al., 2009), service management (Pawar, Beltagui, & Riedel, 2009) and marketing (Gebauer, Ren, Valtakoski, & Reynoso, 2012). More and more manufacturing companies are utilizing the trend of servitization by changing their perspective on value creation and creating product-related services (Shimomura, Nemoto, Ishii, & Nakamura, 2017). The shift towards product-related services can bring to a company a better competitive position (Rondini, Pezzotta, Pirola, Rossi, & Pina, 2016), strengthen global competition (Oliva & Kallenberg, 2003)(Davies, Brady, & Hobday, 2006), and provide better financial results (e.g. revenue stream and profit margin) (Santamaría, Jesús Nieto, & Miles, 2012). It is important to mention that some other authors have also proposed environmental rationales as important (Frambach, R.T., Wels-Lips, I., Gundlach, 1997; Goedkoop, Van-Halen, Riele, & Rommens, 1991; Wise & Baumgartner, 1999).

It is shown that product-related services significantly contribute to the sales of manufacturing firms (Kinkel et al., 2011). The profit rationale behind servitization is often considered in the literature as a financial driver (Baines et al., 2009). For example, researcher explored the financial consequences of servitization using a large international database, and found that the proportion of manufacturing firms reporting to provide services is at least 30% (Neely, 2009).

Several classifications and types of product-related services have been considered in the servitization literature. For example, Kinkel et al. (2011) make distinction between 'traditional' and 'advanced' services while Cusumano et al. (2014) consider product-related services as complement or substitute for purchasing the product. Looking at these services from a different perspective Mathieu (2001) differs services which support the supplier's product or which supports the client's action. On the other hand some authors make distinction between product-related services depending on their orientation towards product or process (Szász et al., 2017). Typical examples of the services provided include installation and training, after-sales services (i.e. product repair and maintenance, customer support and recycling of goods at the end of their lifetime), software development, remote support and modernization (Santamaría et al., 2012).

2.2. Research questions

Based on literature review, it is important to define two different methods for charging the users for product-related services. One method is to directly invoice the service, so user pays for it separately from the product. The second method of indirectly invoicing the service means that company includes the price for particular service in the price of the product. According to this, the following research questions were proposed in attempt to identify the different effects of product-related services on manufacturing's firm performance in transitional economy such as Serbia:

- RQ1: Do product-related services increase revenue, when directly invoiced?
- RQ2: Do product-related services increase revenue, when indirectly invoiced (included in the product price)?

Summation of our research questions is given in Figure 1. Proposed model analyses the effect of product-related services such as installation, maintenance and repair, training, design, consulting, and project planning, software and development, remote support for clients, revamping or modernization, end of life services. The research is based on the hypothesis that observed services have positive impact on the revenue of manufacturing companies.

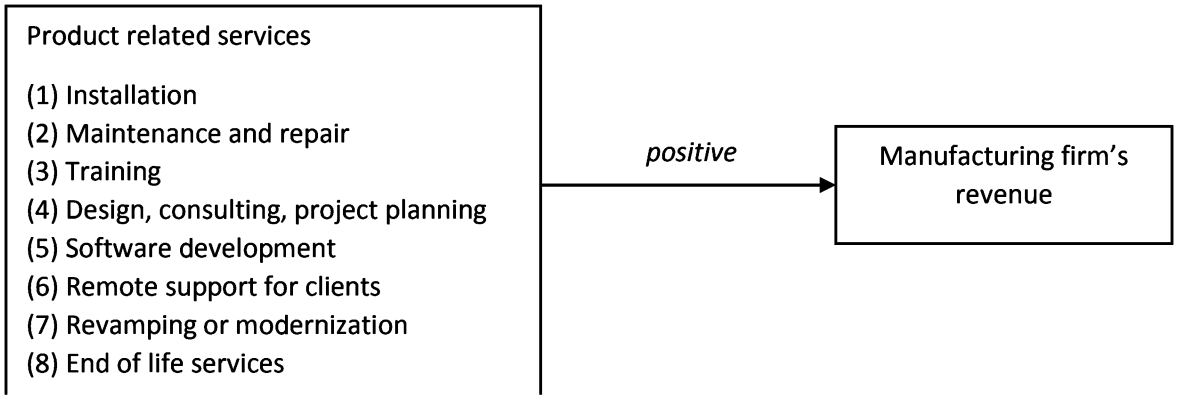

Figure 1: Proposed model

3. METHODOLOGY

Our analysis used the Serbian dataset from the European Manufacturing Survey (EMS) conducted in 2015. EMS is a survey on the manufacturing strategies, the application of innovative organizational and technological concepts in production, and questions of personnel deployment and qualifications in European manufacturing industry (Bikfalvi, Jäger, & Lay, 2014; Lalić, Tasić, Marjanović, Delić, & Cvetković, 2016). For the purposes of this study, the survey was conducted among manufacturing firms (NACE Rev 2 codes from 10 to 33) having at least 20 employees. Total population in Serbia that meets the above criteria was 2043. The initial population was obtained from the Serbian Business Registers Agency. To obtain a representative sample, 828 companies were contacted evenly distributed across all NACE sectors and in all the districts in Serbia. Data collection was done through a pre-test phase and the two mass distribution phases. Total number of companies who participated in the study is 280, representing a response rate of 33.8%. About 38.2% of the firms in the sample are small firms between 20 and 49 employees, another 50.4% of the firms have between 50 and 249 employees, and 11.4% of the firms have more than 250 employees. The largest industry in the sample is the manufacture of food products (NACE 10), followed by manufacture of fabricated metal products, except machinery and equipment (NACE 25) and the manufacture of rubber and plastic products (NACE 22). Tables 1 and 2 give an overview of the sample.

Table 1:EMS database – distribution of firms by size

Firm size	**n**	**%**
20 to 49 employees	107	38.2
50 to 249 employees	141	50.4
250 and more employees	32	11.4

Table 2: Classification on manufacturing sectors according to share on total sample

NACE Rev. 2	**Manufacturing industry**	**Share on total sample (%)**
10	Manufacture of food products	18.2
25	Manufacture of fabricated metal products, except machinery and equipment	13.6
22	Manufacture of rubber and plastic products	8.3
28	Manufacture of machinery and equipment n.e.c.	6.0
14	Manufacture of wearing apparel	6.0
27	Manufacture of electrical equipment	5.3
23	Manufacture of other non-metallic mineral products	5.3
18	Printing and reproduction of recorded media	4.6
31	Manufacture of furniture	4.3
29	Manufacture of motor vehicles, trailers and semi-trailers	4.0
16	Manufacture of wood and of products of wood and cork, except furniture	3.6
20	Manufacture of chemicals and chemical products	3.3
17	Manufacture of paper and paper products	3.3
13	Manufacture of textiles	3.3
	Others	10.9

4. RESULTS

For research questions testing, regression analysis was conducted by IBM SPSS. Each research question was tested with separate model. Model 1 relates to research question 1 – *Do product-related services increase revenue, when directly invoiced?* and refers to the situation when company directly charge user for observed service. Model 2 relates to research question 2 – *Do product-related services increase revenue, when indirectly invoiced?* and refers to including the observed service in the product price by the manufacturing company.

Table 3 presents two different regression models.

4.1. Model testing

Model 1
The overall model was significant, Adjusted R^2 = .453, F = 13.785, p < .001. Three predictors had a significant coefficient – maintenance and repair (B = .352, p < .001), design, consulting, project planning(B = .257, p < .01), and end of life services(B = .186, p < .01). Three predictors had a limited significant coefficient – software development (B = .179, p < .1), remote support for clients (B = -.140, p < .1), and revamping or modernization (B = .164, p < .1). However, installation (B = -.127, p > .05) and training (B = .047, p > .05) were not significantly different from 0. This confirms support for research question 1.

Model 2
The overall model was significant, Adjusted R^2 = .242, F = 4.937, p < .001.Two predictors had a significant coefficient – design, consulting, project planning(B = .275, p < .01) and maintenance and repair (B = .239, p < .05).However, all other predictors were not significantly different from 0, installation (B = .128,p > .05),end of life services (B = .032,p > .05), software development (B = .031,p > .05),remote support for clients(B = -.104,p > .05), revamping or modernization (B = .064, p > .05)and training (B = -.019, p > .05).This confirms support for research question 2.

Table 3: Results of regression models for two research questions

Product-related services	**RQ1**	**RQ2**
Installation	-.127	.128
Maintenance and repair	**.352*****	**.239***
Training	.047	-.019
Design, consulting, project planning	**.257****	**.275****
Software development	**.179**$^{+}$	.031
Remote support for clients	**-.140**$^{+}$	-.104
Revamping or modernization	**.164**$^{+}$	-.064
End of life services	**.186****	.032
R	0.673	0.491
R^2	0.453	0.242
F	13.785	4.937
Sig	0.000	0.000

Note: ***p<0.001; **p<0.01; *p<0.05; $^{+}$p<0.1;

5. DISCUSSION

This research has addressed the problem of servitization from the financial perspective. The results given in Table 3 contribute to the existing literature which is predominantly focused on the measuring the share of product-related services altogether, by the way they are accounted either directly or indirectly, in the total turnover of the companies. As Kinkel et al. (2011) stated, it is important not only to measure and monitor the offer of product-related services in general but also different types of services.

Since the aim of the research is to explore the effects of specific product-related services on manufacturing's firm performance, especially financial performance, two research questions analyzing the possible methods of invoicing these services to clients were proposed: directly (paid separately from the product) and indirectly (included in the product price). The product-related service types whose importance wasanalyzed from the financial perspective are: installation, maintenance and repair, training, design, consulting, project planning, software development, remote support for clients, revamping or modernization and end of life services. Observing given results, it can be discussed that answering the both research questions gives important findings for the manufacturing companies in transition economy such as Serbia because there is a significant difference between the influence of specific product-related service on share of turnover of services in

manufacturing companies which participated in the survey when it comes to the chosen method of invoicing product-related service.

If product-related services are directly invoiced, maintenance and repair have the higher positive impact on the company's turnover with the highest statistical significance. In addition, if companies include design, consulting, project planning in their offer and directly invoice this product-related service, they will increase turnover. The same could be applied on the end of life services. With a limited significance, software development and revamping or modernization have also a positive influence on turnover of the companies in this situation. However, when it comes to remote support for clients, it has a negative influence on turnover which means that turnover will decrease when offering this product-related service and directly invoice. It means that companies should be aware ofthis negative influence and to think it through before including remote support for clients in their offer and to calculate what are the possible benefits for them (e.g.ifthey want to achieve competitive advantage at the market giving to the users the remote support for their products even it decreases the share of turnover).

Second research question analyzes the situation when companies include the price for observed types of product-related services in the price of the product. Analyzing the results generated by this research question it could be discussed that they differ from the results from the first research question. Just two types of product-related services have the statistically significant influence on the share of turnover, both positive. Information acquired from different companies are positively associated with the share of turnover in the situation of design, consulting and project planning and maintenance and repair. Due to positive correlation between these types of product-related services and the share of turnover, design, consulting and project planning and maintenance and repair should be taken into consideration by the companies because we showed that it has the greatest effect on increasing share of turnover when included in the price of the product.

In this study, we have empirically shown that product-related services have the influence on the overall turnover. This study gives important guidelines and information for the Serbian manufacturing companies regarding servitization. We found that only two types of product-related services positively influence the share of turnover in the situation of indirectly charging users for this service. The assessment, which focused on servitization, is consistent with the literature on servitization. Kinkel et al. (2011)found that product-related services have positive impact on firm's performance. Specifically, indirect turnover from services is higher than direct service turnover in general. In addition, Dachs et al. (2014) confirmed in the results of their large-scale survey from 10 European countries that servitization in manufacturing sector is worthwhile. Therefore, plant managers or technical directors should plan which type of product-related services will design and how they will charge – directly or indirectly, included in the product price.

6. CONSLUSION

This research paper examined the influence of product-related services on firm's performance. The findings show that product-related services have positive impact on the company's turnover. Moreover, this paper provides some implications and possible effects for companies which intend to offer different product-related services to customers and charge for them separately or altogether with the product. Some of the observed types of product-related services show the highest positive impact on the turnover of companies when directly invoiced (i.e. maintenance and repair; design, consulting, project planning; end of life services) and indirectly invoiced (i.e. maintenance and repair; design, consulting, project planning). Although, some of the product-related services influence the firm's turnover in both situations, we found that maintenance and repair have the highest positive impact when directly invoiced, as well as design, consulting, project planning when indirectly invoiced. Given results contribute to existing literature and provide important recommendations for companies which want to include services in their product offerings with evidence from the Republic of Serbia.

Limitations to this study are in the areas of sampling. The sample was drawn from a single developing country (i.e. Serbia), probably lacking the diversity that can be expected from a comparable sample chosen from across different economies, both developed and developing. Further research should test the model and relationships in the manufacturing companies within developed economies. Furthermore, it would be of interest to know more precisely what factors drive (or hamper) innovation in new product-related services.

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THE MANAGING OF THE TEMPERATURE MAPPING PROCESS OF THE WAREHOUSE

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Abstract: *The managing of the temperature mapping process of the warehouse is a measurement performed to obtain information about the temperature distribution on the surface or in the space, in the function of time. Temperature mapping represents collecting and presentation of temperature data from the locations which are defined in the space. The method for determination of the degree on which the system is controlled is industrially accepted. The purpose of temperature mapping is to document and control the distribution of temperature within the warehouse space. Based on the measurement data values, the system automatically regulates the observed parameters within the given limits. The role of man is to oversee the entire process, and at the same time to react when there are disturbances of processes that are not being resolved by the automated system.*

Keywords: *temperature mapping, measurement, pharmaceutical industry, improving quality.*

1. INTRODUCTION

In the pharmaceutical industry, it is very important to provide appropriate equipment and procedures for checking of the ambient conditions in which medicines are stored. In point 3.2.1. (Temperature and ambient conditions control) guidelines for good practice in distribution, a short description is given of how a temperature mapping study needs to be done, and it is described temperature mapping in warehouse and talking about the obligation of temperature mapping. "The ambient conditions that are controlled include temperature, light, relative humidity and room cleanliness. Initial temperature mapping is carried out in the area for the storage of medicines, before the beginning of use of the warehouse itself, under representative conditions. The temperature monitoring equipment is distributed in accordance with the results of temperature mapping, ensuring that the temperature monitoring devices are positioned in zones where extreme fluctuations are present. Temperature mapping is repeated in accordance with the results of the risk assessment or when significant changes of space or temperature control equipment are made. For small rooms, areas of several square meters, which are at room temperature, an assessment of the potential risks (eg heaters) is carried out and the temperature monitors are installed accordingly. "(Guidelines of good distribution practice, Official Gazette of the Republic of Serbia, No. 30/10 and 107/12, 2016).

As far as temperature mapping in the warehouses in the Republic of Serbia is concerned, mentioned guidelines of good practice in distribution GDP (Good Distribution Practice) are applied. "GDP is the part of quality assurance that ensures that the quality of drugs is maintained at all stages of the supply chain from the place of production to the pharmacy or other person authorized to issue medicines" (GDP Guidelines 2013/C 343/01). Also, the recommendations of the World Health Organization are applicable, as well as any official recommendations in order to demonstrate compliance with legal regulations, management, clients and inspections.

Considering GDP does not go into details, and the temperature mapping process is not strictly indicated, it is necessary to prescribe proposals and guidelines that will explain and clarify in detail the process of temperature mapping in warehouses. Therefore, this work gives a proposal, guidelines and explanation of the entire temperature mapping process in warehouse of pharmaceutical products, raw materials and packaging.

2. DESCRIPTION OF MEASUREMENT AND RESULTS

To begin the process of temperature mapping of the warehouse, it is necessary to have an approved protocol, which is detailed, clear and comprehensive. The protocol should be approved by the responsible person within the organization, that it has the revision mark, the description and the reason for the change. If the protocol is prepared by an external house, it is necessary that the authorized person signs the consent

(application). If the new system is in question (as is the case in this work), according to the guidelines of good manufacture practice it is necessary to have the following:

- DQ (Design Qualification) –Design Qualification proves that the given design correspond to the needs of users and GMP requirements.
- RA (Risk Analysis) - Defines the extent of testing which should be performed on the equipment and system.
- IQ (Installation Qualification) -Installation qualification proves that the device is installed in accordance with the manufacturer's design and specifications.
- OQ (Operational Qualification) –Operational qualification proves that the whole system really works in the prescribed way. During the OQ, the initial temperature mapping of the warehouse needs to be done.
- PQ (Performance Qualification) – Performance qualification proves that the system functions in the prescribed manner at the expected level of filled. During the PQ it is necessary to do winter and summer temperature mapping of the warehouse.

After confirmation of the correctness and functionality of system, it can start with the "filling" process of the warehouse. In the continuation of this work, the description of the measurement, the results, as well as all the necessary information for the successful execution of the temperature mapping of the warehouse will be presented.
The legal regulations prescribes temperature mapping of the warehouse, and the basic purpose of the temperature mapping study is to identify the temperature deviations that effect on the selected area during the execution of study, so that appropriate corrective actions can be taken.

The methodology for execution of temperature mapping study involves certain steps and the traceability. The listed steps are recommendations and they should be completed before the protocol is approved.

1. **Choose the type of equipment with which testing will be done**. Data loggers are the best solution for conducting a temperature mapping study. Data loggers are electronic devices that record data over a certain time interval, on their internal memory, or directly sent to the computer. During the choosing, make sure that the device has enough memory for the planned duration of the study and for the selected recording interval. An important feature is the time response of the sensor in the data logger, as well as the battery life. All data loggers have to be calibrated (every 12 months) in accredited laboratories according to ISO IEC 17025: 2017, to possess calibration certificates, and to have a error of no more than ± 0.5 °C at each point of calibration. Calibration points on data loggers should cover the allowed temperature range of the warehouse. It is necessary that data loggers be calibrated in 3 points. There should be one calibration point below the permitted range, one calibration point in the center of the permitted range, and one calibration point above the allowed range. To ensure consistency, only one type of data logger per study should be used. Write a working manual for using data loggers before using them, and train staff who will use the equipment. TESTO 174H is the type of data logger used to create this work.
   In case more than 9 sensors are used during the duration of the study, and if 90% of the sensors used for the temperature uniformity mapping test were successfully readout, mapping can be considered successful. In the case of that the measured data after mapping is not available with less than 10% of the used sensors, it is necessary to give a comment regarding the position of the observed sensors as well as the data from the sensors located in the immediate vicinity of them. In the case of that the measured data after mapping is not available with more than 10% of the used sensors, and if it is not possible to get data from the sensors located in the immediate vicinity of them, proceed according to the operational procedures, initiate a deviation and carry out an investigation.

2. **Determine the team that will perform the temperature mapping test in the warehouse.** All members of the validation team should be identified and personally enrolled into the protocol (name, surname, position in the company, signature, initials and date). All team members must be trained for the purposes of conducting a temperature mapping study.

3. **Collect sufficient information about warehouse.** The information listed in following text is quite satisfactory for testing purposes. The width of the tested warehouse is 52.34 m, length 47.3 m and height 14 m. The maximum height of the pallet storage is 11.95 m, and the total warehouse capacity is 6782 pallets. HVAC (Heating, Ventilation, and Air Conditioning)system supplies fresh and recirculated air, and with frequency regulator, regulates fan speed to maintain airflow max 48400 m3/h on the intake and 45400m3/h on the exhaust fan. The required temperature range is from 15 °C to 25 °C. Set point temperature value is 21 °C. In addition to basic warehouse information, it is necessary to attach warehouse drawings that locate racks, pallets, passages and locations of components for heating and cooling.

4. **Establish (determine) the acceptance criteria.** The protocol should define the necessary acceptance criteria, such as the allowed temperature range, the duration of the mapping, the trends from the SCADA (Supervisory Control And Data Acquisition) system, mandatory attachments, and the like. Trial and informative testing, as well as testing for some kind of optimization, can be performed without prior definition of any acceptance criteria, therewith that it is necessary to document such a type of study. If the study is designed so that to include door opening, that should be stated in the acceptance criterion, and the door opening parameters (frequency and duration) should be defined. The establishment of the acceptance criteria for the results of the qualification tests is carried out in accordance with the regulations, where the order of priority is as follows:
   - Pharmaceutical requirements - GMP regulation/ requirements for medical resources,
   - Pharmaceutical requirements - GDP regulation,
   - Requirements and recommendations from the specifications of the materials which is stored,
   - Recommendations from the warehouse domain.

5. **Determine locations where testing will be carried out**. It is best to make a risk analysis, and based on that document, determine the locations and the number of data loggers that is sufficient for testing purposes. Data loggers should be arranged to the network by width and length, so the area is reasonably covered, and data loggers should be setted at every [3 - 30] meter. The selected sensor network should take into account the look of the area to be mapped, the degree to which the air on the insertion and/or the exhaust air can effect on the raffs and products as well as the positions where the pallets are placed. Data logger's positions should match with the pallet locations on which the products are located. Depending on the size of the warehouse differs the number of locations on which it is necessary to carry out measurements depending on the height and surface (volume) of the warehouse. The number of levels in which measurement is made varies:
   - In the case that storage is done at a height of up to 3m, all measurements must be carried out at least in one level, and that in the middle, between the lowest and the highest storage point.
   - In the case that storage is done at a height of up to 6 m, all measurements must be carried out at a minimum of two levels. The first level near the lowest level of storage, and the second level near the highest storage point.
   - In the case that storage is done at a height above 6m, all measurements must be carried out at a minimum of three levels. The first level near the lowest level of storage, the second level in the middle (between the lowest and highest storage points), and the third level near the highest storage point.
   - The distance between measuring instruments and walls (side walls, ceiling, floor), for measuring instruments intended to be located near the walls, should be 10% of the total observed length (width) of the warehouse, respectively should not be below 0.3m, and not more than 6m.
   - In case the temperature mapping is done in one level, it is necessary that the distance between the two adjacent measuring instruments is not greater than 5m.
   - In case the temperature mapping is done in 2 levels, the measuring instruments must be set minimum in each corner and one in the center of the warehouse so that the distance between the two adjacent measuring instruments in the horizontal plane is between 3m and 15m.
   - In case the temperature mapping is done in 3 levels, it is necessary that the distance between the two adjacent measuring instruments does not exceed 30m.

   Add a unique tag to each location of the data logger. Provide a connection between logger data and location, so that the data logger can be traced all the way to the certificate. For the study shown in this work, 35 data loggers were used, setted according to the scheme shown in Figure 1.

6. **Setting up and installation of data loggers**. It is necessary to set up data loggers in the appropriate software (CFR 21-11). Set the same parameters for all data loggers, taking into account that the start time of the study, the duration of the study, and the recording interval are the same for all data loggers. There is no time limit for the duration of the study. It is typical for warehouses that the study does not last for less than 60 hours. Testing was performed, where in the first scenario data loggers were set to sample every 15 minutes, for one week, which provided 6 720 samples. The second scenario is that the data loggers were sampled every minute, for one week, which provided 100 800 samples. The first scenario provided the same general results as the second scenario, and much less time spent analyzing the registered data. The key is the time of response of the data logger. Most temperature data loggers need more than 20 seconds to react to temperature changes, and in rooms of more than 2000 m^2, most temperature changes will occur very slowly over several minutes, making frequent sampling scattered and unnecessary. Data loggers are set in a time interval of 5 minutes and the duration of the study is 72 hours.

7. **Set data loggers according to a pre-made scheme**, take care that they will not be damaged or be moved by someone during the lasting of the study. Keep in mind the time required to stabilize the data logger. Enable the air conditioning system to work at least 24 hours before the start of the study.

   Be sure to set up one data logger in the outside environment. When installing the sensor for measuring external conditions, make sure that the sensor is located in a place that is not exposed to direct heat sources (sun, motors, heat exchangers, light sources, light reflecting effect), and other external factors (snow, rain, air conditioning system condensate). It is necessary to place the sensor at a height of 1.5 meters to 2 meters from the ground, and enable the air to streaming. Duration of testing, as well as the time interval between the samples, should coincide with the data loggers placed in the warehouse itself. Enable enough time for stabilization of the sensors.

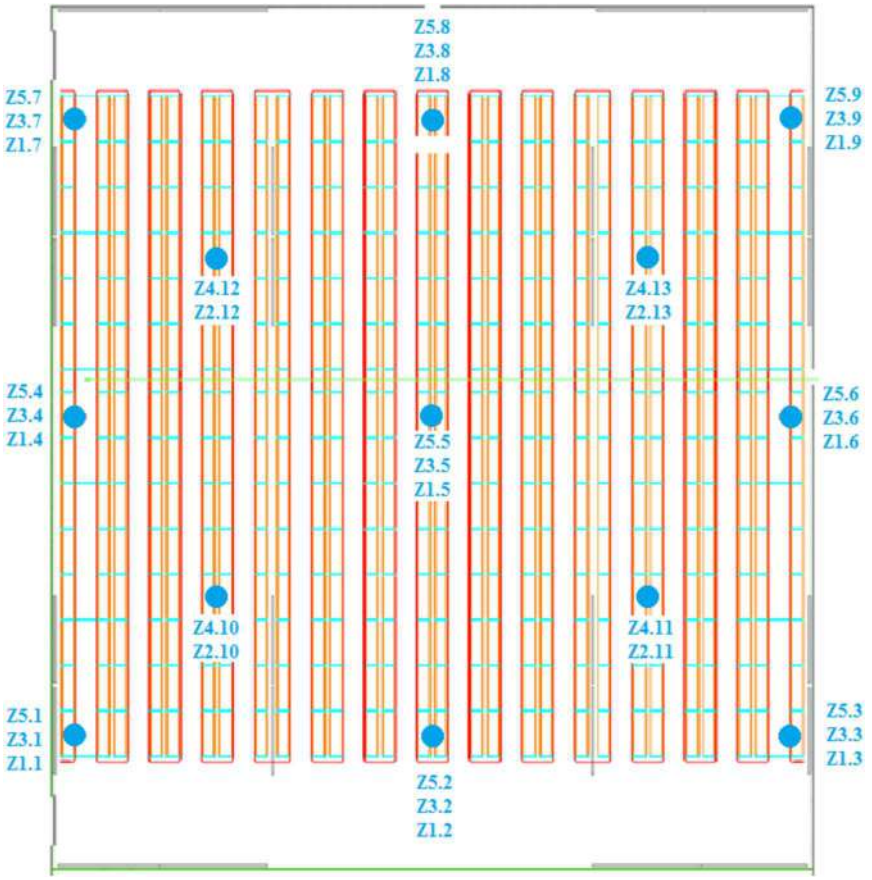

Figure 1: Data loggers positions

Note: *Data loggers are marked in the ZX.Y format where X is the height, and that 1 for data loggers which are set at a height of 1.2 meters from the floor, 2 for data loggers which are set at a height of 3 meters from the floor, 3 for data loggers placed in the central part of the warehouses at a height of 5.5 meters from the floor, 4 for data loggers which are set at an altitude of 8 meters from the floor, and 5 for data loggers placed near the highest storage point, at an altitude of 11.5 meters from the floor. While Y represents the position of the data logger.*

8. **Download and read data loggers.** Download data loggers, read them, and save data for analysis.

9. **The report.** Data analysis procedures should be described and made to show the uniformity of the temperature at a given location over time (time uniformity) and at specific time in the area of interest (spatial uniformity). It is necessary to create a diagram which showing all locations where the temperature readings are taken , and where a link is made between the position and the data logger designation. Tabulate the minimum and maximums for each location, the mean value for each data logger, as well at the standard deviation. The time interval between readings, occupancy rate of warehouse and duration of the study is important to present in the report.
   After the data analysis has been done, it is necessary to give conclusions and recommendations on the further use of the warehouse. Depending on the economic aspect, after an initial qualification, a certain number of internal sensors must be placed in the warehouse, which will perform continuous monitoring.

The results of the initial mapping of temperature in the warehouse will be presented hereinafter, as well as what is needed to complete the complete testing successfully.

2.1. Initial Temperature Mapping

Initial temperature mapping is carried out after completion of the works, under representative conditions, the warehouse should be empty. External conditions need to be monitored, but not relevant at this time. Initial temperature mapping is used to determine the starting points for monitoring and is considered as part of the operational qualification.

In the study performed during the initial mapping, 35 data loggers were used, which are set according to the scheme given on Figure 1. Occupancy rate of warehouse was 0%. The set point of the HVAC temperature was 21 ° C. Mapping of temperature during initial mapping was carried out in the period from 12.06.2017. 15:00 to 15.06.2017. 15:00, ie. 72 hours. The distance between two consecutive measurements was set to 5 minutes. The statistical data for each data logger are shown in Table 1. Based on the analysis of the results, the examination of the critical "warm" and "cold" points, the mean values, the distribution of the temperature in the warehouse and other relevant parameters, the recommended locations for setting internal sensors are: Z1.1; Z1.3; Z1.9; Z2.11; Z2.13; Z3.7, Z3.9, Z4.11; Z4.13; Z5.2; Z5.3; Z5.4; Z5.5; iZ5.7. At these positions, it is necessary to set internal sensors, which will continuously monitor the temperature.

Since the warehouse is intended for storage from 15 ° C to 25 ° C, and the temperature during the study ranged within the allowed range, from 18.3 ° C to 21.3 ° C, and bearing in mind all the indicated results of temperature mapping, the conclusion is that all pallet positions in the warehouse can be used. Monitoring sensors should be placed at recommended locations so it can start with continuous monitoring. It is necessary to perform summer and winter mapping of the warehouse, when appropriate external conditions are created. The final recommendations of the locations for continuous monitoring will be given after the completion of summer and winter temperature mapping in the warehouse. The diagram shows the temperature changes during initial mapping, Figure2. Table 1 shows the measured minimum and maximum values, mean values, as well as the standard deviation of data loggers used during the temperature mapping study. The minimum values are indicated by the blue color, while the maximum values are indicated in red color.

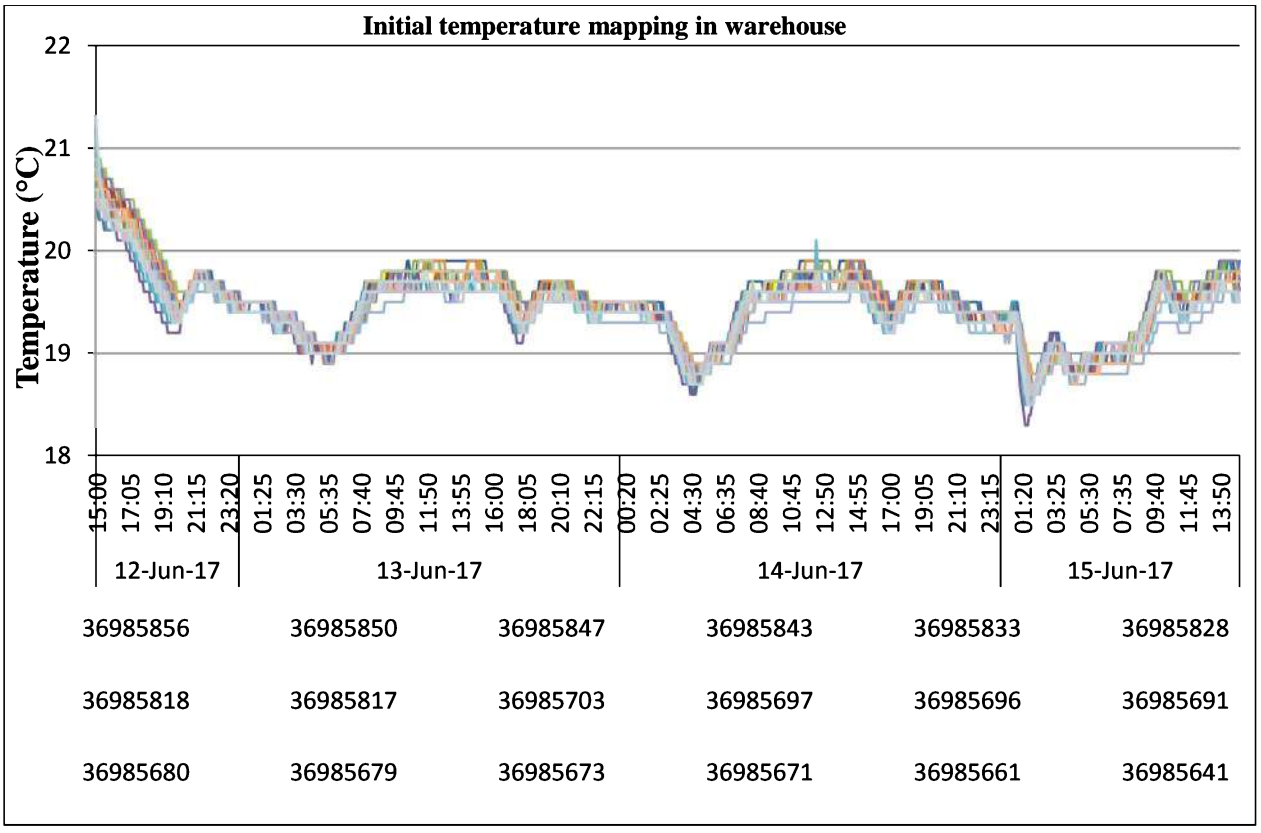

Figure2: Chart of the data from temperature data loggers

Table 1: Results of initial mapping in the warehouse

Results of initial mapping in the warehouse					
Position	**S / N**	**MIN**	**MAX**	**AVG**	**STDV**
Z1.1	36985459	18.7	20.5	19.434	0.279
Z1.2	36985445	18.6	20.5	19.445	0.291
Z1.3	36985594	18.5	20.5	19.325	0.324
Z1.4	36985696	18.7	20.5	19.453	0.277
Z1.5	36985828	18.6	20.5	19.408	0.306
Z1.6	36985691	18.6	20.6	19.478	0.328
Z1.7	36985427	18.6	20.5	19.427	0.279
Z1.8	36985847	18.7	20.6	19.491	0.309
Z1.9	36985843	18.6	20.6	19.466	0.336
Z2.10	36985578	18.6	20.5	19.412	0.295
Z2.11	36985485	18.6	20.9	19.390	0.338
Z2.12	36985817	18.7	20.9	19.478	0.356
Z2.13	36985608	18.5	21.1	19.392	0.326
Z3.1	36985604	18.8	20.8	19.475	0.326
Z3.2	36985661	18.5	20.4	19.420	0.290
Z3.3	36985624	18.5	20.6	19.403	0.342
Z3.4	36985494	18.7	20.7	19.467	0.316
Z3.5	36985818	18.7	20.8	19.550	0.326
Z3.6	36985460	18.5	20.7	19.436	0.359
Z3.7	36985638	18.7	20.8	19.521	0.325
Z3.8	36985440	18.6	20.6	19.420	0.321
Z3.9	36985641	18.6	20.9	19.514	0.379
Z4.10	36985616	18.7	20.9	19.534	0.362
Z4.11	36985697	18.6	21.2	19.463	0.358
Z4.12	36985703	18.7	20.7	19.465	0.299
Z4.13	36985411	18.5	21.3	19.412	0.334
Z5.1	36985622	18.8	21.0	19.516	0.368
Z5.2	36985671	18.3	20.4	19.416	0.301
Z5.3	36985833	18.5	20.7	19.448	0.356
Z5.4	36985679	18.7	20.9	19.451	0.357
Z5.5	36985850	18.7	20.8	19.543	0.339
Z5.6	36985680	18.6	20.9	19.484	0.377
Z5.7	36985673	18.8	21.0	19.553	0.368
Z5.8	36985563	18.7	20.8	19.526	0.334
Z5.9	36985856	18.6	20.9	19.530	0.394

The HVAC system is managed according to the mean value of all 14 internal sensors. Internal sensors take a temperature sample every 15 minutes and they are stored via the SCADA system. Prescribe the way in which the temperature is monitored in the warehouse if there is a power failure or a failure of some of the sensor. In case of short-term deviations from the defined limits occur while reading the results, it is necessary to calculate the Medium Kinetic Temperature (MKT) to prove that the deviations have no effect on the stability of the product or the material in the observed warehouse. MKT - a mathematically determined temperature value that simulates the temperature variation over a certain period of time - during storage and transport. MKT is not used as an alternative to adequate temperature control during storage and transport of the drug, and is not the arithmetic mean of all recorded temperature values. According to USP (United States Pharmacopeia) –Temperature deviations (bouncing) up to 40 ° C are permitted provided that the mean kinetic temperature does not exceed 25 ° C. If the calculated MKT for each location is within the defined limits, the alleged deviations do not have an impact on the product being stored.

3. CONCLUSION

After the successful completion of the initial temperature mapping in the warehouse, the operational qualification is completed. It is necessary to issue a complete report on the completion of qualification tests (when summer and winter mapping is done), and give recommendations for using the warehouse. After the summer and winter mapping is done, it is necessary to prescribe the frequency of re-mapping. It depends exclusively from the way of how critical parameters are monitored. Re-mapping of empty warehouse does not need to be done. Make an analysis of whether it is necessary to carried out mapping both in summer and in winter. If a temperature mapping is performed well (as done in this work) and probes for monitoring are set up on a sufficient number of locations (for a storage of this size, 14 data loggers are more than enough), re-mapping should be done only after bigger changes on the system. Table 2 shows a unique example of a

spreadsheet of all relevant information about temperature mapping in warehouses. It is recommended that each protocol / report has this type of table, due to easy and quick insight into the temperature mapping process.

Table 2: Temperature Mapping Table

	Temperature Mapping Table	**Results**
1	Type of mapping (initial, summer, winter, other)	Initial
2	Dimension (m) / capacity (number of pallet)	52.34 x 47.3 x 14 / 6782
3	Temperature range (°C)	15 - 25
4	Percentage of Warehouse load(%)	0
5	Number of internal sensors	14
6	Number of used data loggers	35
7	Start time – End time	12.06.2017. 15:00 – 15.06.2017. 15:00
8	Sensor accuracy ±0.5°C?	YES
9	Sample rate (min)	5
10	Min- max / avg min -avg max	18.3 – 21.3 / 19.32 – 19.55
11	Outside data logger min - max / avg	12.3 – 32.3 / 23.41
12	Deviations?	NO
13	If there is deviation, calculated MKT	N / A (Not applicable)
14	Certificates attached?	YES
15	Raw data, Diagrams, statistic are attached?	YES
16	Recommended locations for monitoring	Z1.1; Z1.3; Z1.9; Z2.11; Z2.13; Z4.11; Z4.13; Z5.2; Z5.3; Z5.4; Z5.5; Z5.6; Z5.7; i Z5.9.
17	Next temperature mapping	Summer

For the competent authorities (inspections) it is important to have a summarized presentation of relevant data. By inspecting of this type of table, they will receive the necessary information, and if it necessary, they can also request attachments (diagrams, raw data, certificates, etc.). In this work only the initial temperature mapping is shown, due to the scope of the work itself. The summer and winter mapping of the warehouse implies a series of procedures and rules which should be applied in the given conditions and require special research.

For the pharmaceutical industry, the satisfaction of the GMP and GDP requirements is unavoidable, since the legal obligation is the application of the principles and the requirements of good manufacturing practice within which the requirements of good distribution practice are mentioned, which is of great importance for increasing competitiveness. Adopting and practicing recommendations by large companies and world organizations can only contribute to improving quality and increasing competitiveness.

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VIRTUAL TEAMS: CONSTRAINS AND CHALLENGES

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Abstract: *This paper provides a theoretical perspective of teams' efficiency which work in virtual environments. Working in virtual teams has become every day appearance, because companies sometimes need certain skills, which are not available within them. By the usage of information technologies, boundaries such as distance and time are now easily bypassed. Although technology has made it easier to work on mutual tasks working in virtual environment can be very challenging for team members. Literature has addressed multiple issues related to phenomenon of increased number of globally dispersed teams, which differ in culture, language, habits and values. Therefore, building up a team which will be consistent of members, who will differ in so many areas, can be very challenging for project managers, since there are many various aspects which need to be thoroughly reconsidered before setting it up. The main objective of this paper is to provide insight into most common challenges for virtual teams and challenges they need to overcome in order to work effectively.*

Keywords*: virtual teams, project management, information technologies, communication, globalization*

1. INTRODUCTION

A wide range of disciplines and literatures have addressed the notion of virtual teams. Under the influence of rapid technological development, barriers such as space and time are easily crossed since it enables people to work on mutual goals and projects. With newly developed technological solutions, new formations of teams' organizations were created. Those are related to teams which work together on mutual task, but are dispersed worldwide.

On hand of technology, although being physically parted, team members can collaborate, communicate and interact with one another in virtual, Internet mediated environment in order to fulfill delegated duties in time. So far literature has addressed many different standpoints on virtual teams, and has shown both good and bad aspects of individuals being part of these teams. Project managers should carefully reconsider pros and cons of hiring external members as addition to their current team, who will not be present all the time during projects' realization. Therefore, managers have to thoroughly exam all the possible outcomes of this form of team building, especially if they lack international experience in doing business. Barriers such as, values, tradition, time management, perception of goals and trust are only some of possible constrains which can occur during projects' duration.

The first part of the paper will review authors' attitudes towards members' engagement in virtual teams and the most common ways of its description, while the third and fourth segment will deal with the issues faced by virtual teams and constrain they need to overcome in order to establish good communication. Numerous authors, who have dealt with these, have identified certain problems which are likely to occur within teams which operate in virtual environment. Although these formations provide multiple benefits and high flexibility, they also create numerous challenges, which will be addressed in the following sections of the paper.

2. DEFINING VIRTUAL TEAMS

Globally dispersed virtual teams were almost unheard of a decade ago, but today they present a critical element for integration of information, decision making process, and implementation of actions around the globe (Canney, Davison, & Ward 1999). In today's doing business, global virtual teams are increasingly making and implementing important decisions (Maznevski & Chudoba, 2000).According to Cascio (2000) virtual work place, where employees operate away from each other and from managers is a reality for many of them and is likely that this trend will keep growing in the future. On hand of technology they are now able to work on different issues and challenges that company is facing on international scales (Ives & Jarvenpaa, 1991). Powell et al. (2004) suggest that the usage of technology by virtual teams as a key medium represents a foundation of modern business. With electronic and communication technology developing quickly, distributed work had become more efficient, easier and faster (Hertel et al., 2005). These types of formations are an essential organizational mechanism because they allow organizations to stretch limited resources across geographic and other barriers (Munkvold and Zigurus, 2007).

Their reliance on integrated communication links, such as: wires, phones, computers, modems, networks, servers, and databases in order to support almost all interaction makes these teams distinctive (Suchan and Hayzack, 2001). There were many authors who gave their definitions on virtual teams. For instance, Lipnack and Stamps (1997) define them as "a group of people who interact through interdependent tasks guided by common purpose and work across space, time, and organizational boundaries with links strengthened by webs of communication technologies."

Cohen and Gibson (2003) stress three core criteria of virtual teams. Firstly, it is a team interdependent in task management, which equally participates in responsibilities for project results, and collectively managing relationships across organizational boundaries. Secondly, team members are globally dispersed, and thirdly, participants rely on technology supported communications rather than face-to-face interactions.

Balotsky and Christensen (2004) describe virtual teams as geographically dispersed participants who communicate with each other on hand of various technologies and information. Fisher and Fisher (1997) pointed out several advantages of virtual team members: specific technical knowledge, constant desire to improve personal skills, strong problem solving and decision making capabilities and good team working approach.

Although virtual teams are increasingly used, and in some cases stand for the only alternative, there are still authors who argue certain standpoints against usage of virtual formations. For example, study introduced by Lee – Kelly et al. (2004), included the total of eight globally distributed teams and concluded that virtual teams differ a lot from traditionally organized teams and that managers have to face multiple issues when guiding them, whilst the teams who operate regularly, do not have to face these issues and can overcome them easier.

3. KEY ISSUES CONCERNING WORK IN VIRTUAL TEAMS

There are many advantages from which organization can benefit by adoption of virtual teams, but there are also many challenges (Precup et al., 2005). Usage of virtual teams comes with significant challenges for companies wishing to introduce them. Although the majority of these challenges are present in traditionally organized teams, they may become even more dramatic in this set up (Solomon, 1995).

Communication amongst team members can traditionally be characterized as one of the possible issues amongst team members, which in case of virtual teams can be even bigger issue due to physical absence, cultural differences, language and accent difficulties. Some additional issues concerning working as a part of virtual team are related to mistrust between project participants, conflicts, communication break – downs and power struggles (Rosen et al, 2007). When building a virtual team, these problems must be identified in time in order for team to operate effectively (Hunsaker and Hunsaker, 2008). Diversity in culture and nationality are common in transnationally organized groups (Staples and Zhao, 2006). According to Mazevski et al. (1997), culture can be defined as a set of deeply rooted values, shared by the group of people within which certain individual lives. Through the prism of cultural values, certain individual interprets necessary information needed in order to make decisions (Hofstede, 1984). These differences in perspective of information comprehension can be seen as multicultural teams' strength, but due to hidden influences, these teams often meet issues connected to cooperative decision making process.

One of the most important issues related to working in virtual teams is the matter of trust which is considered to be the key for building strong bonds for successful interactions. In regular teams, which operate face-to-face, trust is developed on basis of social and emotional attachments (Furst et al., 2004) while on the other hand, virtually organized teams develop it in a different way. Jarvenpaa et al. (1998) concluded that the lack of social presence and face – to – face interactions can have detrimental consequences to trust building amongst team members. In addition to that, several other authors (Warketin, 1999; Heghtower and Sayeed, 1996) questioned effectiveness of artificial communication as a substitute for regular face – to – face meetings and its influence on team members' creativity and decision making process, which some studies proven to be correct, since face – to – face group performed better than groups who operated via technology (Smith and Vanecek, 1990). Within virtual teams, members communicate with one another in a way that sometimes it can be hard to explain an idea to some of the participants or to advocate the reason behind certain decision. According to Alavi and Tiwana (2002) failure to share and remember certain information in virtual team environments may lead to misunderstandings or misinterpretation of a distant team member's behavior. For instance, being late in responding to e-mail because of an equipment issues, trip, or a local holiday may be related to disinterest, laziness, or disagreement. Electronic communication has multiple pros and cons that are described as "process gains and losses" (Nunamaker et al., 1991). PMBOK (2004) emphasizes the importance of communication planning and it involves determining the communication and information needs as follows: (1) Who needs what information? (2) When will they need it? (3) How it will be

given to them and by whom? According to Bjørn and Ngwenyama (2009) the lack of regular meetings for social or work related activities inhibits the development of a shared meaning context and makes the risk of communication breakdowns bigger.

4. ADAPTIVE STRUCTURATION THEORY IN VIRTUAL TEAMS

DeSanctis et al. (2000) stated that more geographically dispersed administrative teams were more likely to use advanced communication technologies than more geographically closer teams. The more team members' view advanced technologies as capable of reducing coordination related issues and improving the teams work, they are more likely to adopt it.

Adaptive structuration theory (AST) describes a method which is related to the relationship between advanced information technologies usage, social structures, and human interaction. In the heart of this theory is the usage of technology and its application by the employees in sense of reaching maximum performance. It is grounded on structuration theory introduced by Giddens (1984), which takes into account the structure of relationships and their dynamics in order to depict a full understanding of social interactions required.

According to this theory, adaptation of advanced technology structures by organizational actors is a fundamental element in organizational change (DeSanctis & Poole, 1994). Adaptive structuration theory emphasizes that team member make their decisions about engagement in virtual formations on the grounds of an abundance of factors including groups' structure, duties, and the frequency of interaction (Kirkman & Mathieu, 2005). AST, in the context of a group support system, depicts a process within which a group decision support system (GDSS) offers a collection of features to a group, but essentially it is the process through which the team goes as it uses those them for its own purpose that matters (Han et al., 2011).Technological adaptation happens when people learn how to use the technology and the tools available in order to find ways of reaching their communication goals despite technological boundaries like restricted bandwidth and lack of turn yielding cues, while on the other hand work adaptation occurs when people adapt technology to their own way of usage (Qureshi and Vogel, 2001). A key problem in the domain of social adaptation is the form of communication and norms of behavior which evolve within the virtual social environment and which of these is most suitable to the creation of technology supported learning systems (Alavi et al., 1997).

This theory is focused on social structures, rules and resources given by technologies and institutions as the foundation for human activity. These structures serve as starting point for planning and finishing tasks. The way people use technology helps them shape their decision making process.

5. CONCLUSION

Managing globally dispersed team members can be very challenging for project managers, since there are many constrains, which can have a disrupting role in efficient task completion. Information – communication technologies facilitate communication and information flows among virtual team members. However, being able to effectively communicate and delegate tasks, while in the same time lacking face to face communication can be very hard, especially if managers lack in cultural knowledge on their team members. For that reasons, scientists have been developed theories and methodologies for adaptation of advanced technologies in order to ensure maximum performances and effective communication among business entities. One of these theories is described in the paper, it is about Adaptive structuration theory (AST), which is oriented towards technology and social adaptation with aim to facilitate process of communication among dispersed team members. Based on the literature review, authors found this theory as a suitable mechanism for effective communication and decision-making process in virtual environment.

Further research will be focused on the element of *agility* in virtual teams. *"For virtual teams, what does agility mean*?" is the question that the authors' future research will answer.

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AN APPROACH TO EVALUATING GOODNESS OF HEURISTIC SOLUTIONS IN MANUFACTURING CELL FORMATION

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Abstract: *Manufacturing cell formation is the initial and most important step in designing cellular manufacturing system. Through this step the similar parts are grouped into part families, the related machines are grouped into machine cells, and then the part families are assigned to the appropriate machine cells where they should be produced. The focus of this paper is on performance measures suitable for evaluation and comparison cell formation solutions. The particular group of these measures that can be used for evaluating the goodness of heuristic solutions in binary form is discussed. Further, within the case study, the measures are used to compare solutions obtained by GRASP, GAVNS and CFOPT methods. The results show that solution obtained by CFOPT method has the best performance according to grouping efficacy, grouping efficiency, weighted grouping efficacy, grouping index and weighted modified grouping efficacy. Additional valuable advantage of CFOPT is its velocity i.e. minimal CPU time for finding solution.*

Keywords*: cell formation problem, quantitative measures, measures of grouping efficiency, comparative analysis, methods.*

1. INTRODUCTION

Cellular manufacturing can be viewed as a promising operations management practice, a good lean manufacturing approach, an enabler of just-in-time (JIT) manufacturing, a prerequisite for computer integrated manufacturing (CIM) and a strategy for organizing work in order to shorten market response times and minimize inventories and costs (e.g. Hyer & Wemmerlov, 2001; Shah & Ward, 2003; Abdulmalek & Rajgopal, 2007; Ilić, 2014). Cellular manufacturing have been applied in many manufacturing firms within the mechanical, electronics, automotive and other discrete-part manufacturing sectors (e.g. Hyer & Wemmerlov, 2001; Diaz et al., 2012). The first foremost and complex issue in designing cellular manufacturing system is the problem of cell formation. The cell formation problem (CFP) considers grouping the part types into part families and the machines into machine cells, and further assigning the part families to the appropriate machine cells where they should be produced (Paydar et al., 2011; Ilić & Cvetić, 2014; Danilović & Ilić, 2016). The formation of machine cells will foster continual performance improvements by closely locating machines and assigned operators required for processing the part families (Hyer & Wemmerlov, 2001). The main objective is to achieve the minimum of inter-cell and intra-cell movements of parts during the manufacturing process.

Numerous approaches have been developed for solving CFP. These are various clustering methods, similarity coefficient based approaches, mathematical programming, graph theory based approaches and different meta-heuristics such as genetic algorithms, simulated annealing, TABU search and neural networks algorithms (e.g. Ilić & Jovanović, 2008; Paydar & Saidi-Mehrabad, 2013; Danilović & Ilić, 2016; Aalaei & Davoudpour, 2017; Bychkov et al., 2017). The cells have been formed on the basis of different established objectives and constraints (Imran et al., 2017). During the process of solving the same problem, especially one large-scale, by several methods, usually more solutions can be found. The tough issues of how to evaluate the goodness of final solutions and how to conclude which method gives better solutions were always important. To give answers on these questions the different performance measures have been developed and used. In this paper, the CFP is formulated as a block diagonalization problem. The focus will be on using performance measures suitable for comparison solutions obtained by three methods GRASP heuristic (Diaz et al., 2012), the hybrid genetic-variable neighborhood search algorithm GAVNS (Paydar & Saidi-Mehrabad, 2013) and the CFOPT method (Danilović, 2017).

The following definitions and notations will be used in the paper.

Definitions:
Binary machine-part matrix: A matrix that shows which machines are used to produce each part by an entry which can takes value of [0,1].

Block: A sub-matrix of the binary machine-part matrix formed by the intersection of rows representing a machine cell and columns representing a part family (Sarker, 2001).
Block-diagonal space (sparsity): The total number of elements (both 1s and 0s) inside the diagonal blocks of the final machine-part matrix.
Void: A zero (0s) element appearing inside the diagonal block.
Exception: An operation (1s) appearing outside the diagonal blocks.

Notations:
m - the number of machines;
n - the number of parts;
C - the number of cells;
o - the total number of operations (1s) in machine-part matrix;
v - the total number of zeros (0s) in machine-part matrix, $v = m \cdot n - o$;
e_1 - the total number of operations (1s) inside the diagonal blocks;
e_v - the total number of voids;
B - block diagonal space ($B = e_1 + e_2$);
e_e - the total number of exceptions.

The reminder of the paper is organized as follows. In the next section, the measures of grouping efficiency for evaluating the goodness of cell formation solution are presented. Through a comparative case study, these measures are used for comparison solutions obtained by three algorithms GRASP, GAVNS and CFOPT in the third section. Further, discussion of study results and their limitations are presented. In the final section, conclusions and directions for future research are given.

2. MEASURES OF GROUPING EFFICIENCY

The different quantitative measures were developed and used for evaluating the results obtained from grouping the parts into part families and the machines into machine cells. Those related to grouping efficiency are often used for evaluating the goodness of the cell formation solution. These measures are suitable only for binary data arranged in form of machine-part matrix; i.e. the binary machine-part matrix that shows which machines are used to produce each part (Ilić and Cvetić, 2014). The mathematical properties of these measures are: non-negativity and range between [0,1]. Non-negativity means that all the elements of observed measure are positive. The other property is related to extremes: (1) the value of observed measure is 0 when all operations are outside the diagonal blocks; and (2) the value of measure is 1 in case of perfect block diagonal form i.e. all operations inside the diagonal blocks and all voids outside the diagonal blocks. Additionally, the measure should give the appropriate importance to the voids inside the diagonal blocks and exceptions.

Here, several well-known grouping efficiency measures are presented and further used to evaluate solutions obtained by three methods. These are:

- the grouping efficiency;
- the grouping efficacy;
- the weighted grouping efficacy;
- the grouping index; and
- the weighted modified grouping efficacy.

The grouping efficiency (E) is the first proposed quantitative measure for evaluating the goodness of the cell formation solution. The merit for development of this measure belongs to Chandrasekharan and Rajagopalan (1986). The grouping efficiency takes into account the voids inside the diagonal blocks and exceptional elements outside the diagonal blocks. It is defined as:

$$E = q \cdot \eta_1 + (1 - q) \cdot \eta_2, \tag{1}$$

$$\eta_1 = \frac{e_1}{e_1 + e_v},$$

$$\eta_2 = \frac{v - e_v}{(v - e_v) + (o - e_1)},$$

where,

η_1 - is the ratio of the number of operations inside the diagonal blocks to the total number of elements in the diagonal blocks;
η_2 - is the ratio of the number of voids outside the diagonal blocks to the total number of elements outside the diagonal blocks; and
q - is a weighting factor ($0 \le q \le 1$), which can give the same importance to the both functions (in that case $q = 0.5$).

Comments on *E*: The *E* measure is still used very often, although it has a low discriminating power (e.g. Yin and Yasuda, 2005; Keeling et al., 2007). Usually, the value of *E* is high, and even for solution with a large number of exceptional elements *E* can go from about 0.75 to 1. Further, the selection of right value for a weighting factor is difficult. For high-dimensional problems, the lower value of weighting factor has been recommended in order to give greater importance to the second ratio (Sarker, 2001).

The grouping efficacy (Γ) is another measure proposed by Kumar and Chandrasekharan in 1990. The Γ considers the voids inside the diagonal blocks and exceptional elements as equally important. This measure is defined as:

$$\Gamma = \frac{1-\psi}{1+\varphi}, \tag{2}$$

$$\psi = \frac{e_e}{o},$$

$$\varphi = \frac{e_v}{o},$$

where,
ψ - is the ratio of the number of exceptional elements outside the diagonal blocks to the total number of operations in the final machine-part matrix;
φ - is the ratio of the number of voids inside the diagonal blocks to the total number of operations in the final machine-part matrix.

Therefore, the Γ can be expressed as

$$\Gamma = \frac{o - e_e}{o + e_v}. \tag{3}$$

Comments on Γ: The Γ measure is one of the most used measures (Keeling et al., 2007; Bychkov and Batsyn, 2018; Pinheiro et al., 2018), which has overcome the lower discriminating power of *E*. The application of Γ is independent of the process of assigning weights to the voids and the exceptional elements. This measure is more sensitive to changes in the number of voids inside the diagonal blocks, than to changes in the number of exceptional elements (Nair and Narendran, 1996; Sarker, 2001).

The weighted grouping efficacy (*W*) is proposed by Ng in 1993. This measure uses a weighting factor (q, where $0 < q \le 1$) in order to associate weight q with each element inside the diagonal blocks and a weight $(1-q)$ with each exceptional element outside the diagonal blocks. The derived formula for *W* is:

$$W = \frac{q \cdot (o - e_e)}{q \cdot (o + e_v - e_e) + (1-q) \cdot e_e}. \tag{4}$$

Comments on *W*: The *W* measure is tested on ten large-scale problems (dimension mxn, 100x200) (Ng, 1993). This measure implies choosing the suitable value for weight.

The grouping index (*I*) is a measure introduced by Nair and Narendran (1996). The *I* considers the block-diagonal space (*B*) in order to ensure equal weights to the voids and exceptional elements and to provide good discriminating power for problems of all sizes. This measure incorporates a correction factor (*A*) along with the block-diagonal space and the weighting factor. It is defined as:

$$I = \frac{B - q \cdot e_v + (1-q) \cdot (e_e - A)}{B + q \cdot e_v + (1-q) \cdot (e_e - A)}, \tag{5}$$

where A is a correction factor with values $A = 0$ for $e_e \leq B$, and $A = e_e - B$ for $e_e > B$.

Comments on I: The I tends to overcome some of the limitations of the E and Γ measures. This measure gives importance to the block-diagonal space which reasonably should reflect the goodness of the diagonal blocks. The user needs to determine the value of weighting factor by taking into account the size of the matrix.

The weighted modified grouping efficacy (M) is suggested by Al-Bashir et al. in 2018. This new efficiency measure can be expressed as:

$$M = \frac{1}{2}\left(\frac{e_1 + e_e - e_v}{e_1 + 2 \cdot e_e}\right) + \frac{1}{2}\left(\frac{e_1 - e_e + e_v}{e_1 + 2 \cdot e_e}\right), \text{ or simply } M = \frac{e_1}{e_1 + 2 \cdot e_e}. \tag{6}$$

Comments on M: The M measure is derived as a critique of the modified grouping efficacy measure proposed by Rajesh et al. in 2016. The authors of M claim that this measure can be used to evaluate all types of structure data and to logically compare solutions that have the same sum of voids and exceptional elements (Al-Bashir et al., 2018).

It is obvious that all measures of grouping efficiency are based on some assumptions and concept, and that their different definitions lead to different conclusions (Sarker, 2001). The common assumption for these measures is the use of binary machine-part matrix. In case that the other data are important, such as parts production volume, processing times of operations, setup times, or similar, these measures cannot be used. Several authors tried to compare the grouping efficiency measures and concluded that, in general, each measure is unique and have different perspective (Sarker, 2001). Additionally, the process of comparing these measures is difficult for implementation.

3. COMPARATIVE CASE STUDY AND RESULTS

The case study is focused on the cell formation problem of 37 machines and 53 parts introduced by McCormick, Schweitzer and White, in 1972. This problem can be viewed as a large-scale problem. The solutions of the problem are firstly found by applying three recently developed methods, and then the measures of grouping efficiency are determined. The aim is to make contributions in answering question of how to evaluate the goodness of the cell formation solution and how to compare different solutions.

Therefore, the solutions of the problem are found by applying the following three methods: GRASP heuristic (Diaz et al., 2012), the hybrid genetic-variable neighborhood search algorithm GAVNS (Paydar and Saidi-Mehrabad, 2013) and the algorithm CFOPT (Danilović, 2017). The new algorithm CFOPT was coded in C# and implemented on a laptop computer with Intel Core 2 Duo CPU T6600, 2.2 GHz, and 6 GB of installed memory, running Microsoft Windows 7. The GRASP, GAVNS and CFOPT methods are suitable for comparison because all the three have the same objective function i.e. they strive to maximize the grouping efficacy Γ (Kumar and Chandrasekharan, 1990). The relevant computational results obtained by these methods are presented in table 1. The data related to the Γ measure and the CPU time shows that the CFOPT algorithm gives better CFP solution of instance by McCormick, Schweitzer and White (1972), than algorithms GRASP and GAVNS. Of course, the best results regarding CPU time obtained by GRASP and GAVNS are taken for requirements of this comparison.

The derived conclusion about algorithm which gives the better CFP solution is further considered (table 2). The solution found by CFOPT has the minimal number of voids inside the diagonal blocks (e_v) and the minimal number of exceptions outside the diagonal blocks (e_e). The GAVNS also scored the minimal number of exceptional elements. The other measures of grouping efficiency, besides Γ, are calculated and presented in table 2. These are: E, W, I and M. According to all these measures the solution obtained by CFOPT is better than solutions found by GRASP and GAVNS. That was expected results in accordance with determined values of voids and exceptions for this case. The calculation of E, W and I was done for different values of the weighting factor q, because of some earlier discussion related to the selection of right value for q. On the other side, the measure M is insensitive to the weighting factor since it is not weighted measure.

Table 1: Computational results obtained by GRASP, GAVNS and CFOPT

GRASP	
C	2
Γ	0.59854
CPU time	00:03:45.23
Machines	12111212112122212222212112112121222211
Parts	22222222222222222222222211111111111111112222212211222
GAVNS	
C	3
Γ	0.60573
CPU time	00:04:05.68
Machines	13113212112322212222212112113121232333
Parts	22222222222222222222222211111111111111112222212211222
CFOPT	
C	3
Γ	0.61315
CPU time	00:00:00.22
Machines	23223321221311131111121231223212131333
Parts	11111111111111111111111112222222222222221111121122111

Table 2: Performance measures of CFP solutions

Measures		**GRASP**	**GAVNS**	**CFOPT**
o		977	977	977
v		984	984	984
e_1		647	653	653
e_v		104	101	88
e_e		330	324	324
B		751	754	741
E	$q = 0.3$	0.76755	0.77191	0.77847
	$q = 0.5$	0.79440	0.79881	0.80783
	$q = 0.8$	0.83467	0.83915	0.85188
W	$q = 0.3$	0.42538	0.43245	0.43621
	$q = 0.5$	0.59852	0.60575	0.61315
	$q = 0.8$	0.77624	0.78204	0.79440
I	$q = 0.3$	0.93841	0.94007	0.94689
	$q = 0.5$	0.89256	0.89550	0.90707
	$q = 0.8$	0.81515	0.82036	0.83931
M		0.49503	0.50192	0.50192

This case study is limited to only one instance. It was shown how several measures of grouping efficiency can be used for comparative analysis of solutions obtained by three different methods.

4. DISCUSSION

Many different methods are available for solving the cell formation problems that are NP-hard by nature. The efficient implementation of these methods reasonably requires their coding in some programming language. When the complex cell formation problem is solved by different methods more solutions can be found. The next issue becomes how to appropriate assess and quantify the goodness of obtained solutions. Therefore, some researchers ventured into the challenge of defining, testing and using performance measures to evaluate the CFP solutions. The particular case, otherwise very common in research practice, is using input binary data in the form of machine-part matrix, and accordingly, the relevant measures of grouping efficiency. These measures try to find the right balance between the importance of voids in the diagonal blocks and exceptional elements outside these blocks.

In this paper, several well-known measures of grouping efficiency are presented and further used to compare solutions found by three recently developed methods GRASP, GAVNS and CFOPT. These measures are: the grouping efficiency, the grouping efficacy, the weighted grouping efficacy, the grouping index and the weighted modified grouping efficacy. The definitions of these measures are accompanied with useful comments. The case study is carried out to examine the solutions obtained by GRASP, GAVNS and CFOPT with the help of grouping efficiency measures. The comparative advantage of CFOPT is confirmed by all these measures in this case. Moreover, regarding the required CPU time for reaching the solution, the algorithm CFOPT, which was coded in C#, was faster than GRASP and GAVNS. The results of the presented case study are interesting, although only one large-scale instance was considered. In future work, it will be valuable to repeat the same comparative procedures on a set of referent instances from literature in order to generalize the conclusions obtained through this case study. The conclusions can also be expanded for more relevant measures.

5. CONCLUSION

This paper presents the measures of grouping efficiency that can be used to evaluate the quality of cell formation solutions. These measures are based on some assumptions and mostly have different perspective. Therefore, the conclusions about the quality of CFP solutions should be based on using several measures, although the goodness of some solution can be anticipated through the number of voids and exceptional elements. The presented comparative case study was focused on one large-size cell formation problem. This study showed the advantages of using the CFOPT method for solving the cell formation problems over other two methods GRASP and GAVNS. The solution obtained by CFOPT method has the best performance according to grouping efficacy, grouping efficiency, weighted grouping efficacy, grouping index and weighted modified grouping efficacy. Also, the process of finding solution by CFOPT required a minimal CPU time. In future, the following directions can be interesting: (1) A comparative analysis between methods for solving the cell formation problems can be expanded by more performance measures; (2) The comparative analysis between methods GRASP, GAVNS and CFOPT can be conducted on a wider set of referent instances; (3) The CFOPT algorithm can be modified in direction to include various performance measures; and (4) The experimental analysis regarding the measures of grouping efficiency can be performed.

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APPLICATION OF TYPIZATION AND STANDARDIZATION IN ACOMPANY FOR THE PRODUCTION OF PANEL FURNITURE

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Abstract: *Modern business conditions impose conflicting goals to production companies, as well as companies which do production of corpus furniture made of wood-based panels. On the one hand, customers and the market require the production of products by order and quick delivery, and on the other hand, the companies strive to lower the production price of the products. In order to adequately respond to these requirements, production companies choose to apply the typization of the products as well as the standardization of the components of the products. Their application aims to provide a simple, highly productive and economical production of a wide range of products. In this paper, a model of typization and standardization of a production assortment was presented, using the example of a company for production of corpus furniture made of wood-based panels. In addition, the way of designing new products using standardized elements and organizational measures necessary for the process of typization and standardization are presented in this paper.*

Keywords*: furniture production, typization of product assortment, standardization of product's component elements, organizational measures, bar code.*

1. INTRODUCTION

A wide range of products and frequent changes in the assortment are requirements that are imposed on every company for furniture production. A saturated market and a large number of companies that have similar products are the main reasons behind the frequent changes in the assortment. According to the changing trends and demands of the market, companies are changing the design of their products to attract customers. Contrary to the requirements of the market, companies need to reduce production costs and simplify manufacturing process to produce a small number of different products which include a large number of common constituent elements. The answer to these opposing requirements, besides the use of automated machines that have a high degree of flexibility and high capacity, is also thetypization and standardization of the production assortment.

The aim of typization and standardization of structural elements of a product is to reduce the number of different products of the same type that have approximately same measures and then reduce the component elements from the same group to the same dimensions. This enables the reduction of the number of different structural elements. This enables significant salvage in production time, increase of productivity, increase of the percentage of material exploitation and standardization of tools. This provides better business results.

The process of designing new products is one of the key processes in every company. Only a products that satisfies the demand of the customers and at the same time is different from other products, will be accepted by them. The design of new products, which satisfy the requirements of the customers and the production process, is significantly easier if company has defined product assortment, implemented typization of products and applied standardization of the structural elements. In this case, designers have defined structural elements of the product, which facilitate the process of designing the new product.

The assignment of the designers is to design products which hare consisted of a large number of elements that are standardized components in other products from their production assortment. The new product should be designed with a different stacking of these standardized elements. Frequent changes in the decor of the component elements, different way of stacking component elements in a product and using different types of hardware, the company provides wide range of product assortment.

In this paper, the model of typization and standardization of the production assortment in the chosen company is shown, the model for creating new products that are standardized, and the influence of the typization and standardization of the product assortment.

The study presented in this paper was done by the method of field research in the selected company which is currently one of the largest companies for production of wood-based panel furniture in Serbia. This company which applies typization and standardization in their production become one of the leaders in this field in Serbia.

The paper consists of three chapters. After the introduction, the second chapter presents the significance of stylization and standardization of structural components in this production company. The third chapter of this paper explains the results of the research and the model for typization of products and standardization of component elements. The last chapter consists of the conclusions of the study.

2. TYPIZATION AND STANDARDIZATION

The production is a process of transforming sets of input elements into the set of output elements (products) through the production process, with the aim of creating useful values (Lečić-Cvetković, 2015).

Today, many countries have recognized design as a priority direction for the development of education and economy, seeing in it the quintessence of innovation and an opportunity to modernize European economy. However, it should be noted that modern furniture is not only fruit of the work of individual architects and artists. Creating an attractive, functional, ergonomic and safe piece of furniture requires an effort of many people working in interdisciplinary teams (Smardzewski, 2015).

The main goal and motive for introducing flexible production in the furniture industry is to organize the production process with smaller number of different components and to offer an unlimited number of products to the market, according to its requirements, using various combinations of a limited number of components elements (Šuletić, 2012).

The purpose of creating groups of details lies in the fact that through the mass production, reduce of preparatory and finishing time for piece, that increasing the flexibility of the production system (Vukićević, 2011).

The fast change in assortment in individual and serial production influenced the introduction of flexible automation. Flexible technology systems enable the processing of different types of products that belonging same family of products (Figurić, 1989).

Today, a wide and variable production program imposed by the customer and the market and achieve a flexible production. Flexible technological systems have a major role in the realization of such a concept. In these systems, inventories of materials and incomplete production are less (Grladinović, 1999).

Modular design enables simultaneous achievement of a great variety of products and a small variety of components. The basic idea is to develop basic components of products that can be assembled into a large number of different products. Customers can then seems that there are a number of different products, and the production has a limited number of components (Schroder, 1993).

From the aspect of the manufacturer is important that the desired design, composition and properties of the products can be realized in production, and that such production has an economic adequacy, allowing sufficient productivity and economy (Omerbegović-Bijelović, 2006). Every increase of the capacity of existing technical instrumentality leads to an increase in production volume, respectively to the increase of productivity (Glavonjić, 2010).

An important question for a large company with multiple product development projects is how standard or varied the sets of activities it uses to conceive, design, and commercialize products should be across the organization (Rupani, 2011).

Small differences between products from the same group, such as small differences in the dimensions of component elements of products, significantly slowdown the production process, reduce productivity, require larger storage space for basic materials and larger storage space for finished products. They require a large number of documents reduce production flexibility and range of product assortment.

These problems can be solved by reducing the number of different component elements from the same group of products to a smaller number of different component elements, which will be used in the product of the same type and other products can be the solution for this problem. Reduction of the number of different

component elements can be done by application of typization of products and standardization of component elements.

Product standardization is a process of setting generally uniform characteristics for a particular goods or service. Product standardization among the goods provided by different businesses operating in technology-based industries can be useful for consumers since it permits competition among the various suppliers (Product standardization, 2018).

Typization of products is a process of reducing the number of types of products in product assortment. The wide product assortment in furniture industry and a consequence of that imposes the need for reduction of the number of products to the most typical representatives. In addition, products with small differences must be omitted, and thus provide the opportunity for more rational production in larger quantities of the same types of products. The product typization entails the typization of technological procedures, production equipment, tools and devices, working documentation, etc. (Nešić, 1983).

The process of standardization has a similar purpose as the process of typization, i.e. to reduce assortment and increase the quantity of the same products. Unlike typization, which is mainly related to the whole product, standardization is related to the component elements of products, details, compositions and components (Nešić, 1983).

All products included in the product assortment belong to a particular group and type of product. Within one group, almost all products consist of the same common component elements. For example, wardrobes have elements: sides, floor, ceiling, backs, doors and shelves. Chairs are composed of: seats, legs and backrests. Between the elements of one type or group of products there are many small differences, which are primarily seen in the dimensions, which influence to the optimization of the production process.

Standardization aims to increase the number of identical parts of products that can be jointly and simultaneously produced, and later used at different times and in different products. In this way, a large number of different products can be produced from the same sets of component elements (Nešić, 1983).

As standards reduce the variety of practices, they harmonize operations, an effect which also contributes to cost reductions and greater economic efficiency (Clarke, 2005).

The creation of robust processes is a key driving force behind standardization, as it warrants quality consistency of products. Through standardization, production processes are stabilized and become more robust, thus ensuring constant output and constant quality (Clarke, 2005).

3. IMPLEMENTATION OFTYPIZATION AND STANDARDIZATION IN COMPANY FOR PRODUCTION OF PANEL FURNITURE

Company where the study was conduct has a wide range of product assortment. All products in this company are made of wood-based panels. Looking at the diversity of product assortment, it can be noticed that this company makes furniture for different usages. This company produces furniture for storage, including wardrobes, shelf and drawers. The company also produces kitchen furniture, and furniture for resting.

As for a variety of the offer of their product assortment, each of the mentioned types of furniture has a large number of collections that have some different characteristics. In order to recognize the significance of typization and standardization of component elements, for the purpose of this paper, furniture for storage and wardrobes were selected as representatives of this assortment. According to these products, the model of typization and standardization of products was shown as well as the effects of typization and standardization.

Figure 1 shows wardrobes from four collections that can be found in the offer of this company. Differences between these four wardrobes are in the external appearance, dimensions, constructive solutions and technological process, which is different for some segments.

Figure 1: a) Colection1 b) Collection 2 c) Collection 3 d) Collection 4 (Company Data, 2018)

Wardrobes which were the examples of standardization of product assortment are shown in Figure 1. Wardrobes from other collections are different by the number of technological operations during their production, decors which were used and the way of combining the component elements.

Figure 2 shows the appearance of the wardrobe with dimensions of belonging to the first collection in Figure 1.

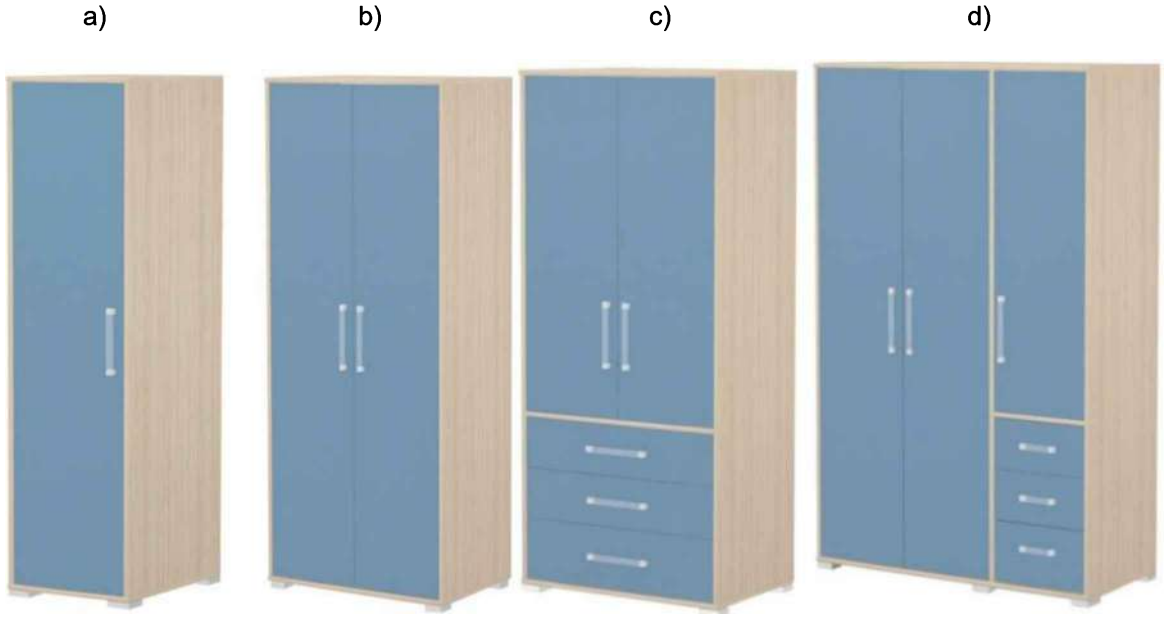

Figure 2: a) Wardrobe *G1*44X189x56 b) Wardrobe *G2* 84X198X56 c) Wardrobe *G23* 84X198X56d) Wardrobe *G33* 126X198X56 (Company Data, 2018)

Figure 3 shows component elements that belonging of collection shown in Figure 2.From Figure 3, it can be seen that a total of sixteen different elements are included in these four wardrobes. The first group of elements make the sides, all wardrobe from this collection have the same side. The other group makes the elements of floor and ceiling. Three different elements belong to this group; their diversity is conditioned by the different width of the wardrobe. The third group consists of shelf elements. Different width of the wardrobes and different constructive role of the shelves condition four different elements in this group.

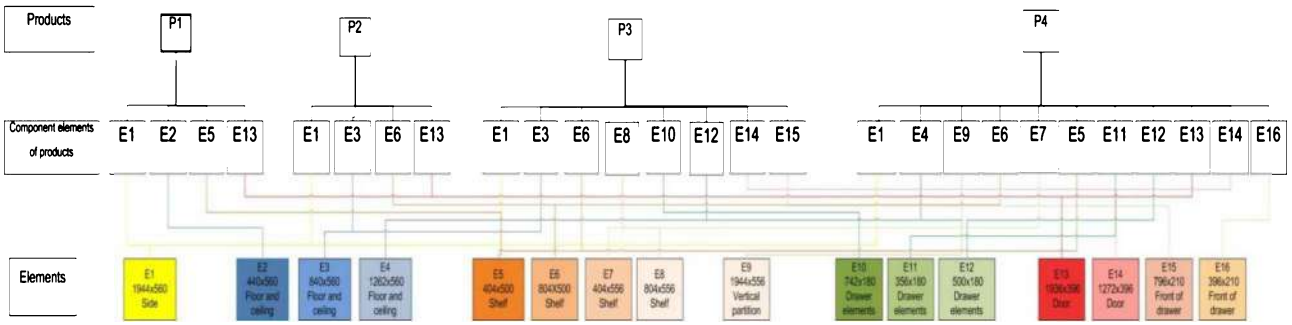

Figure 3: Component elements of wardrobes from Collection 1 (Kalem, 2018)

The fourth group of elements consists of vertical partition. Since only one wardrobe has a vertical partition, there is only one element in this group. The fifth group of elements consists of the drawer elements. As the depth and height of the drawers is the same for all wardrobes, but width is different, this group has three different elements. The sixth group of elements consists of elements of the fronts. This group contains two types of doors; the doors are different in height, while the width is the same. In addition, to two different door elements, this group also has two different elements for the drawer fronts. Due to the width difference, there is a need for different widths of the drawers, while the height for all the fronts of drawers is the same.

The model of typization and standardization of component elements in this company was a two-step process.

The first step was to determine the overall dimensions of a product from one collection. Based on the established dimensions a structural component of the product was created. After a structural component of the product was being made, the number of common components for the products was determined before the typization. After determining the number of common assembly elements, the product was typified.

Typization implies reducing the products to having approximate dimensions to one common dimension. When adopting new dimensions, attention was paid to the products that are in the same group to have dimensions which differ for no more than 10%. In the first step, a formula (1) was used for typization of products. After obtaining a new value, it is necessary to determine in what percentage the new dimension differs from other dimensions from that group. To check this, it is necessary to determine the mean deviation (2), and then the percentage difference in dimensions (3).

Example: Typization of products range

$$Xs=\frac{X1+X2+..+Xn}{n} \tag{1}$$

$$\Delta = \sqrt{\frac{(X1-Xs)^2+(X2-Xs)^2+..+(Xn-Xs)^2}{n}} \tag{2}$$

$$V1=\frac{\Delta}{Xs} * 100\ (\%) \tag{3}$$

After finishing the typization, oversized product dimensions are changed, which requires the adoption of new overall dimensions for all products that are included in the formula. As the change in the overall dimensions of the product causes a change in the dimensions of the component elements, it is also necessary to make a structural component of the elements after typization. After designing the structural component of the product after typization, the number of common components is determined. Adoption of these new dimensions of the products leads to an increase in the number of common component elements. The typization in this company made it possible for the overall dimensions of the products to be the same for all products.

After finishing the typization of products, which reduced products of various dimensions to the products of the same overall dimensions and increased the number of common component elements, it is necessary to do the standardization of component elements.

Different construction of the products and a different number of component elements that make up the product cause the typization of the products is not sufficient enough to increase the number of common component elements to a satisfactory percentage. For this reason, it is necessary to standardize the components of the product.

Based on these new dimensions, component elements are compared to the dimensions of component elements from the same group for several different products. The groups are formed according to the constructive role. With the wardrobes, which were the subject of the study, the first group is consisted of side elements; the second group of floor and ceiling elements, the third group of vertical partitions, a fourth group of drawer elements, the fifth group make up elements of the front and this group has two subgroups.

Based on the established differences in dimensions for the same constituent elements, the standardization of component elements is done.

On the example of the side dimensions of all wardrobes from one collection, a model of standardization will be presented.

Example: Standardization of products component elements

Step 1.

Sides of wardrobe have dimension:
Wardrobe 1: 189 x 54 cm;
Wardrobe 2: 195 x 57 cm;
Wardrobe 3: 194 x 56 cm;
Wardrobe 4: 198 x 55 cm.

Step 2.

The mean value for length and width of side panels is determined using formulae (4) and (5), respectively.

$$M_{len}=\frac{G1+G2+G3+G4}{4}=\frac{189+195+194\ 198}{4}=194{,}75\text{ cm}\approx 195\text{ cm} \quad (4)$$

$$M_{wid}=\frac{G1+G2+G3+G4}{4}=\frac{54+57+56+55}{4}=55{,}5\text{ cm}\approx 56\text{cm} \quad (5)$$

Since the plate elements are made of plates produced in standard dimensions and all elements always have the same thickness, standardization is not required for this measure.

After the elements are reduced to a common value, these elements are applied in the construction of products with the new adopted dimensions. When applying component elements with new values in the products, there is a change in the overall dimensions of the product.

From Figure 2 it can be seen that the dimensions of the wardrobes are standardized; all wardrobes have the same length and depth, while the width varies. In this collection, there are three different widths of wardrobe. The standardization of the component elements of a product from one collection made it possible that a small number of different components to be included in the composition of the products from this collection. For the products shown in Figure 2, the structural analysis of these products shows that the sixteen different elements shown in Figure 3 made up of four wardrobes from Figure 2.

Also, from Figure 2 it can be seen that the wardrobe has a significantly different appearance, which gives a wide range of products, and the production of component elements is simple, productive and economical. When the offer for a certain product, which is standardized, becomes enriched by a large number of decors of corpus and front elements, it provides the variety of product assortment and high flexibility.

When a new product is being designed belonging to the collection from Figure 2, the designer will use the component elements that are available for this collection, which are shown in Figure 3.

Since wood-based panel furniture belongs to the group of cheap furniture, companies want to be competitive with the prices of the product. They must ensure that the production is lean and productive utilization of a material in a high percentage, not less than 94%.With the fulfillment of these requirements, the costs of production become lower as well, allowing a lower selling price of the product. Standardization of component elements of a product has a great importance for shortening the time of production, increasing productivity, utilizing materials, and therefore the sales price of products.

Designers have a key role in product standardization in this company. When designing the products, they pay attention to the fact that the dimensions of the component elements are such that they correspond to the dimensions of the panels from which the component elements are cut. Increasing or reducing dimensions of the component elements, for only a few centimeters, can significantly contribute to increasing the utilization

of the panel from which the elements are cut. Since the difference of several centimeters in overall dimensions does not represent significant data to the customer, this measure significantly increases the utilization of materials.

Customers who want to buy furniture that fit their exact needs according to their dimensions do not buy furniture in companies engaged in serial production of furniture, but in companies for the project type of production. For this reason, product design is a key process for a wide range and optimal production process.

One of the important organizational measures taken by the company, which provides a wide range of product assortment and the flexibility of the assortment, is separate packaging of corpus elements from the front element. This measure ensures that the consumer can choose a certain decor of the corpus and certain decor of the front, and boxes with the ordered decors jointly arrive during delivery. The typization of product assortment and standardization of the component elements has enabled this way of packaging the products and their later delivery to the consumer.

When the component elements of a product are standardized, it is possible to replace an element without affecting other component elements or characteristics of the product. In this company, using standardization of component elements and subsequent separation of corpus elements from the front element, it is possible to always introduce new decors for corpus elements or front elements in the offer, which refreshes the products, the customer is introduced with the new product, and the production remains simple.

In case the elements of the corpus and the element of the front are packed in the same boxes to meet the requirements for the width of the assortment, it would be necessary to engage large funds. Packaging of corpus elements and front elements in the same box would require that each corpus décor in this collection (Oak, Nebraska, Dark Nebraska and White Décor) is packed with each of the front from this collection (White, Sand, Blue, Green and Pink). Combining all the corpus elements decors with front elements décor would require primarily large funds and then a large storage area where these products would be stored waiting for a demand for them.

A separate package of an element of the corpus from the front element requires significantly less money, because it is not necessary to create a large number of combinations of corpus and front decors, independently created and packed each decor in the planned amount for a certain period of time. This quantity is located in the product storage and no matter how the consumer will order a combination of front and corpus decor, these elements will be delivered, and on the other hand, the storage is much smaller and less money is spent.

Standardization of production assortment has enabled the production process to be productive and economical. Since edging and drilling of elements from a large board are basic operations, the standardization of the component elements saved and reduced preparatory time to a minimum using bar code technology. When the machine is set to process one element, regardless of which decor the element is made of, the machine does not need to be adjusted until the element is changed.

Typization of product assortments and standardization of components elements in this company, in addition to the mentioned possibilities, enabled simple production planning as well as quantity of products in the storage. Since the products of this company are standardized, whereby the corpus elements are packaged separately from the elements of the front part, production planning is based on the condition of one and other elements according to the decor for a particular product.

Based on the data about the condition of corpus elements and front elements of a certain decor of a particular product in the storage, and the data on the predicted demand for a particular decor in a certain period of time for a particular product, production planning is performed.

This way of planning based on data about the finished product in the storage, and information on the anticipated market demand for products enables numbers of benefits that are primarily related to financial assets of the company and prompt delivery of products to consumers. This makes it possible to have a sufficient amount of products in the storage of finished products at any moment and to deliver these products to the customer within three days, which is the shortest delivery time compared to competing companies.

4. CONCLUSION

The characteristics of the production of wood-based panel furniture, primarily the use of a smaller number of machines compared to furniture made of other materials, are relatively simple production process which usually consists of only three operations, cutting, edging and making connecting elements. The characteristics of the furniture itself and materials of which this furniture is produced indicate the fact that the production of this furniture is a suitable area for the application of the product typization and standardization of the component elements of the product.

Typization and standardization of product assortment is one of the key approaches in industrial production of corpus furniture made of wood-based panels. The benefits that typization of the product assortment and the standardization of the component elements of the product brought to the study of the company in which the research was carried out are numerous. Product typization and standardization of component elements has provided this company with a wide range of products and flexibility of assortments, which makes it easy to introduce new products into an assortment or to change the appearance of existing products.

Also, the production process has become highly productive and at the same time very flexible. The introduction of organizational measures, primarily a separate package of corpus elements from the element of the front, is another of the actions that brought a lot of advantages to this company with competing companies.

The subject of the future research it will be creation of the super bills of material (BOMs) for the production process from the study. Also, the results of this study will be compared with other similar studies.

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SAP APO APPLICATION IN THE PRODUCTION PROCESS FROM AUTOMOTIVE INDUSTRY

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***Abstract**: This paper presents the application of the SAP APO (Advanced Planner and Optimizer), as a part of the SAP ERP software, for management and planning of production processes in the automotive industry. SAP APO modules and application of PP/DS module, as a tool for production planning on strategic-tactical and operational levels, is presented. The aim of this paper is to present the practical application and support of SAP APO in production management and planning, tracking of customer orders and detailed scheduling on a real example of production process of wiper blades.*

***Keywords**: ERP, SAP APO, Production Process, Automotive Industry, Wiper Blade*

1. INTRODUCTION

ERP (Enterprise Resource Planning) is an integrated, consulate enterprise-wide information system that combines all necessary business functions like production planning, purchase, inventory control, sales, finance and human resource (Yazgan et al, 2009). According to these authors, the implementation of ERP software in a company is done for integration of customer orders, reduction of order preparation time and inventory level, standardization of production process and human resource information. This paper presents the application of the SAP APO as a part of the SAP ERP software, customized for the automotive industry. The main goal of using this software is to coordinate activities for planning and management of all processes within a supply chain with a constant focus on customer requirements.

Companies from the automotive industry have developed departments for the design, development, production, marketing, and sale of motor vehicles and their components. This industry presents one of the most important economic sectors of one country. All processes needed for the function of the company must be defined and planned in advance. Production management and production planning are some of these processes. Companies from the automotive industry use software solutions created according to their requirements, with an aim to provide a continuous production flow.

The paper is organized as follows. After the introduction, activities of the production process management and planning in the automotive industry are explained in the second chapter. In the third chapter are described SAP APO, its modules and the interoperability between ERP and APO systems. The practical application of SAP APO module PP/DS on example of production of wiper blades in the company from the automotive industry is presented in the fourth chapter. The fifth chapter presents the conclusion.

2. PRODUCTION PROCESS IN THE AUTOMOTIVE INDUSTRY

Production presents activities of transforming material elements and different types of energy into material products that satisfy social needs (Lečić-Cvetković & Atanasov, 2015). It considers transformation process of the inputs (materials, energy, and information) into outputs (products or services). In addition to its own size, the automotive industry generates more economic activity through various backward (to supplier industries) and forward linkages (to customers) (Heneric et al, 2005). Production in the automotive industry presents a complex process. There are many activities that precede the production process. This process depends on the customer orders and the ability of the supplier to deliver ordered quantity of raw materials.

The product observed in this paper is a wiper blade. In the windscreen wiper application, a wiper blade slides on a smooth glass surface in order to remove water and/or contaminations from the windshield (Bódai and Goda, 2014). According to these authors, wiper blades have an important role in traffic safety, because the too thick water film and the presence of contaminants hinder the view of a driver. In the company from the automotive industry analyzed in this paper, production planning, as a first phase of production management, is done according to the forecast of the customers. The goal of obtaining genuine forecasts of the industrial production index (*IPI*), makes it necessary to forecast the official quantities at least three months ahead

(Bruno & Lupi, 2004). Characterized as a push system, forecast-driven production is a highly efficient, but rigid system that utilizes historical data and projections to create a production plan and makes use of existing configurations to produce products for stock (Holweg and Pil, 2005). According to these authors, most companies from the automotive industry still rely on forecast-driven production and produce products to stock. The most important input for this kind of a system is the master production schedule created based on the forecast (Zhang & Chen, 2006).

According to the forecast, a department for production planning creates a production plan (what will be produced, when and in which quantity) and procurement plan (raw material and quantity that should be ordered). For every component used in a production, the company from the automotive industry has defined a supplier that produces and deliveries required components. The supplier has to satisfy the order of the company for defined components and to deliver exact quantity of the ordered material on a planned date. Successful company collaboration with customers and suppliers is necessary. SAP APO has the main role in coordinating information from the forecast to the production and suppliers, e.g. creation of the production plan and orders for defined materials to suppliers.

3. SOFTWARE FOR ADVANCED PLANNING AND OPTIMIZATION

There are various types of software for advanced planning and optimization. In this paper is presented the SAP APO (Advanced Planner and Optimizer) software. SAP APO presents one of the APS (Advanced Planning Systems) (Günther, 2005). This software presents a business IT-solution to supports the logistics planning along the global business network. It is an integrated computer system where the planning issues are organized into collaborative planning modules with given optimization models and solving algorithms. In the observed company the SAP APO is integrated with the SAP R/3 ERP system to form a business total solution. The integration is an exchange of data and an alignment of planning and execution processes (Dickersbach, 2005). Although new versions of SAP ERP software are available on the market, observed company still uses SAP R/3 solution because this version is completely customized according to company's business requirements. Additionally, investing in newer system versions is not economically acceptable for observed company. The performance of such a solution depends not only on the data processing efficiency, but also on the decision models (Leu & Huang, 2009). Since SAP ERP is the leading system and SAP APO is the planning system, "real" master data (from SAP ERP) can be used as master data and copied to other models/versions for simulations (such as SAP APO) (Stadtler et al, 2011). Because of this structure, SAP APO enables decision-making process.

The authors (Stadtler et al, 2011) define (from a technical perspective) SAP APO modules:
- Demand Planning (DP);
- Supply Network Planning (SNP);
- Production Planning/Detailed Scheduling (PP/DS);
- Transportation Planning/Vehicle Scheduling (TP/VS);
- Global Available-To-Promise (Global ATP).

In Table 1 are presented SAP APO modules and their basic functionalities.

Table 1: Modules of the SAP APO (adopted and modified from: Kallrath & Maindl, 2006; Stadtler et al, 2011)

Advanced planning and optimization			
Demand planning (DP)	Generates forecast planning figures that are fed into other planning modules.	Alert monitor	Warnings about an existing planning problem according to its configuration.
Supply network planning (SNP)	Coordinates strategic supply chain processes by creation of a suggestion for network design, cooperative supplier contracts, distribution structures, manufacturing programs, etc.		
Production planning and detailed scheduling (PP/DS)	Creates detailed, short-term production plans for individual production areas based on the results from master planning.		
Global available-to-promise (Global ATP)	Helps in order processing.		
Transportation planning and vehicle scheduling (TP/VS)	Determinates which quantities of items are transported via which routes in the supply chain at defined times.		

According to the (SAP Documentation, 2018), SAP APO provides a fully integrated range of functions for planning and executing processes. It supports the following:

- Intercompany interaction on a strategic, tactical, and operative planning level;
- Collaboration with logistic partners from order receipt through stock monitoring to product shipping;
- Maintenance of relationships with customers and business partners;
- Continuous optimization and measurement of the performance of the logistics network.

SAP APO is one of the leading systems that considers long-term (strategic), middle-term (tactical) and short-term (operational) planning. The planning tasks for procurement, production, distribution and sales can be solved under different planning scope and hierarchy. The different hierarchy levels are distinguished by their planning horizon and the typical level of planning details (Kallrath & Maindl, 2006). The architecture of the SAP APO is presented in Figure 1.

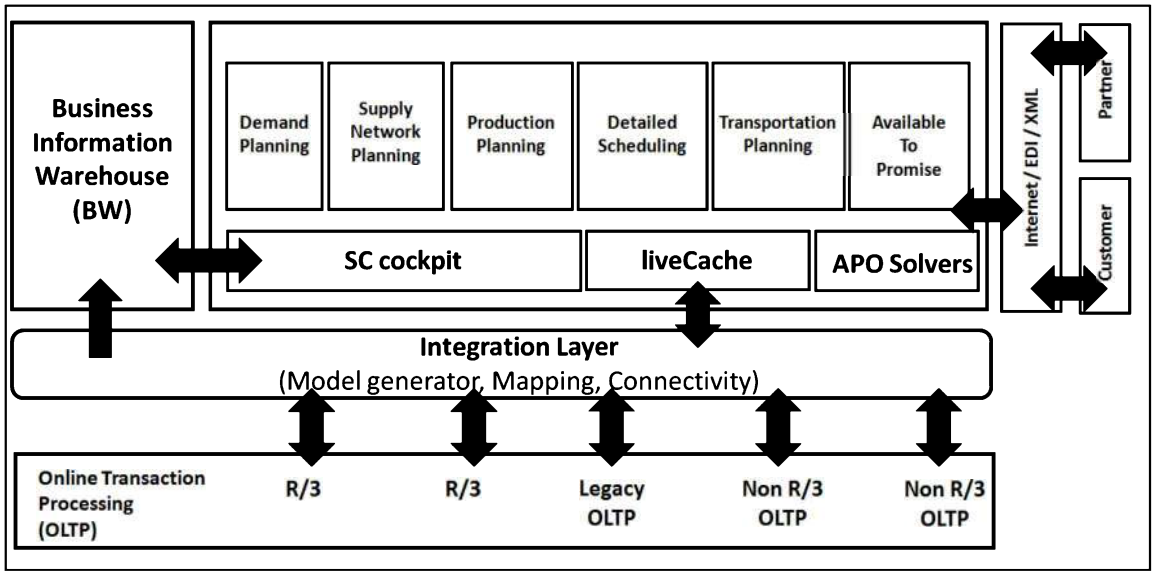

Figure 1: Architecture of the SAP APO (adopted and modified from Knolmayer et al., 2002)

4. APPLICATION OF SAP APO IN THE AUTOMOTIVE INDUSTRY

SAP APO in the automotive industry is created in order to fulfill specific requests of the company and its stakeholders. Since the automotive industry has high complexity in processes, implementation of the SAP APO in this industry can provide additional functionalities in order to fulfill specific requests.

In this paper is presented PP/DS module which can be used for following activities:

- Creation of production or procurement suggestion, in order to fulfill requests related to the final product;
- Optimization and planning of resources as well as detailed scheduling;
- Delivery planning;
- Forecasting of future demand.

Usage of SAP APO is enabled after the BOM (Bill of Materials) and material master views are created in SAP ERP. After settings in SAP ERP are available, products are visible in SAP APO. Purchasing documents are transmitted, but manipulation is done in SAP ERP. In SAP APO they are used as basic inputs.

In the observed company, strategic and tactical levels are considered as one planning horizon, since the forecasting period in PP/DS module is set to 21 months. According to that, the first area of PP/DS model application is strategic-tactical planning and the second is operational planning.

The product planning table for sales scheduling agreements (SDPT table), used for operational and strategic-tactical levels is shown in Figure 2. Sales scheduling agreement is purchasing document, made as long-term agreement between the customers and selling party (in observed company, production plant of wiper blades). SDPT table offers different views to facilitate the operative planning. With the selection of pre-defined views, a planer can choose input that will be presented in main view (customer orders, forecasted volumes or production orders). Also, time range (daily, weekly, monthly) can be defined. Interoperability between SAP APO and SAP ERP enables the usage of PP/DS module to access all information important for planning.

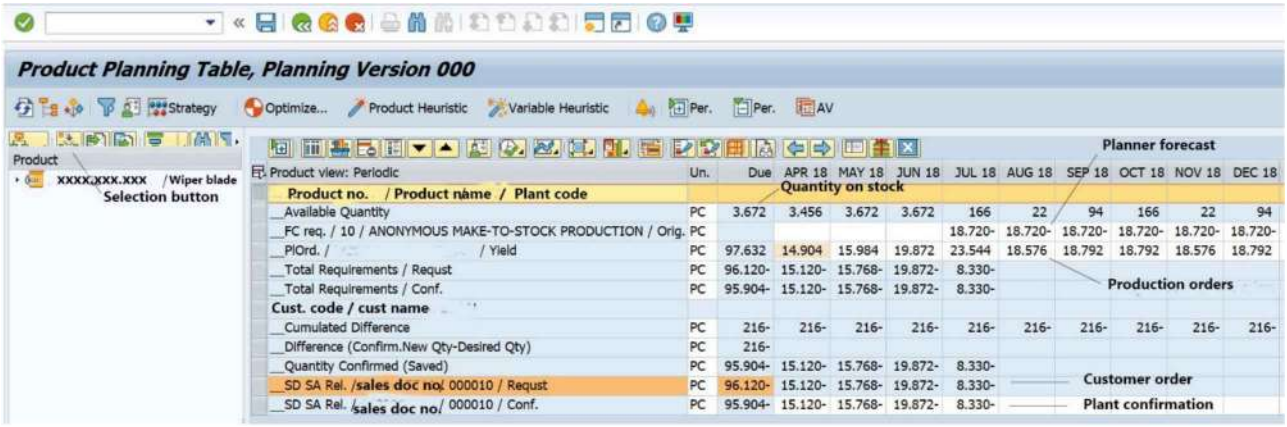

Figure 2: The product planning table for sales scheduling agreements (SDPT table) in SAP APO

4.1 Strategic-tactical planning in PP/DS module

In strategic-tactical planning, the PP/DS module is used to generate a long-term plan for the selected product group. As already mentioned, the time range in the observed company is 21 months on rolling horizon basis. The input data for the forecast are projected monthly sales quantities for various regions demand, provided by the marketing or sales department or based on actual customer orders. The output of forecasting process in PP/DS is production order. Depending on stock and production strategy, production orders can differ. Production strategy can be set as Make-to-Order (MTO) or Make-to-Stock (MTS).

The MTO strategy is used in production with a high variety of specific or expensive products. The main focus is on order and the performance measures. The most important performance measure is a delivery performance of demand fulfillment in terms of volume and date. The competitive priority is shorter delivery lead time. Main operational issues are capacity planning, order acceptance or rejection, and high due-date adherence (Soman et al, 2004). The MTS strategy is used in the production of a low variety of specific and less expensive products. The main focus is on anticipating the demand (forecast) and planning to meet the demand which has fill rate as a main priority. The main operational issues are inventory planning, lot size determination and demand forecasting (Soman et al, 2004). When production strategy is defined all necessary settings are done in SAP ERP and transmitted to SAP APO. In Table 2 is presented the comparison of a result of MTS and MTO strategy.

Table 2: MTO and MTS strategy comparison

		$Month_i$	$Month_{i+1}$	$Month_{i+2}$	$Month_{i+3}$	$Month_{i+4}$	$Month_{i+5}$	Total production order for observed period
MTO strategy	Forecast volume	100	100	100	100	0	100	
	Customer order	100	200	100	100	100	100	
	Production orders	100	200	100	100	100	100	**700**
MTS strategy	Forecast volume	100	100	100	100	0	100	
	Customer order	100	200	100	100	100	100	
	Production orders	200	300	200	200	100	200	**1200**

In Table 2 input data for strategy comparison is plant confirmation of customer order and forecast volume for the observed period of 6 months ($Month_i$ to $Month_{i+5}$). For both strategies are used following input data: the total sum of the customer orders is 700 units and forecasted volume is in total 500 units. According to the selected production strategy, production orders are defined. The basic logic used in MTO and MTS strategy in SAP APO is a comparison of customer orders and forecast volume within a time range defined in SAP ERP. In the case of MTS strategy, SAP APO sums customer orders and forecast volume. A time range for comparison is 0 days, because system transforms forecast and customer order into production orders, independently of each other. In the case of MTO strategy, SAP APO compares customer order and forecast volume within defined time range. In observed case, it is 15 days forward and 15 days backward from the day when forecast requirement is set. Due to simplification, all other time parameters are not activated. If customer order is higher than forecast volume, production order will be equal to customer order. If customer order is lower, production order will be equal to the forecast volume. MTO strategy results in production orders of 700 units while MTS strategy results with 1200 units.

In the observed automotive company, the forecast is done in SDPT table in PP/DS module. Planner adds forecasted figures in the system in specific part of SDPT table. MTS is used in cases when in production planning is included fulfillment of customer order and fulfillment of defined stock level. An example of MTS strategy is product for the secondary market of automotive components, known as automotive aftermarket. Under primary market is considered original equipment manufacturing (OEM). MTO is used when production and distribution are initiated by customer orders. Example of MTO strategy is products for the primary market of automotive components. Resulted production orders are used for identification and allocation of the capacity of machine and labor. The report in SAP APO shows future production quantities for mentioned 21 months and can be presented on a daily, weekly or monthly level. After observation and confirmation of capacities, these figures are decomposed within BOM level. Decomposition enables sending of forecasts for raw materials to the suppliers. According to transmitted data, suppliers can conduct capacity and feasibility analysis.

4.2 Operational planning in PP/DS module

The first part of operational planning refers to the usage of PP/DS for daily tracking of customer orders and dispatches. In SDPT table confirmation of customer order is done. After order confirmation (confirmed completely or partially, depending on production possibilities and raw material availability), information is transmitted to SAP ERP as input for the creation of the delivery documents. SAP APO offers easy detection of customer changes: with every new EDI (Electronic Data Interchange) from the customer, all changes in the order are marked with defined color, in order to easily track changes. Also, heuristics used in SAP APO ensure the fulfillment of the customer orders. According to customer order confirmation, production orders are created. One of the possibilities in SAP APO is automatic confirmation of customer orders which is enabled by choosing one of the pre-defined confirmation models. By choosing appropriate confirmation model, customer orders can be automatically confirmed only if their deviation is in a defined range. Also, orders can be divided according to existing production strategy (for example, if a customer sends monthly orders, but planning and orders towards suppliers are sent on a weekly level, they can be automatically divided). This reduces the manual effort needed for customer order processing in cases of a huge range of products.

The second part of operational planning refers to the usage of PP/DS for production planning and detailed scheduling. In the following six steps is described the general procedure leading from a model of the shop floor to a production schedule (Stadtler et al, 2015):

1. *Model building:* definition of shop floor model with described production processes and material flows;
2. *Extracting required data*: extractions of data from a subset of the data available in ERP system. Data regarding master and demand planning will be used in production planning and scheduling;
3. *Generating a set of assumptions (a scenario):* in addition to already existing data, production expert should integrate current and future situation and expectation in production scenario;
4. *Generating a production schedule:* production schedule will be automatically generated for a given scenario;
5. *Analysis of the production schedule and interactive modifications:* before making detail schedule, the proposed scenario should be evaluated and modified by production expert;
6. *Approval of a scenario:* once evaluated all available alternatives, the expert will choose the most promising production schedule relating to a scenario;
7. *Executing and updating the production schedule:* selected production schedule will be transferred to the MRP module - to explode the plan, to ERP system - to execute the plan and to transport planning module (if in use) - for transport organization.

Planning board for detailed scheduling, shown in Figure 3, presents the table for detailed scheduling as the main tool for production scheduling. In this table are displayed operations, orders and resources loads. Prerequisite for detail scheduling is setting of fixed horizon which will enable disturbance in scheduling and execution of the current plan. One of the PP/DS functionality allows access to one object by multiple users simultaneously. After saving, the latest saved production schedule becomes active (Dickersbach, 2005).

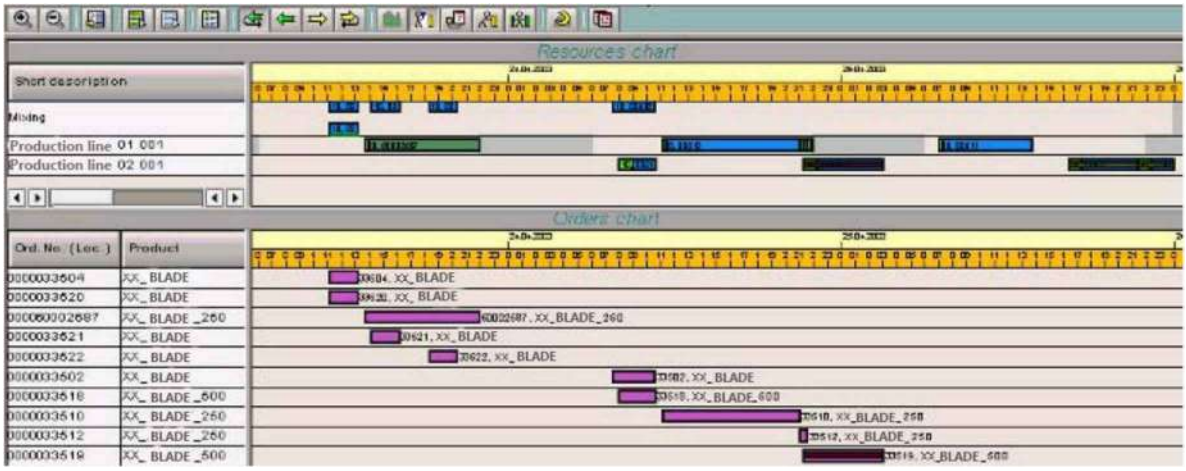

Figure 3: Planning board for detailed scheduling (adopted and modified from Dickersbach, 2005)

5. CONCLUSION

Implementation of the SAP APO is important for a company in order to provide planning and management of the entire production process. Interoperability with other modules within the SAP ERP allows tracking of all materials and problem detection at all levels in the process of adding value to the final product. SAP APO integrates with SAP ERP in a real time, thus all changes in one system are immediately transferred to another system (and reverse).

The SAP APO provides support in the planning department with the task to ensure the functioning of the company's processes. This module has various options for planning assistance (heuristics, macros, optimization models, etc.). The benefits of advanced planning and optimization software, such as APO, are reflected in the transparency of data important for decision support in production management and on the ability to apply complex planning and optimization technologies in order to create the better plan.

In this paper is presented the application of SAP APO for management and production planning process in a company from the automotive industry. PP/DS module is observed as a tool for production planning on strategic-tactical and operational levels. The aim was to present the application of SAP APO in production planning, tracking of customer orders and detailed scheduling on a real example of production process of wiper blades.

The application of SAP APO in the automotive industry has advantages and disadvantages. Some of the advantages of using this module are: easy tracking of deliveries per customer, simple detection of changes and the ability to respond on time. Significant is the ability to balance orders with automatic confirmation. This system gives planners ability to manage the production process. Disadvantages of planning with SAP APO are related to an inefficient overview of the order history. This overview requires manual operations and is only possible at the level of one product. The SAP APO also does not offer an acceptable solution for a more detailed study and analysis of customers and market behavior.

Beside wiper blades, observed company produces other components for the automotive industry. The first direction of further research of the authors of this paper would be implementation of the SAP APO in production planning process of the other components in observed company. The second direction of further research would be application of the SAP ERP in the activities of the operative production of wiper blades based on the production plans created in SAP APO.

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EXPLORING THE LIMITS OF LEAN IMPLEMENTATION IN ENGINEER-TO-ORDER ENVIRONMENT: CASE STUDY

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Abstract: *Lean has proved itself numerous times as a successful approach to productivity improvement. However, most of the evidence about success of lean comes from manufacturing environment close to the one lean originated in, i.e. stable and repetitive manufacturing. However, more empirical evidence is needed in order to analyze lean applicability in complex and dynamic environment, such as Engineer-To-Order (ETO) operations. This paper presents a case study of lean implementation in ETO company, and is aimed towards answering three questions: what lean in the context of ETO operations means, what are the limits of existing lean practices in ETO environment, and what are the challenges for lean implementation an such an environment.*

Keywords*: lean manufacturing, engineer-to-order, complexity and dynamism, case study*

1. INTRODUCTION

Since its inception, lean has become dominant manufacturing paradigm in the world, and is often considered as one of most important steps in the development of operations management (Thürer et al., 2017; Tomašević et al., 2016). Lean can be defined as a systematic effort aimed at reducing lead time by reducing non-value adding wastes (Ohno, 1988). Waste reduction is achieved through minimization of supplier, customer, and internal variability (Shah & Ward, 2007; Gong et al., 2009). Lean has helped many companies in the world to improve their efficiency. Although evidence of lean implementation success are abundant, most of them 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. stable and repeated manufacturing of limited array of similar products in relatively high volumes). Engineer-to-order (ETO) operations represent high-mix/low-volume environment that is highly uncertain (complex and dynamic), and is considered under-researched regarding lean implementation (Birkie et al., 2017; Hines et al., 2004). Lean might be interesting to ETO operations, having in mind that many ETO companies base their competitiveness on flexibility and short led times. Although lean strategies have been proposed in ETO sector, the extent to which lean practices are suitable for ETO operations has been questioned (Cooney, 2002). Many challenges stem from the fact that ETO environment differs significantly from the one typically found with low-mix/high-volume manufacturers. As a consequence, practitioners are often confused about what lean in the context of ETO operations means, as well as what are the limits and challenges in applying "traditional" lean concepts and practices. As a result, empirical evidence in support of or against lean implementation in ETO operations are fairly limited, and 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). In addition, it is recommended to move away from cookie-cutter based approach to lean implementation, and to take more contingency-based approach suitable for a specific manufacturing environment (Gosling & Naim, 2009; Naim & Gosling, 2011).

This paper analyzes lean implementation in a typical ETO company. The aim of this paper is twofold: to establish a model for lean implementation in dynamic and complex environment, and to analyze the case against this model in order to explore the limits of lean in ETO environment. The reminder of the paper is organized as follows: Section 2 presents literature review on lean in ETO environment; Section 3 presents research design; results and discussion are presented in Section 4; discussion and conclusion follow in Section 5.

2. LEAN IN ETO OPERATIONS

Lean was largely developed and applied under the leadership of Taiichi Ohno (1988). Waste reduction plays a central role in lean (Bhamu & Sangwan, 2014). Although waste is a common term in lean, it has often been taken for granted, and used in various ways. For the sake of this paper, waste is considered to be 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 (Thürer et al., 2017). Waste can be divided in two types: type I – obvious or big waste, that can be reduced without creating another form of waste (see e.g. Liker & Meier, 2006); and type II – buffer waste, consequence of variability and uncertainty that has to be buffered in some way, that cannot be reduced without reducing its source, i.e. variability (see e.g. Hopp & Spearman, 2008). Since certain amount of variability is inherent to any system, some form of buffer has to exist (inventory, capacity, or time, see e.g. Hopp & Spearman, 2008), and it is up to management to determine which type of buffer is most efficient in a given situation. Having this in mind, lean implementation can be summarized as follows (Thürer et al., 2017): (i) eliminate obvious waste (i.e. everything that does not add value to the customer, and has no rational reason for existing); (ii) reduce both internal and external variability (i.e. decrease the requirements for buffers, thus transforming buffers to obvious waste); and (iii) right-size and balance remaining buffers in order to improve flow and reduce buffering costs (i.e. swap expensive buffer such as inventory for a less expensive one such as capacity). In addition, Jayaram et al. (2010) state that Toyota solves its problems through continuous cycle of variability elimination (acknowledging that variations exist, detecting variations, eliminating the source of variation) and standardization (standardizing the solution for eliminating the source of variation).

Although lean is considered to be universally applicable to wide array of business environments (Womack & Jones, 1996), there are authors who criticize it for its lack of applicability in operations that differ significantly from low-mix/high-volume environment that lean was developed in, stressing tool-based implementation and car-manufacturing focus as its main weaknesses (Cusumano, 1994; Hines et al., 2004). ETO is manufacturing strategy where design, engineering, and production start only after a customer order has been received, and is typically characterized by a high variety of customized products produced in low volumes, and long lead times due to the additional elements such as engineering and procurement lead time (Powel & van der Stoel, 2016). However, short lead 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). This is why more and more ETO companies turn to lean as a way to increase their competitiveness. Still, evidence of using lean in ETO operations is scarce. Whyte & Prybutok (2001) claim that percent of non-repetitive systems with standard lean practices implemented (e.g. quality circles, TQM, Kanban, group technology, etc.) is relatively high. For example, around 60% of surveyed companies implemented Kanban, but what cannot be seen is how they implemented it, for what purpose, and what the outcomes of implementation were. Jina et al. (1997) state that cookie-cutter approach to lean implementation in ETO companies has to be avoided, and that lean implementation has to be tailored according to specificities of turbulent manufacturing systems. Some authors have taken contingency based approach by analyzing lean practices on a conceptual level, in order to determine the goal of a specific practice, and adapt the practice to specificities of non-repetitive manufacturing environment (see Djassemi, 2014; Horbal et al., 2008; Lander & Liker, 2007). Although improvements have been reported, they are piecemeal and not sufficient to generalize lean implementation in ETO environment, and the studies do not give answer to question what lean is in that specific environment.

Recognizing what lean is for ETO companies is crucial for the success of lean implementation. Inadequate understanding of lean principles, as well as lean tools and practices, resulted in misapplication, strengthening the argument that one-size-fits-all approach might not be suitable (Powell & Netland, 2016; Pavnaskar et al., 2003). Matt & Rauch (2014) suggest that, while basic lean tools such as 5S and continuous improvement might be completely applicable in ETO environment, some more advanced lean practices such as value stream mapping and Kanban have limited applicability. This is not a surprise, given the fact that context in which lean manufacturing has been developed – namely Toyota Production System – differs significantly from ETO environment, and that this fact requires lean to be re-examined, both as a philosophy and as a set of tools and practices (Powell & Netland, 2016).

3. RESEARCH DESIGN

This paper seeks to address three questions:

- What lean in ETO context means?
- What are the limits of existing lean practices in ETO environment?
- What are the challenges for lean implementation in such an environment?

This section presents the research design established in order to answer these 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 posed questions.

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 (Yin, 2013).

Company OMEGA (real name is obscured) is selected as a typical ETO company. 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 external influences, mostly 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. External influence coming from suppliers is present as well, mainly as a consequence of small order volumes, due to the fact that production volumes are relatively low as well.

The company has a long-standing experience with lean implementation, and has had some success (according to employees), mainly with shortening lead times. In order to analyze the experience the company had with lean implementation, and answer the questions that have been posed, a set of semi-structured interviews has been conducted. Process manager, production manager, sales representative, designer/engineer, and chief of digital printing took part in interview sessions. Interviews lasted roughly 45-60 minutes, were recorded and later transcribed. In addition to interviews, archival data analysis and direct observation have been used in order to ensure triangulation.

3.2. Lean implementation conceptual model

Having in mind the definition of waste and steps for lean implementation stated in section 2, conceptual model of lean manufacturing has been devised. Large amount of variability can be attributed to variability (Hopp & Spearman, 2008). However, one must be careful when eliminating variability in ETO environment, since some of the variability is inherent to ETO operations, and can present source of competitive advantage. Therefore, variability can be classified into three categories (Deuse et al., 2018):

- Variability which must be eliminated (non-value adding) – causing fluctuations and losses in productivity or product quality;
- Variability which cannot be eliminated immediately or entirely (non-value adding) – current work conditions dictate the existence of variability, or variability is due to common causes;
- Variability which must not be reduces, at least directly (value adding) – it represents customer benefits, and therefore should be buffered and managed (demand variability, process routing variability, work content variability, etc.).

The conceptual model for lean implementation is given in Figure 1, with the inclusion of variability classification scheme. This inclusion puts lean implementation in special context of ETO operations, and shows what lean operations are in a specific environment, and how they can be achieved.

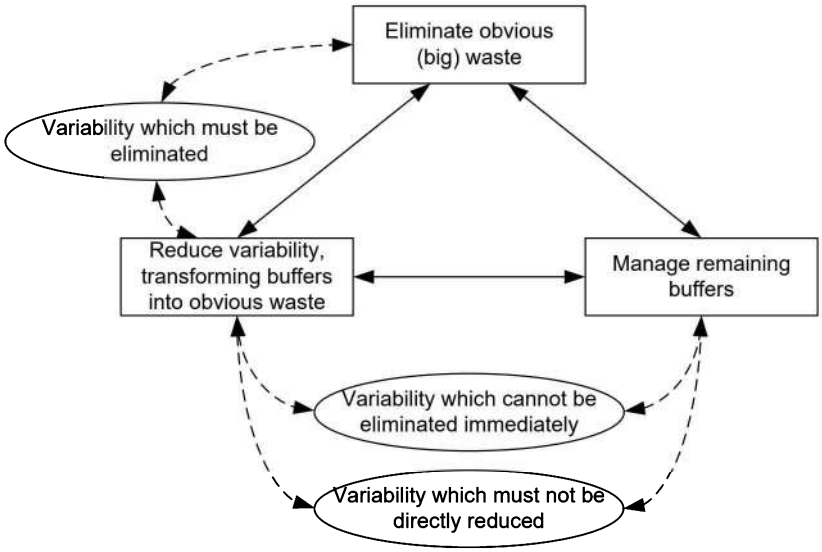

Figure 1: Lean implementation conceptual model

The model is tool-agnostic, and tries to encompass the substance of lean, without prescribing practices that should be used. As such, it is universally applicable, and it shows what the essence of lean is. It has special value for ETO operations, as it takes into account specificities of variability present in a specific environment. Lean implementation in company OMEGA will be analyzed against the proposed model.

4. CASE ANALYSIS AND RESULTS

All of the interviewees claimed that lean implementation can be deemed successful, at least to some extent. Archival data show that lead times have been shortened, and that lead time distribution became narrower with lean implementation, making lead times more predictable. Other operational performance measures were not collected systematically by the company, so only indirect connection between them and lean implementation could be established. Management was supportive, and thought that lean implementation might be beneficiary to the company. However, it was evident that management lacked deeper knowledge about lean, which oriented the company towards tool-based lean implementation. Employees were encouraged to actively participate in continuous improvement efforts,

The company has implemented standard lean tools, such as 5S, visual management, SMED and TPM. 5S implementation is regularly measured through audits, and the score is in constant growth. TPM has reduced machine downtime, increasing the availability of the equipment. Both 5S and TPM procedures are well maintained and available at all work places. 5S and TPM implementation reduced some variability in processing time, giving workers more time to perform value adding work. The company tried to standardize operating procedures (mainly through efforts to maintain Quality Management System), but they were not always followed. Working procedure disruptions were not seen as opportunities for improvement, but often led to abandoning the procedure. 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.

It is interesting to note that lean implementation started with Kanban. However, Kanban usage was strange to say the least. The company realized that Kanban cannot be implemented in the way it usually is in repetitive manufacturing environment. Still, they were persistent to lead Kanban implementation to some conclusion. The result was that none of the goals of Kanban implementation were fulfilled. Kanban did not limit the level of work-in-process (WIP), nor did it control the flow of material and information in any way. It ended up being some form of work list, communicating the worker what should be done on what work order..

Table 1 shows the analysis of lean implementation against conceptual model presented in Figure 1.

Table 1: The analysis of lean implementation in company OMEGA against the conceptual model

Implementation step	Type of variability	Type of problems	Actions taken	Buffer mgmt.
Eliminate obvious waste	Must be eliminated	Over-production; Waiting; Equipment availability; Over-processing;	Visual management; 5S; SMED; Continuous improvement; TPM;	No buffer management required
Reduce variability	Cannot be eliminated	Processing times; Common cause variability;	SOP; Worker flexibility; Worker training	Excess capacity
	Must not be eliminated	Demand variability; Work content variability;	No actions taken	Excess capacity; Excess level of WIP

Table 1 shows that most basic lean tools and practices (e.g. 5S, TPM, SMED, etc.) can be used in ETO environment just the same as in repetitive manufacturing environment. These tools are used to eliminate most recognizable types of waste (*muda*). What was not addressed well were overproduction (this will be discussed later in the text) and over-processing. 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. However, problems can occur when *muda* is due to *mura*, and *mura* is not being recognized. This situation might require some type of buffering, before source of variability is eliminated.

Problems occur with reduction of variability that cannot be eliminated immediately or must not be eliminated. Some actions have been taken in order to address variability that cannot be eliminated immediately or

entirely, such as worker flexibility and training, and standard operating procedures. However, order complexity and constant pressure caused often for standard procedures to be abandoned. This type of variability is usually buffered with capacity, which is common type of buffer in non-repetitive and job shop manufacturing (although it might be expensive). Still, company OMEGA did not use this type of buffer in a systematic manner. Capacity planning was at a low level, and production manager was mainly occupied with day-to-day activities. This is why short term capacity adjustment in the form of extra shifts was the action of choice. But capacity adjustments were erratic, often just one day in advance.

Most problems came with variability that must not be eliminated, but must be managed in some way. Demand variability can be high, but customer enquiry management was not considered as a possible solution. All orders were accepted, usually on customer terms, since a lost sale is considered to be a problem even if the company was aware that customer requirements regarding delivery date might not be met. Variable demand resulted in periods of starvation (when demand was low) and congestion (when demand was high). Kanban was used, but it did not deal with this type of problem, since management was not fully aware of Kanban goals and functionality. Kanban might have limited applicability in ETO environment, but this does not mean that principles of pull production are not applicable. The question is which the right way for them to be operationalized is. The result was high level of WIP, and often over-production (producing earlier that was needed). Rationale behind high levels of WIP was that some kind of work has to be done every day. This means that orders were released to shop floor immediately when the product design has been finished. This affected lead times, leading to lead time paradox, where earlier order release causes longer lead times.

It is obvious that company OMEGA missed many opportunities to lower variability, or to manage remaining variability and buffers. Table 2 summarizes some of those missed opportunities.

Table 2: Some of potential opportunities to address problems in company OMEGA

Potential opportunities	Problems that might be addressed
Customer enquiry management	Demand variability
Order splitting	Processing times variability; Work content variability;
Pull production (CONWIP, Workload control, etc.)	Over-production; Excess WIP; Shop-floor congestion; Work flow management; Starvation avoidance and congestion prevention; Lead time reduction and predictability; Waiting;
Design for manufacturability	Over-processing; Processing time variability;

The analysis shows that most potential opportunities lie in the field of pull production. There are many benefits that might stem from pull production, but ETO companies are often puzzled how pull production can be implemented, having in mind that replenishment system (e.g. Kanban) cannot operate in dynamic environment. However, main intention of pull system of limiting WIP (Ohno, 1988; Hopp & Spearman, 2004) could and must be put to use in ETO operations, since limiting WIP can have significant impact on lead time shortening (Little, 1961). Also, as this case confirms, ETO companies rarely explore the possibilities of customer enquiry management that might reduce at least some of demand variability.

What is also evident from the case is that the company was not aware of the length of the value chain, which starts with design every time the order is placed. What was also out of the sight that all steps in value chain are highly coupled. Focus of lean implementation was mainly on production, but what company failed to acknowledge was that large amount of variability in production is due to problems earlier in value chain, e.g. in design or procurement.

5. DISCUSSION AND CONCLUSION

Being lean for a ETO company means the acknowledgement of the notion that variability that causes waste and hinders the performance exists, but that some of this variability is needed due to characteristics of ETO operations, and that they have to be carefully managed. Some variability can be eliminated, and this is where traditional lean tools and practices come in handy. However, traditional lean implementation is limited to basic tools, and real challenge is to find a way to implement advanced principles that cannot be operationalized in the same way as in repetitive manufacturing. This requires deeper understanding of what lean is, and how leanness can be achieved. In addition, this means that cookie-cutter lean implementation needs to be avoided, since it can warp lean and turn it into its opposite. This means that lean implementation must be based on underlying principles, while it is up to company to find the best way to put those principles to work in practice. It might require out-of-the box thinking, and finding solutions that might appear different to those recognizable as standard solutions.

Greatest challenges lie in obtaining unhampered flow of material, i.e. the field of pull production. Pull production represents one of the most recognizable features of lean production. However, most of the limits are due to the nature of the pull. While repetitive manufacturers use replenishment pull, ETO companies should use capacity pull, where signals for order release are not sent when certain quantity of goods have been consumed from supermarket, but rather when certain amount of capacity has been freed (i.e. when some work order has been finished). There are some possible solutions for pull implementation in ETO environment, such as CONWIP (Spearman et al., 1990) or COBACABANA (Land, 2009). Seeing that high level of WIP is a common thing in ETO operations, pull would be a good way to manage WIP buffer.

Some potential for variability reduction lies in customer enquiry phase, where special terms might be offered to customers for following a certain pattern when ordering (steady orders in regular time intervals, or standard quantities), instead exclusively for ordering large quantities. This would stabilize the inflow of the orders, which will in turn stabilize the shop floor. Customer enquiry management would require for some orders to be declined, which is an unlikely situation in ETO environment. On the other hand, managing lead time as a buffer might also serve as a form of customer enquiry management mechanism, where quoting long lead times might buffer some variability, but long lead times can also discourage some customers from ordering.

This paper sought to address the question of lean applicability in ETO environment. Lean can help ETO operations to improve competitiveness, since it is aimed at reducing lead times, which is one of order winning factors. However, lean implementation call for caution, since ETO environment is significantly different than the one lean originates from. In order to assess the limits of lean implementation in ETO environment, and to identify challenges of lean implementation, conceptual model of lean implementation has been devised. Typical ETO manufacturer was analyzed against devised model. As case study showed, implementation of standard lean toolset is constrained by characteristics of ETO operations, where practices are limited to basic tools (5S, TPM, continuous improvement, etc.), and that real challenge lies in obtaining unhampered flow, which is one of the basic principles of lean production, and requires implementation of more advanced practices, such as pull and heijunka. This calls for out-of-the-box thinking when devising tools that might be more appropriate for ETO environment, which in return requires deeper and tool-free understanding of what lean is, and what are its underlying mechanisms.

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WASTE ELIMINATION IN CONTEXT OF WORKPLACE CLOSURE AND STABILIZATION AND LEAN PRODUCTION

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Abstract: *In the last few decades, the need for business improvement is growing due to the turbulent environment. In order to remain competitive, companies are looking for ways to increase the main business performance - productivity. This paper shows how identification and subsequent elimination of wastes (Muda) can help in workplace closure and productivity gain. The key factors that impact on low productivity were analyzed, which is the first step for workplace closure and stabilization. The resault of the research represent how, by eliminating wastes, a company, through workplace closure and stabilization by means of waste elimination, can increase productivity.*

Keywords*: productivity, productivity improvement, waste, workplace closure, Muda.*

1. INTRODUCTION

Productivity is one of the key factors for measuring the performance of the manufacturing system (Rawat, Gupta & Juneja, 2016). Snyman and Smallwood (2017) say that the continual increase of productivity is the main factor to stay competitive.

Every company needs a manufacturing system which is capable of producing the high quality product with the minimum input (Rawat, Gupta & Juneja, 2016). This can be achieved by keeping the manufacturing system productivity high. Productivity measurement can show whether the level of productivity is satisfactory. Because of that, organisations are continuously reviewing their methods and skills in order to increase their value-added outputs with fewer resources (Snyman & Smallwood, 2017).

By improving productivity, an organisation can benefit from cost and quality advantages in comparison to its competitors (Snyman and Smallwood, 2017). Companies with a low level of productivity can hardly survive in a today's turbulent environment. Otherwise said, companies with a low level of productivity are creating wastes. Low productivity samples can be identified the best by consideration the smallest organizational cell – the workplace.

The workplace represents the smallest organizational unit of production in which the worker, labor and work items are located (Mileusnić, 1977). Moreover, as Mileusnić (1997) says from the perspective of work organization in the workplace and organization of the production process, there are three basic organizational forms of workplaces: open, closed and stabilized workplace.

Open workplace represents the lowest level of work organization in the workplace, where three types of waste are identified: work breaks and disruptions due to the poor organization (G_1), work of workers resulting from the poor organization (G_2) and unrealized output as a result of poor organization and work method (G_3). Closed workplace is an organizational form of a workplace with a high level of organization, where the waste of G_1 and G_2 are eliminated. The condition for creating a stabilized job is to close the workplace. Closed workplace is the most effective and humane, and the work performance is the greatest (Radović, 2011). At that time, productivity is at the highest level and exists everything that is needed to make the worker perform only operations that add value to the product (Mileusnić, 1977).

On the other hand, Lean manufacturing has been receiving attention lately from lots of organizations. More and more companies are now combining lean with their other improvement principles. Lean production recognizes seven types of wastes, which are known for one word – *Muda* – the Japanese term for waste (Womack & Jones, 1996).

This paper shows the connection between organizational waste in open workplace and Lean waste. The focus of this paper was how elimination of wastes can influence productivity improvement, in the light of workplace closure and stabilization. It also shows the principles for measuring productivity and wastes in organization, and the conections between identfying wastes in order to close and stabilize workplace.

2. THEORETICAL BACKGROUND

Not everything that happens in a day's work adds value. In fact, the vast majority of the typical worker's labor is *movement* and very little indeed is actually *work* (Hirano, 2009). In workplaces, everything that is organizational good and what is not good can be recognized. Most often, the organizational shortcomings of the whole company are reflected in the workplace in the production process.

It is not easy to find all wastes, when wastes appear in many aspects. In a factory, *useful* is the same thing as *value-adding* (Hirano, 2009). The processing done in the factory is what adds the most value to the products. Everything that does not add value is a form of waste. Hirano says that *waste does not process anything, nor does it add any value.* Womack and Jones (1996) say that waste means specifically any human activity which absorbs resources but creates no value.

„No factory is without waste" (Hirano, 2009, p. 147). How much waste a factory contains, depends the most on how well it responds to its problems. The wastes that destroy so many factories often starts with simple incorrect responses to problems (Hirano, 2009). Sometimes the entire operation can be some sort of waste, because there is a cheaper way to do the same operation. It is especially important to start from the right place and identify all problems.

2.1. Organization of workplaces as an elementary production process

The level of organisation is a measure of quality of organization (Radović, 2011). Early mentioned, organitation recognizes three types of workplace: Open, closed and stabilized workplace. Open workplace has the lowest level of organization (Mileusnić, 1977). At that time the worker is least productive. Only when a worker is productive, value is being created and everything else can be considered a waste. Causes of low productivity can be different: the worker is not assigned the appropriate task, the worker is absent from the workplace, an adequate division of work is not carried out, there is no proper documentation. All of these activities that do not add value are divided into three groups: G_1, G_2 and G_3 (Radović, 2011). The time period in which the productivity and wastes of a company is measured is called the available time (Radović, 2011).

G_1 waste represents breaks and interruptions in work due to the poor organization. The causes of these wastes can be different: the worker is not in the workplace, there are no materials, tools and documentation, the machine is defective and exists waiting. Since G_1 wastes represent a break in operation, it can be concluded that in this period of available time no value is being created for the customer.

G_2 waste includes the work of a worker resulting from a poor organization. This includes poor programming and planning production, preparation of production done by workers, poor labor division, finishing or repairing of products with defects and quality control while the machine is in use. All this results in value not being created for the customer.

G_3 wastes are the most difficult to identify and measure. This represents an unrealized outcome or a poor method of work at the workplace. In this case the worker works, but with not the best method of work. (Radović, 2011) The scheme (Figure 1) shows productivity Pr, wastes G_1, G_2 and G_3, available time (Shift hours), worker occupancy Z and capacity utilization rate ηk.

Occupancy (Z) represents the part in available time in which the worker is working (Radović, 2011). If the worker is busy, it does not mean that he creates a value. In the case of productivity, the worker should be busy. However, the employee is busy even when it does not create a new value (this includes wastes G_2 and G_3). Capacity utilization rate η_k is the part in available time that includes productivity of worker, unrealized outcome or a poor method of work at the workplace (G_3) (Radović, 2011). This is the portion of time where value is created for the customer, although not always in best possible way.

According to the study conducted in selected companies, the relationship between productivity and waste was found. There was a big gap between them. Productivity accounted for only 40% of the time available, while 60% of the time was spent on not different types of wasteful activities (Radović, 2011). The scheme notes that the possibilities for improving the organization of production and the work process in general are high (Figure 1).

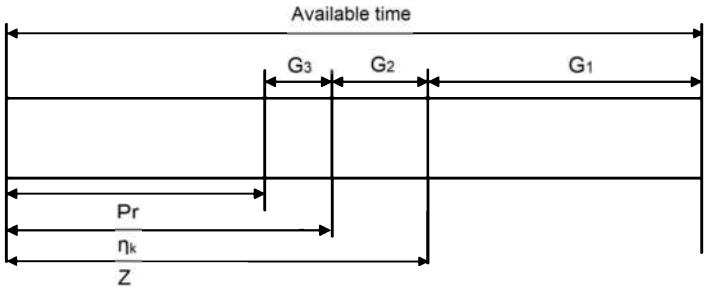

Figure 1: Structure of available time at workplace (Radović, 2011)

Mileusnić (1977) mentions that the organization of workplaces should be a closed type workplace and allow workers to get a fully prepared job, in the case that all conditions for production are met. In order to increase the productivity of the organization and improve business results, a reorganization of production is required. The measures to be taken consist of the reorganization of the workplace and the entire work organization, as this is the requirement that production at the workplaces is optimally carried out.

Closed workplace is distinguished by the fact that unnecessary work breaks in workplaces, due to organizational disadvantages, are excluded and that the useless work is reduced to a minimum (Mileusnić, 1977). The worker should only perform his work at the workplace, while other workers provide, deliver and dispatch work for their position. The worker should not interrupt work in order to bring the job or take it and his workplace should provide that the work is continuously running.

Psycho-physiological conditions and working environment conditions are also studied in organizing the workplace. Mileusnić (1977) says that the purpose of studying operations and its components is to make the work of workers easier, to reduce his efforts and to increase the output. In order to ensure the proper delivery and dispatch of work and tools for work, there should be a workshop preparation in the process (Mileusnić, 1974). Workshop preparation should allow workers in the production process to use their time on product development.

Good workshop preparation might not be sufficient condition for workplace closure and stabilization. Mileusnić (1977) says that it is necessary to establish a good connection between the procurement function that acquires the necessary material and tools for operation, as well as the sales functions that ensure the sale of products. If the workplaces have the appropriate employees in the production, they organize appropriate training and ensure the health of the employees, then the human resources contribute to the process of workplace closure. Studying, measuring, improving and humanization of work at workpalce is also an important step in workplace closure. When productivity is increased, a good level of organization is established and a workpalce closure is created, then the conditions for a stable job are created. The stabilized workplace is organized in the most rational way, and then the worker only performs activities that add value to the product (Mileusnić, 1977)

2.2. Elimination of waste in Lean production

At the international level, a lot of attention is attached to Japanese production philosophies, and as one of them to Lean production. Lean production is a production philosophy that shortens waiting times eliminating wastes between receiving orders and distribution to the customer (Vasiljević & Slović, 2015). Vasiljević and Slović (2015) say that Lean is a system of integrated elements that work together to increase the performance of the production system over time. Lean forces attention to how the value is generated rather than how any one activity is managed.

One of the main principles of Lean production is elimination of waste – *Muda* (Womack & Jones, 1996). Lean production should provide cost savings by eliminating all forms of wastes. As a basis for defining waste, it is necessary to classify the activities of the company on:

1. value aided activities,
2. non-value aided activities,
3. necessary non-value adding activity (Hines & Taylor, 2000).

Value adding activity are activities that, in the eyes of the final customer, make a product or service more valuable. Non-value adding activity represents activities that, in the eyes of the final customer, do not make a product or service more valuable and are not necessary even under present circumstances. These activities are clearly waste and should therefore be the target of immediate or short term removal. Necessary non

value adding activity are those activities that, in the eyes of the final customer, do not make a product or service more valuable but are necessary unless the existing supply process is radically changed (Hines & Taylor, 2000).

In manufacturing or logistics types of environment, the gap between those three activities is high. Hines and Taylor (2000) have developed a guide to the proportions of these three types of activity that might appear in a company before any lean improvements. The total value stream time of a company is: 5% value adding activity, 60% non value adding and 35% necessary but non value adding activities (Hines & Taylor, 2000). This is represent on Figure 2.

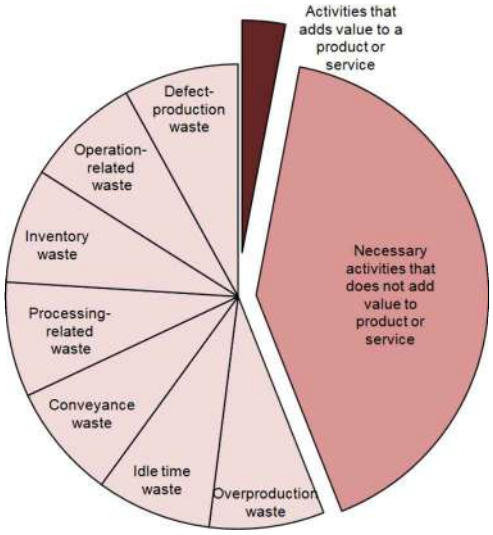

Figure 2: Structure of activities and wastage in production (Slović & Vasiljević, 2015)

The Toyota Production System relies on elimination of waste as essential. Taiichi Ohno (Hirano, 2009), a Toyota executive, identified seven types of waste found in any process:

- Overproduction waste – production of products that is not needed.
- Inventory waste – in-process inventory or finished products waiting to be shipped.
- Conveyance waste – unnecessary transport of parts under production.
- Defect-production waste – production od defected products.
- Processing-related waste – unnecessary operations in production.
- Operation-related waste – unnecessary movement of people working on products.
- Idle time waste – time spent waiting for something.

Each type will be analyzed in the continuation of the paper.

3. WASTE ELIMINATION IN CONTEXT OF WORKPLACE CLOSURE AND STABILIZATION AND LEAN PRODUCTION

Productivity represents how much of management resources are required for a certain amount of management results (Sakamoto, 2010). When a company is looking for the best method for productivity improvement, it is important to decide which methods they should implement. Combining Lean with other improvement principles, companies can easily improve their productivity. The goal of waste elimination in workplace closure and stabilization is also the productivity improvement. In this paper will be found a connection between this two principles.

If the productivity level is low, it is probably because of wastes that causes organizational disorder. Different problems within the organization affect the generation of wastes, which then reduce productivity. By applying these principles (elimination of waste in workplace closure and in the Lean production), the company can identify what are the wastes that affect the business. In the following table, the activities are identified, columns show productivity and wastes G_1, G_2 and G_3. In rows are given activities that add value to the product or service, the necessary activities and seven types of waste – *Muda*.

Table 1: Wastes in open workplace and wastes in Lean – *Muda*

Lean		Open workplace			
		Pr	**G3**	**G2**	**G1**
Value Adding Activities		+*			
Non-value adding Activities		+		+	(+)
Wastes - Muda	Overproduction			+	
	Idle time				+
	Conveyance			+	(+)
	Processing-related		(+)	+	
	Inventory			+	
	Operation-related		+		
	Defect production			+	

* + represents explicit connection, (+) represents implicit connection

Based on indicators, it is possible to sufficiently determine productivity of production, where the highest wastes are in time, the extent to which the capacity utilization rate can be increased and in what direction it should be operated (Radović, 2011). The direction of the organization's development should be such that the design of the new organization of work and its implementation create conditions for the workplace closure (Mileusnić, 1977).

Necessary activities are necessary because of the abilities of the existing process and they require radical changes for eliminating (Slović & Vasiljević, 2015). Necessary non-value adding activity includes the time when the worker is productive, but also the waste of G_2. This means that in addition to the necessary activities, the employee also performs work preparation activities, which is not in his workplace specification. The worker should not prepare workplace, but it is necessary that other workers who are in charge of it, provide, deliver and dispatch work for his position. He does not create a new value, but the activity is necessary because its non-execution would lead to an interruption, or G_2 would be converted to G_1. Therefore, it is necessary to recognize what aree the organizational reasons by which the worker should prepare for work, and work on their removal, so that G_2 can be transformed into productive work.

Overproduction waste can be defined as “producing what is unnecessary, when it is unnecessary, and in an unnecessary amount” (Hirano, 2009, p. 164). The overproduction also represents when the products are produced outside the optimal production plan. The worker at the workplace should only produce the planned amount from the optimal production plan, however in this case the worker has produced much more. The worker can also work on products that are not planned for him, probably because he does not have the right information, material or resources. The cause is poor production organization, and this type of waste is classified as a waste of G_2. Hirano (2009) says that overproduction waste is the worst of all forms of waste, because it contributes to inventory waste, and the inventory naturally leads to more transportation. All this increases the cost of production and the creation of inventories of products that can not be sold. Although overproduction is not directly G_3, because it increases G_3 in case the working method is not examined and rationalized, or because the worker has an opportunity to do with a bad method. Then the waste is double: G_2 because the worker is producing out of the optimal production plan, and G_3, because the worker works in an inadequate way. The worker should always have the correct production plan and comply with it. By closing the workplace, part of the waste of G_2, or overpoduction waste, would turn into productive work.

A special kind of interruption in work is waiting in the workplace, because the worker is not provided with a job. Idle time waste is a term that includes both human idle time and machine idle time and covers a wide variety of cases (Hirano, 2009). Idle time is generally time spent waiting for something. The cause may be, for example, a procurement function that did not provide material. This leads to delays and waiting, which is also identified as the type of waste (Idle time). This is the only type of waste that is classified as a waste of G_1. Absence of workers from the workplace is not classified in any type of waste and it should be further analyzed, in order to be classified into a one of categories of wastes.

In the event when the waiting period is eliminated, the worker would receive a fully-fledged job, it would still not be enough to close the workplace, because the breakdown of work is due to the organizational disorder of the workplace. These wastes due to poor organization represents G_2, identified in 5 types of waste: Overproduction waste, Conveyance waste, Inventory waste, Defect-production waste and Processing-related waste.

Hirano (2009) says that Conveyance waste is a term for covering everything from conveyance made necessary by poor layout, material handling (such as picking things up, setting them down, and stacking them up), and just moving things around. Conveyance wastes are classified as G_2 wastes because they represent a poor organization of labor. However, if the transport of worker is considered as a break in operation, this type of waste could also be the waste of G_1. The worker then stops because of transporting, if he works alone or if someone needs to be replaced. At the transport, in which others carry out the transport process, there is only G_2 waste.This can be seen on Figure 3. The arrows indicate that wastes (*Muda*) may belong to several types of wastes G_1, G_2, G_3. The black arrows show a direct classification, and the red ones shows how can wastes be classified under different conditions.

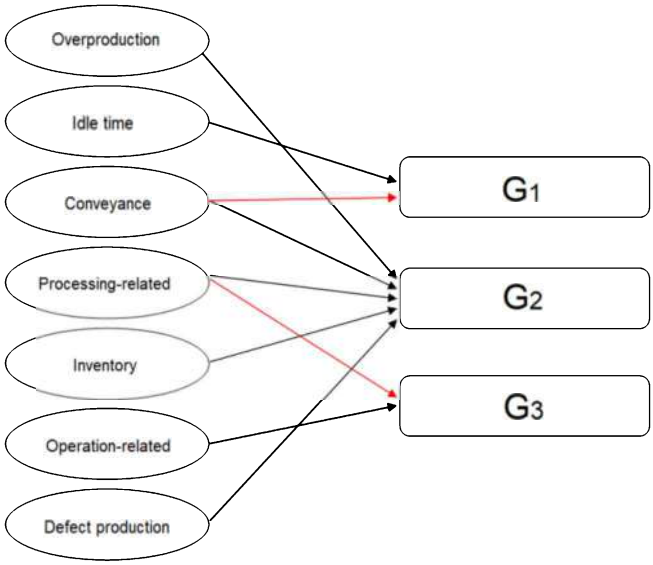

Figure 3: Connections between wastes (*Muda*) and wastes G_1, G_2 and G_3

Sometimes, the waste can be seen in the conveyance system as the consequence of long conveyance distances and heights or insufficiently used conveyor systems. The reorganization of layout in woorkplace could be the solution for eliminating conveyance wastes. The main goal is to transform those wastes into productivity, for also increasing the capacity utilization rate η_k.

Processing-related waste indulges in unnecessary operations in production and therefore are classified as a waste of G_2. Poor organization and programming of production is a problem for people at higher level of organizational hierarchy. They can be eliminated by product modification, reprogramming the production process, using just-in-case logic, etc. (Vasiljević & Slović, 2015) However, if processes in production are not clearly defined, it may happen that the worker performs operations that are not intended for production. Then those losses could be classified in G_3.

Inventory waste are including not only wastes in the warehouse, but also in-process inventory. This means materials, parts, finished products and whatever that is located between or in the end of operations (Hirano, 2009). Inventory wastes represent the waste of G_2, because inventories are the result of procurement or production, the amount of production which exceeds actual production needs.

Operation-related wastes are the only wastes that belongs to G_3. The worker then works on creating value for the end user, but does not do it in the best possible way. The worker makes unnecessary movements that affect the longer duration of the operations, and consequently the lower productivity. Workers should be trained in order to rationalize their work method and be a part of creating standard operating procedures (SOP). Workers should be actively involved in creating standard operating procedures to better accept and respect them.

Defect-Production waste is the waste associated with costs for inspection of defects in materials and processes, customer complaints, and repairs (Hirano, 2009). This type of waste is the waste of G_2 because there are omissions at the organization level. Causes of defective products can be: inaccuracy in documentation, inadequate process control and product quality, poor condition of equipment, inadequate training of workers, etc. (Vasiljević & Slović, 2015)

Good organization needs work, so for the beginning it focuses on eliminating unnecessary traffic, for example, changing laiout. Different quantitative methods can determine the empty movement of workers, the

efficiency of the system, and in this way obtain the true images of the performance system. This could have the effect of reducing interruptions and increasing productivity. Then, work preparation should be done, which results in great wastes. Better operational preparation, constructive and technological documentation and synchronization with procurement and sales functions is necessary.

In order to reduce the necessary activities, alternatives for existing operations should be analyzed. In time, it is considered whether there is a modern machine for some operation or a better way of working. Closing workplace for the purpose of productivity also includes calculating the indicators of occupancy and the degree of capacity utilization. When Z is high it does not mean that the productivity is also high. It is important to analize how the worker is busy. Also, the degree of capacity utilization increases with increased productivity.

In order to close the workplace it is necessary to organize a work place so that only the productive work is done. This proces of workplace closure can be difficult in implementing the improvement because of some reasons:

1. being unable to recognize waste as it occurs in the factory;
2. waste remains hidden within abnormal conditions or problems in the factory and is thus not readily apparent;
3. even when waste becomes evident in connection with abnormal conditions or problems in the factory, people do not know enough to recognize the waste (Hirano, 2009).

It should be careful not to convert one type of waste into another, and the elimination of activities that does not add a value to a product or service at the moment, but are necessary, does not actually turn into wastes (G_1 into G_2). Radović (2011) believes that in practice, the conclusion comes from observing financial performance indicators. That image of a working organization can not be complete. Therefore, it is necessary to identify several different indicators on which the exact quality of organization of the production process and the process of work as a whole will be determined.

4. CONCLUSION

Productivity improvement, in every organization, should be the main factor for business improvement. For productivity improvement, companies should improve their performance by utilising performance measures, reorganizing the proces of production that causes problems and establish stabilized workplace. Many companies are also have implemented certain methods of improvement like 5S, Kaizen and Kanban.

Various factors were analyzed: productivity, activities that add and do not add value to the end product, necessary activities, waste – *Muda* and the way to close and stabilize workplace. Both principles, workplace closure and stabilization and waste elimination, cover various possibilities that cause workplace wastes, and can be said to be complete in identifying wastes. G_1, G_2 and G_3 and *Muda* elimination are perfect for businesses as the starting point for improving productivity. Both methods are applicable in an enterprise and it is very useful to apply them in order to have a complete picture of the performance of the company. There is a significant synergetic effect, because the structure of the available time can serve to quantify the results of elimination of waste, through the calculation of indicators, such as the degree of capacity utilization and occupancy. Eliminating wastes can be the starting point for improving productivity. Many companies have also implemented certain methods of improvement like 5S, Kaizen and Kanban, which are the solution in the long run.

The waste elimination has positive influence on productivity improvement. The benefits of workplace closure and elimination of wastes are enormously, because of the resaults they bring. The identification of wastes is the first, but not the least important, step in eliminating wastes. It is necessary to have a good knowledge of the enterprise, to identify the processes within the enterprise, then the problems and their causes. Both principles cover the various causes that cause wastes at workplace, and can be said to be complete in identifying losses. Both methods are capplicable in an enterprise and it is very useful to apply them both for a complete picture of the performance of the company.

The direction of future research is the practical application of the workplace closure and the elimination of waste as an integrated methodology in practice. A workshop would be analyzed from both workplace closure and waste elimination views, in order to see what effects this approach whould have on productivity improvement. Practical case, would give the right picture of productive work and wastes, and the results would also be used to illustrate productivity improvements, and to further develop this synergetic approach to workplace closure and waste elimination.

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INFORMATION AND COMMUNICATION TECHNOLOGIES AS SUPPORT FOR INVENTORY CONTROL IN THE AUTOMOTIVE INDUSTRY

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Abstract: *This paper presents four types of information and communication technologies as support for inventory control in the warehouse, on the example of the company from the automotive industry. Considered information and communication technologies are: voice technology, pick-to-light technology, barcode technology and drone technology. The Analytical Hierarchy Process (AHP) method was used to analyze and select the best technology based on ten defined criteria. The aim of this paper is to present one of the methods to select the most suitable type of information and communication technology for inventory control in the automotive industry.*

Keywords*: Information and Communication Technology, Inventory Control, AHP, Comparative Analyze, Automotive Industry*

1. INTRODUCTION

Information and communication technology presents a unique name for a group of technologies that can be applied to problem-solving, including inventory control. Those problems can appear during activities in the warehouse: searching, finding, identifying, preparing, packing and sending final product to the customer. The process of preparing products for delivery can be simplified and stabilized by application of information and communication technologies. Reduction of activities needed for products preparation, walking paths through the warehouse and lifting of heavy weights can be gained through this application (Richards, 2017). According to (Wild, 2002) inventory control presents the activity of organizing the availability of products to the customers. The main goal of inventory control in the warehouse is to meet customer needs on time, with an aim that inventory and procurement costs stay on low level (Wild, 2002). It is necessary to organize inventory control in a way that will enable improvement of the production process, customer satisfaction, labor humanization and employee satisfaction.

The paper is organized as follows. In the second chapter are presented four types of information and communication technologies that can be applied for improvement of inventory control in the warehouse of the automotive industry. There is an explanation of technologies' methods, areas of their possible application, but also problems that those technologies can solve. In the third chapter are defined the most important criteria for the warehouse workflow. Based on defined criteria, quantity analyzes and comparison of those technologies is carried out by application of the AHP method. Also, the most suitable technology is selected based on results of this analysis. The fourth chapter presents the conclusion.

2. INFORMATION AND COMMUNICATION TECHNOLOGY AND INVENTORY CONTROL

Inventory control in the warehouse is very important in modern management and it has a main role in the whole supply chain (Atieh et al., 2016). It is necessary to track product movements from supplier to the warehouse, stock inventory, movements through the warehouse-from entry to shelves and from storage places to the exit zone. Besides this, it is also important to track product movements from the warehouse to the customers in order to ensure delivery on time. Setting up more efficient inventory control system in the warehouse is important to achieve the best possible results in key performance (costs, customer satisfaction, orders collection, orders packing, etc). Also, humanization of labor cannot be disregarded (Caridade at al., 2017). It is necessary to provide adequate space organization in the warehouse for product manipulation. This includes marking zones for product receiving, storage and dispatch zones, as well as paths for workers and transport movement in the warehouse.

In addition to good warehouse organization, it is necessary to establish automation in processes which are performed in the warehouse. This automation can be gained through the implementation of information and communication technologies that can enable control of inventory level and provide adequate and real-time information (Atieh et al., 2016). The main purpose of applying information and communication technologies

in the warehouse is to increase the efficiency of warehouse operations, in order to ensure that customers receive products on time. Usage of information and communication technology in inventory control reduces the need for labor. Processes, which these technologies are used for, decrease number of workers important for the performance of all necessary activities in the warehouse (Richards, 2017).

2. APPLICATION OF INFORMATION AND COMMUNICATION TECHNOLOGY IN INVENTORY CONTROL

A large number of information and communication technologies have been developed in last few decades and have found application in many industries. This paper presents four information and communication technologies that can be implemented in the warehouse for improvement of the inventory control. Those are the following technologies: voice, pick-to-light, barcode and drone. RFID (Radio Frequency Identification) technology also presents one of the information and communication technologies that can be implemented as a support for improvement of the inventory control. But, the implementation costs (information system, equipment, trainings, etc.) are higher than the costs for the implementation of the barcode technology. This presents the main reason why priority was given to the barcode technology and why RFID technology is not considered in this paper.

2.1. Voice technology

The basic principle of voice technology is a verbal transmission of instructions. There is a subsystem within a voice technology system that provides instructions based on information of inventory availability and storage location. Using this technology, workers receive information as instructions for actions they have to perform in order to pick needed products for delivery. In addition, workers send information about the execution of the given instructions in the form of voice report, but also notifications about changes that can influence the voice system workflow. The system accepts and records received notifications. Voice technology allows two-way communication between worker and the system, which increases the accuracy of work. Headsets with a microphone are required equipment of implementation of the voice technology. Workers carry them in order to receive instructions from the system and to send feedback. Besides headsets, Internet connection (LAN-Local Area Network or RF-Radio Frequency) is required to be installed in order to enable simple communication (The Ackerman Company, 2002). This technology is fully adaptable to all types of dialects, accents, and languages. The communication requires adequate encryption of products and storage locations. In a case there is not enough required inventory on the storage location, workers send information to the system that provides feedback as an action needed to be taken. One advantage of the voice technology is the accurate instruction of what to do and provision of the exact answer to the asked question. Thus, all confusions, problems, and mistakes made by workers can be eliminated (Berger & Ludwig, 2007).

2.2. Pick-to-light technology

Pick-to-light technology enables improvement of worker's ability in the warehouse activities. This improvement is shown as the increase of workers' efficiency expressed by the number of orders executed in the unit of time. In pick-to-light technology, light signals are used for highlighting storage locations where workers have to pick required product units. Each storage location contains a device that emits light signals and displays quantities needed to be picked. A storage location that is systematically detected as the location where the desired product can be found emits light signals and gives a sign to the workers where they can take products needed for the customer order. After finding a required amount of the product, workers have to press a button to send a signal to the system as a confirmation of the fulfilled action. If the confirmation is successfully accepted by the system, storage location will stop lighting. Information of inventory level is automatically updated in the system (Bragg, 2011). This technology is used in warehouses organized by zone, where a group of workers is in charge of executing given orders in each zone. When the products are picked in one zone, all containers, boxes and other types of packaging are sent to next zone, where light signals define products for the further picking. Pick-to-light technologies require the adequate organization of the main warehouse that involves well-arranged logical structure, in order to make the process of picking and packaging more efficient. Its application in the warehouse improves the organization of work by keeping every worker in his zone with the exact task schedule to be performed (McCrea, 2015).

2.3. Barcode technology

A barcode presents a group of bars and spaces arranged according to a set of rules that determines the way of presenting data. Different bar and space patterns are used to express different symbols, readable only by

a scanner (Islam & Shuva, 2010). Barcode technology is an optical technology for displaying all data from a barcode of one product. Although it was discovered decades ago, it is still in use today with all new technologies. Application of this technology creates savings, raises the level of automation, and does not require complicated and expensive implementation (Kuglin & Hood, 2008). The barcode is characteristic and easily recognized because of the parallel black lines of different thickness. The encrypted part of barcode contains the same data as lines in an alphanumeric array of characters below black bars.

Regardless the type of the barcode technology that is applied in the warehouse, there are four main components (Singh & Sharma, 2009):

- *Barcode printer*: allows printing of barcodes in order to follow the movement of the product;
- *Barcode*: can be directly applied to products or storage locations (as labels);
- *Barcode scanner*: allows reading of data from barcode lines by decoding and translating them into a format understandable for a computer system;
- *Database*: a set of data of all items that movement is monitored with barcode technology. All information from barcode lines is connected with information in a database. When some changes occur and when the barcode is scanned, it is updated in a database.

Barcode technology is mostly used for inventory control in the warehouse. The main reason for that is the low cost of purchase and installation, large savings in time needed for the performance of the warehouse activities and update of the inventory level in the system. Activities that barcode technology can support are: updated inventory level in the system, automation of products receipt and dispatch, and tracking of storage locations and products movements.

2.4. Drone technology

The drone is one of the latest information and communication technologies that can be used for support of inventory control without human interference. Drones use cameras with technology based on geolocation that enables movement with predefined flight path through the warehouse. Besides this, it is also important to have devices that will help in creating flight path, activating drones, commanding, flight monitoring and control. For this, it can be used mobile devices, such as smartphones, tablets, and others. Drones can be used to define current inventory level in the warehouse and to locate products needed for realization of the orders. Drone technology is compatible with other information and communication technologies, such as barcode and RFID technologies. The combined application of previously mentioned technologies can significantly automate warehouse activities. Application of the drone technology minimizes the need for human recourses and enables faster performance of all activities in the warehouse. This technology can provide accurate information about inventory level and automatically send it to the system for inventory control, based on the application of barcode or RFID scanners that are located on drones. The application of this technology can determine the exact location of the requested product in the warehouse.

The use of drone technology is suitable for storage areas with high storage shelves that can put workers at risk of falling while scanning products. The main advantage of this technology is that one drone can replace a large number of passive RFID readers because of the ability to move around the storage space. The drones are completely safe technology since they do not come in contact with people. They are small size and they do not disturb workers during everyday activities. In order to prevent accidents and injuries at work, it is necessary to mark the area of drones and inform workers (Lechmaher, 2017).

3. SELECTION OF THE MOST SUITABLE INFORMATION AND COMMUNICATION TECHNOLOGY FOR INVENTORY CONTROL

The previous chapter presents the information and communication technologies' function in the inventory control, their characteristics, advantages and possible application in problem-solving. Base on that, criteria for application of the AHP method are defined, in order to do the comparison of the chosen and presented information and communication technologies and to select one technology as the most suitable for inventory control in the warehouse in the company from the automotive industry.

The most important criteria for the inventory control in the warehouse are:

1. *Administrative productivity*: the improvement of administrative activities in the warehouse, that determines the method of data transmission from the source of creation to the location of application;
2. *Labor productivity*: workers' performance in a certain period of time;
3. *Accuracy*: precision in work during the performance of warehouse activities, as well as data validity in the system for inventory control;

4. *The automation level*: reduction of human recourse participation in the warehouse activities;
5. *Ergonomic performance indicators*: security in working conditions in the warehouse;
6. *Error occurrence*: the possibility of error occurred during the performance of the warehouse activities;
7. *Updated inventory stock*: update of the inventory level in the system;
8. *Work safety*: safe working environment;
9. *The simplicity of use*: the simplicity of workers' training process;
10. *Costs*: procurement, implementation and training costs for application of the information and communication technology in the warehouse.

The AHP method is used to compare and select the most suitable information and communication technology for improvement of the inventory control. This method is an effective tool for complex decision making and helps to the decision makers to set priorities and choose the best decision. It is also a method of optimization because it chooses the best possible solution among all given alternatives (Bhushan & Rai, 2007). The main purpose of AHP method is to choose the optimal solution for a problem in order to achieve and satisfy the set goals.

The alternatives that are compared by the AHP method are:
1. Voice technology;
2. Pick-to-light technology;
3. Barcode technology;
4. Drone technology.

Figure 1 presents all parameters of AHP method used for selecting the most suitable information and communication technology for inventory control.

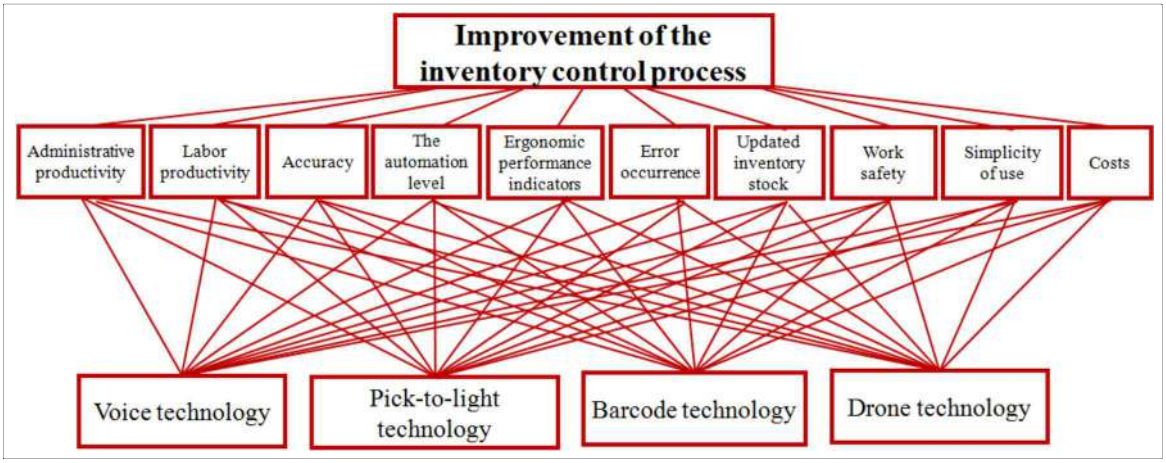

Figure 1: Parameters of AHP method for selection of the most suitable information and communication technology for the improvement of the inventory control

After defining all parameters of AHP method, it is necessary to assign grades to the pair of alternatives in relation to all level attributes. For comparison and assign priority to alternatives, AHP method uses a table of relative scores named *The fundamental scale*, created by (Saaty, 1987). Table 1 presents the rating values for each part of this scale.

Table 1: The fundamental scale (Saaty, 1987)

Intensity of importance on an absolute scale	Definition
1	Equal importance
3	Moderate importance of one over another
5	Essential or strong importance
7	Very strong importance
9	Extreme importance
2, 4, 6, 8	Intermediate values between the two adjacent judgments
Reciprocals	If activity *i* has one of the above numbers assigned to It when compared with activity *j*, then *j* has the reciprocal value when compared with *i*
Rationales	Ratios arising from the scale

Decision maker estimates alternatives by assigning rates from 1 to 9, according to his preference among alternatives. A rate 1 is given when decision maker has the equal preference between comparing alternatives. A rate 9 expresses extremely strong domination of one alternative (Bhushan & Rai, 2007).

The final rank among all alternatives is obtained through multiplying criteria weights with values given as a result of alternative comparison against certain criteria. This is known as the additive sum. The best alternative has resulted with the highest value of the additive sum. Considering that selection of the best possible alternative among given information and communication technologies for inventory control is a complex problem (contains ten criteria and four alternatives), rules of transitivity and consistency must be applied. They ensure that alternatives have corresponding rates and ranks.

3.1. Comparative analyze of information and communication technologies

In the next step of applying AHP method it is necessary to compare all alternatives versus defined criteria. In order to assign rates to alternatives and comply with transitivity and consistency rules, all alternatives are ranked by each criterion based on the preference of decision maker. An overview of this analyzes is shown in Table 2, with following abbreviations: VT – voice technology, LT – pick-to-light technology, BT – barcode technology, DT – drone technology.

Table 2: Alternative evaluation ranks according to defined criteria

Administrative productivity	Labor productivity	Accuracy	Automation level	Ergonomic performance indicators	Error assurance	Updated inventory stock	Work safety	The simplicity of use	Costs
VT	DT	VT	DT	DT	ST	VT	VT	BT	BT
DT	LT	DT	VT	LT	GT	LT	LT	LT	LT
LT	VT	LT	LT	VT	DT	DT	BT	VT	VT
BT	BT	BT	BT	BT	BT	BT	DT	DT	DT

It is also necessary to make criteria prioritization in order to determine the significance of each criterion in relation to the others. In order to simplify the prioritization of defined criteria, decision maker determines a list of ranked criteria, as an additional step in AHP method. The proposed ranked list of criteria is:

1. Accuracy;
2. The automation level;
3. Updated inventory stock;
4. Labor productivity;
5. Administrative productivity;
6. Error occurrence;
7. Work safety;
8. Ergonomic performance indicators;
9. The simplicity of use;
10. Costs.

The criteria prioritization is based on their interdependence and comprehensiveness. For example, the automation level of inventory in the warehouse affects other criteria, such as accuracy, updated inventory stock, and labor productivity. It has a higher rank in relation to those criteria. Work safety and ergonomic performance indicators are lower ranked because all criteria for higher position contribute to achievements of these two. Determination of the initial rank of available alternatives by each criterion, as well as criteria prioritization allows priority assignment to alternatives and their normalization.

3.2. Results

Tables 3 and Table 4 present rates of alternatives and criteria that are determined as a result of estimation process in AHP method. According to a certain assessment of all alternatives and criteria, and their established weights, it is easy to comply with final decision matrix. It consists of alternatives presented in the columns and the criteria presented in the rows of the matrix. Table 5 presents final decision matrix.

Table 3: The rates of criteria prioritization

Criteria	Accuracy	Automation level	Updated inventory stock	Labor productivity	Administration productivity	Error occurrence	Work safety	Ergonomic indicators	The simplicity of use	Costs
Accuracy	1.00	2.00	2.00	3.00	3.00	3.00	4.00	4.00	5.00	7.00
Automation level	0.50	1.00	2.00	2.00	3.00	3.00	4.00	4.00	5.00	7.00
Updated inventory stock	0.50	0.50	1.00	2.00	4.00	3.00	4.00	4.00	5.00	7.00
Labor productivity	0.33	0.50	0.50	1.00	2.00	2.00	2.00	3.00	4.00	7.00
Administration productivity	0.33	0.33	0.25	0.50	1.00	4.00	2.00	2.00	4.00	6.00
Error occurrence	0.33	0.33	0.33	0.50	0.25	1.00	3.00	2.00	3.00	6.00
Work safety	0.25	0.25	0.25	0.50	0.50	0.33	1.00	2.00	3.00	6.00
Ergonomic indicators	0.25	0.25	0.25	0.33	0.50	0.50	0.50	1.00	3.00	6.00
The simplicity of use	0.20	0.20	0.20	0.25	0.25	0.33	0.33	0.33	1.00	7.00
Costs	0.14	0.14	0.14	0.14	0.17	0.17	0.17	0.17	0.14	1.00
∑	*3.84*	*5.51*	*6.93*	*10.23*	*14.67*	*17.33*	*21.00*	*22.50*	*33.14*	*60.00*

Table 4: The results of criteria normalization

Criteria	Accuracy	Automation level	Updated inventory stock	Labor productivity	Administration productivity	Error occurrence	Work safety	Ergonomic indicators	The simplicity of use	Costs	AVG
Accuracy	0.26	0.36	0.29	0.29	0.20	0.17	0.19	0.18	0.15	0.12	0.2219
Automation level	0.13	0.18	0.29	0.20	0.20	0.17	0.19	0.18	0.15	0.12	0.1809
Updated inventory stock	0.13	0.09	0.14	0.20	0.27	0.17	0.19	0.18	0.15	0.12	0.1642
Labor productivity	0.09	0.09	0.07	0.10	0.14	0.12	0.10	0.13	0.12	0.12	0.1065
Administration productivity	0.09	0.06	0.04	0.05	0.07	0.23	0.10	0.09	0.12	0.10	0.0936
Error occurrence	0.09	0.06	0.05	0.05	0.02	0.06	0.14	0.09	0.09	0.10	0.0741
Work safety	0.07	0.05	0.04	0.05	0.03	0.02	0.05	0.09	0.09	0.10	0.0576
Ergonomic indicators	0.07	0.05	0.04	0.05	0.03	0.02	0.05	0.09	0.09	0.10	0.0501
The simplicity of use	0.05	0.04	0.03	0.02	0.02	0.02	0.02	0.01	0.03	0.12	0.0855
Costs	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.02	0.0155

Table 5: Decision matrix

Decision matrix	Voice Technology	Pick-to-light Technology	Barcode Technology	Drone Technology	Weights
Accuracy	0.4451	0.1598	0.0796	0.3154	**0.2219**
Automation level	0.2111	0.1204	0.0391	0.6293	**0.1809**
Updated inventory stock	0.5133	0.2900	0.0574	0.1393	**0.1642**
Labor productivity	0.1428	0.2760	0.0418	0.5393	**0.1065**
Administrative productivity	0.3555	0.1914	0.2280	0.2251	**0.0936**
Error occurrence	0.2924	0.4614	0.0648	0.1814	**0.0741**
Work safety	0.5975	0.2458	0.1019	0.0548	**0.0576**
Ergonomic indicators	0.1122	0.2051	0.0455	0.6373	**0.0501**
The simplicity of use	0.0682	0.1136	0.2731	0.5451	**0.0355**
Costs	0.1278	0.2494	0.5868	0.0360	**0.0155**

The final result of alternative estimation is obtained by the additive sum, by multiplying alternative rates with criteria rates and summing all results by each alternative and criteria combination. If O_{ij} presents the rate of alternative i in comparison with criteria j and if P_j presents weight of criteria j, additive sum A_i of alternative i can be expressed as is in formula (1) (Bhushan & Rai, 2007).

$$Ai = \sum_{j=1}^{10} Oij * Pj \quad (1)$$

Table 6 presents a final result of AHP method consisting of rates and ranks of compared alternatives. The best alternative for improvement of the inventory control in the warehouse is drone technology with rate 0.3537. Voice technology is in second place with the rate of 0.3359. Considering the extremely small discrepancy between the rates of those two technologies, it is important to clearly emphasize the domain in which the drone technology is better than voice technology and to highlight the difference between them. Drone technology is more dominant in the criteria with higher priority. It has a considerably higher level of automation because its application reduces the need for human recourses during the activity performance. Data transmission is completely electronic. Ergonomic performance indicators are highly ranked, considering that implementation of drone technology prevents workers from any kind of physical work, because of the high level of automation. Accuracy in finding the required storage locations and collecting required and valid data is one of the biggest advantages of the drone technology.

Table 6: AHP method results

Alternatives	Rank	Rang
Voice technology	0.3359	2
Pick-to-light technology	0.2187	3
Barcode technology	0.0917	4
Drone technology	0.3537	1

Criteria that reduce the overall drone technology results are: error occurrence and updated inventory stock. These two criteria are interdependent. Considering that drone technology is high-level technology, its reliability must be observed. Therefore, it is necessary to procure high-quality equipment in order to avoid stagnation and process errors. Work safety also has a lower rank that indicates providing of needed space for drone movement in order to protect workers from possible injuries. Drone technology is the most expensive alternative. For this reason, to the procurement, implementation, and training costs have not been given priority over other criteria that were considered more important by the decision maker.

Implementation of the drone technology in the warehouse has its own limitations, considering warehouses of the automotive industry. This industry considers warehouses of significant space dimensions that indicate a large number of drones in order to improve the productivity of inventory control. Well functioning of the drone technology depends on the quality of equipment (hardware and software), important for reducing the number of errors that may occur.

4. CONCLUSION

The support of information and communication technologies for improvement of the inventory control in the warehouse presents a necessity in modern terms of business. Some of the goals are reduction of the time required to perform the activity in the warehouse, as well as increasing productivity and customer satisfaction with product quality and deadlines for delivery. In this paper are presented four information and communication technologies: voice technology, pick-to-light technology, barcode technology and drone technology. All these technologies can be used as a support for solving problems in the warehouse. The function of certain technology determines the level of improvement of the inventory control. AHP method is used for comparison and selection of the most appropriate information and communication technology for the inventory control. It requires the definition of all criteria that decision maker considered as relevant. Defined criteria enabled comparison of selected technologies.

As a result of the application of AHP method presented in this paper, drone technology was selected as the most appropriate information and communication technology for improvement of the inventory control in the warehouse in the automotive industry. This technology has the highest ratings by defined priority criteria: accuracy, the automation level, labor productivity and errors occurrence. The disadvantages of this technology are: the high purchase costs of high-quality equipment and the need to reorganize the existing storage space to enable functioning of this technology. Drone technology, as one of the latest information and communication technologies, is still in the process of development which affects on high costs of the

necessary components. But, application of this technology is almost unlimited. As a highly reliable and efficient solution, drone technology can be used as a support to the improvement of inventory control in the warehouse of the automotive industry.

Today, information and communication technologies are rapidly developing. Changes in business circumstances and development of technology influence on a creation of new technologies. These changes affect the selection of other information and communication technologies (as alternatives) that implies the definition of new criteria in AHP method. This and application of other decision-making methods are the directions of further research of the authors of this paper.

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SPREADSHEET APPLICATION AND ALTERNATIVE DEVELOPMENT DIRECTIONS FOR A DIGITAL AGE

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Abstract: *This paper presents an overview of present-day spreadsheet technology usage and future directions of its development. It introduces some of application areas of spreadsheets, analyzes new challenges that digital business environment brings up and questions whether is this type of technology competitive in the period of Big Data and increased need for processing large amount of data. The paper points out some of the new directions of spreadsheet development which effectively respond to the modern business needs and are the basis for further development of this technology, such as spreadsheet model for handling streaming data, platforms that allow collaborative work within spreadsheets and framework for end-user spreadsheet-based service composition, which are described in this paper.*

Keywords*: spreadsheets, spreadsheet development, end-user development, collaborative spreadsheets, contemporary business challenges*

1. INTRODUCTION

Since they were firstly introduced, over the past 30 years, spreadsheets have become ubiquitous tool, which is inevitable in today's business world. Spreadsheet programs represent response to customer needs and preferences expressed through the market. These applications constantly evolve in order to increase user satisfaction. They have found their application in a wide range of organizational functions, in different areas of industry and become widely accepted and necessary in everyday tasks. Spreadsheets are one of the most successful end-user software development tools. End-users are usually domain experts, which are not interested in learning software development methodologies. Consequently, spreadsheet is just perfect for them. Spreadsheet users work in a variety of business functions: finance, engineering, manufacturing, marketing, sales and administration, etc. Many professionals make important decisions based on spreadsheet models and simulation analysis. Organizations rely on them in record keeping, forecasting, analyzing, planning etc. Spreadsheets are extensively used as data storage, manipulation and modelling tool.

Despite overall acceptance of spreadsheets in the areas of business and science, arising question tackles capability of these tools to meet growing needs of contemporary companies and business people. Modern business of digital age implies rise of Big Data and Artificial Intelligence (AI), as well as mobile and tablet computing, for which spreadsheet have not been fully adjusted. This paper is oriented towards key questions related to future directions of spreadsheet development, possible adaptations or adjustments and alternatives for these technologies. The paper presents examples of: spreadsheet enhancement for stream processing and streaming data handling, a virtual space for tabular data exchange that exploits the typical permanent asymmetric cell links supported by spreadsheets, a platform for distributed spreadsheet collaboration and composition and a framework that implements requirements for spreadsheet-based service composition.

Starting from this point, the paper is organized as follows. Section 2 presents and describes some of the most important spreadsheet application fields. Section 3 points out some of the challenges that modern business puts ahead of spreadsheet users, which consequently lead to responses to those challenges through developed spreadsheet solutions described in Section 4. Finally, the last section relates to conclusions and summary of all the above mentioned.

2. APPLICATION AREAS OF SPREADSHEETS

Spreadsheets imply diverse areas of application. Initially, creation and development of this program was directed to accounting and finance. Even more, according to Power (2004), the name itself originates from the accounting jargon: "A *spread sheet* is a large sheet of paper with columns and rows that organizes data about transactions for a business person to examine. It spreads or shows all of the costs, income, taxes, and

other related data on a single sheet of paper for a manager to examine when making a decision". Although application area is significantly expanded, spreadsheets still represent inevitable tools in accounting and finance field. Having in mind that the role of the management accountant has shifted from capturing and recording transactions to business issues analyzing, preparing of financial ledgers and comprehensive reports are almost impossible without spreadsheet solutions (Spraakman et al., 2015). Spreadsheets are inevitable tools for traditional responsibilities such as planning, budgeting, forecasting as well as newer decision-making responsibilities (Bradbard et al, 2014). Despite ubiquity in this area, numerous experiments show that spreadsheets can be very dangerous for business, because of their error-proneness (Caulkins et al., 2007; Panko, 2005, Panko & Aurigemma, 2010, Powell et. al., 2008). Within European Spreadsheet Risk Interest Group (EuSpRiG) conferences a lot of significant evidences about spreadsheet errors that caused huge financial losses have been collected and presented over the last fifteen years (European Spreadsheet Risks Interest Group - spreadsheet risk management and solutions conference, n.d.). Consequently, spreadsheet risk awareness has been significantly increased and researchers have proposed a number of techniques and automated tools aimed at supporting end-users in the development and usage of error-free spreadsheets (Jannach et al., 2014).

Spreadsheet applicability can be considered from the aspect of logistics and supply chain management. Supply chain problems can be effectively presented and analyzed in spreadsheets. Spreadsheet can be appropriate environment for implementation of different analytical methods, aimed at obtaining of the feasible and practicable solutions (Smith, 2003). The use of spreadsheets as decision making software tool for logistics is driven by the need to optimize and integrate the supply chain. These tools are effective in determining the optimum number of distribution locations, the appropriate mix of transportation modes, production scheduling, inventory optimization, product rationalization, strategic planning exercises, etc. In comparison to the specialized logistics software, spreadsheets provide required flexibility through the analysis from many different perspectives. These models can be easily modified and enhanced in order 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. Spreadsheets may implement simulation or optimisation models or both in the same time. Understanding of spreadsheet simulation models represents a basis for understanding of different logistics problems, which is important for practical investigations or for further shifting to special software (Djordjevic & Vasiljevic, 2013). Of course, complex logistics or supply chain problems require advance knowledge of spreadsheet modelling and domain knowledge. Although this can be considered as one of disadvantages, because of spreadsheet popularity which is partially based on the ease of usage without formal programming education, an alternatives of spreadsheet modelling and simulation require much longer learning curve. Logistics and supply chain managers are usually more familiar with spreadsheets then with programming languages. Additionally, errors in such models may cause inconceivable consequences.

Spreadsheets are related to engineering area, too. They have become accepted computational tool and a powerful platform for engineering calculations. Relatively simple and flexible development, the use of named ranges and labels that enhance readability of formulas and ability to manipulate matrices have contributed to the popularity of spreadsheets in this field. The use of macros for looping and other high-level programming needs, and its widespread availability and portability also promoted its acceptability (Oke, 2004). Considering wider area there are many examples: use of spreadsheet programs in electromagnetic (Yamani & Kharab, 2001), complex multidisciplinary engineering models implemented as spreadsheet models (Birch et al., 2014) business modelling in spreadsheet (Leong & Cheong, 2008), spreadsheets for operations research problems (Munisamy, 2009), production planning (Walton & Metters, 2008) and production research in spreadsheets (Johnson, 2002), spreadsheet simulation models as a platform for understanding of discrete events and system dynamics (Robinson, 2003), etc. Another significant advantage, provided by spreadsheets, is research modeling. Spreadsheet research modeling can be defined as a usage of spreadsheet program as a tool for structuring, exploring and understanding of different engineering problems. In this manner, modeling process enables cognition of key questions, problem redefining, construction of main logic and even a solution obtaining.

When it comes to the field of education, it is necessary to highlight usability and adaptability of spreadsheets. Examples of successful integration of spreadsheets and different subject curriculum are numerous: management science courses (Grossman, 2006), operations management (Gardner, 2008), logistics management (Djordjevic & Vasiljevic, 2013), engineering education (Oke, 2004), business modelling (Leong & Cheong, 2008), finance and accounting (Howcroft, 2006; Willis, 2016), decision modelling (Regan, 2005; 2006), decision support systems (Palocsay & Markham, 2002), etc. Spreadsheets enhance the collaborative component of education, with an increased focus on the learning process. These applications reduce the need for tedious calculations allowing greater attention to be focused on the subject itself. Even more, students are encouraged to design and develop their own templates and models in each content area, aimed at problem solving and decisions making based on quantified evidence. Spreadsheets enable motivating of

students. Students can model problems by themselves quickly, in that way understanding of problems is easier, and very important, students can see result of their work in the short time (Đorđević et al., 2017). In spite of the overall acceptance of spreadsheets in educational area, methods of incorporating spreadsheets in curriculum are often questionable. There is a common misperception that spreadsheets are somehow "easy" to use. However, the spreadsheet is a powerful rapid development computer programming language that requires software engineering for serious work. People struggle to efficiently build effective, transferable spreadsheet models. Students need certain spreadsheet engineering principles that they do not know, but value highly when they learn them (Grossman, 2006). According to Grossman (2006), spreadsheet engineering education should be considered as a hierarchical model where levels are: skills, capabilities and practices. Additionally, spreadsheet management principles and standards related to documentation, usage, modification, sharing and archiving are often not included in the content of the curriculum.

Certainly, beside described spreadsheet application areas, there are many others. According to research presented in Baker (2006), which included almost 1600 respondents, spreadsheet end-users work in a variety of business functions: finance, engineering, manufacturing, marketing, sales, administration, etc. Interesting example of spreadsheet prevalence, presented in Iyengar & Svirbely (2005), includes even medical-related spreadsheets, where MS Excel spreadsheets encoding medical algorithms from 45 different areas of medical practice.

3. CHALLENGES OF CONTEMPORARY BUSINESS WORLD

It is indisputable that essential spreadsheet features have enabled overall success and acceptance of this technology, over the past three decades. However those characteristics are also the cause of a number of constraints and challenges. Spreadsheet error-proneness represents burning issue in the professional and research communities. Errors caused by insufficient user's knowledge or even simple omission are easy to make but difficult to detect. Further, spreadsheet models are usually developed in an informal manner, intuitive, without any formal rules, standards and good design practices as well, which consequently leads to erroneous spreadsheets and bad decisions. Bad decisions caused by spreadsheet errors results it financial losses, business failure or industry and research horror stories (Croll, 2009; Thorne, 2013; Herndon et al., 2014). As it is previously mentioned, there are many researches proposing a number of techniques and automated tools aimed at supporting end-users in the development and usage of error-free spreadsheets (Jannach et al., 2014). Furthermore, high error rate is consequence of hidden underlying structure of spreadsheet models. Understanding of wider hidden structure, especially when formulas interact across worksheets is quite difficult.

Although spreadsheet represents one of the favourite tools of end-users, because they are enabled to build their own supporting software tools, which directly encode their expertise, this same ability may cause problems. Usually, end-users are not professional programmers familiar with software development methodologies and standards. Professional programmers understand the difficulties of creating error-free code and they are trained to avoid errors (Powell et al., 2009). Spreadsheet developers are mostly self-taught and consequently less aware of dangers that errors pose. Additionally, end-users often don't have "clear picture" about spreadsheet model structure and elements.

Another important constraint of spreadsheet technology is limited scale. According to Birch (2018) "Current spreadsheets are unable to scale to support large datasets which are increasingly encountered. While the maximum number of rows Microsoft Excel supports has increased from 65536 (2^{16}) to 1,048,576 (2^{20}) over the last decade, this limit is still frequently less than the data encountered and which professionals seek to gain insight from".

In addition to the existing restrictions, contemporary business sets new challenges for spreadsheet tools. Challenges, which include Big Data analytics, end-user computing, mobile computing, digital business, cloud computing, unquestionably shape the evolution and use of spreadsheet technology. Increased volume of data requires external databases or files or APIs, while spreadsheet should provide new mechanisms for working with such data. Another interesting idea considers extraction of algorithms from spreadsheet and application over data in the cloud. Data analyzes should be extended beyond structured numeric data, in accordance with heterogeneous and unreliable data. Although, spreadsheet data analysis tools constantly evolves, further incorporation of machine learning algorithms for classification of data or advanced statistical tools for model testing, is necessary. Certainly, cloud based spreadsheets are already all around us and this direction is the opportunity for the large amounts of computing to be applied to models, as well as online collaboration and joint analyzes. However, online spreadsheets open new questions related to multi-user editing, shared workbooks and overall security and accuracy issues.

Considering fast-growing changes in technology, increased need for processing large amount of data and all the above mentioned, there comes up a question "How can we make the most of it by using spreadsheets and is this technology appropriate in contemporary business environment?". In order to satisfy needs of modern users, related to data processing, spreadsheet technology is directed toward modification. Following section represents some of new, alternative manners of developing spreadsheets, aimed at keeping up with new technologies and tasks that modern business puts ahead of it.

4. NEW DIRECTIONS OF SPREADSHEET DEVELOPMENT

People are still struggling to respond to the challenges of modern business of digital age, using only spreadsheets. In accordance with the needs those challenges bring up, many authors developed spreadsheets in order to adapt them to these needs. This section presents some of the new, and in some sense alternative directions of developing spreadsheet technology which can keep up with the challenges of nowadays business.

4.1. A Spreadsheet Model for Handling Streaming Data

Considering the fact that nowadays data analysts often have a need to work with some real-time data such as market orders, news feed, sensor network data etc. appropriate tool for working with this type of data is necessity. This data usually originated from web and in order to use it one has to write a complex code which provides streaming of real-time data. Even though creating these types of tools, which provide streaming data from web and possibility of manipulating with, it requires a lot of time and effort. Additionally one of important flaws is lack of customization. In order to overcome this flaw and to make easier creation of such a tool, authors Chang and Myers (2015) developed a dynamic model using spreadsheet that allows end users to work with streaming data from web data sources. There are a few possibilities that the model provides to its users: first, model allows users to stream data from web without need to preprogram sources of streaming into the tool; second, it presents a design for spreadsheet cell "metadata" which further describes cell's value with information about source and fetched time and consequently allows user to manipulate streaming data within spreadsheet; and finally it's possible to pause and restart streaming at any moment. Also, it enables gathering of data from web input elements, such as textboxes on websites. The biggest point of difference of this model is its ability to provide temporal information of time when data are retrieved, whereby user is allowed to manipulate with it in the way he/she wants. This tool is a web application with client-side spreadsheet and a backend server where all of the streamed data is stored.

- The key features of the tool are (Chang & Myers, 2015):
- Creating a data stream in the spreadsheet – in order to do so, the user needs to enter URL in the source pane of the tool, and to select spreadsheet range where data pulled from the web should be shown;
- Manipulation of streaming data by using temporal information – each streamed cell contains metadata for value stored in that particular cell, concretely about its source and fetched time. Consequently, data can be displayed or manipulated by using its value, source and temporal information. In order to access metadata of cell, authors have provided formulas called *FETCHTIME (cellName)* which shows retrieval time of cell and *SELECTBYTIME (startTime, endTime, range)* which returns data in defined range that has been streamed between *startTime* and *endTime*;
- Streaming time control – the user can set when he/she wants data to be streamed;
- Stream data from web input elements – a user can stream data from web UI elements such as textboxes or forms;
- Save and close a spreadsheet – a user has possibility to save a spreadsheet on the server and to choose whether to save streamed data after closing a spreadsheet.

4.2. SpreadComp platform

Nowadays, a lot of organizations, regardless their size, use spreadsheets in order to process data of some critical business processes. Data processed in such a way usually have to be shared between some employees whereby spreadsheet-based "distributive workflow" has to be created (Mangiante, Maresca & Roncarolo, 2012). To make it possible, there has to be created collaborative way of working with these spreadsheets among employees within organization. It could be performed by using cross-spreadsheet links, manual techniques (copy and paste) or by sharing spreadsheets through e-mail. All of these mentioned possibilities have many flaws in domain of various kinds of errors, security and data loss. Authors of *SpreadComp* (Mangiante, Maresca & Roncarolo, 2012) state that spreadsheet users should not work with tools other than spreadsheet applications in domain of collaboration. From this perspective, authors created a platform based on three collaboration (data sharing) patterns:

1. Flat scenario – the simplest scenario in which user shares data from his spreadsheet with other users via internet network. User selects range of data within his spreadsheet that he/she wants to share and uploads it to the file which then becomes available to the other users. File is linked to its source, so file gets updated when changes are made in its source. This scenario is base for other two.
2. Reverse peer to peer scenario – case in which user requests other user to provide him data by filling out predefined template in the form of formatted spreadsheet area. After receiving request, data provider fills out template with requested spreadsheet data and sends it back to requester.
3. Composition scenario – this scenario implies a complex collaboration which includes several users and/or templates where is determined from whom the data is provided and who is its consumer.

In order to make collaboration possible, the platform is based on client-server architecture. Client part is in the form of Excel's add-in by which user can control operations of data import and export. *SpreadComp* server communicates with Client Add-In via Web Service which provides a set of functions that allows users to be authenticated and to perform CRUD (Create, Read, Update, Delete) operations on exported/imported data. Server includes spreadsheet engine and enables uploading of a file to a server, aimed at reevaluation of the file as a result of changes in its source, even when the client's Excel file isn't opened. A web application includes platform which enables administrator to manage user accounts and to control whether the whole process is taking place in the right way.

4.3. The Spreadsheet Space

Spreadsheet Space is a virtual space for tabular data sharing that is based on cross-spreadsheet links by which spreadsheets in different systems can be connected. Connection is established through Internet with no limitations. The *Spreadsheet Space* empowers spreadsheet interconnection and allows its users to develop a variety of models based on this technology. One of the biggest advantages of this platform is a power of cloud-based sharing additionally empowered by security of desktop application. In order to provide these abilities synchronization of spreadsheets has to be established, which is implemented by cross-spreadsheet references. Those references present dependencies of cells from different spreadsheets. Because of its dependency, update of a cell in one spreadsheet can trigger updates in other dependent cells which mostly belong to other spreadsheets.

In order to understand how the platform works, the terms "view" and "image" has to be explained. Creating a "view" is associated with choosing element, which can be a cell, a range of cells or table. "View" is created and controlled by spreadsheet user and presents a persistent copy of associated element. "View" is also, constantly synchronized and is only associated with its element. On the other hand, "image" is associated with view and through it, with spreadsheet element itself. Using an "image" other user can obtain data that "view" creator provided. Synchronization among spreadsheets is maintained as a combination of synchronizing between "view" and element, and between "image" and "view".

Exchange of data between users is triggered by requests which are made by users itself. In order to request data sharing, user fills out a form as a formatted cell range, called spreadsheet overlay, and exposes it to other users as a "view". Then, invitation to targeted users is sent with attached form, or forms which they have been requested to fill out or receive. As soon as all the participants have confirmed their participation, data sharing is taking place.

The *Spreadsheet Space* platform uses system which includes the server and client software. The server is responsible for persistency and synchronization, while the clients are associated with spreadsheets and software platforms by which they can participate in *Spreadsheet Space* platform. Users of this platform have pointed out some of the key factors of successful acceptance of its usage, and those are: known interaction patterns, trust and a sense of security.

4.4. Spreadsheets as a Service Composition Tool

There are a lot of spreadsheet users that on a daily basis create their own solutions for automatization of their work within spreadsheets. They are end-user developers because their main job is outside of computer science and they use simple techniques and methods in order to be more efficient during regular work. The main goal of authors (Obrenović & Gašević, 2008) was to enable spreadsheet-based service composition where various services could be achieved by end-users through spreadsheet formulas. In order to do so, authors created *AMICO:CALC*, a framework for end-user spreadsheet-based service composition. It is an extension of middleware platform called *AMICO* which makes easier process of adaptation, abstraction and mediation of various software services. *AMICO:CALC* connects spreadsheets to different software services with simple user interface enabled. Two main parts of *AMICO:CALC* are (Obrenović & Gašević, 2008): middleware for heterogeneous services (which allows choosing and starting diverse services) and

spreadsheet extension for service composition (functions for service composition). Compared to other existing solutions, the biggest point of difference of this framework is its wider scope, because it can work with various software services and it integrates additional services. In order to make various service composition, user can use functions for reading and updating, *AMICO* variables developed by authors Obrenović and Gašević (2008): *AMICO_WRITE(<variable-names>,<values>)* and *AMICO_READ(<variable-name>).* The first one updates variables with given values, while second one updates the spreadsheet when new value is received. These functions allow user to organize the input and output of services. One of the examples of this framework usage is selection of coordinates from Google Maps service to the updates of spreadsheet cells, and then calculation of distance between these coordinates.

5. CONCLUSION

This paper presents some of the most important spreadsheet application areas and in the same time points out some of the major issues and challenges that modern business puts ahead of spreadsheet users. Furthermore, the authors of the paper indicated a few of alternative development directions, which should provide the answer to the question whether spreadsheet can "survive" in the future. Described newly developed spreadsheet solutions include handling streaming data, collaborative work within spreadsheets and end-user spreadsheet-based service composition.

At the present time, it cannot be known for sure weather elements necessary for spreadsheet improvement going to become regular part of the software or external complimentary tools. All of that imposes another new challenge for spreadsheet users, who will be oriented toward permanent learning of additional tools and effective usage of them. In the same time, spreadsheet should remain simple and flexible tool for working with data, analyzing and modeling. Indisputably, development of spreadsheets has to driven by the needs of modern business. Spreadsheets can keep up with the challenges of contemporary business world only by further development of this technology. In a view of modification of existing technologies and their adaptation to the needs of modern business, spreadsheets are very convenient, because of their widely user-acceptance and possibilities for end-user development, which allows creating models and applications by users whose main job is outside of computer science. Regardless organization size, presented spreadsheet solutions are very useful for all of those who are processing a large amount of data on a regular basis and want to use well known and easy to learn software for analyzing their business processes.

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THE S&OP: PRACTICAL AND ADVANCED MID-TERM PRODUCTION PLANNING

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Abstract: *This paper aims to present and explore the process of Sales and Operations Planning in production companies in Serbia. The Sales and Operations Planning (S&OP) is practical and advanced mid-term planning process where company define production planning strategy to fit intermediate-range demand from market and production capacities. The paper outlines S&OP process according to applicable view from company managers and executives and the advanced view from management science. Besides, this process is described from the organisational point of view, i.e. hierarchy and connection among S&OP activities and people who participate in them. The result of the S&OP process is the plan that determines aggregate levels of production. Furthermore, the sales and operations plan links strategic company goals to production and coordinates the various planning efforts in a business, including: marketing planning, financial planning, operations planning, human resource planning, customer lead time (backlog) planning, new product development planning. The select part of this paper is dedicated to advanced concepts in S&OP where techniques of mathematical programming dominate. In addition, the author also presents the level of S&OP application in SME and large companies in Serbia and benefits of S&OP implementation on enterprises performance.*

Keywords*: Sales and operations planning (S&OP), aggregate production planning, advanced production planning, mixed integer programming, production companies in Serbia.*

1. INTRODUCTION

If we ask the management of a company, what would be the ideal sales and production plan, the answer will be fixed for the longer period. Fluctuations in business impose problems for managers to continuous review the defined plans. Adjustment of demand and supply (by the quantity and mix) must be on the short, medium and long-term, of course with best enterprise performance. Demand and supply synchronisation is determined through forecasting sales, capacity planning, production volume, workforce level, inventory planning, procurement, marketing, logistic, and other value chain activities.

This paper presents the concept of sales and operations planning (S&OP) process that helps managers to find the midterm solution for the balance between forecasting of customers' sales and enterprises business operations and capacities. The S&OP is defined as making intermediate-range decision to balance supply and demand, integrating sales, financial and operations planning (*Stevenson*, 2009, str. 611). From a manufacturing perspective, the S&OP provides the basis to focus the detailed production resources on achieving the firm's strategic objectives (*Vollmann et al.* 2005, p. 61). Similarly, *Gansterer* (2015) name this process as aggregate production planning, with the meaning of balancing capacity requirements and production quantities for medium-term planning horizons. The S&OP helps managers to obtain answers on these issues: the mid-term sales forecasting, mid-term flexibility of operations and their capacity, the key milestones in rolling planning horizons, different scenarios and actions for adverse events (*Vollmann et al.* 2005, str. 80). *Jelačić* (2017, p. 25) defined the S&OP as a very important tool, particularly for integrated business planning (marketing, operations, finance) and media for connection of strategic plan with daily business operations.

The S&OP problem in this paper is considered from two sides of view on this problem. The First view is the practical process of adjustment managerial decision about planning business operation. The second view presents the scientific answer to this problem with mathematical models which aim is to provide support in the decision making process. This paper is structured as follows: After the introduction, section 2 presents the concept of S&OP. Section 3 describes the organisation of this process as well as the small survey on the S&OP application in Serbian companies. Section 4 presents the advanced concepts of S&OP. Section 5 concludes the paper.

2. SALES AND OPERATIONS PLANNING

The Sales and Operations Planning (S&OP) is probably the least understood aspect of manufacturing planning and control. However, the outcomes from a well-designed and well-executed the S&OP are huge (*Vollmann et al.*, 2005, p. 60). The S&OP is positioned between strategic and operational planning level. Actually, the S&OP is like a tactical level of planning for the period from one to 18 months. In the S&OP, planning impulse comes from strategic level (top-down) and then continues to the Master Production Schedule (MPS), from the other side, input data for planning, analysis and making decisions, comes from the bottom-up side.

The S&OP links company's strategic goals to production and coordinates the various planning efforts in a business, including marketing planning, financial planning, operations planning, human resource planning, etc. If the sales and operations plan does not represent an integrated, cross-functional plan, the business can fail to succeed in its markets. (*Vollmann et al.* 2005, p. 60). The S&OP also provides the key communication links for top management to coordinate the various business planning activities (strategic planning, marketing planning, resource planning, financial planning, demand planning). Figure 1 shows the S&OP main connection (*Vollmann et al.* 2005, p. 61). Marketing initiatives dealing with entry of a new product in the market can be coordinated with an increase in production capacity to support the marketing plans. At the same time, financial resources are organised to maintain the working capital for the inventories.

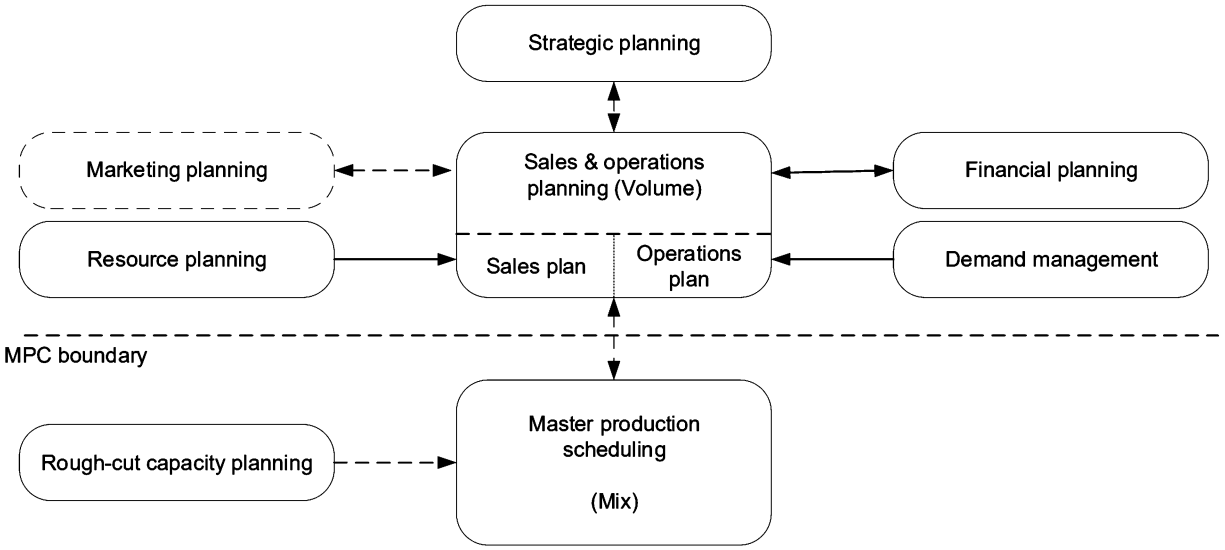

Figure 1: Key linkages in S&OP (*Vollmann et al.* 2005, p. 61)

Figure 1 also shows the S&OP link with demand management, which is realised through order entry, order promising, physical distribution and forecasting. The S&OP link with resource planning is achieved through capacity and material requirements (raw materials, parts, subassemblies). The S&OP is a process for determining aggregate levels of production, and it provides the framework within which the Master Production Schedule (MPS) is developed. Subsequent the MPS decisions can be planned and controlled, and material resources and plant capacities can be coordinated in ways that are consistent with strategic business objectives (*Vollmann et al.* 2005, p. 61). The S&OP links with the MPS and resource planning provide the essential data for what-if simulations of alternative plans. In that manner, quick evaluation of alternatives can facilitate the S&OP process.

There are four fundamental dimensions in S&OP: demand, supply, volume and mix. When demand exceeds supply, customer service decrease because manufacturing cannot provide the number of products required by a customer. Consequently, cost increase due to overtime, and quality suffers. Similarly, when supply goes beyond the demand, the effects are the following: inventories rise because of an imbalance between demand and manufacturing capacity; layoffs of workers results from production rate reduction and plant efficiency drops (*Vollmann et al. 2005*, p. 61). The primary goal is to maintain a proper balance between demand and supply and to provide early warning signals when they are becoming unbalanced (*Vollmann et al. 2005*, p. 61).

Two other fundamentals are volume and mix. The volume concerns big-picture decision about how much to make and the production rates for product families, while the mix concerns decisions about which individual products to make, in what sequence and for which customer order. Smart companies carefully plan their volumes first and then focus on mix decisions. If the amounts are efficiently planned, mix decisions become

much more comfortable to cope with (*Vollmann et al.* 2005, p. 62). The volume concerns rates: overall sales rates, production rates, aggregate inventories, and order backlogs. Unlike the MPS, the planning object in the S&OP is significant product families (a group of products that have similar characteristics), and the planning horizon is typical 15 to 18 months (*Olhager*, 2013). One of the S&OP issues is product families' determination, i.e. defining how many groups of product to consider in developing the sales and operations plan. *Vollmann et al.* (2005, p. 78), recommended six to twelve families. As a result of adequate volume planning the problem of the mix (individual products, orders and SKUs) in the MPS become more easier. Then, the MPS is a result of disaggregation of the S&OP process (*Vogel, Almada-Lobo, & Almeder*, 2017), where we defined the time for production and quantity of individual products. The MPS is base for further detailed planning activities: material requirements planning, job scheduling, raw material and components ordering, production dispatching (*Ivanov, Tsipoulanidis, & Schönberger*, 2017). The MPS might be stated in units that use particular bills of material to manage complicated operations and do not correspond to the units to communicate with top management (*Vollmann* et al. 2005, p. 63). However, the S&OP has that role of communication.

Figure 1 also presents that, the S&OP is divided on the operations plan (OP) and sales plan (SP). The OP is the planned production stated on the aggregate basis, for which manufacturing management is to be held responsible. The SP is base on a forecast of demand. The operations plan does not have to be equal to an estimate of aggregate demand. According to *Vollmann* et al. (2005, p. 63), it is not always profitable to satisfy all of the demand in a peak monthly period, but production would be levelled over the course of a seasonal cycle. Likewise, a strategic objective of improved customer service may result in the aggregate production more than aggregate demand.

The S&OP process in the literature (*Heizer & Render*, 2011; *Stevenson*, 2009), is also known as aggregate production planning. The S&OP is perhaps broadly defined because it includes financial planning consideration of operations decision and top management final decisions, however in the central and core part of this process is the domain of aggregate production planning. According to (*Omerbegović-Bijelović*, 2005, p. 69; *Gansterer*, 2015), aggregate production planning (AP), means the plan for aligning the capacity of production with demand in the mid-term, from 3 to 18 months in advance, i.e. determining aggregate volumes and period for production. *Gansterer* (2015) also defined the AP as integrated planning and coordination of enterprise resources (labour workforce, machine and tools capacity, inventories) and demand for quantity of different types of products in times period in which they are produced. Additionally, the AP can be observed for whole value chain of diverse production/service units. The S&OP and AP mechanism consider next decisions production rate, workforce level with hiring and firing, inventories level, overtime and under time production and work, alternative capacity forms such as outside contracting. The primary goal is a minimisation of overall costs (inventory cost, backorders cost, cost of workforce and production) in observing period.

Heizer & Render (2011, p. 547), and *Stevenson*, (2009, pp. 616-618) observed two main options in the AP and S&OP:

Capacity options:

a) Change of inventory level – this options is realised through a adjust of inventory level as a result of demand fluctuation and constant level of production. The advantage of this option is constant production level with steady workforce, which influences the stability of production organisation. Disadvantages of this options are: high inventory costs which can be 15-40% of product price (costs of: storage, insurance, manipulation, obsolescence, opportunity cost, stockout cost, cost of non-satisfied demand);
b) Change of workforce level (hire and lay off workers) and consequently change of production rate – one way for balancing among production and demand is constant correction of production and workforce level according to demand. The advantage of this options is the minimisation of overproduction and inventory cost. The disadvantages of this option are workforce fluctuation, which result of cost of training for rookies and severance pay for firing people. Also, the productivity of newly hires people, not on a high level. The Layoff is a process of omission people with knowledge and experience. Change of workforce level also means overtime, slack time, part time and under time work of employees. *Imai* (2017, p. 244) stated that in some industries in Japan, part-time or under time workers make 50% of total workforce. Part-time and seasonal workers are mainly present in the service sector.
c) Subcontracting – Enterprise subcontract jobs with other similar enterprises during period of increased demand. This option takes the risk of product quality and delivery time as well as customer cession to another enterprise form the same industry.

Demand options:

a) Influence on demand – when the forecasted demand is at the lower level than production capacity, demand can be increased with the impact of marketing mix elements (product, price, promotion, and place).

b) Backorders – in a period of increased demand, an enterprise can accept orders with longer lead-time to maximise capacity utilisation over the more extended period and to satisfy customers that are willing to wait.
c) A seasonal mix of product – Enterprises adopt portfolio products with complementary demand pattern and this result in its relatively constant demand and capacity utilisation during all time periods.

Enterprises usually combined all mentioned options to defined midterm production strategy which are the essence of S&OP/AP process. Typical basic or pure strategies for meeting uneven demand (*Stevenson*, 2009, p. 618) are:
Chasing demand strategy – implies to match production rate according to forecasted demand period by period. This strategy is realised via next options: production rate change, hire and lay off workers, overtime and undertime.
Level strategy – is achieved through two directions „maintain a level workforce" and „maintain a steady output rate". As a result of this strategy, we have inventory change, growth and decline, from period to period.

Beside two pure strategies, in practice there much more mix of this two strategies through a combination of different options (a, b, c) and their decision variables, to obtain minimal costs in the planning period. The S&OP/AP strategy with minimal costs, i.e. optimal strategy is not always easy to find. However, different methods and techniques help in finding an optimal strategy (*Thomé et al.*, 2012). General procedure for realizing the AP, according to *Stevenson* (2009, p. 618), include next steps: 1) Forecast demand for each period; 2) Determine capacities for each period (regular, overtime, subcontract); 3) Identify company or department policies that are pertinent; 4) Determine unit costs (workforce, inventory, production rate); 5) Develop alternative plans and their costs; 6) Select the plan that best satisfies objectives, otherwise return to step 5.

3. ORGANISATION AND APPLICATION OF S&OP PROCESS

If we ask the management of a company, what is the S&OP process, they will replay that this is the process of making mid-term planning decisions, which coordinate sales and production activities with forecasted demand and market requirements. The S&OP is the process that is realised through a series of cyclically held meetings, which are maintaining at different levels and among different sectors. The S&OP aim is a generation of precisely defined and relevant information (plans, indicators and performances) for management decision making (*Đorđević*, 2017., p. 44). Hence, in the process of making mid-term strategy, i.e. plan, representatives of various organisational units participate (demand and supply manager, production manager, purchasing manager, financial manager and CEO). The S&OP cycle is present, in Figure 2, with following types of meeting:
Product review – within this meeting, product range/portfolio are revised, new products, which will be launched in next period, are eventually defined. Furthermore, the particular brand performances, as well as future marketing activities, are reviewed.
Demand review – within this meeting, sales department estimate demand volumes in general time periods. The base for this activity is information about the market, its potential growth and decline, and sophisticated method for forecasting future demand.
Supply review – this meeting prepare the answer, as a result of the previously defined information. Results of this meeting are outlined midterm production and supply strategy and scenarios. The critical issues for this phase are: Can we produce already defined products? Can we satisfy sales through production and supply? Are there enough capacity to meet forecasted demand? Are the supply costs adequate? The result of supply review meeting is production strategy, which includes the balance of production resources and inventory levels with customer service level.
Financial review – aims to harmonise and approved all previously defined assumptions, analysis, and decisions, with business indicators (costs of supply, profit, investment, and cash flow).
Top management business review – the purpose of this top management meeting is to defined final strategy, i.e. midterm plan, which is based on all other decisions from previous phases. This review is not the end of the S&OP process. The S&OP is rolling and continual planning process, which is realised once a month. Like each other planning process, it needs to adjust to specifics of particular company or industry.
Types of meetings, their agenda and frequencies are not fixed defined. Moreover, the development of the S&OP process and it's primary activities may be different which depend on organisation implementation of this process. *Lapide* (2005 p. 14) presents in detailed the Maturity model of the S&OP process implementation with next four stages: marginal process, rudimentary process, classic process, ideal process. The difference of this four stages of the Maturity model refers to formality and integration of planning process, level of organisation of planning process, use of IT, and collaboration with other value chain participants.

To examine the level of production planning development, and the S&OP application we surveyed large, small, and medium-sized production enterprises in the Republic of Serbia. In the period from September and November 2017, we examine 79 production companies with the self-administered questionnaire. Here we present the small part of the survey with relevant questions for S&OP topic: the organisation level of planning process, the integration level of planning process, the application of aggregation planning method. The primary respondent groups were owners and employees (operations manager and planers) from production enterprises. The enterprises were from next categories by size: 29 are from the category of large enterprises, 53 are SMEs. Mean value of the total number of employees, in surveyed enterprises, was (M = 226), with standard deviation (SD = 335.7). Surveyed enterprises were from the following categories, observing the type of manufacturing process: 39 enterprises from make-to-order category, seven from engineering-to-order, and 32 from make-to-stock category.

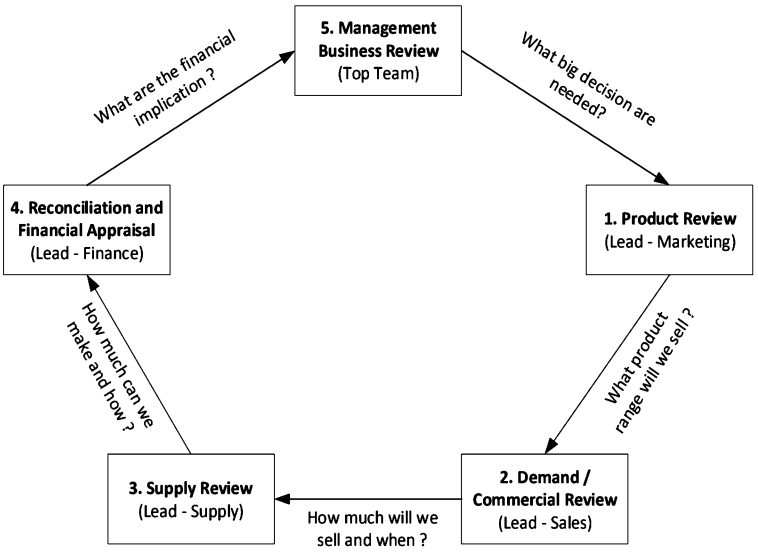

Figure 2: The S&OP cycle with different meetings (*Đorđević*, 2017., p. 44):

The significant questions in the survey about the level of production planning development were:
The organization of production planning process, the scale with next levels: 1 – Plans are created by owner/manager of company; 2 – plans are created by production managers 3 – plans are designed by group of production managers and planers; 4 – During the planning process, decisions are coordinate with other organizational units (marketing, finance, HR); 5 - During the planning process, decisions are coordinate with other value chain participants.
The integration of production planning process within the entire enterprise planning system, have next levels: 1 – planning activities are not connected and there is no interchange of data within the planning system; 2 – planning activities are connected, the data interchange is realized manually, by physical data input into forms and tables; 3 – planning activities are connected, the data interchange is realised across spreadsheet tools (e.g. MS Excel tables); 4 – planning activities are connected, the data interchange are obtained across automated electronic data interchange system (EDI); 5 – planning activities are connected, the data interchange is obtained across totally automated and integrated planning system within ERP software;
The application of aggregate production planning method the scale with next levels: 1 – have not heard about the mentioned method; 2 – have heard about the mentioned method, still do not use it; 3 – have heard about the mentioned method and you plan to implement it; 4 - have heard about the mentioned method, and you use it occasionally in production planning; 5 - have heard about mentioned method, and you use it frequently in production planning.

Table 1: Survey results

Observed variables and their values (1-5 scale)	Mean (M)	Standard deviation (SD)
The organisation level of the planning process	3,18	1,52
The integration level of the planning process	3,09	1,12
The application of aggregate production planning method	1,65	1,16

The survey results on the sample of 79 enterprises in Serbia are presented in Table 1, in the form of mean values (M) and standard deviation (SD) in respondents answers on previously defined questions.

First, we present result about organisation level of production planning process. The results obtained on the observed sample (N = 79), shows that the organisation level is on average (*M* = 3,18; *SD* = 1,52). This result indicates that, on average, there is a group production planning by the team of managers and planers. However, the plans are not in tune with other organisational units and sectors, which is the case in the S&OP process. The second result was about integration level of production planning process. Among surveyed enterprises in Serbia, integration of production planning process was on the average level (*M* = 3,09; *SD* = 1,12). More precisely, it means that particular activities in the production planning process are connected, and the data are interchange across spreadsheet tools. This results point out that there is still more opportunity for improving the level of production planning development at Serbian enterprises, as well as the S&OP is still a big challenge for implementation. As regards to application of aggregate production planning, results show the very modest level of implementation in surveyed Serbian enterprises. The average values (*M* = 1,65; *SD* = 1,16), in the studied sample, were among questionnaire statement about ignorance and just conversance of this method without any implementation.

Notwithstanding that survey results, which presents the condition of Serbian enterprises, were not favourable, *Đorđević* (2017, p. 46), show numerous advantages of the S&OP implementation in case of some companies. Table 2 presents benefits in the form of quantitative indicators. The same author (*Đorđević*, 2017, p. 46) stated the next qualitative indicators of advantage in S&OP implementation: reduction of redundant activities, better response to customer requirements, employees' teamwork, increases the level of responsibility.

Table 2: Benefits of implementing the S&OP process. Source: *Đorđević* (2017, p. 46)

No	Benefit	Value difference (Δ)	direction
1.	Profit margin	5,5-8,5%	↗ increase
2.	Sales forecast accuracy	42-84%	↗ increase
3.	Raw material and finished goods inventory	25-31%	↘ reduction
4.	Obsolescence of product	31-40%	↘ reduction
5.	Stock-out	46%	↘ reduction
6.	Planning delivery time	25%	↘ reduction
No	**Benefit**	**Value level**	
1.	Service level (OTIF)	82-91%	

The particularly significant benefit of the S&OP process is obtained strategy of production resource capacity adjustment. Different decisions about production capacity adjustment have a different period. For example, decisions about expansions of production capacities, through purchasing of new production equipment, machines, can be realised in a few months. On the contrary, an introduction of new shift schedule with new engage workers and overtime work is a decision that can be achieved in the short term, several days in advance. Depending on a difference between required capacity (which is defined across demand) and available capacity (which is a consequence of machine and workforce condition), it is necessary to identify recommendation for increasing available capacity. Examples are increase of Overall Equipment Effectiveness, purchasing of new equipment, machines and tools, new workforce shift plan, subcontracting, investments in new production facilities.

Plans that are adopted in the S&OP process are further transfer to master production schedule (MPS), where the product mix and precise volumes by every SKU are defined, and rough schedule by production line in time. Bearing in mind that capacity of different value chain participant may limit the capacity of leading manufacturer, adequate information from the S&OP process at the right moment, may be of crucial importance. In that manner, the S&OP and aggregate planning found its importance in planning of other activities in the value chain.

The S&OP processes primarily use internal supply-demand data (customer orders, shipments, on-hand inventories, and production capacities) as inputs. More recently, external information from other value chain participants (using the concepts: Vendor Managed Inventories (VMI), Collaborative Planning, Forecasting, and Replenishment (CPFR), Point of Sale (POS)), provide for every company, external information about future supply and demand. (*Lapide*, 2004).

4. ADVANCED CONCEPTS OF THE S&OP PROCESS

In the S&OP there is the strong need for modelling determination of the best mid-term production planning strategy with mathematical programming techniques. This part of the paper presents the advanced approach for modelling aggregate production and inventory planning which is the result of the S&OP process. For

mathematical modelling in the S&OP process, it is particularly important to define following parameters in every period: production rate, sales forecast, the method for determining costs, the volume of workforce and their production rate. In the next model of mixed integer programming (*Vollmann et al.* 2005, p. 415), the aggregate plan is determined on a product family basis. The product families are defined as groupings of products that share common manufacturing facilities and setup times. In this case, overall production, workforce, and inventory plans for the company are mostly the summation of the plans for individual product lines. The mixed integer programming mathematical model provides one method for determining the number of units to be produced in each product family, in each period. The goal is to find the best aggregate plan with the lowest value of criteria function, i.e. total cost function.

$$min \sum_{i=1}^{n}\sum_{t=1}^{m}\left(C_{si}\sigma\left(X_{it}\right)+C_{mi}X_{it}+C_{Ii}X_{it}\right)+\sum\left(C_H H_t+C_F F_t+C_o O_t+A_{1t}C_R W_t\right) \quad (1)$$

subject to

$$I_{i,t-1}-I_{it}+X_{it}=D_{it} \quad \left(for\ I=1,...,n\ and\ T=1,...,m\right) \quad (2)$$

$$A_{1t}W_t+O_t-\sum_{i=1}^{n}X_{it}-\sum_{i=1}^{n}\beta_i\sigma\left(X_{it}\right)\geq 0 \quad \left(for\ t=1,...,m\right) \quad (3)$$

$$W_t-W_{t-1}-H_t+F_t=0 \quad \left(for\ t=1,...,m\right) \quad (4)$$

$$O_t-A_{2t}W_t\leq 0 \quad \left(for\ t=1,...,m\right) \quad (5)$$

$$-Q_i\sigma(X_{it})+X_{it}\leq 0 \quad \left(for\ t=1,...,m\ and\ I=1,...,n\right) \quad (6)$$

$$\sigma\left(X_{it}\right)=\begin{Bmatrix}1 & if\ X_{it}>0\\ 0 & if\ X_{it}=0\end{Bmatrix} \quad (7)$$

$$X_{it},I_t,H_t,F_t,O_t,W_t\geq 0 \quad \left(for\ t=1,...,m\right) \quad (8)$$

$$Q_i=A,\quad Q_i\geq\sum_{t=1}^{m}D_{it} \quad (9)$$

Where:

X_{it} - Production in hours of product family *i* scheduled in month *t.*

I_{it} - The hours of product family *i* stored in inventory in month *t.*

D_{it} - The hours of product family *i* demanded in month *t.*

H_t - The number of employees hired in month *t.*

F_t - The number of employees fired in month *t.*

O_t - The overtime production hours in month *t.*

W_t - The number of people employed on regular time in month *t.*

$\sigma(X_{it})$ - The binary setup variable for product family *i* in month *t.*

C_{si} - The setup cost of product family *i.*

C_{Ii} - Inventory carrying cost per month of one labour-hour of work for product family *i.*

C_{mi} - The material cost per hour of production of family *i.*

C_H - The hiring cost per employee.

C_F - The firing cost per employee.

C_o - The overtime cost per employee hour.

C_R - Regular time workforce cost per cost per employee hour.

A_{1t} - The maximum number of regular-time hours to be worked per employee in month *t.*

β_i - Setup time for product family *i.*

A_{2t} - The maximum number of overtime hours per employee in month *t.*

n - The number of product families.
m - The number of months in the planning horizons.
$Q_i = A$ - Large number used to ensure the effects of binary setup variables;

The criteria function (1) presents the total cost function, which includes cost of regular workforce, cost of hire and fire, cost of inventory on hold, cost of overtime and undertime, cost of setup time. Following explanations of constraints in the mathematical model is presented: (2) inventory constraints; (3) production and setup constraints; (4) workforce level change constraints; (5) overtime constraints; (6) setup constraints; (7) binary constraints for setup. Furthermore, constraints (6) and (7) in mathematical model assumes all the setups for product family occurs in the month in which the end product is to be completed. Constraint (7) is a surrogate constraint for the binary variables used in constraint 6. This constraint forces $\sigma(X_{it})$ to be nonzero when $X_{it}>0$, since Q_i is defined as at least the total demand for a product family over the planning horizon; (8) nonnegative constraints. Additional constraints should be added to the model to specify the initial conditions as the start of the planning horizon; that is, constraints specifying beginning inventory for the product family I_{io}, and workforce level in the previous month W_o, are required. Likewise, constraints defining workforce level at the end of the planning horizon, and minimum required closing inventory balance at the end of each month in the planning horizon may be added.

5. CONCLUSION

This paper presents Sales and Operations Planning (S&OP) process from the production-planning point of view. After the detailed introduction of the S&OP concept, this paper presents the survey on level of production planning development and implementation of S&OP concept in enterprises in Serbia. The results show that this concept is on the low level of application. Furthermore, the process of production planning in Serbian companies is at the middle level of planning organisation and integration. These results show that there are much more challenges for improvement. Additionally, the S&OP is still the big issue for Serbian enterprises. The particular part of the paper is dedicated to the advanced concept of the S&OP. It tries to find answer on following question: How can aggregate production planning can be modelled using mathematical programming technique? The author presents the model of mixed-integer programming. Further research in this field of study should focus on detail analysis of the S&OP implementation level in Serbian companies. Also, the author intends to apply the proposed mathematical model in real business practice.

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DEVELOPMENT OF A MODEL FOR DETERMINING THE NUMBER AND PLACEMENT OF ACCESS POINTS TOTHE PUBLIC POSTAL OPERATOR NETWORK

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Abstract: *This paper shows a developed methodology for defining access points to the Public Postal Operator (PPO) network. Based on an analysis of postal services market, which has shown the ongoing process of liberalization in the Republic of Serbia (RS), we have suggested a methodology for determining the number and placement of access points; this method will ensure the universal postal service (UPS) throughout the whole country and competition in urban and rural areas. The main purpose of the study is to create a dynamic model which will define possible alternatives and set criteria for optimization. In this paper, optimization of access points has been done applying qualitative methods (the Delphi Method and Scenario method) and the method of multiple criteria analysis. Optimal postal network access points will contribute to faster development of e-commerce and goods distribution in the whole country.*

Keywords*: postal network, postal market, access points, liberalization, optimization*

1. INTRODUCTION

Until recently, the postal services sector in the Republic of Serbia was focused primarily on providing traditional postal services (letters and packages). However, the evolution of modern technologies, electronic communications and the Internet have directed the development of postal services towards new e-postal services, e-commerce and digitalization. The postal network, due to its availability and uniqueness, opens up new possibilities for meeting users' needs on the communications market, which gives it a significant role in an overall development in the digital era.

In the Republic of Serbia, the Public Postal Operator is „Post of Serbia“, which is the leader in the field of electronic communications, which is confirmed by CePP - Centre for Post of Serbia E-business. CePP is a multimedia service provider that offers e-services to meet users' needs, while guarantying top protection of electronic transactions and transferred information. CePP offers numerous electronic services, grouped in categories (e-post, e-government, e-finance and e-commerce), and Serbian Post Certification Authority (SPCA) is of great importance because it issues digital certificates, which are intended for all participants of electronic business in the Republic of Serbia, regardless of whether they are legal or natural persons.

Analysis of PPO postal services in the RS shows a constant decrease of letter posts since 2012. The number of letters in 2016 dropped by 12 million comparing to 2015. The number of packages has also deteriorated greatly over the last few years, whereas the number of express and courier services has grown (Strategy, 2017). Considering that the postal sector is changing fast and that the volume of express services is constantly on the rise, whereas letter posts decreases, it is necessary to redefine and improve many business processes and activities within the postal system, in order to ease the shipping of goods purchased on the Internet and create new possibilities for postal market development.

The level of development of the postal market can be monitored through the UPS share in the total scope of services. According to National Regulatory Authority (NRA), in 2016 the UPS accounted for 91% of all postal services, whereas the revenue of the UPS in 2016 was 49%. This implies that commercial services are very profitable and therefore it is important to stimulate e-commerce, which is expanding in the whole world (Strategy, 2017).

The access is supposed to balance the UPS provision, because the PPO is, unlike other competitors, obliged to provide the UPS (Tehnika, 2017). Determining the number and placement of access points on the PPO network would facilitate the expansion of distributing centres and collection points for online purchased items, which would propel the progress of e-commerce and e-exchange, especially when the RS becomes a member of the EU and the borders are removed. Hence, it is important to offer a unique platform for postal

network access, with available parcel collection points, with a developed information communication basis and available PPO resources.

2. POSTAL NETWORK ACCESS IN THE REPUBLIC OF SERBIA

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 (Unterberger, 2016). 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"*(Directive 2008/6/EC)**,** in order to protect the interests of users and ensure continuous, quality and sustainable provision of a universal postal service" (Unterberger, 2016).

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 shown that the models of access differ and are specific for each country (Unterberger, 2016). Each country based on its demographic, social and economic characteristics, as well as numerous characteristics of the postal services market, defined the access points as well as all other necessary conditions (prices, type and quantity of shipments), but the manner of definition was not determined.

It is known that postal operators can use two basic access models: *upstream* and *downstream* access (Dieke et.al., 2013). Downstream activities require a local network for the delivery of postal items, while all other activities take place upstream. Upstream activities include the acceptance, grouping, sorting, and stamping of mail from different sources, before accessing the public network (ERGP, 2012; ERGP, 2013).

In the Republic of Serbia, the PPO (at the same time the only provider of the UPS) is Public Enterprise "Post of Serbia", which is comprised of around 1500 post offices covering almost all remote locations. The UPS market is partly liberalized, and postal operators (57 of them on the territory of Serbia in 2016, according to UPU) are given a possibility to provide the universal service without owning a network, except for reserved postal services (letters weighing up to 100 grams, paper and electronic money orders, judicial letters and administrative and misdemeanour procedure letters).

The Republic of Serbia is a candidate for EU membership and the main prerequisite for opening negotiation chapter 3 (Right of establishment and freedom to provide services) is the enforcing of Directive 2008/6/EC, which requires the implementation of postal network access, as well as other activities. Although the access is available in the RS (Ordinance 2014 and Ordinance 2016), no postal operator has actually submitted a Request for accessing the PPO network.

Reasons for this are described in the paper (Unterberger et al.,2016) and an analysis has shown that none of the postal operators is interested in providing the UPS, and that there are multiple factors affecting the postal network access. The first and most important factor is the presence of reserved postal services, as well as operators being insufficiently informed, poor cooperation with NRA. A study in the paper (Šarac et al., 2017) has shown that alpha coefficient values from the point of view of "expected" and "delivered" are fairly similar. The difference between expected and experienced values is quite small ($\alpha_{expected}$= 0,87 i $\alpha_{experienced}$ = 0,86), allowing us to conclude that the public postal network can meet the expected requirements of accessing operators. Analysis of the scenario of a complete market liberalization (access to all UPS) in the paper (Unterberger et al.,2017) envisages a significant increase in the number of postal operators providing UPS (at least five postal operators will provide the UPS).

According to the given scenario, this paper develops a model for determining the number and placement of access points on the PPO network, which will provide access to all users in different places on the network, in a complete market liberalization.

3. METHODOLOGY FOR DETERMINING THE NUMBER AND PLACEMENT OF ACCESS POINTS

For defining a methodology for determining the number and placement of access points on the PPO network, the following steps are suggested:

Step 1: Pinpointing possible alternatives

Step 2: Specifying types and number of criteria

Step 3: Solving a multicriteria task using the Promethee method (determining the type of preference function, relative weight coefficients, etc.)

Step 4: Ranking the alternatives

The research starts with a supposition that all postal network units can also be units for users to access the postal network, because this would meet the criterion of general accessibility as well as sustainability of the UPS.

In the RS all postal network units on the whole national territory are grouped into levels according to their share in business. The criteria for classifying post offices into levels are: average total work per month (in norms of minutes) in the last year and average monthly revenue in the last year (Ordinance, 2015). According to these criteria, all post offices on the RS territory are grouped into: posts out of levels, top level and posts from I to VIII levels.

4. METHODOLOGY IMPLEMENTATION AND DISCUSSING RESULTS

4.1 Pinpointing alternatives

Every multicriteria problem implies a number of alternatives and criteria for ranking and choosing (Nikolić, 2012). Defining alternatives (access points) has been done according to the Ordinance on grouping postal units (Ordinance, 2015) and according the scenario analysis and experts' opinion that access points can also be at start postal units (upstream approach) or at postal units (downstream approach). Apart from defining postal units categories, experts claim that possible access points are also Regional Postal-Logistic Centres (RPLC) and Local Postal-Logistic Centre (LPLC). Twelve alternatives given for dealing with the problem of multicriteria ranking are shown in Table 1.

Table 1: Definition of alternatives (access points) (Unterberger, 2016)

ALTERNATIVE – POINT OF ACCESS			
A1	Posts out of levels – start points	A7	RPLC - start
A2	Posts out of levels –destination points	A8	RPLC –destination
A3	Posts from I to III levels - start	A9	LPLC - start
A4	Posts from I to III levels - destination	A10	LPLC - destination
A5	Posts from IV to VIII levels - start	A11	All posts - start
A6	Posts from IV to VIII levels -destination	A12	All posts - destination

4.2 Defining criteria

The choice of criteria in a multicriteria analysis is a fairly complex and responsible job, because the choice of criteria has a direct effect on the process, and on the final ranking of the alternatives. According to (Radojičić & Žižović, 1998) the choice of criteria is very significant because leaving out a criteria also leaves out some of the requirements for the alternatives, whereas having too many criteria can mean some of them are unnecessary. Therefore, opinions of experts from scientific institutions, Ministry, NRA, and public postal operators in Serbia and Croatia, have been used. The following criteria have been defined:
K1: Number of postal network units
K2: Avoided costs for letters
K3: Avoided costs for packages
K4: Access points capacity
K5: Existing demand for access

K1: Number of postal network units

The number of postal network units is a very important criterion in defining the postal network access, because it provides a necessary condition for the availability of the UPS and the whole postal network. In order to perform the access, the exact number of postal network units has to be defined. The number of postal network units is available and can be determined for each specified alternative, according to the Ordinance on categorizing postal units into levels (Ordinance, 2015).

Based on work-sharing done by operators accessing postal network, there are certain cuts in work, that is, in PPO activities. These cuts are shown in norms of minutes and calculated for "letters" and "packages". The amount of avoided costs depends on the location of access. Letter posts (letters up to 2 kg, insured items and recorded delivery items) and packages in UPS represent the greatest part within the scope of the UPU (Unterberger et al.,2016). Therefore these two types of postal items are referred to as "letters" and "packages". According to the Ordinance on statistics and norms (Ordinance, 2006) in which standardized timings for all types of mail are given, certain activities for letters, from collecting to delivery, and for packages are selected. The average value of norms of minutes for work operations performed from collecting to delivering letters is 2.68, whereas for packages that value is 3.64.

The results in the paper (Blagojević et al., 2013) indicated the percentage of each technological stage in various services, which is used in the paper for an accurate estimation of activities in certain types of costs. For "letters", collection stage accounts for 15% of costs, outward sorting accounts for 11%, transport for 10%, inward sorting for11%, and delivery for 41%.

Table 2 shows savings which postal operators will have if they use each of the alternatives with letters and packages, which represent avoided costs for the PPO.

Table 2. Cost percentage of each technological process stage for letters and packages (Unterberger, 2016)

Alternative	***Percentage of technological process stages for LETTERS***	*collection* U_{p1} *= 15 %*	*outward sorting* U_{p2} *=11 %*	*transport* U_{p3} *=10 %*	*Inward sorting* U_{p4} *= 11 %*	*delivery* U_{p5} *= 53 %*
	Percentage of technological process stages for PACKAGES	*collection* U_{k1} *=13 %*	*outward sorting* U_{k2} *= 11 %*	*transport* U_{k3} *=24 %*	*Inward sorting* U_{k4} *= 11 %*	*delivery* U_{k5} *= 41 %*
A1	Posts out of levels – start points	√				
A2	Posts out of levels –destination points	√	√	√	√	
A3	Posts from I to III levels - start	√				
A4	Posts from I to III levels - destination	√	√	√	√	
A5	Posts from IV to VIII levels - start	√				
A6	Posts from IV to VIII levels - destination	√	√	√	√	
A7	RPLC - start	√				
A8	RPLC - destination	√	√	√		
A9	LPLC - start	√				
A10	LPLC - destination	√	√	√		
A11	All posts - start	√				
A12	All posts - delivery	√	√	√	√	

Avoided costs for PPO (in norms of minutes) for letters ($U_{letters}$) *and packages* ($U_{packages}$)*, for the alternative* ***A1 "Posts out of levels – start points"*** are calculated using relations (1), (2), (3), and (4):

$$\mathrm{U_{letters}} = \mathrm{N_{mp}} \times \frac{\mathrm{U_{p1}[\%]}}{100\%} \tag{1}$$

$\mathrm{N_{mp}}$ –average value of norms of minutes for letters is 2.68
$\mathrm{U_{p1}}$ – collection stage, for letters (Table 2)

$$\mathrm{U_{letters}} = 2{,}68 \times \frac{15\ [\%]}{100\%} = 0{,}40\ norm\ of\ minutes \tag{2}$$

$$\mathrm{U_{packages}} = \mathrm{N_{mk}} \times \frac{\mathrm{U_{k1}[\%]}}{100\%} \tag{3}$$

N_{mk} - average value of norms of minutes for packages is 3,64
U_{k1} – collection stage, for packages (Table 2)

$$\mathrm{U_{paketi}} = 3{,}64 \times \frac{13\%}{100\%} = 0{,}47\ norms\ of\ minutes \quad (4)$$

For the alternative **A2 "Posts out of levels – destination points"** savings on letters and packages are calculated using relations (5) to (12):

$$U_{letters} = \mathrm{N_{mp}} \times \frac{\mathrm{U_{p1}[\%]}}{100\%} + \mathrm{N_{mp}} \times \frac{\mathrm{U_{p2}[\%]}}{100\%} + \mathrm{N_{mp}} \times \frac{\mathrm{U_{p3}[\%]}}{100\%} + \mathrm{N_{mp}} \times \frac{\mathrm{U_{p4}[\%]}}{100\%} \quad (5)$$

U_{p2}, U_{p3}, U_{p4}, U_{p5} – proportion of the stages of outward sorting, transport, inward sorting and delivery, for letters

$$U_{letters} = 2{,}68 \times \frac{15\%}{100\%} + 2{,}68 \times \frac{11\%}{100\%} + 2{,}68 \times \frac{10\%}{100\%} + 2{,}68 \times \frac{11\%}{100\%} \quad (6)$$

$$\boldsymbol{U_{letters} = 1{,}26\ norms\ of\ minutes} \quad (7)$$

$$U_{parcels} = \mathrm{N_{kp}} \times \frac{\mathrm{U_{k1}[\%]}}{100\%} + \mathrm{N_{kp}} \times \frac{\mathrm{U_{k2}[\%]}}{100\%} + \mathrm{N_{mp}} \times \frac{\mathrm{U_{k3}[\%]}}{100\%} + \mathrm{N_{mp}} \times \frac{\mathrm{U_{k4}[\%]}}{100\%} \quad (8)$$

U_{k2}, U_{k3}, U_{k4}, U_{k5} – proportion of the stages of outward sorting, transport, inward sorting and delivery, for packages

$$U_{parcels} = 3{,}64 \times \frac{13\%}{100\%} + 3{,}64 \times \frac{11\%}{100\%} + 3{,}64 \times \frac{24\%}{100\%} + 3{,}64 \times \frac{11\%}{100\%} = \quad (9)$$

$$\boldsymbol{U_{packages} = 2{,}15\ norms\ of\ minutes} \quad (10)$$

Calculating norms of minutes for other alternatives is done in a similar way, and the results are shown in the evaluation Table 3.

K4: Access points capacity

The significance of this criterion is in determining available storage space, needed for postal items which users drop off at defined access points (defined alternatives). The criterion describing the size of storage is given in numbers 1 to 5. Regional and local postal logistic centres, as well as posts out of levels, have the largest storage and are therefore given marks 5,4 and 3, whereas the least storage is in posts from IV to VIII levels, and their mark is 2. In all other posts, start and destination, the capacity is given an average mark of 2.5.

K5: Existence of demand for postal network access

Beside postal operators, consolidators and users who drop off only their items can also access the postal network (Ordinance, 2014). Consolidators are legal entities or entrepreneurs that collect postal items from various users, consolidate them and hand them over to the PPO for further processing. This criterion is significant because it increases availability of all postal services within the scope of the UPS, but also other commercial services already provided by private postal operators. Introducing this criterion into the optimization process offers a possibility for meeting users' needs on the communication market.

An analysis of opinions of experts (postal operators) on abolishing reserved services, has offered demands for postal network access, in each of the alternatives, shown in the last column of Table 3.

4.2 Evaluation of defined alternatives and criteria

The PROMETHEE Method has been used for multicriteria ranking, which gives 12 alternatives (access points) ranked by 5 criteria. Values for each criterion are shown in Table 3.

Table 3: Evaluation of defined alternatives and criteria (Unterberger, 2016)

Serial number	CRITERIA / ALTERNATIVE	Number of postal network units	Avoided costs for letters	Avoided costs for packages	Access point capacity	Existence of demand
A1	Posts out of levels – start points	31	0,4	0,47	3	3
A2	Posts out of levels – destination points	31	1,26	2,15	3	2
A3	Posts from I to III levels - start	169	0,4	0,47	2,50	3
A4	Posts from I to III levels - destination	169	1,26	2,15	2,50	2
A5	Posts from IV to VIII levels - start	1106	0,4	0,47	2	3
A6	Posts from IV to VIII levels - destination	1106	1,26	2,15	2	2
A7	RPLC - start	3	0,4	0,47	5	6
A8	RPLC - destination	3	0,96	1,38	5	5
A9	LPLC - start	14	0,4	0,47	4	4
A10	LPLC - destination	14	0,96	1,38	4	7
A11	All posts - start	1481	0,4	0,47	2,5	1
A12	All posts - delivery	1189	1,26	2,15	2,5	2

4.4. Defining the type of general criterion and Relative Weight Coefficients for each criteria

Table 4 shows the choice of a generalized criterion (function type). For calculating weight coefficient for the criteria, opinions of experts from science (Faculty of Technical Sciences, Novi Sad, and Faculty of Transport and Traffic Engineering, Belgrade), Ministries, NRA – RATEL and postal traffic (PE "Post of Serbia" and Croatian Post Inc) have been used.

The sum of relative weight coefficients is calculated by relation (11):

$$\left(\sum_{j=1}^{k} W_j = 1 \right) \tag{11}$$

where W_j , j=1,2,...,k, are weights given to each criterion and are real numbers.

The sum of all coefficients should be 1, and relative weight coefficients for each criterion are determined using experts' opinion. This is shown in (12) and (13).

$$W_1 + W_2 + W_3 + W_4 + W_5 = 1 \tag{12}$$

$$0,15 + 0,19 + 0,21 + 0,24 + 0,21 = 1,00 \tag{13}$$

Table 4: The choice of criteria type, parameters and weights for all criteria (Unterberger, 2016)

Basic characteristics of the criteria	Tags	K1	K2	K3	K4	K5
Minimum or maximum	MIN/MAX	MIN	MAX	MAX	MAX	MAX
Relative weight coefficients	w	0,15	0,19	0,21	0,24	0,21
Preferential function	H_d	Type III	Type V	Type V	Type III	Type III
Q: Indifference	Q	-	0,37	1	-	-
P: Preference	P	3	0,82	1,57	0,86	4
Minimum	min	3	0,40	0,47	2	1
Maximum	max	1481	1,26	2,15	5	7
Minimum difference	min_r	14	0,56	0,91	1	1
Maximum difference	max_r	1478	0,86	1,68	3	6
AVERAGE	$\bar{x}$	443	0,78	1,18	3,25	3
Standard deviation	σ	560	0,39	0,76	0,99	2

Experts have given the highest mark to the criterion K4 – Access points capacity (average mark is 4.00), then comes the criterion K5 – Existence of demand and Avoided costs for packages (average mark 3.50). The criterion K1 –number of postal network units, that is a number of potential access points, should be minimized (Table 5), whereas all the other alternatives (avoided costs for letters and packages, access points capacity and existance of demand) should have maximum values. For criteria K1 and K4, preference function type II is chosen (criterion with linear preference), and for criteria K2, K3 and K5, the function with linear preference and indifference threshold is chosen.

Table 5: Ranking of alternatives withpositivevalues of clear stream(Unterberger, 2016)

Alternative	Rank	**ALTERNATIVE**	**Clear stream (T)**	**Output stream (T^+)**	**Input stream (T^-)**
A8	**1**	**RPLC- destination**	**0,3861**	**0,4176**	**0,0315**
A7	**2**	**RPLC-start**	**0,2249**	**0,4275**	**0,2026**
A10	**3**	**LPLC- destination**	**0,1791**	**0,3351**	**0,1560**
A9	4	LPLC-start	-0,2131	0,1980	0,4111
A2	5	Posts out of levels-destination	-0,2306	0,2179	0,4485
A4	6	Posts from I to III levels-destination	-0,3464	0,1600	0,5064

Ranking of the alternatives based on the given criteria has been done using the software tool Visual Promethee (available at www.promethee-gaia.net). Using Promethee Method the alternatives are ranked by values of clear stream $T(a)$, and results have shown that 6 alternatives have positive values of clear stream (alternatives A8, A10, A7, A2, A9 and A4). Repeating the whole ranking procedure, for 6 alternatives (using the same criteria, the same marks, function types and weight coefficients), has given the results shown in Table 5. The highest alternative, with the highest value of clear stream has the alternative A8: RPLC – destination. Beside this alternative, alternatives A7: RPLC- start and A10: LPLC – destination also have positive clear stream value.

5. CONCLUSION

The presented methodology for defining access points combines former research on postal network access, which identified key factors which exclude demands for network access. It is important to note that the existing postal network of PPO in the RS can meet the expected future access users' demands, which would enable better utilization of automated sorting centres. In order forpostal operators and consolidators to accessthe postal network, it is necessary to completely liberalize the postal market, abolish the current reserved domain, in other words, allow the access to all postal services within the scope of the UPS. It means that users accessing the PPO's postal network could also provide for postal services from the scope of the UPS,and use available PPO information communication resources.

Postal operators planning to engage in e-commerce could access the PPO postal network in the defined access points and thus make e-commerce services available throughout the whole territory of the RS. For the whole process to take place it is necessary to have a single public postal logistic communication (PPLC) network, which would ensure mail tracking from a sender (seller) to receiver (buyer). The current PPLC network, available PPO resources and network access can connect all relevant institutions (banks, insurance companies, health institutions, state administration, etc.) and give a single platform of universal service which is crucial for further evolution of economy and e-commerce and e-exchange in Serbia.

The results of multicriteria ranking have shown that top level alternatives are regional postal logistic centres both at start points (upstream) and at destination points (downstream), as well as local postal logistic centres at destinations.The model for determining access points on the PPO network required opinions of experts from relevant institutions in the country and region, and hence it approaches the defined criteria from various aspects. The given alternatives and criteria have enabled users who want to access the PPO postal network to do it from a location they choose, according to their possibilities and performed business operations.

The support from the State and the competent Ministry is of crucial importance for the overall process of implementing the approach, which is why soon (according to Strategy, in the third and fourth quarters of 2018) further steps are expected towards the liberalization of the postal services market and adapting the postal sector in the process of joining the EU.

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ENVIRONMENTAL AND SOCIAL IMPACT OF DIGITALIZATION **1083**

Nenad Badovinac

ANDROID APPLICATION FOR RECORDING SIGNED CONSENTS FROM GDPR REGULATION **1084**

Nedeljka Živković

DIGITAL AGE AND SUSTAINABILITY OF THE ENVIRONMENT IN THE FIELD OF HIGHER EDUCATION **1089**

Jovan Parušić , Uroš Šošević, Dejan Stojimirović

DIGITAL DISRUPTION OF AGRICULTURE 4.0 **1097**

Davorin Žnidarič, Marjan Senegačnik, Drago Vuk

ENVIRONMENTAL AND LOGISTIC ASPECTS OF INTRODUCTION OF ELECTRIC AUTOMOBILE **1104**

Tijana Milanović , Gordana Mišev, Maja Milanović

E-WASTE MANAGEMENT: ENVIRONMENTAL AND SOCIAL IMPACTS **1113**

Nikoleta Šarenac, Marko Ćirović, Nataša Petrović

ENVIRONMENTAL AWARENESS, ATTITUDES AND CAUSAL BEHAVIORAL PATTERNS: AN OVERVIEW WITH A GLANCE AT ENVIRONMENTAL IMPACTS OF DIGITAL ERA **1122**

Nataša Plavša, Nataša Čačić, Jovana Pupovac

IMPLEMENTATION OF MODERN TECHNOLOGIES IN TRAFFIC AND THEIR CONTRIBUTION TO THE PROTECTION OF THE ENVIRONMENT **1129**

Ismar Velić

INFLUENCE OF FOREIGN DIRECT INVESTMENTS ON THE ENVIRONMENT **1135**

Nikola Vujanović

INVESTMENT IN RENEWABLE ENERGY SOURCES - ANALYSIS AND ASSESSMENT OF JUSTIFICATION **1143**

Golub Marković

PAPER AND MUNICIPAL WASTE MANAGEMENT IN THE REPUBLIC OF SERBIA AND EU PRACTICES **1153**

ANDROID APPLICATION FOR RECORDING SIGNED CONSENTS FROM GDPR REGULATION

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Abstract: *The General Data Protection Regulation (GDPR) defines the regulations on the protection of personal data of individuals from the European Union (GDPR 2016/679/EU). Countries like Serbia, where individuals from the European Union do business, should also apply this law (GDPR, 2016). According to Article 3, the GDPR regulation (GDPR, 2016) seeks to harmonize the protection of fundamental rights and freedoms of individuals related to the activities of personal data processing. The idea presented in this paper is a conceptual model of an android application that should enable individuals to actively manage the fundamental rights provided by the GDPR regulations. This android application will speed up and simplify the process of recording signed Consent, sending requests to companies (controllers) (EU-GDPR, 2018) in order to get the information about purposes of the personal data usage. It will then simplify the fulfillment of the individual's right to erase personal information or to transfer it to third parties. In addition, the android application runs the process of recording possible violations of privacy. All these processes will be integrated into the Android MyGDPR application that will be available to the user on the smartphone. The application has an integrated interface linked to the internet forum where this GDPR regulation is discussed. In order to complete the process of managing the fundamental rights of personal data security, communication with the consulting team of legal experts dealing with the issues of GDPR regulations, through this android application, is available to the individuals.*

Keywords*: GDPR regulations, mobile applications, android.*

1. INTRODUCTION

Modern information and communication technology has accelerated the flow of personal data on the Internet. Therefore, there is a need to use this technology for the protection of personal data. From the May 25th 2018, there will be current GDPR regulations concerning the protection of personal data (Directive 95/46/EC). This is a law relating to: rules for the protection and processing of individuals personal data, the protection of fundamental rights and the freedom to manage personal data and the guarantee that personal data can be freely exchanged within the European Union (GDPR, 2016). In short, GDPR deals with ways of processing personal data. GDPR - The General Data Protection Regulation is to allow people to control their personal information (MA Healthcare Ltd, 2017). Most articles of the GDPR regulations relate to companies (controllers) and ways in which they need to process individuals personal data (EU-GDPR, 2018). The GDPR regulation defines the rule that before the data usage, the company will allow an individual to sign an agreement by which he/she gives the company the right to use his/her personal data. Since individuals will be signing different Consent for many companies, it will be harder to keep records of all signed Consents over time.

The idea of this work is to create a conceptual model of Android smartphone application that will serve for recording of signed Consents and will simplify the management of rights. This Android application should help individuals in the management of personal rights and establishing contacts with legal consultants dealing with GDPR regulations.

2. INDIVIDUAL RIGHTS DEFINED BY GDPR REGULATIVES

The GDPR regulation defines the rights related to the protection of individuals personal data. Individuals in different companies will sign different Consents. By the regular organization of the signed Consents a user will be able to record and make it easier to use his rights. Individuals rights provided by GDPR regulations (GDPR, 2016) are:

- Consent - According to GDPR, a company that collects individuals personal data must indicate for what purpose it collects them. Companies need to ask for the consent from individuals for data collection and processing. By signing the document, the individuals gives his consent to the company.

- Right to access by the data subject - At any time, individuals may request information about where and for what purpose the data is used.
- Right to erasure (right to be forgotten) - Individuals has the right to request the deletion of personal data kept by the company. This means that he/she can withdraw his original consent.
- Right to data portability – Individuals may require from a company that processes his data to send it to a third party.
- Violation of privacy - If an unlawful use of personal data occurs, a company is obliged to notify individuals within 72 hours.

3. MYGDPR APLICATION METHODOLOGY

It is anticipated to develop the mobile application for the Android platform, because it is the system that is most represented on the mobile phone market with 85.1% of the market share (F.Richter, 2017). Android mobile applications will simplify the process of registering issued consent and managing individuals requirements for: changing personal data, deleting personal data, transferring personal data to third parties. The methodology of the MyGDPR application is shown in Figure 1. The user logs in to the mobile application with his user login and password. At the first sign-up, the user enters his/her personal information and thus registers for the application. A company official gives a user the consent for the signature. When a user signs the agreement he makes a photo of a signed consent using his mobile phone. The application stores the photo and processes data recognized by the OCR algorithm. The application has an interface to the Internet forum and to a legal service specializing in GDPR regulations.

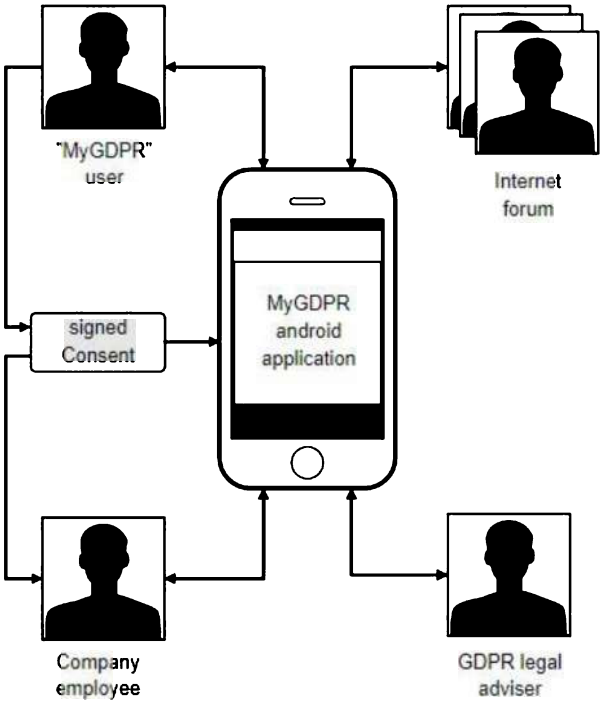

Figure 1. Diagram of subjects' activities in the MyGDPR workflow process

The application enables the user to contact the companies from which he can claim fulfillment of his rights in accordance with the GDPR regulations. The rights provided by the GDPR can be achieved through the MyGDPR application, which are (GDPR, 2016):

- For the "Consent" right - in the MyGDPR application, the user will be able to take a photo of the signed Consent document that will be OCR read and written in the database. The date of signing the Consent and the purpose for which the data is collected will be written all together with the Consent.
- For "Access Right" – Individuals can search through the MyGDPR application which companies have got his/her personal data and contact them via an email service embedded in a mobile application.
- For "Right to Forget" - MyGDPR application provides easy contact with companies in case individuals wants to delete concrete data.
- For the "Right to data portability" - the application allows the user to request the company to forward specific personal information to a third party.
- Violation of privacy - MyGDPR application will record any company's notification of in the event of leakage or unauthorized use of personal data.

4. THE CONCEPTUAL APPLICATION MODEL

The application has several input data, such as: the signed Consent that has been photographed and read by the OCR algorithm and the list of personal data that the user links with the scanned Consent. These will be those personal data for which the user has signed the Consent. Extraction of text data from digital photos is a key prerequisite for the accuracy of personal data, therefore it is important to choose the optimal OCR algorithm (A. Chiatti et al. 2017). Smartphones allow the executation of the text recognition process. There are many OCR algorithms where for the specific purpose should be used the one which takes a photo of a signed document using a camera embedded in a smartphone, recognizes the text and forwards it to MyGDPR application (JC. Burie et al. 2015).

Table 1 Subjects' privilegies in the process

Entity	Writes	Reads	Executes
A user of MyGDPR application	Yes	Yes	Yes
Company employee (controller)	Yes	No	No
Forum users	No	No	No
Legal adviser for GDPR	Yes	No	No

Table 1 shows the privileges of individuals entities. A user has the ability to add personal data to the database. He can access the forum and send messages to companies (controller) and legal advisers. Data is recorded in the database, such as: personal data, sent and received messages, complete user activity in the forum. A user can exercise his rights in the application. A company employee (controller) can only share messages with MyGDPR application. Forum users do not have access to the application. Legal advisers can write their expert opinions in the database (M. S. Malkari et al. 2018).

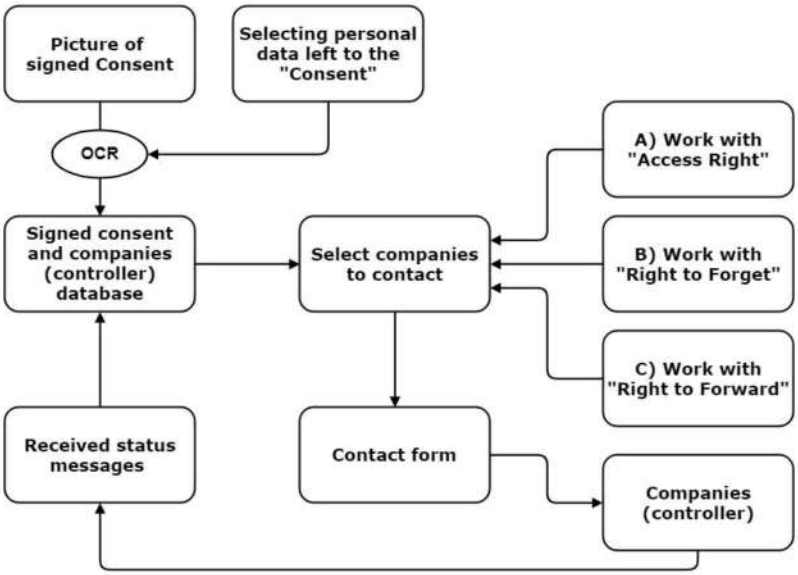

Figure 2. The conceptual application model

Figure 2 shows the conceptual application model. The first step is to take photographs of the signed consent. The scanned document is recognized by the OCR algorithm and the user marks the data from the list for which the Consent was signed. Data is stored. By selecting the A, B or C functions from Figure 2, the user is offered a list of those companies (controllers) that have signed the Consent. Choosing the right and selecting a company will launch a contact form with a pre-defined message sent by the application to the selected company. After sending the notification, the company is obliged to fulfill the request. The feedback will be recorded in the program module "Messages" and the database, and the user will be notified of the status of his rights. The Privacy Recovery feature allows the user to record notifications from the company.

5. MODEL IMPLEMENTATION

MyGDPR application model is shown in Figures 3a, 3b and 3c. Figure 3 shows the basic screen, with the "Input Consent" function. This feature allows you to scan and input signed Consents into a database. On this screen, the user of the application can choose the type of rights he wants to use. The user can manage "Messages". By choosing "Forum", he/she is allowed to access the user forum and follow the discussion on GDPR regulations. There is a function "Entering personal data" as well. Figure 3b shows a mobile application screen that can be called by the "Input Consent" function. A user assigns a list of personal data

that is stored in the database to the scanned Consent. Figure 3c shows a screen that is called when the user wants to search the database of all companies that have signed the agreement and select the companies in which he wants to exercise his rights. When selecting companies, the user needs to click on "Send Requests". At that moment a pre-defined email message is sent to companies that will reply in the timeframe prescribed by law.

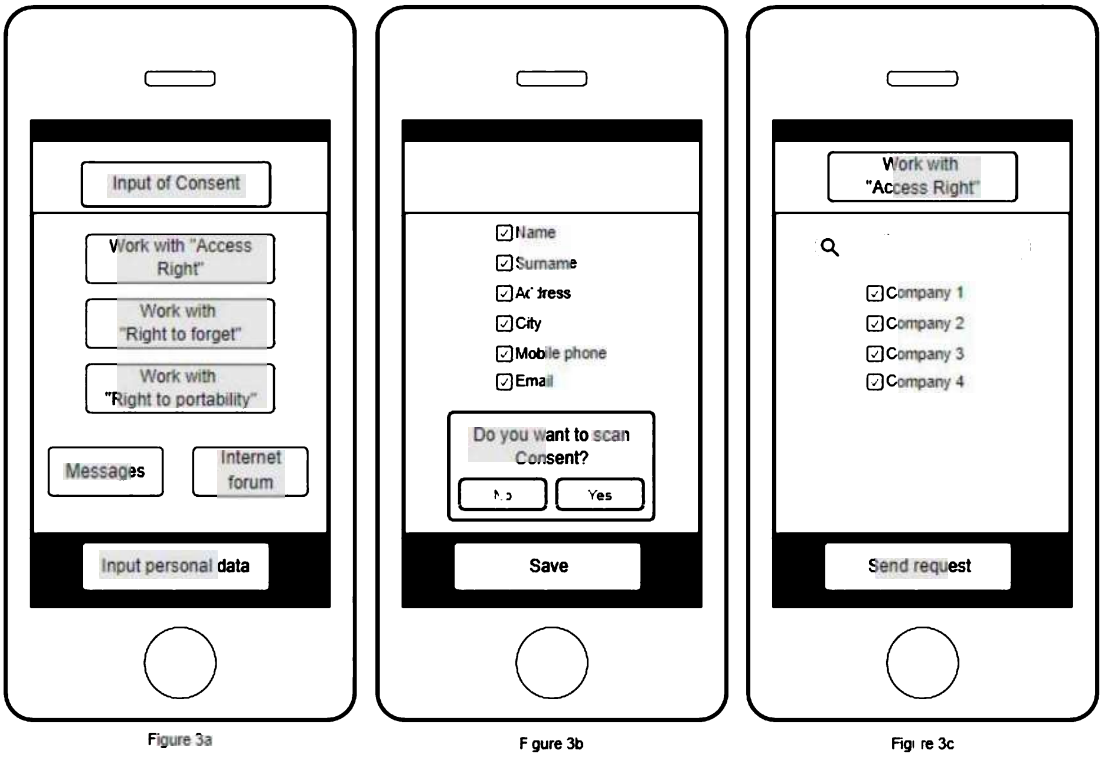

Figure 3a, 3b and 3c. Show MyGDPR application design

6. DISCUSSION

The presented application offers the user the opportunity to use his rights defined by GDPR regulations. A link to an internet forum for sharing comments and suggestions will motivate the user to further exploit his rights. Forum users can more easily share knowledge and experiences about their rights defined by GDPR regulations. The idea presented in this paper is an Android application that in an intuitive way offers users the ability to record the signed Consents and help to fulfill the rights prescribed by the GDPR regulations. Using advanced algorithms, with minimal modification, it is possible to install an additional fuzzy configuration which, by consulting external databases, could provide the user with a timely reminder to activate certain rights. With an adequate business plan, this application can definitely be widely used, from which investors could make money. For the security of personal data, this system needs to be protected, because many applications communicate with each other and thus exchange personal data. This requires the use of authentication techniques (Pieterse et al. 2018). For system security, it is necessary to use a software module that will log in to the system in case some personal data is accessed by a third party. The software module in charge of the security of the data should be used to control suspicious applications requesting permission to access personal data (P. Berthomé et al. 2012). For example, it is important to control the operation of the camera that takes pictures of the signed consent on which personal information is placed.

7. CONCLUSION

The purpose of the mobile application presented in this paper is to raise user awareness of his/her rights brought by GDPR regulations. A mobile application can best organize the record of the signed Consents and the reminder's functionality to his or her rights. After creating a business plan, it will be easier to get in touch with a potential investor who would invest in the development of this application. Following the discovery of the investor, the next step needed to realize the idea is to consult legal experts in the area of GDPR regulations that would give their final opinion. After that, the development and publication of the application is possible.

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DIGITAL AGE AND SUSTAINABILITY OF THE ENVIRONMENT IN THE FIELD OF HIGHER EDUCATION

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Abstract: *The aim of this paper is to present the research of the impact of higher education in the sustainability of the environment in the contemporary digitalization process. The higher education area represents an important segment in sustainability of the environment protection via raising the awareness of students as future experts in the process of transformation and adjustment of organizations. The paper places an emphasis on the importance of the transformation of the environmental protection management system in the process of digitalization and sustainability of the environmental protection in the higher education area. A series of specific features of one institution of higher education in the system of higher education is brought to the attention. Furthermore, based on the data availability, the application of the use of standard ISO 14001 in the organizations in various geographic areas is also presented. The following segment of the paper is dedicated to the importance of adjustment of organizations in the process of digitalization of environmental protection through the higher education area, especially because higher education institutions are specific institutions which must participate in the process of digital transformation of entire economy. The demand for overall participation in the environmental protection is justified and binding.*

Keywords*: environment, higher education, higher education institutions, digital age, ecological management*

1. INTRODUCTION

Higher education provides a significant contribution to the digital transformation of the ecologic management. The consequence of the environmental disturbance became prominent as of the middle of 20th century. In present conditions it is unequivocally clear that the contemporary technology is not in correlation with the level of the environmental protection which causes tremendous consequences for the environment. Ecological categories of the level and manner of environmental protection have become of great importance. The fundamental idea of the digital age for sustainability of the environment in the higher education area starts with the development and raising of the ecological awareness with students as future developers, engineers, designers and other skilled people who acquired higher education and who will represent the backbone of the systematic management of the environmental management system in institutions of higher education in the times to come. *Weert and Kendall (2003) state that "the progress of computer sciences in higher education initiates compact studies of the environmental protection".* Current natural environment is the consequence of insufficient and non-systematic work in past. Therefore, the expectations from higher education institutions to participate and promote the importance of ecological protection at digital age as macro-goal are higher. Based on the report of the Association for the Advancement of Sustainability in Higher Education from 2014, in the USA there were 1,274 programs of study dealing with the education on environment and sustainability, as stated in the report AASHE (2014). The basic goal of the environmental management system in the higher education area is to introduce and apply business rules with regards to the natural business environment, especially by efficient actions aimed at preventing the emergence of pollution, uncontrolled and excessive consumption of natural and energy material and resources influencing the pollution of the environment, with the development of effectiveness and efficiency of business operation in accordance with these goals in future.

2. THE IMPORTANCE OF SUSTAINABLE DEVELOPMENT OF THE ENVIRONMENT IN THE HIGHER EDUCATION AREA

Contemporary natural environment results in major global changes threatening the resource sustainability due to insufficient and non-systematic work in past and present on preservation and protection of the environment. *Filipović and Đurić (2009) emphasize that "the management of satisfactory ecological quality of products is a part of the quality management and environmental management".* The fundamental goal of the application of the standard of the ISO 14000 series is to support the environmental protection as well as the preventive actions to the influence of pollution pursuant to the principles of sustainable development. The environmental management system (EMS), ISO Survey (2015) is the manner of contribution presentation of every organization in the protection and influences to the environment pursuant to the strategy, politics and

goals of the organization as well as the policy and goals of environmental protection. The production of products and provision of services are developed by the people within the environment, as stated by Goetsch and Davis (2016) The environment management system should establish mechanisms for the process of transformation and choose the option of determination of goals and implementation of determined policy as well as the prevention of environmental protection and accomplishment of consistency. The system of digitalization transformation as a part of the environmental management process is the responsibility of each organization in the function of accepting the responsibility and gaining trust of all interested parties as well as the fact that the top management is responsible for the fulfillment of requirements on changes of the environmental protection with the higher level of application of preventive than of corrective measures. The number of certified organizations which are certified by 14001 standard in the world is presented in Table 1.

Table 1: 9 world countries with 14001 certificate (Bevilacqua, Ciarapica and Giacchetta, 2012).

Geographic area:	**The number of certified organizations**
China	6159
Italy	2745
Spain	2505
Germany	975
Korea	938
Sweden	729
Romania	702
Turkey	505
Switzerland	503

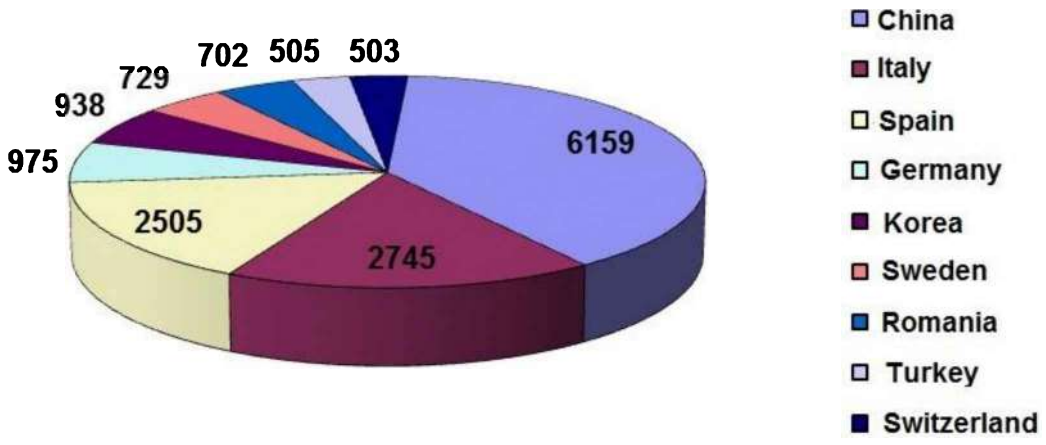

Figure 1: Graphic representation of 9 world countries with 14001 certificate

Even though the number of certified organization is rapidly growing, it is still smaller than the number of certified organizations with regards to the application of the standard of ISO 9000 series. The response should be the raising of the awareness about the importance of environmental protection and effective and efficient management in this field. Raising the awareness of students through the process of higher education may contribute to the improvement of the ecological management system and have positive results. Products-services are the subject in focus of human activities and mutual actions. The road to digital transformation and consistency with requirements of natural environment and environmental protection is accessed to in a systematic manner. The systematic analysis and application of corresponding regulations, rulebooks and other documents result in clear criteria.

2.1. The role of digitalization in the environmental protection management system in the higher education area

Recently, the term ecological management has become increasingly present. Nowadays for an organization to survive at the market it is not sufficient just to produce a product or provide services which satisfy the quality features at the market and competent price. Therefore, each organization must find satisfactory solutions among economic and ecologic requirements as well as the readiness to fit into the digitalization process by establishment of the environment management system. A specific field of environmental management system refers to the part of process of overall changes related to waste, water, air, pollution, noise, etc. The tendency of the environmental management system is to provide, by compliance with and application of corresponding requirements and transformations, the application of requirements regarding the environmental conditions as well. The system of higher education provides significant support and incentive to organizations so that they could fit in the part of the process of digital age. *(Maletič, Borojević, Petrović, Maletič and Senegačnik* (2017) emphasize that "*when it comes to the quality of education, it should be pointed out that this quality represents a dynamic and multidimensional concept which does not refer only to the model of education but also to the mission and goals of the educational institution as well as to specific standards which are applied in education*". The role of higher education in the management system in the sphere of environmental protection helps the top management of an organization to provide the following:

- Structure of tracking the market demands;
- Activities for tracking own influences to the environmental protection;
- Establishment of good relations with all interested parties (stakeholders);
- Continual efficiency improvement;
- Motivation of all employees for accepting changes.

Each management system has its own specific properties, but all of them are based on following activities:

- Policy and goals;
- Planning;
- Functioning;
- Performance measuring;
- Continual improvement;
- Management review.

The environmental protection management system helps organizations in the adjustment within the transformation process to establish mechanisms for their own impacts on the preservation of the environment. The role of higher education in the environmental protection management system is based on the increase of the awareness of future experts and prevention of certain activities and processes with negative impact on the environmental systems. Realistic goals are determined and necessary operational measures for the accomplishment of these goals are introduced. Higher education institutions play an important role in the accomplishment of comprehensive goals in the process of adjustment to digitalization. Pursuant to legal and other acts, sustainability of activities of the impact to the environmental protection helps every organization identify its performances in the field of preservation of the importance of environmental protection. The environmental protection management system establishes mechanisms as a response to increasing demands of the environmental protection. The environment represents the surrounding of the organization as follows:

- water;
- air;
- natural resources;
- people and their mutual relations;
- flora;
- fauna

Produced products or services have an impact on the quality of the environment. Contemporary technology and industrial revolution have a major negative impact on the environment. The greatest consequences of negative impacts are present at industrially most developed geographic areas: USA, Western Europe and also other countries in recent decades. Higher education institutions should encourage organizations, in the application of contemporary technology, to improve environmental protection through the digitalization process. As time passes, more and more organizations invest great efforts to show their contribution to solving the problem of transformation in the environmental protection by establishing mechanisms for control and reduction of negative consequences. It is important to emphasize that the development of a more strict legislation and economic and other measures influence the environmental protection as well as an increasing concern of the interested parties of an organization.

3. THE SUSTAINABILITY IN THE HIGHER EDUCATION AREA USING CONTEMPORARY TOOLS OF FUTURE

Planning, design and environmental protection may provide organizations with enormous positive changes by application of the standard on environmental protection. The basic purpose of the standard is to control the risk of pollution of the environment. The series of ISO 14001:2015 (ISO 2015) standard is relatively generally accepted application, not like ISO 9001, but more than other standards. The standard is also systemic because it requires audits, reviews, goals, etc. The standard is compatible with legal and other requirements, which in the Republic of Serbia means that the requirements, as normative requirements, are on a very high level.

The application of the standard and certification are important for each organization. The adoption and application of the standard function as a generally accepted model at international level as the model of the environmental management system which emerged as a consequence of increased responsibility for the environment. By applying the standard, each organization has consistency and evidence of responsibility toward the environment. Moreover, the organization proves the application of international rules and regulations as well as creation of market reputation. The basic goal of the standard application is to create an international model of rules about the environment. Even though the application of the standard is voluntary for organizations, many individuals among interested parties demand the application of the standard for environmental protection. With implementation and application of the standard, the mechanisms for tracking of the process and activities with negative impact on the environment are established, and then realistic goals and necessary operational measures for prevention of the environment are designated. Basically, the standard requires the top management of an organization to establish and implement the environmental policy. The strategy and policy of environmental protection should be documented and accessible both to employees and to general public. *Lee (2002) points out that "in future, the majority of organizations will be forced to comply with legal and other regulations, as well as with the* requirements *of interested parties for the implementation of ISO 14000 standard".* It is completely realistic that there are negative consequences, that there are products or services at the market with negative impact on the environment due to their processes and activities. Organizations should aim at achieving double effect, from both economic and environmental aspect. Therefore, the proper manner of perception and understanding of these issues is to implement and apply ISO standard of 14000 series.

3.1. Environmental protection in the role of higher education

Ecological education represents an identification of scope of activities of the society in general. It provides very complex knowledge of ecological issues of the contemporary society. It also develops negative and critical attitude toward degradation of the environment and natural surroundings. The basic principle of ecological education is to raise ecological awareness with students about the preservation of the environment. With regards to the development of technology and technological progress, ecological environment must be more present and prominent especially with students as future experts. From the aspect of ecological awareness with students, the education through higher education aims at raising the awareness about the need and mandatory ecological protection and it is expected that students be future leaders of the implementation of environmental protection development. Filipović, Đurić and Teodorović (2008) point out that the research of the importance of environmental protection may enable building and lifting of the awareness about healthy surrounding of a man's life and work which consequentially impacts human activity. Higher education may indicate to the roads of human action and provide necessary knowledge about the laws of nature and transformation into digitalization of the environmental protection.

Students with acquired and applied knowledge should be involved into positive actions with the aim of environmental protection. Students may greatly contribute to the role of environmental protection and natural surrounding by organizing ecological actions and improving ecological awareness. Educational institutions are the backbone of education in this field. Education for the environmental protection is the process which may influence people in terms of the development of their intellectual, spiritual and physical abilities, which insist on the sustainable development and functioning of the human society as a community. The introduction of the ecological topic into the basic scientific processes of today represents a crucial segment of education for the environment.

3.2. The model of the environmental protection management in the higher education area

According to the standard, the model of environmental management may be classified into the following categories:

- Environmental protection policy,

- Planning,
- Application and implementation,
- Audits,
- Top management review,
- Continual improvement.

The strategy, goals and policy of the environmental protection refer to the methods and curricula related to the environmental protection. The planning refers to the establishment of the mechanism for the analysis of the environmental aspects. The application and implementation refer to the organization of activities which are of importance for the environment. The audit refers to the process of tracking and measuring as well as of taking preventive and corrective measures with significant impact on the environment. The top management review significantly contributes to effectiveness. The continual improvement comprises continual improvement of all activities and processes. The education system represents a traditional service-providing activity.

Based on the standards, strategies and policies of the environmental protection in the higher education area, it should be provided that all mechanisms for the introduction and continual improvement of the management system in the sphere of environmental protection are established. As previously said, higher education institutions are specific organizations which are regulated by law on higher education, which requires from the top management dedication, compliance and application of legal and other regulations so that it would be clear primarily to immediate users – students, as well as other interested parties. The top management of each organization must introduce mechanisms for the subject and field of application of the environmental management system as follows:

- Corresponding impact on the environment,
- Consistency with legal and other regulations,
- Activities referring to continual improvement of pollution prevention,
- Provision of model for the establishment of general and specific goals,
- Sufficient documentation, application and sustainability of all aspects in the sphere of the environment,
- Notification for all employees, both in teaching and non-teaching process,
- Availability, audit and measures
- Environmental protection policy should be communicated to all employees and they must be introduced to the rules, regulations and actions in the sphere of environmental protection.

3.3. The aspects of the environment with reference to higher education

Each organizational unit, in this paper higher education institution, should introduce mechanisms for the identification of all aspects related to the environmental protection as well as for faster transformation of digitalization in economy in general. In the sphere of studies at the level of graduate studies, master studies, specialist and PhD studies, special attention is dedicated to environmental protection and studying of this field. Many higher education institutions have specialized programs of study in the sphere of environmental protection. The major impact of higher education is to transfer scientific knowledge as well as to create a permanent program for successful battle with all forms of danger to the environment. The creation of highly competent professionals contributes to the creation of the foundation for successful design and planning of the development of ecological security and safety. The basic role of programs of study which deal with ecological knowledge should be to identify the research and scientific approach in the sphere of environmental protection and also to raise the level of higher education ecological knowledge. In order to implement the model of sustainable ecological community, it is necessary to transform all fields in the sphere of environmental protection.

Based on the standard, in essence, there is no a unique frame for the identification of environmental protection aspects. Apart from all the aspects which each organization may control (this especially refers to production companies) and since the subject of this paper refers to the service-providing scope of activities as providing and transfer of scientific knowledge, each organization should consider also those aspects it may influence. In the identification of environmental aspects, the top management should determine the criteria and methods for those of importance. Even though there are no unique methods for determination of important ones, it should be focused on those which achieve the best results and which are consistent in application. I the review and analysis of information referring to important aspects of the environment, the top management should take into consideration the need for preservation and archiving information of importance for the environmental protection.

3.4. The application and implementation of digitalization of the environmental protection system in the higher education area

Kopnina and Cocis (2017) say that the increased interest in ecological education resulted in raising ecological awareness of students even by short educational programs with eco-centric value included. The top management in organizations should establish the policy of obligatory establishment and functioning of an efficient and effective environmental protection management system and by digital transformation organizations should fit in the contemporary manner of functioning and operation of organizations. The identification of goals represents the concept based on which the subject and the field of application are designated. Essentially it means that is should be determined what type of data is requested and in what manner they will be collected in the process of application and implementation of an efficient environmental protection management system. Pursuant to the ISO 14001 standard organizational systems therefore higher education institutions as well should be actively oriented toward an efficient and effective process of environmental management. Therefore, it is important to define:

- Resources:
- Orientation;
- Policy;
- Responsibility and authorizations.

According to the standard, in order to accomplish a successful application of the environmental protection management system the support of all employees is required. With regards to that, these functions do not refer only to those activities which are immediately related to the environment but also to all the activities with indirect impact on the environmental protection. Students and employees may find the strong orientation toward the environmental protection extremely important. This orientation is connected with the management and more efficient activities within the environmental protection management system by organizing processes and procedures for continual training for all employees from the field of:

- Teaching process and
- Non-teaching process

As previously stated, the consistent implementation of legal and other requirements is of crucial importance. The top management of a higher education institution should establish a strategy, policy and goals of environmental protection. Basically, the responsibility and authorizations refer to the top management so that it could define responsibilities and authorizations for the application and sustaining of the environmental protection management system. These activities refer to the processes of the environmental protection management system as follows:

- Planning
- Design
- Application
- Sustainability and
- Continual improvement in the application of the environmental management system.

The top management must appoint the representative of the top management for managing the system of environmental protection. The representative of the top management directs the activities referring to tracking of the application of the activities of the environmental protection with continual improvement. Simultaneously, the rule of timely reporting to the top management about decisions and actions as well as about key responsibilities in the system of environmental protection should be complied with.

As stated Ušćumlic and Babić (2011) International Standards (ISO) for the management system (quality – which is the most frequent, environmental protection, food health safety, information security, risk, social responsibility etc. may be applied at organizations of all sizes and scopes of activities regardless of the type and business orientation. Their application is voluntary and their aim is to help organizations create effective and efficient management systems through their requirements and instructions. Some of these standards comprise requirements according to which the certification of corresponding management systems is done. Other standards are designed as recommendations or instructions which should be followed in business activities, but they are not planned for the purpose of organization certification, so these are primarily standards which supplement standards designed for the organization certification. According to the requirements of mentioned standards, organizations may certify their management systems individually or they can integrate them in a unified system (IMS –integrated management system).

These standards affect the increase of the organization capability regarding the evaluation and improvement of all processes and activities in the sphere of environmental protection management systems in all organizations and therefore in higher education institutions, too. The necessity of international standards is very prominent, since all organizations operate within the global economy by selling or purchasing products

and services from the sources outside domestic market. ISO standards specify basic requirements for the management system which the organization must fulfill so as to show its capability to produce its products (services included) in a consistent manner and thus to increase the satisfaction of users and comply with the valid legal regulation.

In the process of application of ISO standard the top management of a higher education institution (management body) adopts the procedures by sustaining and application of the standard in the higher education institution, which comprise:

- Management system planning,
- Management,
- Standard application provision,
- Manners of all performances improvement.

The readiness of the management and controlling structures for the acceptance of essential importance of the requirements of standardization in higher education institutions is of crucial importance in the mechanism of organization and operation of all higher education institution systems. The characteristics called certification is an essential mechanism of the organization manner, overall functioning of all processes and it should be a constant vision and mission of the higher education institution. The fundamental organization means for complete integration of high and constant improvement of activities and all processes is the compatibility with other systems in the organization, i.e. with information system as one exceptionally important subsystem in organizations. Improvements are accomplished not only by applying the standard requirements for which the management system is certified, but also similar standards which are not intended for the certification and function as a supplement to certified fields, management systems for which the system certification is not executed, and also by applying the model of business excellence. The acceptance and implementation of standardization challenges in all parts of the operation process of a higher education institution is the adjustment to an easier and faster approach to the Bologna Convention and the postulates it is based upon. Since a higher education institution is a specific institution with many sensitive processes, it is necessary to control all aspects influencing the management system intensively.

4. CONCLUSION

The aim of this paper is to research the importance of sustainability of environmental protection via the process of digitalization as well as the importance of raising the awareness of students in the higher education area. The scope of activities of higher education is specific, therefore it requires the introduction of certification as a model for business excellence in the process of digitalization in the sphere of environmental protection. The higher education institution have significant share of participation in the process of digitalization and transformation and it is, as a rule, a very complex approach, which is difficult to measure and improve. The feedback obtained from the service users represents an important resource of tracking of the higher education institution operation in the process of digitalization and environmental protection sustainability. They may be used for tracking of the trend of satisfaction of all interested parties (students, employees at higher education institutions, relevant ministries, owners, high-school population, social community, etc.) as well as for the comparison with the competition, understanding of user expectations, determination of priorities for improvement, etc.

The ISO 14001 international standard was created as a result of increased concern for environmental protection. The basic purpose of the standard is to control the risk of pollution of the environment. The series of ISO 14001 standard has relatively generally accepted application, not like ISO 9001, but on a higher level than other standards. The basic function of the standard application is to identify aspects, perceive risks, establish control and track performance of each organization with regards to the environment. The purpose of this standard is to use the information obtained by tracking and measuring via review for the purpose of improvement of educational service providing in the sustainability of environmental protection. It is in the interest of the entire higher education institution and higher education system to establish an effective and efficient system of environmental protection management in the process of adjustment to contemporary technologies via the process of digitalization.

A higher education institution must provide an adequate space and work environment to meet certain technical-technological, urban and other conditions necessary for smooth performance of teaching process during the transfer of scientific knowledge to future experts –students in the process of adjustment to the digitalization using the application of contemporary tools of future. For contemporary execution of the teaching process it is necessary for the space and work environment of the higher education institution to comply with health and safety standards. The rulebooks on technical standards of a higher education institution stipulate that the premises of a higher education institution as a public institution must meet the required aspects with regards to the environmental protection. Since the higher education institution is a specific scientific institution contributing to the development and raising of the students' awareness in the

sphere of sustainability of the environmental protection as well as of the adjustment process to the contemporary technology, it may have a significant impact on the environment. Taking into consideration the development of technology and technology progress, the ecological awareness must be more present and prominent, especially with students as future experts. From the perspective of ecological awareness, the main impact of higher education must be aimed at raising the awareness with students. The strategy of environmental protection is of essential importance for the whole region and planet as a whole and it represents one of the most important tasks of the human society, and on an individual level, the participation of higher education institutions represents a small piece in the mosaic of the accomplishment of this goal.

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DIGITAL DISRUPTION OF AGRICULTURE 4.0

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Abstract: *This document covers the digitalization of agriculture as an important which as a goal has prevention and neutralization of global problems caused by agricultural expansion and operations, such as CO2 emissions and global warming. Authors point to the high-tech solutions for the issues in question presented in the use of innovative technologies such as cloud-based software, drones, IoT, blockchain, big data and AI. Paper explains the magnitude of global problems caused by agricultural expansion and the benefits of integrating modern technologies into the agricultural ecosystem. Research and personal experience and expertise in the industry by the authors are included, along with the latest trends from the ecosystem. Paper will indicate the importance of ICT in modern Agriculture and creation of planet-saving value chain.*

Keywords*: Digitalization, Agriculture, Farm Management, Drones, IoT, Blockchain, Big data, CO2, Global Warming, soil, AI*

1. OVERVIEW

In the last decade, there have been constant calls to different planet-saving operations and projects. Humanity is evolving and adapting in order to survive. One of the most important paths of planetary change is the expansion of digital era and exponential growth in the ICT area. The high pace of tech development has been brought by the need for improvement in environmental and planet-saving operations. Different technologies are being developed as a way to slow down the environmental changes caused by agricultural operations. Such uncontrolled operations occurred due to the increasing population number, hunger and climate changes. Therefore, we will focus on agriculture as one of the main pillars of global sustainability and its most recent transformation attempts. We want to explore the importance of smart sustainability based on an implementation of digital tools and decision-making based on the data analytics. This paper will point to environmental issues and the possible solution based on the latest developed technologies.

2. ENVIRONMENTAL ISSUES

Several interconnected environmental issues are considered as high-class threat to plant. We would like to emphasize some of the main issues connected to agriculture:

- CO2 emissions caused by deforestation and meat and dairy production
- The scarcity of agricultural resources and arable land
- Population growth

2.1. Deforestation and co2 emission

Carbon dioxide (CO2) is a heat-trapping (greenhouse) gas, most commonly released through human activities such burning fossil fuels, deforestation, land clearing for agriculture and degradation of soils (NASA, 2018). It is very important to emphasize that land can also remove CO2 from the atmosphere through reforestation, improvement of soils, and other activities (The United States Environmental Protection Agency, 2018). At the global scale, CO2 is the key greenhouse gas emitted by human activities with estimation of 65% of all emitted gases (The United States Environmental Protection Agency, 2018) as shown on the Figure 1.

Research shows that agriculture participated in 10% of the EU's total greenhouse-gas emissions in 2012. Decline in livestock numbers, more efficient application of fertilizers, and better manure management reduced the EU's emissions from agriculture by 24% between 1990 and 2012 (European Environment Agency, 2018).

On the other hand agriculture in the rest of the world is moving in the opposite direction, as global emission from crops and livestock production grew by 14% in a period between 2001 and 2011. This was driven by increased global food demand and changes in food-consumption patterns due to rising incomes in some developing countries (European Environment Agency, 2018).

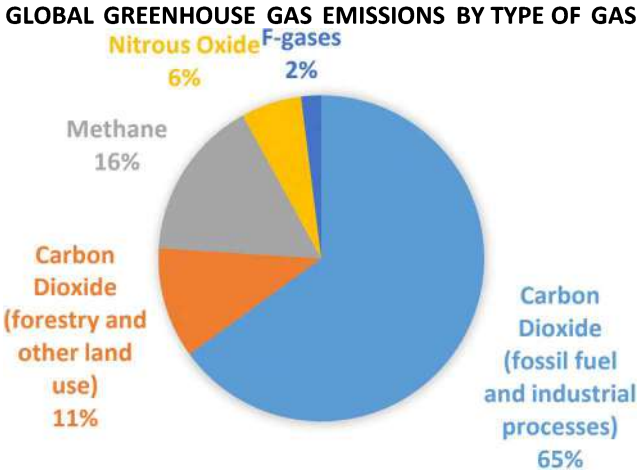

Figure 1: Details about the sources of global greenhouse gas emissions (IPCC, 2014)

In the research of greenhouse-gas emissions presented by European Environment Agency 2018, we can see that livestock and fodder production each generate more than 3 billion tons of CO2 equivalent. There is a general opinion followed by several initiatives, that by reducing food waste and our consumption of meat and dairy products, we can contribute to cutting the greenhouse-gas emissions of agriculture.

Measurements show a constant rise of CO2 levels in last decade, and an annual increase of CO2 - Figure 2 and Figure 3.

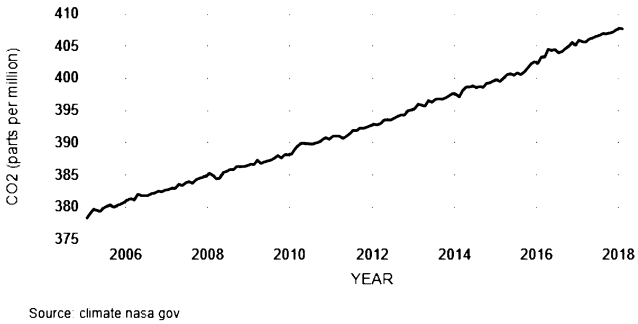

Figure 2: Monthly measurements (average seasonal cycle removed). (NASA, 2018)

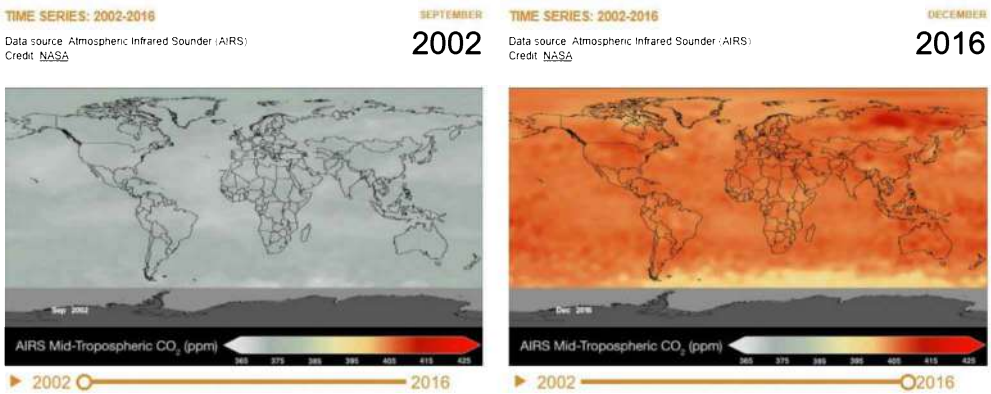

Figure 3 : Changes in distribution and variation of the concentration of mid-tropospheric carbon dioxide in parts per million (ppm). (NASA, 2018)

In many researches, agriculture has been considered to be a main driver of deforestation (Gibbs et al., 2010) – another source of the CO2 threat. Recent studies show that drivers vary on the continental and regional level, but nevertheless, that is not changing the fact that tropical forests are disappearing at a rate of ca. 13 million hectares per year, which is approximately the size of Greece (EU Commission, 2008). Agriculture as a deforestation driver in Africa is changing net forest area of 15000km2/yr.; in Latin America 42000 km2/yr.; Sun-tropical Asia 13000 km2/yr. (FAO, 2010)

Given the central importance of food in our lives, a further reduction of greenhouse-gas emissions from agriculture remains quite challenging. If we consider that agriculture is estimated to be driver for near 80 percent of deforestation worldwide and that commercial agriculture is the driver of 66 percent of deforestation in Latin America, (Kissinger, Herold & De Sy, 2012), we are free to say that such trend will continue, and that catastrophe is inevitable even if education and control measures are introduced together with huge efforts in consumer education and food waste management.

In the John Hopkins's Center for livable future report, which was prepared in advance of the United Nations Conference of the Parties 21 (COP21) in Paris, Kim (2015), Neff (2015), Santo (2015) and Vigorito (2015), presented the facts explaining that if global trends in meat and dairy consumption continue at the same pace, global mean temperature rise will exceed 2°C, even with intense emissions reductions across non-agricultural sectors. The immediate radical measures resulting in substantial reductions in wasted food and meat and dairy intake, particularly ruminant meat (e.g., beef and lamb), are imperative to mitigating catastrophic climate change. The urgency of these interventions is not represented in negotiations for climate change mitigation.

2.2. The scarcity of agricultural resources

Reduction of meat and dairy consumption represents a huge challenge, due to consumer behavior and global emissions targets which will make more difficult for the animal-agriculture sector to operate as it has been. Let's assume that in future all targets reached, and all paper-ambitious plans are achieved. We have to think about what are the other consequences of such actions.
Challenges arise in developing countries, due to the scarcity of quality land, soil nutrients, and water. Global assessment of all land types shows that 25% of lands are highly degraded, 8% are moderately degraded, 36% are stable or slightly degraded and % are ranked as "improving. The rest of the earth's land surface is either bare ca. 18% or covered by water ca. 2% (The State of the World's Land and Water Resources for Food and Agriculture, 2011). Same reports, says, that "1.6 billion hectares of the world's best, most productive lands are currently used to grow crops. Parts of these land areas are being degraded through farming practices that result in water and wind erosion, the loss of organic matter, topsoil compaction, salinization and soil pollution, and nutrient loss."

2.3. Higher demand and population growth

It is imperative that we take in the consideration the forecast explaining that over the past years, agricultural production has increased, and studies predict that aggregate agricultural consumption will be increased by 69% in a span from 2010 to 2050. The scarcity of land and water resources have placed a number of key food production systems around the globe at risk, posing a profound challenge to the task of feeding an expected world population growth from 7 billion to 9 billion people by 2050. (Pardey, Beddow, Hurley, Beatty & Eidman, 2014).

We have to think how we will reimburse for the gap in food value chain caused by the lower production and consumption of meat and dairy products and population growth by 2 billion people. This could lead to increase in the sector of agronomy crop and vegetable consumption, which will result in higher demand for agronomical resources.

3. SUMMARY OF THE AG ISSUE

Projections to 2050 suggest the emergence of growing scarcities of natural resources for agriculture (Alexandratos and Bruinsma, 2012). Fight for these resources could lead to their overexploitation and unsustainable use, degrading the environment and creating a destructive loop whereby resource degradation leads to ever-increasing competition for the remaining available resources, triggering further degradation and increased CO2 emissions (FAO,2017). FAO predictions say that fewer opportunities are left for further expanding the agricultural area. Moreover, much of the additional land available is not suitable for

agriculture. Bringing that land into agricultural production would carry heavy environmental, social and economic costs (FAO, 2014).

4. DIGITALIZATION OF SOIL

The introduction of planned measures for reduced production of meat and dairy products could potentially lead to a closed loop. Less meat and dairy will mean increased crop, fruit and vegetable consumption. We can assume that without proper measures, in theory, agriculture will grow horizontally. Considering the already present scarcity of arable agricultural land resources, such actions could lead to more deforestation and continuous growth of CO2 emission, as shown in Figure 4.

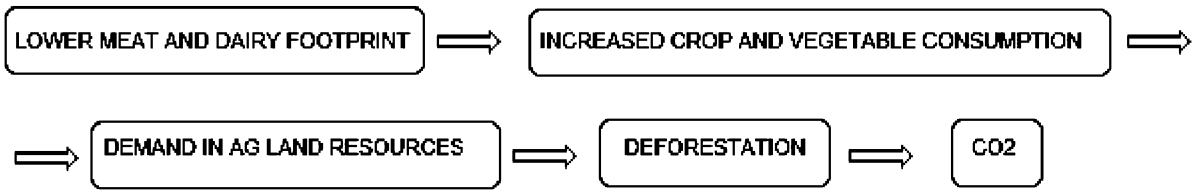

Figure 4: Potential "boomerang effect" caused by preventive agricultural measures

We believe that solution for such situation is the introduction of Digitalization of Soil. With the help of adequate regulative, Digitalization of soil should include merging various technologies which would allow us to gather more information, create historical records and intelligent forecasts based on collected data. This kind of system would bring the intelligent decision making in farming.
Some of the benefits of proposed system are:

- Better quality of crops and higher yields per square meter
- The decrease of negative environmental impact & prevention of soil erosion
- Reduction of water & pesticide usage

4.1. Incorporating the Blockchain

In theory, the goal would be to treat 1 square meter (sqm) of soil as a Soil Basic Unit (SBU) – congruent, square shape with sides of 1m by 1m. SBU cannot be divided into smaller units, similar to the pixel. Every SBU has 4 vertices. Each vertex is defined by geo-referenced data – point's longitude and latitude.

Every SBU inherits its name from its 4 vertices, (vertex 1 lat/lon; v2 lat/lon; v3 lat/lon; v4 lat/lon;), e.g. (44.966069, 19.856436 ; 44.966070, 19.856436; 44.966069, 19.856437 ; 44.966070, 19.856437).

Here we would like to introduce Blockchain, as a centerpiece of the system, as we will treat every SBU as a distributed ledger. SBU will work as a database updated independently by each node included in the network. Nodes will be data collecting platforms such as a cadastral database; drone analytics platform; IoT communication platform; farm management software, etc. Every single node on the network processes every transaction, coming to its own conclusions and then voting on those conclusions to make certain that the majority of network agrees with the conclusions.

This will allow the ecosystem to manage a historical diary of records for every square meter – SBU. By doing this we are leaning towards efficiency and maximizing yields of SBU. It is in line with the agricultural strategy of vertical growth.

Depending on how we want to present the data, it can be stored on blockchain in one of three ways:

- Unencrypted data - can be read by every node in the network, and is fully transparent.
- Encrypted data - can be accessed only by participants with a decryption token. The token allows access to the data on the blockchain and can prove who added the data and when it was added.
- Hashed data - can be presented together with the function that created it, to show the data wasn't tampered with.

Blockchain technology will create a continuously growing historical list of records – blocks, for each SBU. Every input collected by platforms (nodes) in the network is realized as a transaction and is stored in a block. That means that when a tractor's GPS or a seeder control unit, which is also an IoT device, sends some data such as variable seeding rate back to its mother platform, every seeding rate per SBU will be stored on SBU's blocks.

This means that we want to create a historical record for every square meter of soil, and every action (transaction) of every agricultural operation that took place on that SBU and information extracted from it. Some of the information stored on a block could be:

- Type of a crop
- Sowing rate
- Yield
- Weed pressure
- Stresses occurring – diseases, irrigation, pest
- Fertilizer rates
- Applied herbicides
- Moisture
- Minerals

4.2. IOT technology

Internet of things (IoT) is all devices connected to the Internet, which communicate and exchange date with each other or with cloud-based data-collecting platforms. IoT can be a sensor, vehicle, home appliance or any other piece of electronics, and is used to improve processes by collecting data, analyzing it and performing an adequate action. Communication and exchange of data through a network is crucial for IoT functionality. The IoT network consists of a device or a sensor with a communication module, communication protocol, edge device or a router and a cloud data center. In agriculture IoT devices are used as sensors on the field measuring climate conditions – moisture of ground, air humidity, temperature; detecting pests – pest traps, improving pest control and saving the yield by monitoring insect activities.

Some agricultural hardware producers, such as John Deere, are incorporating specialized IoT devices into their products. One of the examples is a piece of their planting equipment – row unit. In this example, John Deere's seeder has a sensor which communicates with a driver, by showing pressure applied to each seed as it's planted. Sensors will send the pressure information, but it will also provide data about the softness of the soil. The farmer then can adjust the pressure, in order to plant the seed on the right depth, and on the right distance. John Deere's sensors can also communicate with its mother cloud platform where all data are processed and stored. E.g. variable seeding rate for each sqm – seeding distance, and seeding depth. The same principle works with sprayers, where a device will communicate the herbicide prescriptions and spraying maps.

Automatic sensor communication with cloud-based mother platforms are allowing us to automatize and improve processes – such as irrigation, spraying, seeding, harvesting etc. Besides improving processes, this technology is making them Intelligent, as processes are based on sensor-collected data.

Storing valuable information such as spraying maps, yield maps, soil moisture, seeding rates, as individual transactions on blockchain blocks for each SBU, will provide us with historical overview and conditions for intelligent decision making based on historical data.

4.3. Drone analytics

One of the main challenges for farming is large cultivated areas and inefficient crop monitoring. Until recently, the most advanced form of monitoring was satellite imagery. The main limitation of such practice was a high price, fixed interval of taking images, and cloud interference which could lower the quality and precision of the output. Drone technology solves that problems and offers a variety of crop monitoring possibilities at a lower cost. It can be utilized for any of the vegetative or reproductive growth stages in the crop life cycle. Unlike satellites, drones have a versatile function in precision agriculture operations. Besides collecting data they could be used for aerial spreading of seeds and spraying. One of the advantages of drone tech is an integration of various sensors which could be used for data collecting:

- RGB sensor
- Multispectral & Hyperspectral sensor
- NIR sensor
- Thermal sensor
- Gyroscope

Collected data is transferred into orthomosaic maps, which are eligible for analysis and extracting the drone analytics. Today, digital solutions can provide valuable data and evaluate sources of stress for every sqm based on the compiled orthomosaic (Agremo, 2018). Data could show population and number of plants on the field or different types of stress that are affecting the field and the plants. As all of the drone data is

georeferenced with a timestamp, storing such information on an SBU block as a new transaction is pretty straightforward. A good example of the transaction would be the measured plant density for the SBU. E.g. 10 plants/ sqm, which we could compare with the seeding map created by an IoT device.

4.4. Decision making

Accumulation of data from various sources improves the agricultural knowledge base. Storing all data in blocks will allow us to have a historical overview of all the actions performed on each SBU. Imagine what we could do if we knew historical data for every square meter of agricultural land, ranging 50 years back. We could know all the crop cycles, yields, problems, stresses; each agricultural take measure, with every tool used in the process, following the weather conditions. Huge amounts of data would be a challenge to process, but by introducing AI and machine learning, historical data could get its bright future. All transactions from the past would be used for intelligent decision making, analyzing trends, the anticipation of the agricultural needs, potential threats and creating forecasts as shown in Figure 5.

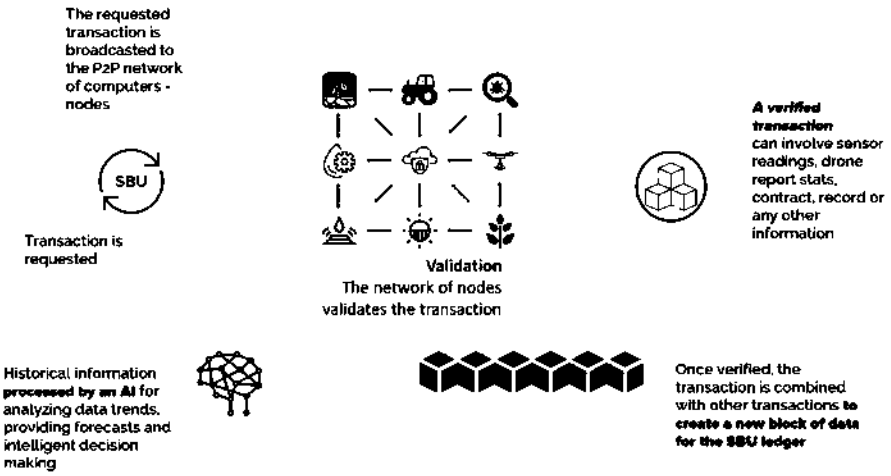

Figure 5: The intelligent agricultural decision-making system

With such system, agriculture could tackle many of the existing and future threats - increase yields and productivity per square meter, lower emission of CO2 and deforestation rates, avoid soil erosion, regardless the population growth. The system would also enforce sustainability rules, as every transaction would be verified by the vast network of nodes.

5. CONCLUSION

After lining up the facts presented in this paper, we can easily understand the magnitude of the problem humanity is facing. We strongly believe that severity of the problem will exponentially grow unless we don't stand united around the idea of sustainable development. We want to implement a chain of modern technology as tools in that process. Continuous development of modern technology and ICT will not only guarantee the improvement of the tools covered by this document but also emerge the new tools which will bring more efficiency and effectiveness in the process of digitalization. This should lower the cost of global implementation of such tech and improve the general knowledge about the problems we are fighting against. Digital disruption of agriculture explained in this paper, besides the needed technology and funds, will also require a strong support of political establishment in creating a positive atmosphere, regulations, and ecosystem for this process, which hopefully will be established.

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ENVIRONMENTAL AND LOGISTIC ASPECTS OF INTRODUCTION OF ELECTRIC AUTOMOBILES

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Abstract: *The present paper is regarding with the introduction of electric automobiles. Various aspects of electric automobiles use are considered as are environmental, logistic and economic ones. There is included also a brief historical review of the development of electric cars. Particular emphasis is given to the comparison of environmental impacts of electric and internal combustion engine powered cars as well as on logistic problems connected with the introduction of electric cars. There is included a brief review of the current situation in the European Union with the special emphasis on the situation in the Republic of Slovenia.*

Keywords*: Electric automobiles, environmental aspects of automobiles, air pollution, greenhouse gases, charging stations network*

1. INTRODUCTION

Electric automobiles in the period of last years have made an important breakthrough. Only a couple of years ago an electric automobile observed on the street seemed almost an exotic example attracting views of passers-by. Currently electric automobiles have become quite normal vehicles and can be seen on roads every day. Nevertheless, the share of electric vehicles in European countries is still very low – the share of battery electric vehicles sold in the European Union market in 2017 was 0,54 % for battery electric vehicles (BEV) and 0,64 % for plug-in hybrid electric vehicles (PHEV) (EAFO, 2018). This may seem a marginal share, however in 2012 the shares on the market were 0,12 % for BEV and 0,07 % for PHEV and at least for BEV in the period 2012-2017 a continuous growth of the market share can be observed (EAFO, 2018). Therefore, nevertheless the current share of electric vehicles is low when considering such a trend important changes can be expected in the period until 2030. In Slovenia in the year 2017 there was share of electric vehicles approximately 0,1 % – estimated number of about 1200 electric cars in comparison to the total number of personal automobiles in use which is about 1,1 million in 2017 (RTVO SLO, 2017; SURS, 2017). According to certain estimations there is expected that the number of electric automobiles in Slovenia in 2030 will be about 200.000 (Kolednik & Pavšič, 2017). Such an increase in the number of electric cars will demand also important changes in certain other sectors particularly in the field of electric energy supply. There can appear problems connected to production of sufficient quantities of electricity as well as regarding the development of an electricity network with a sufficient number of charging connections.

2. HISTORY OF ELECTRIC CARS

It is interesting to present a brief historical review of electric automobiles. According to the great increase of the number of electric automobiles in the last years there sometimes appears a wrong opinion that electric automobiles are one of the latest inventions. Contrary, electric automobiles have almost exactly the same long history as automobiles with internal combustion engine. In 1884 Thomas Parker constructed the first usable electric automobile and in 1885 Carl Benz presented the first commercial car with spark ignition engine (Guarnieri, 2012; Owning an electric car, 2010-11; Elwell-Parker, n.d., Daimler, n.d.).

In the period about 1900 and also until the beginning of 1920s electrical automobiles were completely competitive with gasoline automobiles. The production of electric vehicles in United States achieved its peak in 1912 (Business insider, 2015). Electric vehicles surpassed cars with internal combustion engine in silent and clean operation as well as in easy driving. Their weak points – short driving range and long time necessary for battery charging – at that time were not so outstanding as cars were used mainly for short urban driving (Guarnieri, 2012). However, some important changes happened around 1920 (Guarnieri, 2012):

- Due to the improvement of road network longer intercity driving became more interesting
- Some technical improvements (particularly invention of electric starter in 1912) facilitated driving of internal combustion engines powered cars

- Lowering price of gasoline according to the discovery of new oil deposits in various regions of United States.

All these facts supported the use of cars with internal combustion engine. This was already the period of the beginning of massive production of automobiles in the United States and until the beginning of 1930s the role of electrical automobiles became only marginal. Electric cars were used for certain niche purposes. There was observed certain interest for electric vehicles during the oil crisis in 1970s, however, it had not important consequences (Owning an electric car, 2010-11). Situation has begun to change in the 1990s mainly according to environmental demands. This was the beginning of something that could be called the rebirth of electric automobiles. Particularly after 2010 the number of electric automobiles has begun to increase substantially and practically all automotive companies have included electric car models in their production programs.

As mentioned the main motives for the return of electric automobiles in mass use were mainly environmental. However, the most important fact that enables the recent breakthrough of electric automobiles was a great progress in the development of batteries with much better characteristics.

3. ENVIRONMENTAL ASPECTS

3.1 Emission in the atmosphere

Environmental care was without a doubt one of the most important motives for promotion of electric vehicles. Automotive emissions are one of the most important contributors to the atmospheric pollution. However, when regarding noxious impacts of substances emitted in the atmosphere (automotive emissions but also emissions from other sectors as are energetics, industry, individual heating devices) these substances can be divided into two groups:

i) Air pollutants and
ii) Greenhouse gases.

Nevertheless, these substances are often related or certain substance (by example tropospheric ozone) may belong to the both groups these two groups should not be mutually replaced as there exists difference in the mode on which individual substance harms to the environment.

Air pollutants are substances which exhibit direct noxious impact on living organisms by example they cause poisoning, suffocating, promoting development of diseases etc. Elevated concentrations of pollutants in the air present a threat to the human health and are harmful to the environment. Pollutants which derive from automotive emissions are carbon monoxide, hydrocarbons, nitrogen oxides, particulate matter and ozone (Mondt, 2000; Schäfer & van Basshuysen, 1995).

Greenhouse gases are substances present in the atmosphere which can absorb infra-red radiation and thus increase the ability of the atmosphere to retain heat. This process is to certain degree natural. However, the problem present additional emissions of greenhouse gases caused by human activities which are known as anthropogenic greenhouse effect and are responsible for the disruption of natural equilibria and global warming. More than half of the anthropogenic greenhouse effect is ascribed to the emissions of carbon dioxide (Botkin & Keller, 2003). Among the most important sources of carbon dioxide emissions are traffic and energetics.

Both heavy air pollution in urban areas as well as prognosis of considerable temperature increase present serious environmental threat and this was a reason to search systematic solutions of lowering automotive emissions.

When considering air pollution there has been for decades invested a lot of effort in control of emissions. There have been developed very efficient catalytic converters which enable considerable lowering of emissions. Therefore, a typical car produced in the year 2000 emits only 5 % of pollutants in comparison with a car produced in the beginning of 1970s (Mondt, 2000). Catalytic converters reduce emissions of carbon monoxide, hydrocarbons and nitrogen oxides, meanwhile emissions of particulate matter are reduced by filters. However, in spite of this poor air quality in urban areas still presents a considerable problem worldwide. Reasons are high traffic density and the fact that during short urban driving catalytic converters cannot achieve the adequate temperature for full efficient operation (Mondt, 2000). Two of the most problematic kinds of pollutants are particulate matter (particularly in the cold part of the year) and tropospheric ozone (in summer) as their boundary levels are often exceeded (ARSO, 2017). The consequence of the elevated levels of particulates in the air is that many European cities have just limited

entrance of automobiles with compression ignition (diesel) engines. The problem of particulate emissions has been for many years connected only with compression ignition (diesel) engines. The conventional (indirect injection) spark-ignition (Otto) engines have much lower emissions of particles which are in comparison with diesel engines treated as almost negligible. However, the situation has changed considerably in the last years with the introduction of direct injection (DI) spark-ignition engines. These engines exhibit much improved performance and reduced fuel consumption what is beneficial also from the environmental point of view. However, unfortunately DI spark-ignition engines exhibit similar or even higher particulate emissions as diesel engines (Kirchstetter, Harley, Kreisberg, Stolzenburg & Hering, 1999 in Fruin, Winer, & Rodes, 2004; Miguel, Kirchstetter, Harley & Hering, 1999 in Fruin et al. 2004, Senegačnik, Vuk & Petrović, 2017).

Particulate matter – especially black carbon fraction of PM 2,5 category (finer particles with the diameter less than 2,5 μm) present a serious threat for the human health. According to the results of Global Burden Disease analysis it has been estimated that air pollution with particulates is responsible for approximately 3 millions of premature deaths worldwide every year (Curry Brown, 2013). Exposure to particulates is harmful not only for respiratory tract but there is still stronger evidence of its influence on the development of cardio-vascular diseases (Curry Brown, 2013, Suglia, 2007). Short-term exposure to increased particulate concentrations enhances a frequency of cardio-vascular incidences as are hearth ischemia, hearth infraction, arrhythmia, hearth failure or stroke (Brook, 2004, Brook et al., 2010, Dominici et al., 2005). There has been observed a positive correlation between particulate level in the air and incidence of necessary defibrillator discharges (Peters et al., 2000). On the other hand long-term exposure to elevated levels of particulates promotes development of atherosclerosis and therefore presents an increased risk of cardio-vascular mortality (Dockery et al., 1993 in Brook et al., 2004, Pope et al., 2004). As mentioned the problem of particulates is more severe in winter according to higher emissions (besides other sources also the contribution of heating devices is added) and temperature inversions.

In the summer another pollutant is problematic – tropospheric ozone. It should be emphasized that ozone is not component of exhaust gases but it is formed by photochemical reactions in the atmosphere from nitrogen oxides and hydrocarbons. Hydrocarbons and nitrogen oxides are both components of exhaust gases. They are already by themselves harmful to human health, however, boundary values of both pollutants are seldom overcome. By example, when regarding air quality reports for Slovenia, there have been practically never reached boundary levels neither for hydrocarbons neither for nitrogen oxides but on the other hand concentration of ozone often exceeds limiting value (ARSO, 2017). Ozone is harmful for the respiratory tract and particularly affects people suffering from asthma.

From the facts stated above it can be evident that polluted air in urban areas presents a prominent health threat and the contribution of automotive emissions to this problem is considerable. Therefore, the use of electric automobiles could efficiently help to lower emissions of pollutants. Electric automobiles are zero emission vehicles – they do not produce any tail pipe emissions. Of course certain emissions are generated when electricity is produced in thermal power plants. However, even in such case the emissions are at least moved from the exhaust pipe of a vehicle to the chimney of a power plant. As power plants are usually not located in the centres of cities this will help to improve the urban air quality and considerably lower the health risk.

On the other hand, the situation is different in the case of greenhouse gases emissions. Both automobiles and thermal power plants are important sources of carbon dioxide – the most important greenhouse gas. The global warming contribution depends on the quantity of greenhouse gases emitted in the atmosphere and there is not important where these emissions happen. Therefore, it seems – contrary as in the case of pollutants - that there is no profit of substitution of internal combustion engines powered cars with electric cars when the majority of electric energy is produced in the thermal power plants. The situation is different when electricity is produced from carbon neutral sources but the capacity to produce such a kind of electricity is often limited. When electric automobiles are charged from the public electricity network the carbon footprint depends on the national electricity production structure. Thus significant differences are observed between individual countries. In those countries which generate the majority of electricity from thermal power plants also in the case of electric automobiles indirect emissions of carbon dioxide cannot be avoided. Therefore, the carbon dioxide (CO_2) emissions intensity of electric energy production in Greece is as high as 829,9 g CO_2/kWh The situation is much better in those countries which produce a majority of electric energy from carbon neutral sources as are by example in France (nuclear power plants) – 34,8 g CO_2/kWh or in Sweden (hydroenergy) where emission intensity is as low as 10,5 g CO_2/kWh. European Union average is 275,9 – all data are for the year 2014 (EEA, 2017).

3.2 Environmental impact of batteries

When considering environmental impact of automobiles like any other product the entire life cycle should be considered – production, use and decomposition. In the case of electric automobiles there is particularly emphasized the environmental impact of batteries. Modern electric automobiles use particularly lithium ionic batteries. It is estimated that in the future between 75 and 90 % of electric cars will use lithium ionic batteries. Production of the adequate number of batteries will require between 65.000 and 145.000 tons of lithium carbonate (Li_2CO_3)(Conot, 2011).

Lithuim is unevenly distributed – main sources are in the Southern America (Argentina, Bolivia and Chile), Australia and China. Lithium is mainly produced from brine. The production of 1 ton of lithium requires about 750 tons of brine and about 24 months. The procedure uses also great amounts of water and energy – production of 0,05 g -1 g of lithium requires about 1000 litres of water. As lithium rich regions are usually arid such water wasteful process is also questionable from the environmental aspect of view. Lithium can be produced also from sea-water but the procedure is more expensive (Battery University, 2018; Huš, 2016).

Lithium can be also produced from spent batteries – about 20 tons of spent Li-ion batteries are necessary for 1 ton of lithium. Unfortunately, the existing recycling technologies do not allow the production of pure enough lithium for the second use in batteries (Battery University, 2018).

In lithium ion batteries lithium ions moves from the electrodes – the cathode is usually lithium doped cobalt oxide, the anode is carbon (graphite) and the electrolyte is lithium salt in organic solvent (Electronics LAB, n.d.).

4. TECHNICAL AND LOGISTIC ASPECTS

4.1. Charging stations

Charging stations can be divided into individual charging stations (in private houses –garages) and public charging stations. According to charging time stations can be divided into classical charging stations (slow charging) and fast charging stations. Some characteristics of various charging stations are shown in Table 1.

Table 1: Characteristics of different types of charging stations (PP Plan-net, 2018).

Charging power/ kW	***Charging speed/kWh h^{-1}***	***Necessary voltage***	***Typical use***
3,7	*24*	*Single-phase*	*Households*
7,4	*48*	*Single-phase*	*Households, companies, public parking places*
22	129	*Three-phase*	*Public parking places*

Rapid charging enables 80 % charging of the battery capacity in 20 to 30 minutes – depends on the charging voltage and current as well as on the capacity of the battery. This mode of charging is appropriate when it is important to charge battery in a short time – by example during driving on long distances. In the case of short distance driving when the charging time is not crucial (by example overnight charging) it is more appropriate to use slow charging mode (also from the view point of costs). Some technical specifications of charging station Chademo EV Charger are shown in Table 2.

Table 2: Technical specifications of Chademo EV Charger.

Type of voltage	Three-phase
Voltage	380 V
Frequency	45-55 Hz
Total harmonic distortion (THD)	<5 %
AC entrance Power factor	0,99
Input overvoltage protection	323 + 5 V
DC output voltage – nominal output voltage	750 V
Output current	200 A
Regulation precision	<0,5 %
Steady current	<1 %
Output charging voltage	350-750 V
Short-circuit current	<30 A
Output power	200 kW
Working temperature	25 °C – 50 °C

AC-alternating current, DC – direct current

4.2. Electrical connectors for charging stations (transformers)

In the case of household (domestic) charging with relative low power (3,7 kW or 7,4 kW) there is no necessity of special transformers.

Household connector with maximal output power 3,7 kW requires a power cable with cross section of 4 mm^2 for single-phase voltage and a 16 A fuse.

Connectors with higher powers (7,4 kW or 11 kW) require power cables with larger cross sections (6 mm^2). In the case of 7,4 kW power variant a 32 A fuse for single-phase is necessary, meanwhile for 11 kW a 3 x 16 A fuse system for three-phase connector is necessary. Costs of such charging stations are (without mounting) between 800 and 1500 Euros. Costs of public charging stations are over 5.000 Euros for pillar (Schrak, 2018; PP Plan-net, 2018).

When planning larger charging capacities with different charging stations (AC, DC, fast charging stations with greater charging power) separate transformers should be used because of greater energy use. These transformers should be connected to the medium voltage network.

Standardized types of transforming stations are used: 50, 100, 160, 250, 400, 630 and 1.000 kVA. The costs of 400 kVA station are, by example, about 22.000 Euros, and the total costs of a building of such a transforming station can rise up to 55.000 or 60.000 Euros (Elektro Ljubljana, 2018).

As urban charging networks in majority of cities currently do not exist the question arises where, when and how many charging points will be built. Nevertheless, additional charging stations and medium voltage networks will be necessary.

Meanwhile locations of individual charging stations (by.example stations in individual houses in the countryside and suburbs) do not present an outstanding problem the situation is expected to be different in densely populated urban areas. In the case of large residential buildings (by example skyscrapers) nowadays it is often difficult even to find enough parking places for cars with internal combustion engines. As the number of electric automobiles is currently very small their charging does not present a considerable problem yet. However, in the future when it is expected that the share of electric automobiles will rise up to at least 10 or 15 % it seems an unrealistic task how to assure adequate number of charging stations for all these vehicles.

There will be important also to regulate the standardization in the field of electrical automobiles charging. The most important standards in this field are (Kordiš, 2018):

- SIST EN 61008
- SIST EN 61851
- SIST EN 62196
- SIST IEC 14443
- SIST IEC 61851 and
- SIST IEC 15118.

These standards include communication levels between automobile and charging station, types of connectors – but there exist certain differences between European Union, United States and Japan. Various charging modes are used – direct current (DC) and alternating current (AC), there are also differences in connectors – couplings used both on cars as well as on charging stations.

As has been emphasized there is particularly desired to use renewable sources of electricity for battery charging. Into this purpose for charging stations with small power (3,7 kW or 7,4 kW) solar systems could be used. Such photovoltaic systems could in favorable conditions replace electric energy from the public network. When using direct current (DC) systems there would not be necessary to transform direct current into the alternating current and there will be no necessity to use inverter which will lower the costs. In the case of energy surplus the excess electricity can be emitted in the public network.

4.3. Energetic aspects

As has been mentioned above short driving range is probably the weakest point of battery electric vehicles. In spite of the important development in battery performance during the last years energy density of batteries is still poor when compared with energy density of fossil fuels. A brief comparison of a spark-ignition engine using gasoline and a battery electric engine is presented:

- Gasoline has energy value of approximately 47 MJ/kg. Modern spark-ignition (Otto) engines achieve efficiency of 40 % (older engines 30 %). In the case of the 50 litres of a tank volume this means cca. 38 kg of gasoline with energy potential of approximately 1,8 GJ of available energy from which 720 MJ (or 530 MJ in the case of older engines) is practically used for transportation and ensures the vehicle's driving range between 700 to 950 km. Compression-ignition (diesel) engines exhibit higher efficiency and therefore can achieve still longer driving range (Huš, 2016).
- Electric engines have considerable higher efficiency than internal combustion engines – by example at the Tesla Model S about 80 %. For driving range of 700 km it will be necessary 660 MJ of energy (or 900 MJ for 950 km). 7616 of NCA 18650 batteries can contain 324 MJ which assures driving range of 400 km. To reach driving range of 700 km or 950 km there would be necessary 12364 cells or 18099 cells , respectively. Such a high number of cells would present a spatial problem as well as a considerable increase of a vehicle's mass (Evannex, 2017, Huš, 2016).

5. PRESENT SITUATION

5.1. Electromobility in European Union

The total number of new registrations of electric automobiles in the European Union according to the data of EAFO is shown in Figure 1. Both battery electric vehicles (BEV) and plug-in hybrid vehicles (PHCV) are included (EAFO, 2018). Therefore, it can be seen that the number of new registered cars has increase in the period 2012-2017 almost ten times – from 23146 electric cars in 2012 to 217461 electric cars in 2017 (EAFO, 2018).

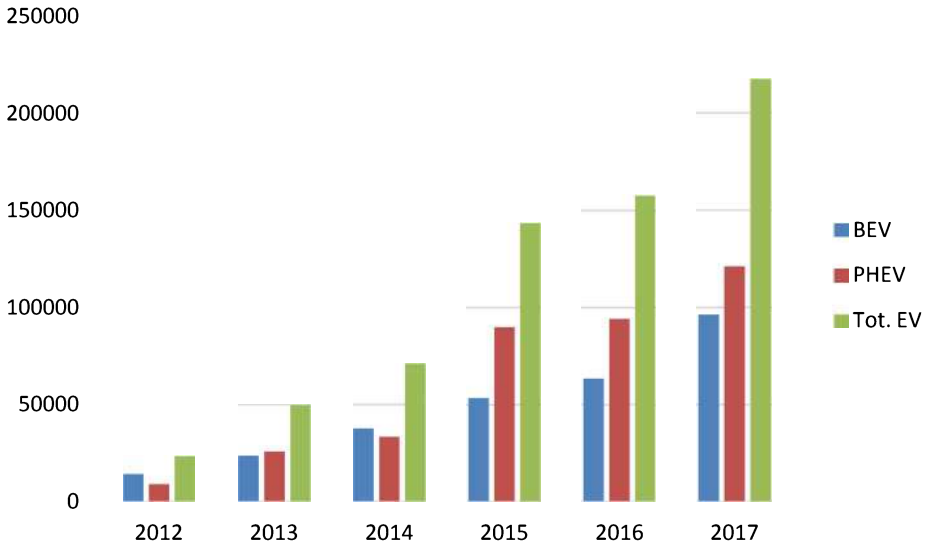

Figure 1: Total number of new registrations of electric automobiles in the European Union for the period 2012-2017: BEV – battery electric vehicles, PHEV – plug-in hybrid vehicles, Tot-EV – total number of electric vehicles (EAFO, 2018).

In Figure 2 the share of electric vehicles in the European Union market is shown. There can be observed approximately 7,5 times increase in EV share (from 0,19 % in 2012 to 1,44 % in 2017) (EAFO, 2018).

5.2 Electromobility in Slovenia

The number of electric automobiles in Slovenia is still very low (according to the data of DEVS – Slovenian Society of Electrical Vehicles only about 500, some other estimations are bit higher but not more than 1200 vehicles) (RTV SLO, 2017). Therefore, it is not surprising that network of charging stations is relatively undeveloped. Actually the number of stations in comparison with the number of vehicles is not so small – according to the data from the end of the year 2016 there were 228 charging stations with 553 plugs. This means that the ratio of electric cars and charging stations is approximately 3:1 and the ratio of electric cars and plugs is almost 1:1. The problem may arise according to the uneven distribution of charging stations as they are concentrated in the vicinity of motorways and Ljubljana (Pavšič, 2017).

According to certain opinions the relative small number of electric vehicles in Slovenia is ascribed to low degree of environmental awareness. However, when comparing prices of electric cars and average income of a Slovenian middle class family such an opinion is only partially true. It seems that economic reasons are the main obstacle for the greater prevalence of electric cars.

Figure 2: Market share (in %) of electric automobiles in the European Union for the period 2012-2017: BEV – battery electric vehicles, PHEV – plug-in hybrid vehicles, Tot-EV – total number of electric vehicles (EAFO, 2018).

The prices of electric cars are still too high for the capacity of an average Slovenian household nevertheless the maintenance (services, fuel/energy) of electric vehicles is less expensive than in the case of cars with internal combustion engines. As economic aspects are usually the most important for an average user or owner of the car it is reasonable to compare some data. The cost of energy consumed for 100 km of driving for an electric car vary – depending on the tariff between 1 Euro and 2,5 Euros (EVSVET, 2018). The costs are therefore several times lower than in the case of gasoline, diesel and even gas fuel. However, the costs of an electric automobile are still too high in spite of subsidies of the Slovenian ecological fund (3000 – 7500 Euros, depending on the category, age of the car etc.). There should be also included technical and logistic problems as are shorter driving range, time of battery charging, life time of battery. All these aspects present considerable obstacle for the enforcement of electric vehicles in everyday practice.

Besides this there presents considerable uncertainty for potential future owners or users of electric cars also the fact that it is not known how long will the subsidies apply as well as how long it will exist the possibility of free charging of batteries on public stations.

6. PROPOSALS AND CONCLUSIONS

In cities like Ljubljana and Maribor it is possible to build charging stations at the entrance in the city for external visitors with electric cars. It will be possible to organize public transport to the center of the city from the charging stations at such guarded parking lots. In such a way it will be possible to reduce traffic density in the center and thus avoid traffic jams.

Charging stations in the centers of cities are problem by themselves because of necessity of building of additional voltage support system (transformers) as well as because of spatial restrictions.
In the case of a greater number of users of electric cars there will be reasonable to plan charging stations in underground garages. Besides this it will be possible to build charging points also in large parking lots at shopping centers, sport halls, stadiums etc.

When constructing new residential neighborhoods the placement of charging infrastructure will mainly not present a problem. The situation is different in the case of those urban areas where all the infrastructure is already build and subsequent construction of charging capacities is difficult or even impossible.

Because of the increasingly restrictive environmental legislative and limited natural reserves of oil it can be expected that in the future electric automobiles will gradually prevail over the automobiles with internal

combustion engines. This fact will bring certain problems which have to be sold as well as a number of new challenges.

As has been mentioned one of the main questions is how in countries like Slovenia assure enough electric energy. It is particularly desired to use electric energy from renewable sources as only in this way it will be possible to reduce the carbon footprint. Another problem is the necessary upgrade of the electricity network. It is also not real to expect that in the future the electric energy for charging of automotive batteries will be so cheap as it is currently. Today it is possible to charge batteries at a very low price or sometimes even for free because of promotion of electric cars use. However, when the share of electric cars will reach a certain value it is not realistic to expect that this will continue. It should be mentioned that also in the price structure of gasoline or diesel fuel the considerable share present taxes or duties. It can be expected that in the future also electric energy used for charging batteries will be according to certain duties considerably more expensive than electricity used in households.

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E-WASTE MANAGEMENT: ENVIRONMENTAL AND SOCIAL IMPACTS

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Abstract: *One of the biggest issues of environmental policy in the Republic of Serbia is unsystematic and inadequate waste management, especially when it comes to hazardous waste. Continuous growth of society generates the accelerated development of modern technologies, leading to greater production and usage of diverse electric devices and equipment without which the everyday life is unimaginable. Therefore, electric waste is inevitable by-product of technological revolution. Raw materials used in the production of electronic equipment also have negative influence, causing the expansion of electronic and electric waste problem which, consequently, to a large degree contributes to the total environmental pollution. Redistribution of responsibility between the producer and the consumer should contribute to the full affirmation of ecological awareness about catastrophically negative influence of electronic and electric equipment on the environment and human health.*

Keywords: *technological revolution, digitalization, e-waste, environmental protection, green industry*

1. INTRODUCTION

The increase of waste represents the overall economic activity of a state, and, it could be said to be in direct correlation with its national economy. Therefore, the formation of waste depends on the level of industrial development, social environment, life standard and other parameters that determine the amounts of generated waste of a state on annual level. Very often, the activities of people have negative influence on the environment. But also, the special issue is the advanced generation of all waste types, and along with revolution of information technology, the rapid growth of the amounts of electric and electronical devices waste represents true challenge for every country and the world in general.

According to the Article 5 of the Law on Waste Management (*The Official Gazette of the Republic of Serbia, No. 36/09 with amendments*), hazardous waste *is the one that as a result of its origin, composition or concetration of unsafe substances can cause danger to environment and human health and it contains at least one of hazardous features in accordance with special regulations*. The waste classification is done in accordance with the Rulebook on Categories, Testing and Classification of Waste (*The Official Gazette of the Republic of Serbia, No. 56/10*). The Rulebook, inter alia, is used for implementation of the European Waste List (EWL – Commission Decision No. 2000/532/EC with amendments). With the EU Decision No. 1600/2002/EZ (Commission, 2002) regarding the establishment of *The Sixth Environment Action Programme* (EAP) it has been emphasized that the basic principle of sustainable waste management is the separated management of waste produced by economic activities. Ecologically acceptable and sustainable waste management requires the integrated system of waste collection, recycling, reuse and disposal.
The European Commission defined several “specific waste streams” also including the electric and electronic waste. In order to prevent the creation of hazardous waste within the specific waste streams, several EU Directives prohibited the use of hazardous substances for fabrication of products, among which are included the electric and electronic waste, as well. The waste of electric and electronic products refers to household appliances and technologies (TVs, computers, mobile telephones, analog, plasma and LCD screens, music devices, fridges, freezers, air conditioning devices, etc.). Because of their containing components, most of the aforementioned products are considered to be hazardous waste (Serbia, 2010). Apart from recycling materials (metal, rubber, cables and glass) with their own utility value and without the hazardous waste features or unsafe substances (heavy metals, greenhouse gases, mineral oils, asbestos, freon), the electric and electronic waste can also have great number of dangerous and harmful substances. In accordance with *The Regulation of products that become special waste streams after use* ("Official Gazette of the

Republic of Serbia", No. 54/2010, 86/2011, 15/2012, 41/2013 - Rulebook and 3/2014) the electric and electronic products are classified according to the type of electric and electronic equipment in the following manner:

Table 1: Types of E-Waste

E-waste types	
1st class	**2nd class**
Large Household Appliances	Small Household Appliances
3rd class	**4th class**
IT and Telecommunications Equipment	Oprema široke potrošnje za razonodu
5th class	**6th class**
Lightening Equipment	Electric and Electronic Devices
7th class	**8th class**
Toys for Recreation and Leisure-time Activities	Medical Auxiliary Devices
9th class	**10th class**
Surveillance and Tracking Instruments	Slot Machines

Collection and treatment of hazardous electronic and electric waste requires the precise planning and clear defining of rules and duties of all participants in the management chain of this type of waste. Considering the fact that the expiration date of electronic devices is short and usually are thrown away afterwards, but also it is difficult to reuse and recycle them, e-waste is one of the areas with the reported highest growth.

2. E-WASTE GENERATION

There is not an area that has not been influenced by technological changes: trade, energetics, sports, industry, catering, health and intellectual services, etc. Rapid development and cheap production of technologies has contributed to the fact that almost every household in the 21st century contains electric and electronic devices. Before the digitalization process, there was the era of mechanical recordings and magnetic sound carriers (film, magnetic recording on wire and tape, vinyl record, video cassette). For the last thirty years, we have witnessed the gradual crossing over of all types of communication from classical, analog to digital technologies. With the era of digitalization, computers and internet, we got accustomed that everything can be available any time, any place and with accessible prices. As a result of greater accessibility of electric and electronic devices and equipment, the number of household appliances has increased. The development of industry has also been followed by modernization and digitalization in order to keep up with global tendencies and changes. Malfunctioning devices are rarely taken to repairs, because usually people just replace them with new items being this simpler and more economical solution. Due to the advanced development of IT sector, the average expiration date of computers and mobile telephones has decreased from six to two years. Even though household appliances have longer expiration date, each year the technology market is growing bigger. The incredible development of electronic industry combined with short expiration date of devices have lead to abrupt escalation in generating the increasing amounts of e-waste. Waste electric and electronic equipment (WEEE) or e-waste has become the growing challenge for countries around the world.

Obtaining raw materials for the production of electric and electronic device has also a negative influence. These raw materials used for production are mainly gained through mining which leads to great amount of harmful gases. Over 1,000 thousand different materials are used in production of electronic devices and their components (chips, printed circuits, disk drives, etc.). Many of these are poisonous and contain diluents based on chlorine, bromine compound, polyvinyl chloride, heavy metals (lead, mercury, arsenic, cadmium), plastics and gases (BEWMAN 2011). The aforementioned substances, if not handled with care, can be harmful to human health and the environment. Instead of producing more efficient, long-term equipment less hazardous for human health and the environment, the rapid development of technologies causes the use of cheaper and less quality resources which consequently means shortening of expiration date of products and increasing e-waste generation. Every year, each country uses hundreds of thousands, and maybe even hundreds of millions of electric and electronic devices. When talking about the Republic of Serbia, the import of used electric and electronic products, unless being for personal needs, is prohibited. However, the production and the import of new items has been steadily growing. As stated in the records of The Chamber of Commerce and Industry of Serbia, the number of enterprises in Serbia in year 2015, was 325,094 which in comparison to 2008 is 21,150 enterprises more (that is 7,0% more). In year 2016, the

investments in IT sector were based on the support from over 2,000 domestic IT enterprises dealing with production or distribution of hardware, software or IT services that have over 20,000 employees (SITO, 2016). Due to technological changes and internet services development, the role of electronic communications has expanded on all segments of society. According to the data from the Environmental Protection Agency (SEPA), in 2016, the producers put up on the market for sale approximately 9578,2 tons, that is 12,845,433 of electronic and electric devices were turned into specific waste streams upon their use. The majority of devices belongs to IT equipment (7,764,913) with the short expiration date, meaning that those are the products which households, but also companies, tend to change more frequently for new products (Agency, 2017). One of the causes of consumer society is mass production. The market game has put the emphasize on obtaining the bigger profit by lowering the selling prices, that is by offering the cheapest possible products. The consumer society, the product of globalization, together with the use of television, internet and other media influence, has been increasingly expanding and influencing on all areas of life. In economy, consumerism refers to the economic policy with aim to enhance the spending, and in accordance to which free choice of consumers should dictate the economic structure of society (Trendafilovic, Radonjić, & Filipović, 2013). Products such as cars, electric machines, television sets have become something ordinary and easily accessible in almost every household. The importance of quality of a product has been replaced by its quantity, turning this into the prerequisite upon choosing certain goods, and this way of thinking has very much expanded with digitalization process.

Digitalization has entered into all business spheres, but it has also been selling as a product itself. The number of digital devices, systems and applications is significantly large and the list of new products that we could expect on the market in the future is endless. With the development of industry, the number of companies with increasing products, including the EE products, is growing. As a result of faster software development, the most frequent changing devices nowadays are computers and computer equipment. Back in 1994, it was estimated that 20 millions of computers all over the world were obsolete, while the total amount of electronic waste was estimated to be 7 million tons. In 2004, the number had gone up to 100 millions of computes. Nowadays, the numbers are significantly higher and keep rapidly growing. When it comes to the EU member states, the annual amount of generated e-waste is estimated to be 14 – 15 kg per capita (Pavlović, Tadić, & Popovic, 2011). Furthermore, the European studies show that the amount of e-waste has been increasing 3 – 5 % per year, which is 4 times faster than communal household waste. This e-waste makes 5% of the total waste amount, with increasing growth rate per year. In accordance with estimations of the United Nations Environment Programme (UNEP 2005), each year 50 million tonnes of e-waste is produced in the world, and majority of that ends in developing countries. Leading continents in annual production of this hazardous waste is North America (about20 million tons), followed by Europe and Asia (about 14 million tons each) while other continents reach up to about 5 million tons (E-reciklaža, 2012). When it comes to the Republic of Serbia, 40 thousand tons of e-wast is generated annually (2016), which is four times more than in year 2012 (Agency, 2017).

If e-waste cannot be avoided, it is necessary then to reuse it, and to recycle and regenerate anything considered to be a useful resource. Electric and electronic waste recycling has been increasing during years reaching the level of approximately 19,000 tonnes (Chart No. 1) in 2013, which is about 2 kg of e-waste per capita keeping the Republic of Serbia still at the beginning. According to the National Plan, it has been conceived that recycling of this kind of waste should reach the level of 4,5 kg per capita by year 2018. Nevertheless, that level was reached back in 2016.

Table 2: Electric and Electronic Waste (Agency, 2017)

Year	Disposed Waste (t)	Treated Waste (t)	Exported Waste (t)	Imported Waste (t)
2011	/	7084	793	/
2012	62	10601	1381	/
2013	/	18998	2799	/
2014	0,1	20972	240	/
2015	/	27351	2311	/
2016	56	37004	3293	/

If the adequate handling of products after their production and its life-cycle are not being taken into consideration, that can further lead to the production of electronic equipment which can leave behind toxic substances and harmful gases upon recycling, especially if the appropriate techniques for e-waste management are not being applied. E-waste recycling is not an easy task since it contains hazardous substances, as well as those that require special procedures while handling them.

According to some estimations, less than 10% of e-waste is recycled in Serbia. The negative statistics leads directly to conclusion that the largest percentage of e-waste ends on communal or wild landfills, which also says a lot about the insufficient public awareness regarding negative consequences of inappropriate treatment and e-waste disposal on landfills.

3. E-WASTE MANAGEMENT IN SERBIA

In the Republic of Serbia, the ministry in charge with environment issues the licenses for hazardous waste management. Each operator that deals with waste management (collecting, transport, treatment, storage or waste disposal) should have the waste management license, and in case of preforming more than one different activities regarding the waste handling, the operator should get the integral license (Serbia G., 2009).

Until March 2018, 2,144 waste management licenses were issued in Serbia. The first time, license is issued for the period of five years time after which it should be renewed. Out of the number of enterprises with waste management licenses, 746 of them treat secondary raw material on different technological levels, while only 129 deal with hazardous waste. Among these enterprises there are also companies for electric and electronic waste recycling. However, the complete recycling process is not being done in these factories. Recycling requires great financial investments, special infrastructure and sophisticated technology with up to a value of several million euros, which on the one side creates possibility for growth of the, so called, *green industry,* additional job places and investment development, but on the other side it means great (financial) challenge for the economy of a country that is still without full capacities. Since the recycling represents the perspective aspect of a country's economy, with inevitable progress in the future, the implementation of contemporary methods for electric and electronic waste streams management is necessary as stimulus for operates to further develop this type of industry.

Table 3: Waste Management License (SEPA, 2018)

	Ministry			**AP Vojvodina**			**Local Self-Govrenmnts**
	total	non hazardous	hazardous	**total**	non hazardous	hazardous	non hazardous
Collecting	750	712	205	64	59	17	163
Transport	852	818	186	79	75	17	180
Storage	143	115	106	98	89	50	648
Treatment	138	112	98	79	77	31	529
Disposal	3	3	1	3	2	2	34
Total licenses by authority		1131			178		835
Total issued licenses				**2144**			

The process itself for obtaining a waste management license is very slow and requires extensive documentation that a future operator is in obligation to present. This includes working plans, programs and waste management methods (Serbia G., 2009), consents and permits from different authorized institutions, financial guarantees and administrative fees. Depending on the type of a license, the duration of documentation collecting can even be several months. Also, the process of issuing the license can be very slow and it is the obligation of the ministry in charge to start the procedure of request processing within a month, under the condition that all necessary documentation was previously collected and provided by operators. Only after this, the process of license preparation can start. The waste producer, the owner or any other waste holder are obliged to keep a daily track about the waste and submit annual reports to the Environmental Protection Agency, alongside with the *Document about the waste movement* and the *Annual Report* that should be filled via on-line application, but also in written form on a paper and all of this makes the process of e-waste management more complicated and duplicated. For this reason, it is necessary to establish clear and shorter standard operating procedures (SOP) defined for electronic and electric waste, but also the advanced IT system available both to entities and natural persons.

Waste management involves collecting, transport, treatment, storage and waste disposal. The waste equipment should be storaged in such a manner to avoid squashing, crashing or destructing in any

other way, or mixing with some other substances. This way the reuse and recycling are set up without any large costs. The collector does not dismantle the waste equipment, but rather gives it to the operator or the collecting operator. The operator's duty is to apply recycling and provide the reuse of entire equipment. The e-waste treatment is done with best available treating and recycling techniques. E-waste treatment rooms should be spacious enough for adequate storage of dismantled spare parts which can be classified as recyclable or non-recyclable material. The recyclable parts are all with the usage value (plastic, metal, cables, aluminiun, glass) and are given to the authorized operators for the further treatment. The non-recyclable parts in the Republic of Serbia as well as the hazardous substances are disposed into the special packages and exported. Hazardous waste management, including the storing at the place of its origin and the transporting, always involves a certain risk, which includes the environment pollution (of land, sources of water including subterranean waters), fires and release of toxic gases into the atmosphere. More than 38 different chemical elements can appear as the product of e-waste management process, and some of which can be really harmful for the environment and should be destroyed inside special plants since there is no possibility for their further use.

Organizing and functioning of sustainable collecting net is one of the main problems in establishing the efficient management system of electronic and electric products waste. The other problem refers to the effective recycling process that requires great financial investments, which are economically unsustainable without the help from state subventions.

3.1. Financial Instruments

The main sources for financing the environmental protection in the Republic of Serbia are the state budget and fee income. In accordance with the *Regulation on Products that become specific waste streams upon use*, everyone who puts on the Republic of Serbia's market the products that upon use become the specific waste stream (TV sets, fridges, tyres, accumulators, batteries, vehicles, oil, etc.) are obligated to pay the quartal fee, that is the ecological fee. This system is also know as: *payed by the pollutant*. In practice, this fee is payed once a year after the Serbian Environmental Protection Agency (SEPA) delivers the necessary data to the Ministry of Environmental Protection regarding the produced/imported amounts of electric and electronic products, based on which the Ministry further calculates the appropriate fee and brings the resolution about the payment. The fee amount varies since it dependes on the type of e-waste. In year 2015, income tax of the environment area were 167, 19 billion dinars (rsd), which makes it the 11,1% participation in the GDP. When it comes to the EU, and member states with less than 10% participation: Slovenia had 10,6%, Greece 10,3% and Bulgaria 10%. On the opposite side of the scale much less participation had Belgium (4,7%), France (4,8%), Luxembourg (4,9%), Germany (5%) and Sweden (5,1%). However, the devastating fact is that energy tax is more than ¾ of total elcological fee income (76,7%); transportation fee is 19,8%, while the pollution and resources fees are only 3,5% (Euroaktiv, 2017). On the other hand, the state provides necessary financial funds (incentive measures) for e-waste management process through obligatory fee payment for produced and imported products that after their use turn into e-waste. Every year, the Ministry releases the Rulebooks on types and quantity of incentive measures for all waste types including the EE waste, which is the way to repay the funds received from the producers of products that become specific waste streams upon use. These are economic instruments used to show to economy entities and citizens that there are also financial benefits in environmental protection investments. According to SEPA data, the Image No 1 shows the structure of incentives given between 2010 and 2016 (SEPA, "Environmental Protection Entities", 2018):

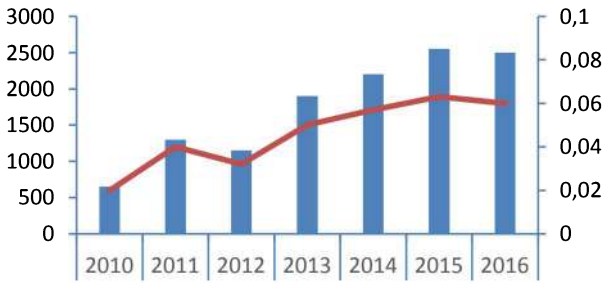

Figure 1: Incentive resources for 2010-2016

The waste managment has three goals: decreasing the waste amounts; adequate waste collecting and waste recycling, that is waste reuse. Providing the incentives for e-waste treatments is necessary measure, since the recycling itself requires great financial investments, mainly because recycled products are more expensive than products from natural resources. Recycling has ecological, economic and social meaning and it accomplishes the following: saving natural resources (all materials are of natural origin and can be found in nature in limited amounts), energy savings, environmental protection and new job positions (the so called, *circular economy* or *green industry* create the need for new job positions).

4. DIGITALIZATION CHALLENGES

Understanding the importance of Information Technology, developed countries (mainly the USA and the EU) have chosen to enhance the growth of IT sector for the last two to three decades. Choosing the liberalization of telecommunication market and the increasment of competition in all IT areas, we have achieved the global telecommunication market and endless competitions between increasing number of telecommunication companies (Mišev & Kaloserovic, 2017). With this trend of progressive digitalization and technological innovations in general, one of the issues is how to decrease e-waste generation with scrutiny and advancement in quality of technological procedures that produce electric and electronic items. From rapid obsolescence of products, that is from shorter market renewal cycles with new models, the ones that benefit the most are producers. Being the result of digital technology, is the thing these products have in common. Nowadays, everything is digitalized, from television and radio signals (sounds), bank services, on-line shopping to written documents. The inevitable steps to be taken in digital economy development start from investing in infrastructure, with aim to introduce the broadband internet in every household in Serbia, through forming the e-administration, to initializing an incubator for start-up companies. Speed and range of digital transformation affects almost every industry, which futher causes new IT companies with aim to provide the integration of new technologies. Innovations happen very fast (so called *industrial revolution*), and within a few years digitalization will affect the development of many areas. Digitalization process will ensure that industrial production becomes completely automated. This, basically, means that the number of employees hired on a production will decrease, while as the number of products and services will increase. The functioning of a modern society cannot be imagined without computers and the supporting IT equipment. The development of telecommunication and information technologies, that is the hyper production of means of communication, furnishes the increased availability of modern telecommunication means, also leading to the increased number of users (Stanojević, Mišković, & Mišev, 2017). Digital technologies fundamentally transform organizations, with the pace of technological change exacerbating the challenge. For these reasons, organizations must have a coherent strategy that includes a plan to reskill workers. Whereas previous technological revolutions (most notably the industrial revolution) played out over a relatively long period of time, the speed of digital transformation is such that companies need to act fast (WEFORUM, 2018). This influence is seen in cost cuttings of economy entities business running (which automatically increases their competitiveness), but also in making completely new ways for doing the existing economy activities and starting the new ones (Mišev & Kaloserovic, 2017). The most affected industries will have the impact on some of the employees, more than on the others (the low qualified ones, or those not willing to learn more). Job positions, such as those in sale, finance and administration, are threatened by automation. The industries in which the number of job positions is expected to increase are: architecture, engineering, informatics and mathematics (ManpowerGroup, 2017). All production procedures are unimaginable without the use of electronic and electric equipment and devices, and their increase is mostly expected in developing countries, including Serbia.

When, for any reason whatsoever, IT and similar electric and electronic equipment becomes outdated and useless, it is turned into e-waste that should be taken care of. Electric devices producers are the cause of the problem, but they can also be it's solution by taking the responsibility for their goods during their entire life-cycle: from the production day, until the time when they are turned into waste. They need to finance the treatment costs of their own products that become specific waste streams upon their use, while as the consumers should be given the opportunity of returning their old electronic equipment to the producers without any charges. Nevertheless, paying the ecological fee is not the sufficient financial instrument to deal with this kind of issue. The unnecessary technology should not be thrown into garbage, but rather handed over to licensed recycling centers or back to the manufacturers, which is something that should be introduced as obligatory through primary waste separation in every household. On the other side, the producers need to:

- Manufacture ecologically acceptable products, that is, the technological procedures need to be more sensible and done with more responsibility towards the environment and public health;
- Manufacture the higher quality and long-lasting products;
- Receive back their products in order to reuse and safely recycle them.

Just as there is a notable rise of ecological vehicles production in the world which, at this stage, cost more than the classic vehicles, that is those with fossile fuels, the production of electric and electronic devices and equipment is also conceivable with faster technological progress of industry. The good example for this is the company *MicroPro* that presented the first ecological computer six years ago. The Irish company brought to public view the computer made out of wood *lameco v3*, which could be named "the most ecological computer in the world". Almost the entire computer is recyclable, while 20% of it is set for direct recycling without any additional procedures and the wooden computer case of Imeco emits 70% less CO2 than "regular" desktop or laptop computer (B92, 2012).

Considering the fact that the market game is not being useful to the environmental protection, the state needs to manage this area. Nevertheless, only since the last decade of the 20th century, has legislation in the field of the environment started to deal with ecological features of industrial products and principles of projecting the new products. It is becoming obvious that the producers with their ecological engineering solutions are paving the way to new directives that increasingly impose ecological and technical standards. Considering the market game that dictates the cheaper production, for gaining more profit, it is impossible to regulate this field without any legal basis. *Energy Labelling Directive* (2010/30/EC) has brought significant energy savings and has undoubtedly contributed to technical progress within the sphere projecting the electric products of mass consumption. The energetic efficiency classes were defined with this Directive. In order to prevent the negative influences of complex industrial products during the developing phase, the European Commission brought back in year 2003 (and supplemented it in 2009) the *ErP Directive* (*Energy-related Products Directve 2009/125/EC*), the framework for setting the criteria in area of ecologically oriented projection of products that spend energy during the exploitation phase. Its aim is to improve the eco-features of a product and the quality of life environment, as well the rational use of energy products. However, the EU has gone even further with its *Directive RoHS 2 (EU) 2015/863* with which the use of the following substances is limited (Glišović, 2016):

- lead (Pb)
- mercury (Hg)
- cadmium (Cd)
- hexavalent chromium (Cr6+)
- polybrominated biphenyls (PBBs)
- polybrominated diphenyl ether (PBDE)
- bis (2-ethylhexyl) phthalate (DEHP)
- butyl benzyl phthalate (BBP)
- dibutylphthalate (DBP)
- diisobutyl phthalate (DIBP)

It has been confirmed that aforementioned substances might have negative influence on recycling, human health and environment during the e-waste treatment. In accordance with the RoHs2, the products are tagged with CE label (fr. *Conformité Européenne*) and their use is under scrutiny of the *Executive Agency for Implementation of Trade Standards*. The application of the RoHS 2 Directive certainly helps in decreasing the ecological consequences and in protecting human health. Development of new alloys and technologies has enabled the advanced companies to, on their own initiative, harmonize with RoHS (Glišović, 2016) requests. Application of these Directives implies the use of alternative raw materials which would make recycling not only more profitable, but also more ecological.

5. CONCLUSION

Instead of producing the long-lasting and efficient equipment that is with less negative influence on the environment, due to the advanced technological progress, the trend of hazardous substances use for electric and electronic equipment production remains unchanged further leading to increased amounts of e-waste that is the hazardous waste with the fastest rate of generation on global level. The accumulation of e-waste is the consequence of increased technological progress, especially in the area of informatics and telecommunication. Therefore, it is necessary to establish the sustainable

system of e-waste management in Serbia in ordered to reduce its long-lasting devastating impact on the environment and public health. The e-waste management includes the complementary use of different procedures in order to provide safe and effective e-waste management, from the moment of collecting, transporting, separating of useful components, recycling up until final waste disposing. In order to form the quality and clear information system, there needs to be a complete change in current organizations of those companies dealing with this kind of business. If producers and manufacturers would be willing to obtain certain product components with recycling, rather than keep obtaining them on the market, that would largely contribute to promotion of e-waste recycling and therefore to its reduction. It is impossible for this area to develop properly without clear and systematic acts of the state. The efficient administration is one of the leading drivers for the improvement of quality, efficiency, economy and transparency of public bodies. The system should provide the improvement of environment standards followed by producers, importers, distributers, vendors and final users during the life-cycle of electric and electronic products, but also after their use. E-waste management implies the use of advanced business procedures that further establish following functions:

- Supporting the operators in business procedures of e-waste management (development of financial instruments);
- Simplifying the administrative procedures and reporting (IT system development);
- Easier and modern tracking systems for waste movement (scrutiny) using the modern applications;
- Data analysis, problem recordings and support of the changes (through legislation, public informing and improvement of social responsibility).

In the Republic of Serbia, the collecting of hazardous waste from households is currently separated, but it is only in some municipalities and cities. Electric and electronic waste with valuable materials are largely separately collected by authorized operators of unofficial sector. However, the further scrutiny of electric and electronic waste, collected in this way, is still limited. Collecting hazardous electric and electronic waste from area of economy, especially from households, by authorized operators is just at the beginning and because of numerous procedures and obstacles the progress of this sector is very slow. For the development of e-waste management, the Directive WEEE 2012/19/EU was adopted in 2014, with principle aim to collect 45% of residues of sold electronic equipment since the year 2016; and 65% of sold equipment, or 85% of generated electronic waste since 2019. The Republic of Serbia is in the European integration process and is obliged to harmonize its legislation with the EU's and therefore achieve to goals. Firstly, ecologically acceptable products should gain more space on the Serbian market; secondly, organized and systematic solutions for e-waste management issue should be accomplished. Nevertheless, globally, on the one side, solutions need to stimulate producers to make eco-products, while on the other, considering the fact that the market is flooded with "obsolete" technology, producers should fulfill their responsibilities by building recycling plants within their companies. Perhaps, the motive could be eco-fee exemption of a company, for certain amount of collected and treated e-waste (the so-called "old-for-new" system), as a stimulus to households to dispose e-waste adequately in shops for technological devices and equipment. At the moment, regulation power of the market does not help in dealing with ecological damage caused by electronic and electric products that become specific waste streams upon use, which is why the legislation is necessary. Apart from the waste management, the legislation could also contribute to development of a product's general ecological profile. It is certain that technological innovations will have the driver's role for the future development. Digitalization has great social and economic impact, however, it also has the greatest negative impact on ecology, meaning that it directly provokes environment damage which requires faster and more efficient e-waste management. Therefore, state should offer higher financial motivations, and not just to operators whose job descriptions include this, but to producers as well. On one side, this would close the circle in production and marketing of electric and electronic equipment, while on the other in collecting and e-waste recycling. Digitalization inevitably leads to automation of business processes and consequently to reduction of job positions. However, foreign companies that apart from production sector of electronic equipment and devices, also have special sector for recycling, provide new job positions which require new knowledge and perspectives. The green industry can contribute to reduction of negative consequences of digital transformation on employment, as well as the negative impact it has on the environment and human health.

Talking about the environment, it is necessary to raise the awareness of citizens for them to pay more attention on eco labels during shopping and that way contribute to the market game of ecologically

acceptable products. But also, for people to become aware of the consequences that electric and electronic devices, which are outdated and considered to be waste, might have on human health if not treated in accordance with e-waste management regulations. Increased waste generation is directly related to development of consumer society. Therefore, as the consequence of consumption development, numerous ecological issues, which also have impact on sustainable development, arise. For this reason, providing more information about ecological issues is fundamental for people to understand the ecological processes and for them to recognize the modern life problems, their lethal impact on human safety and health, but also the survival of natural resources in the future. The aim of public awareness are the changes in behavior and taking the active role in challenges of recognizing and solving numerous issues in protection of the environment. Therefore, the ecological marketing requires sustainable and socially responsible products and services, which are achievable as the result of consumers' behavioral changes. Finally, within the symbiosis of society and economy, social corporative responsibility as ecologically responsible business doing could be seen as part of overall social responsibility.

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ENVIRONMENTAL AWARENESS, ATTITUDES AND CAUSAL BEHAVIORAL PATTERNS: AN OVERVIEW WITH A GLANCE AT ENVIRONMENTAL IMPACTS OF DIGITAL ERA

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Abstract: *Considering the increased influence of environmental negative effects that are exponentially affecting daily lives of all fellow humans around the globe, this paper tries to present the research that had an aim to spot and assess the relations between* environmental knowledge awareness, attitudes and causal behavioral patterns in regards to positive and negative environmental practices. *This was done through research conducted by distributing a questionnaire for which 294 answers were collected. Statistical analysis was performed and results are presented through three research questions, which imposed itself within the pre-research process. Namely, the research concentrated on assessment of connections: 1) between accepting goals of environmental protection and paying attention to negative environmental influences; 2) between education levels and contemplation of global environmental crises, and 3) between education/income and environmental beliefs of respondents and understanding the environmental impact of ICT technologies and digital era impacts. Analysis was done using the statistical software package SPSS and results are presented and given in the final chapters of this paper.*

Keywords*: environmental awareness, environmental attitudes, environmental behavioral patterns, environmental policies, environmental actions*

1. INTRODUCTION

As far as industry has been developing, it was always followed by the repercussions reflected in negative environmental effects, problems and challenges. Economic growth as a wishful outcome of that development has been, almost without exception taken, at least, perception-wise as an ultimate good. Hence the years of unquestionable unsustainable use of non-renewable resources, the destruction of biological diversity and the emission of greenhouse gases that have triggered global environmental crises while also increasing the gaps between rich and poor have rarely previously been challenged (Martin & Alvez, 2015). Although, there have been many improvements, such as global technology development that changed lives for the better globally, medical improvements that contributed to overall decrees in mortality rates, higher living standards for many etc., there are environmental problems that came as a consequence of the unquestionable constant growth that are now here and have to be faced by the humanity as a whole (Meadows, Meadows, Randers, & Behrens, 1972; Heylighen, Bernheim, 2000). Today's biggest environmental challenges include but are not limited to: climate change, overpopulation, global warming, pollution, natural resource depletion, waste disposal et cetera. Countless species of animals and plants have been wiped out from planet Earth, many of which have had potential for agriculture and medical use beneficial for the humans. Rapid population growth cause natural resources to be over exploited. The effects of population growth on natural resources are particularly felt in developing countries (Flower, 2015). Instead of reaching the era of abundance challenges to they are more reflected in a question how to find sustainable ways to feed new world residents as well as the millions of world residents who are malnourished and undernourished, more than ever (Chiras, 1998). This why the main goal of this paper will be to put a spotlight and examine general environmental awareness, attitudes and causal behavioral patterns that people have based on an assumption that exactly lack of substance in these categories is what usually drives environmental irresponsible and negative behavior (Kollmuss, & Agyeman, 2002).

If conditions of life are to be improved and maintained, principles of sustainability should be followed (Diesendorf, 1997; Petrović, Slović, & Ćirović, 2012). With limited amounts of natural resources that are critical to existence, humanity is faced with the issue of sustainability. To be sustainable, the rate of extraction must be decreased to the lowest level possible. Term sustainability started to appear in mid 80's in academic journals and since then it has taken a long way to make it to people's everyday lives. Most people today acknowledge the term sustainability from the definition provided by World Commission on Environment and Development in 1987 which stated that sustainability is a development that "meets the needs of the present without compromising the ability of the future generations to meet their own needs" (WCED, 1987).

The main objective of the learning process in contemplating, protecting, and resolving environmental issues has been globally accepted since the early 1970s (Shobeiri, Omidvar, & Prahallada, 2006). Newhouse (1990) considers attitudes and emotions as a motivating factor for human action, hence they influence how we behave. Researchers have done great deal in evaluating population knowledge and attitudes towards the environment within the entire spectrum of human demographics (Uzunboylu, Cavus, & Ercag, 2009; Ramsey & Hungerford, 1989; Weigel & Weigel, 1978).

The relationship between behavior patterns and attitudes towards environment remains insufficiently explored (Steg, & Vlek, 2009). Behavior patterns are recurrent ways of acting by an individual or a team toward a given object, in a given situation, or a recurrence of two or more responses that occur in a prescribed arrangement or order (Prochaska, DiClemente & Norcross, 1992). Many patterns develop through globally accepted reward and punishment mechanisms and are called learned behavior. Usually these mechanisms are referred to as "carrot and a stick" (Andreoni, Harbaugh, & Vesterlund, 2003). Behaviour patterns (outside of simple instinct) come from three general areas (Norcross, Krebs & Prochaska, 2011):

- your particular strengths and weaknesses;
- learned reactions from experience.

Behaviors begin mentally therefore training your body, mind, and emotions to do what you want. When you consider how you behave, you discover that your thoughts, your emotions, and even your beliefs are the true roots of these behaviors (Norcross, Krebs & Prochaska, 2011).

This is a reason why many authors suggest that carrot and a stick recognized on a state level as subsidies and penalties for specific environmental behavior can influence tremendously and motivate either positive or negative environmental behavior but awareness and/or attitudes as well and hence influence population-wise particular strengths and weaknesses, experiences and habits. Aim of this paper was to examine a population behavior within the Republic of Serbia and tries to examine the causal factors within them.

2. LITERATURE REVIEW

General mechanisms of motivating and demotivating environmentally responsible and irresponsible behavior are noted in literature in ethics long ago but came to research interests with more significant public eye focus, when negative environmental effects already escalated, hopefully not to the extent that is to late but rather that the time is right (Birnie & Boyle, 1994; Daly & Townsend, 1996).

Roche et al., (2015) gave general recommendation how data on this issue should be better registered and acquired in terms of data applicability. Hilborn (2004) found that moving from single species to ecosystem fisheries management together with appropriate penalties gives betterment effects in maintaining fish capital and prevents the destruction of marine habitat, and similarly was concluded from Cury (2004). Brukas & Sallnäs (2012) found that when implemented similar measures through forestry management policies also improves the overall state and quality of forestry's.

Put on the more global level, McEntee (2013) gave the overview on how agricultural subsidies in New Zelnad didn't quite balanced out the costs of the negative environmental effects, and similarly was concluded by Myers (2001), that used the term "Perverse subsidies" for the subsidies that undermine the environmental effects and later these costs are bore by the entirety of the population.

3. BACKGROUND AND MATERIAL

The lecturers of Faculty of Organizational Sciences, University of Belgrade, Republic of Serbia, conducted the survey in march of the school year 2017/2018, within the course of Environmental Management (obligatory course), and collected the sample of 294 responses to the questionnaire in regards to common and specific environmental knowledge as well as to environmental practices students employ. What is important to know here that students participating within the research were also asked to distribute, this questionnaire within their social structure which included the variety of people affiliating with different social groups that included different working statuses, age groups (parents, siblings, friends), educational backgrounds and financial capabilities.

Questionnaire was made out of three parts; first part was dealing with standard demographic questions in order to acquire data on educational, social and economic background of the respondents. Second part was there in order to acknowledge the status quo on environmental awareness and environmental attitudes of respondents, and third part was there to cross check and compare correlating environmental behavior of respondents.

In total the questionnaire consisted out of 54 questions/statements. First part was made out of 6 standard demographic inquiries. Second part that was there to evaluate environmental awareness and attitudes consisted of 19 questions/statements and the third part that was used to evaluate respondents' environmental behavior consisted out of 29 questions/statements.

For the second and third part of the questionnaire, standard ordinal Likert scale, as a bipolar scaling method, and format of a typical ten-level Likert measure of agreement and disagreement was used for measuring the respondents' self-evaluation on frequency of their specific environmental positive or negative conducts, and measuring either positive or negative response to a statement for evaluation of their awareness, attitudes and even knowledge on specific environmental issues and problems.

4. RESEARCH QUESTIONS

In order to find a matching attitude and behavior of people, we defined three research hypotheses:

Hypothesis 1 – There is a connection between accepting goals of environmental protection and paying attention to negative environmental influences of purchased products/people's daily actions.
Hypothesis 2 - People with a higher level of education more seriously understand the problem of global environmental crises.
Hypothesis 3 - People with a higher level of education/income and environmental/beliefs have higher level of understanding the environmental impact of ICT technologies and digital technologies.

5. RESEARCH AND RESULTS

Within the research two general hypotheses is were considered, but paper goes beyond this and will analyze additional results gained from the research.

The correlation between the attitude about environment and behavior acquired by Pearson Correlation method. The variable attitude refers to the answers from the questionnaire regarding the question "The goals of environmental protection are the goals which I personally value and accept", whereas the variable Behavior refers to the answers from the questionnaire regarding the question "I pay attention to negative environmental influence during the purchase of a product/people's daily actions".

Table 1: Results by statistical method Correlation

		Attitude	**Behavior**
Attitude	Pearson Correlation	1	0,432**
	Sig. (2-tailed)		0,000
	N	294	294
Behavior	Pearson Correlation	0,432**	1
	Sig. (2-tailed)	0,000	
	N	294	294

The correlation between the personal acceptance of environmental protection goals and paying attention to negative environmental influences of purchased products/people's daily actions is shown by Pearson's coefficient of linear correlation. By the process of calculation, the middle value is given: r=0,432, n=294. Pearson's coefficient which is 0,432 shows that there is a positive correlation between the two variables observed, which means that high values of X are consistent with high values of Y, in this case: The more the person values and accepts the environmental protection goals, the more likely it is that he will behave according to them and pay attention to the negative environmental influence of the product when choosing it and people's daily actions.

Another factor that is worth considering is the strength between the variables. The strength refers to whether the Pearson's coefficient is closer to 0 or absolute 1. Different authors give different interpretations regarding the strength of correlation between the variables. According to Cohen, this correlation is the middle value, which only shows that one's attitude doesn't always match his behavior.

The correlation between understanding the problem of global environmental crisis and education acquired by analysis of variance (ANOVA) used to analyze the differences among group means.

What was found within the research was that there is statistically significant influence that level of education has on how people perceive the severity of environmental problems and how well do they understand the global environmental crises, using the single-factor analysis of variance. The respondents were divided by the level of education into six groups (1st group – high school, 2nd group – student, 3rd group – bachelor's degree, 4th group – master's degree,). It has been found statistically significant difference of $p<0,05$ in results of Life Orientation Test in order to asses individual differences in generalized optimism about general state of the environment within four educational groups ($F(3, 290)=3,029$, $p=0,03$).

Categorical independent variable "Attitude about environmental crises" refers to the question "So-called "global environmental crises" are exaggerated and they are not such a problem", which means that the higher the value is the lower the understanding of severity of environmental crises is. Dependent variable Education refers to the last acquired level of education.

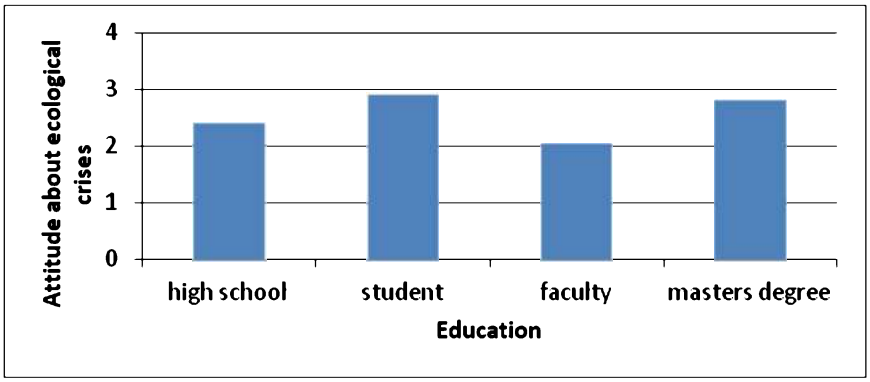

Figure 1: Middle value diagram for different educational groups

Based on the middle value diagram presents here it can be seen that the category of "students" has the least comprehensive understanding of the global environmental crises, whereas those who have acquired university degree after applying Life Orientation Test have the lowest middle value, which means that they have the most comprehensive understanding of the problem.

Finally, hypotheses three accrued as a wish to take a brief overview of how different demographic groups perceive, behave and how aware they are of the environmental impacts of ICT technologies and related activities. Namely, Hypothesis 3 - People with a higher level of education/income have higher level of understanding the environmental impact of ICT technologies and digital technologies. Hypothesis 3 was constructed as a result of the pre-research regarding that no demographic groups showed statistical significant difference in answering to questions related to negative ICT and digital environmental impacts except when the respondents' income levels were compered to their practices more concretely:

- Higher the income, higher the number of respondents which use online paying methods ($p<0,005$).

This is not enough to make any notable conclusion, regarding that although there is a statistical significance of $p<0.005$), correlation is weak and it requires further research in order to make stronger claims because response for this can be many.

And again statistical significance was noted in comparing the answers to questions that regard person actions and their wellbeing, hence statistical significance was noted in:

- Higher the respondents value their wellbeing and their offspring's wellbeing and future generations, more they care to remedy the negative influences of modern technologies (unplug the TV' computers cellphones) with a statistical significance of $p<0.01$) same as previously).

Correlation is again weak and it requires further research in order to make stronger claims because response for this can be many.
Therefore, authors of this paper have to remain agnostic about this hypothesis.

6. DISCUSSION

For the first hypothesis it can be noted that it came as true, by showing the statistically significant correlation between respondents who personally accept goals of environmental protection and paying attention to negative environmental influences of products they purchase and people's daily actions. This indicates that people who are environmentally aware respect environmental values in everyday life. Since, standard of living in the Republic of Serbia is generally lower compared to the countries within the European continent as stated by the World Bank GNI index in the annual reports (2016; 2017), research was followed by the

presumption that, when purchasing a product, consumers are mostly influenced by its price rather than by its environmental effects. That was a reason to investigate if there is correlation between household income amount and paying attention to negative environmental influences of purchased products. This doubt was incorrect, which means that there is no any relation between salary and paying attention when purchasing a product. Non the less correlation was showed as given previously, between the people with specific environmental values which in a same time accept the environmental protection goals, and their positive environmental behavior and daily activities and when making purchasing choices.

In second hypothesis, we examined if there is a correlation between the level of education respondents have and their understanding of the problem of global environmental crises. We compared six groups of respondents that fall within the next categories: with elementary school, high school, students, bachelors, masters degree and PhD. There is no statistically significant difference shown here, but what it must be noted that people with a degree of a higher education are the group that understands the most global environmental crises. Namely, the 92,86% of them are highly familiar with the problem of global environmental crises. This could be because these group are most active when it comes to acquiring non formal knowledge. Additionally, LOT analysis showed that the same group has the lowest middle value, which means that they have the most comprehensive understanding of the problem.

7. CONCLUSION

Finally other results of the research showed the statistically significant correlation between various answers respondents gave, and they will be presented here and interpreted to some extent, but not into the great detail because the authors of this paper believe that they should be a part of the analysis of the different paper regarding that this was only the pilot study and that these questions should be a part of the additional research. Mainly because the results go over the scope of the preliminary established hypothesis.

Hence 11 statistically significant correlation have been noted during examination of the respondents' answers and will be grouped in three categories:

1. Significance related to the respondents' financial background and their environmental actions;
2. Significance related to the significance of the respondents' environmental ethics and moral values and correlating behavior;
3. Significance related to the correlation between person actions and their wellbeing.

First group includes statistical significance found in following compared answers:
There was statistical significance noted within the answers related to the question that regarded the respondent's monthly household income and following answers:

- Higher the income, higher the number of respondents that have their own refill water bottle ($p<0,001$).

This is probably not related to the belief that higher income respondents take care more for the environment, but rather refill bottles are more of a trend and can be perceived as unnecessary cost for the respondents with the lower income.

- Higher the income, lower the number of respondents that purchase power saving light balls ($p<0,001$).

Again, this is probably not related to the belief that higher income respondents take care more for the environment, but rather the fact that in the Republic of Serbia people have significantly lower income than the majority of population living in Europe, preceded only by Bosnia and Hercegovina, Macedonia, Albania and Kosovo (WB 2016; WB 2017).

- Higher the income, higher the number of respondents which use online paying methods ($p<0,005$).

This is more likely the result of the banking system in the Republic of Serbia, which offers more options for those with higher income and these options are more accessible financially for those who have higher income, same applies for regular internet connection and ICT literacy. But as mentioned before this has to be a topic of a further research.

- Lower the income, higher the number of respondents use public transportation ($p<0,005$).

Here we can note that lower the income lesser the access to regular usage of personal transportation is, hence again does not have correlation to respondents environmental usage.

Second group includes statistical significance found in following answers:

- Higher respondents' affiliation with the goals of the environmental protection are higher the level of their care for the negative environmental effects of products they purchase ($p<0,0005$). This was elaborated and goes in line with the second hypothesis.
- Higher respondents' belief that the environmental crisis is a hoax lower the level of their education is ($p<0,0005$). This was elaborated and goes in line with the second hypothesis.

- Higher respondents' belief that the environmental crisis is existing one but that it is exaggerated, lower the level of their education is ($p<0,0005$). This was elaborated and goes in line with the second hypothesis.
- Higher the belief respondents have that humans have moral right to exploit the environment and its' resources, higher the belief is that humans control the environment rather than other way around ($p<0,0005$). This was elaborated and goes in line with the second hypothesis.

Third group includes statistical significance found in following answers:

- Higher the respondents value their health in regards to their environment quality, higher their interest is for the negative environmental effects of products they purchase have and daily activities they undertake ($p<0,001$). This was elaborated and goes in line with the first hypothesis.
- Higher the respondent value their health in regards to their environment quality, higher their interest is for the negative environmental effects of products they purchase have and daily activities they undertake ($p<0,001$). This was elaborated and goes in line with the first hypothesis.
- Higher the respondents value their wellbeing and their offspring's wellbeing and future generations, more they care to remedy the negative influences of modern technologies (unplug the TV' computers cell phones) with a statistical significance of $p<0.01$) same as previously), correlation is weak and it requires further research in order to make stronger claims because response for this can be many.

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IMPLEMENTATION OF MODERN TECHNOLOGIES IN TRAFFIC AND THEIR CONTRIBUTION TO THE PROTECTION OF THE ENVIRONMENT

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***Abstract**: The vast majority of larger cities in the world faces several major issues concerning traffic and transport on a daily basis. These problems range from traffic jams and congestions to noise and air pollution as well as the emission of the green-house gases that are responsible for the ever increasing holes in the ozone layer. These factors directly influence the quality of life and the accessibility of transport services in the urban communities. Our intention is to present some of the possible solutions that would reduce the harmful effects mentioned above through optimization of the transportation processes.*

***Keywords**: traffic, internet of things, environmental protection*

1. INTRODUCTION

Emissions of harmful gases in urban areas have a negative effect on human life and health. Inadequate implementation of modern technologies in traffic is causing unexpected vehicle failures, traffic jams and poor quality of everyday life.In Serbia these problems are mostly caused by the use of inadequate equipment and outdated technology, low quality of fuel and the lack of modern solutions in practice. Half of the entire traffic fuel consumption is burnt and its toxic gases are released inside major cities. Approximately 98% of the energy market concerning traffic is oil dependent with 75% being consumed in road traffic. It is expected that the fuel consumption will have increased by 30% by the year 2030.

The drastic upset of the natural environment is directly caused by the state of the traffic systems which is a direct consequence of the changes that the society is going through. The air pollution by toxic fumes(carbon monoxide, nitrogen,sulfur oxides, hydrocarbons, lead and formaldehydes) from cars and buses is quite high even though there exists a solution for its reduction or complete elimination of some of the pollutants mentioned. According to research, cars in Serbia(and there are around 1.8 million) are twelve years old on average and most of the 240 000 vehicles that are imported annually represent European vehicle waste. Fumes from such engines are above allowed limits by health regulations both by the amount and the content of the toxic substances. Oil refineries in our country could soon become a target of an ecological ban in the European market due to their inability to invest in the new methods of processing. The amount of sulfur in diesel fuel is 20 times greater than in the countries of the Western Europe and only recently has the percentage of lead in gasoline been reduced (from 0,6 to 0,4) despite the fact that it has been completely removed from gasoline in the developed countries for quite some time. All the readings of the concentration of toxic fumes done in intersections confirm these facts(the annual amount of 8 mg/m^3 of carbon monoxideinstead of the allowed. Around 60% of air pollution in urban areas is caused by internal combustion engines. A great amount of polluting particles is produced by the friction between tires and road surface. In many countries tires that have been used up are becoming a problem that needs addressing. Also, significant amounts of used motor oil if not collected and disposed of properly, present a potential hazard, especially for world's water.

2. CONCEPT OF INTERNET OF THINGS

The traffic jams, lack of parking spaces, finding optimal routes, traffic regulation etc. are just some of the daily traffic problems that traffic participants face. Current technical achievements certainly have a great influence on the consideration and approaches to solving these problems. One of the new technologies that offers solutions to these situations is Internet of Things. It is believed that the application of this modern concept can contribute to improvement, cost reduction, and increase revenues in the field of transport.

IoT is currently one of the most advanced technologies that can find application in everyday life, from e-health, to making smart cities, buildings, classrooms, etc. IoT can be defined as a global information society infrastructure that provides advanced services by connecting physical and virtual "things" based on already developed interoperable information and communication technologies as well as those that are in the

process of development. This modern concept can find great application in all modes of transport. Using IoT, traffic participants are able to send useful information to traffic management centers, which can then use them in short-term, operational guidance, or in strategic management or management for a longer period.

The concept of the Internet has been drastically changing and over time it has become a global network that, apart from connecting computers, connects various digital devices, everyday objects, or "things". The word "thing" in the Internet Property coin represents an object from a physical ("physical thing") or information world ("virtual thing") that has the ability to be identified and integrated in communication networks, or any thing that can be assigned an IP address and provided the ability to send certain data via a global network. This is achieved by installing sensors that have several functions in the IoT system. The sensors measure and collect data on certain parameters, then they send this data over the Internet, and on the basis of these data they start the appropriate actions. A "physical matter" can be represented in the information world by one or more "virtual creatures", while the virtual thing can exist independently of "physical things". The device is part of the equipment that serves for communication, and it can also store data and process them. Devices collect information and forward them to information and communication networks for later processing. They can also communicate with other devices via communication networks with or without gates, but also directly without them. Communication networks have the task of effectively transmitting data collected by devices efficiently and safely, using existing TCP / IP protocol-based networks, but also some new ones developed for that particular purpose. The IoT reference model consists of four layers: an application layer, a layer that serves as a service and application support, a network layer and a layer that relates to the device itself.

The number of connecting devices grows at a high speed, which is in correlation with the growing number of IoT platforms. IoT platforms can be explained as a set of generic functionality used to create IoT applications and which connect IoT to Cloud, as well as output devices. IoT platforms allow applications to manage, control, and monitor devices, in order to provide an independent and secure connection between them. They access intelligence-aware information, store and transform it, securely integrate these data, and integrate with business prosecutions and systems, and control the sensors. Thanks to information and communication technologies, it is possible to connect "anytime" and "anywhere", while the IoT concept adds a new dimension to the connection of "anything", which suggests that communication is possible not only between computers but also between people without the use of computers, such as and communication between people and things, but also the very things.

3. IMPLEMENTATION OF INTERNET OF THINGS IN TRAFFIC

The most effective way to solve every problem is to eliminate its main cause. The problem in this paper is one of the most serious problems in the world, and certainly attracts the most attention when it comes to environmental protection, and that is the pollution of the environment by the emission of harmful gases. The most massive cause of this problem is of course traffic. According to a study by a Chinese university, fuel consumption will grow in the coming years, and traffic in this consumption will have a share of as much as 61%. Consequently, attention should be directed to this sector. A significant share of the total number of vehicles on the streets is taken every day by specialized vehicles for the transport and delivery of various transport, courier or postal organizations. That is why, in developed countries, digitalization and implementation of IoT is increasingly being discussed in this sector.

Today, there are already more connected devices over the Internet than people in the world, and this number is expected to rise to 100 billion by 2050. In developed countries, the Internet of Postal Things (IoPT) has already been developed, and its main purpose is in the following:

- In transport and logistics for monitoring the functioning and status of the vehicle through the supply chain. The aim of this group is to reduce fuel costs, reduce the need for manual vehicle maintenance interventions, and optimize the operation of people, systems and equipment.
- Smart postal facilities that direct systems to control energy consumption, safety and security of the facility, as well as to reduce maintenance costs.

There are three elements within the postal traffic that justify the implementation of IoT:
Large infrastructure: Postal traffic in every country has a very large infrastructure that includes facilities, and mobile equipment. Most of these elements do not 'tell' at the moment, which means they do not collect and exchange data among themselves. The density and coverage of the country by the postal network provides unlimited potential for IoT.

Experience in collecting and analyzing data: The Postal sector has always shown great competence in managing large databases. In postal traffic, some types of IoT are already used, such as RFID tags for measuring quality in postal traffic.
Customer Requirements: There is a significant growth in the customer's request regarding the provision of services and the capabilities that accompany it. It is expected to track shipments, forecast delivery dates, more options related to the way shipments are sent and the location of their delivery, as well as the simplified process of returning shipments. UPS as well as many other mail at global level already follow these trends, enabling users to choose or change delivery time.

If we take the operation of the JPPT Post of Serbia for the territory of Vojvodina for the analysis, we will see that in the fleet there are 230 vehicles of various brands, year of production, fuel consumption and mileage. On average, during one year, each vehicle has mileage of 24040km, and consumes 2223l of fuel. According to EIA (US energy information administration) analyzes, each burned gallon (3.785l) of fuel for vehicles with internal combustion engines emits 8.91 kg of CO2 in the atmosphere, which in our case means that only postal vehicles the territory of Vojvodina annually emit 5233kg of CO2 in the atmosphere. On the other hand, the cost of an average vehicle annually amounts to almost $ 35 billion for fuel alone. In order to reduce these fuel costs and, consequently, to protect the environment, we indicate the following applications of IoT which by their implementation would lead to improvement of the situation:

- **Education of drivers using digital technologies in order to reduce fuel consumption by changing their driving style:**

Numerous studies have shown that driving style has significant implications for fuel consumption. Gonder et al. (2012) conducted experiments on a light-duty vehicle and found that different DSs can generate a difference of approximately 30% in fuel consumption in the urban driving cycle. The difference can reach 20% in the high-speed way driving cycle. They also believe that by changing DS, aggressive drivers can reduce fuel consumption by 20%, whereas mild drivers can decrease consumption by 5–10%. As for heavy-duty vehicle, Liimatainen (2011) found that different DSs can generate a difference of approximately 20% in fuel consumption. Bingham et al. (2012) discovered that the DS can also make about 30% energy consumption difference for electric vehicle.

- **Sensors for data collection:**

These sensors are placed on oil filters, valves, engine pistons, exhaust pipes, etc., and thus find anomalies, detect and predict in advance when a specific part is to be replaced, or e.g. Change oil to prevent malfunction.

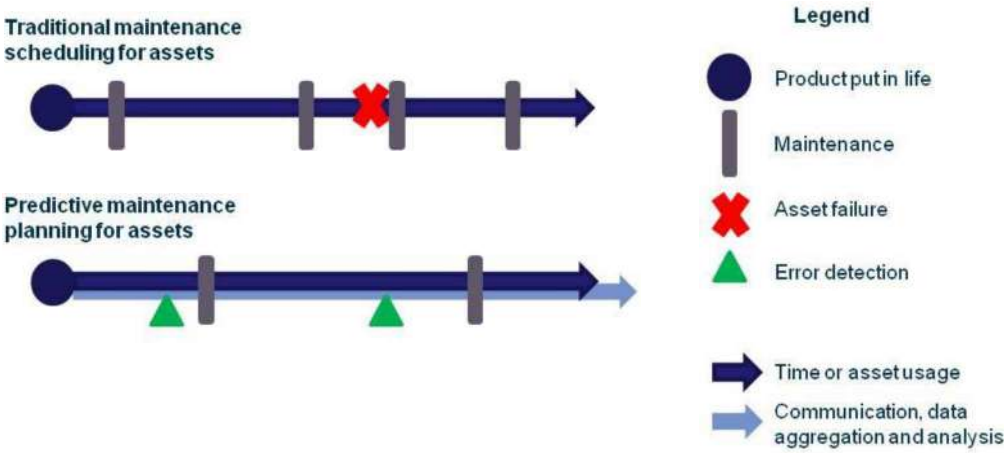

Figure 1: The benefits of predicting maintenance of the vehicle in comparison to conventional maintenance

- **Connecting all vehicles over the Internet:**

In transport, courier and postal organizations is currently used a static method of routing vehicles that finds the shorthest path (route) for driving before the vehicles go to work that day. Connecting all vehicles over the Internet would allow dynamic routing, such as those already tested in DHL's SmartTruck program, which work on the basis of information collected by sensors and calculates the route on the go. In this way the route is formed and changed during the ride in accordance with the new obligations that have arisen. Sensor data are also combined with real-time data relating to traffic jams or new transport requests.

- **Shared Last Mile delivery:**

The growth of E-commerce also increases demand for vehicles in courier and postal organizations, which move every day mostly with the same routes. This causes not only poor efficiency in the work but also

bottlenecks and problems of ecological nature in already polluted urban areas. The situation in the future will probably be even worse, as the market is liberalized and there are more and more operators and transport companies (Uber, courier organizations, etc.) every year.

Shared delivery solves many of the above mentioned problems, especially on Last Mile delivery, which usually causes the most cost, high fuel consumption, and therefore it is the biggest impact on environmental pollution. Sensors would collect vehicle location data, its movement, free parking space at the place of delivery, loading, unloading, in order to make Last Mile deliveries as efficient as possible. This mode of transport on the Last Mile section would suit both the couriers and the postal operator. Courier organizations could outsource this part of the delivery using a smaller number of larger and more completed vehicles, and thus save money on the number of vehicles, on fuel, on labor and on maintenance. Reducing the number of delivery vehicles on the streets would also contribute to local authorities that are continually striving to reduce the traffic density on the streets and CO2 emissions.

This type of delivery has recently been applied in both the Dutch and the Belgian post offices. The Belgian post estimates the savings of 30% of the total number of miles remaining, it also contributes to the reduction of fuel costs, and therefore directly reduces CO2 emissions.

Successful implementation of IoT in the postal, courier and other transport companies requires not only a strategic vision, but also careful consideration of numerous factors, such as the priority of the application of technology. It would be necessary to start developing ideas with already tried and tested applications, while the company would have to formulate a business plan to justify the adoption of this new technology.

4. GREEN SOLUTIONS AND THEIR CONTRIBUTION TO TRAFFIC

It is a fact that the biggest consumers of fossil fuels are the vehicles in road traffic and thus they are the main issue concerning sustainable development and so the application of green solutions should be our priority. By implementing innovative and more sophisticated technological solutions we are making our companies more efficient through faster and more accurate data processing, which in turn gives them the advantage in the market and that is the main goal of any company. Taking into account that the Post Office of Serbia as a state enterprise has one of the largest car parks and that its traffic network covers all of Serbia (her “last mile delivery” service), it would mean a great deal if it started implementing green solutions not just for the environment, but for its image as a prestigious company with forward thinking leaders.

One of the possible green solutions are “Oxygene” tires, developed by “Goodyear”, with revolutionary design that has live moss growing on the side of the tire. This innovative concept was presented at the Geneva car fair. The open and “smart” design of the tire tread collects moisture and water from the road necessary for the growth of the moss, which enriches the air with oxygen through photosynthesis. “Smarter” and “greener” infrastructure as well as “smarter” transportation are the key for solving the problems of mobility and development of urban areas. “Oxygene” tires (Figure 2), offer several solutions for a greener future:

Filtration of the air: with its unique tire tread, “Oxygene” absorbs moisture from the road and carbon dioxide from the air that feed the moss, which produces oxygen through the process of photosynthesis. In the city as large as Paris with its adjoining suburban areas, with approximately 2.5 million vehicles, this would mean around 3000 tons more oxygen and approximately 4000 tons less carbon dioxide in the air annually.

The recycling of the used up tires: the design of “Oxygene” tires is done by 3D printing, and the material used is rubber powder produced entirely of recycled tires. These tires present a firm solution without the potential danger of being punctured, require very little maintenance and last longer.

Generating its own energy: “Oxygene” accumulates the electricity produced by photosynthesis and uses it to power the installed electric components such as car sensors, processors of artificial intelligence and adjustable light tapes which warn other drivers and pedestrians of the change in the direction the vehicle is moving by changing its colour.

Light speed communication system: “Oxygene” uses light speed communication system or LiFi, which enables the tire to connect to internet, Internet of Things to be more precise, which allows the transfer of data between vehicles (vehicle-to-vehicle – V2V) and also between vehicles and infrastructure (vehicle-to-infrastructure-V2I) which is crucial for management systems of smart mobility. This way “Oxygene“ would increase the quality of life of citizens in urban areas as well as their health through cleaner air. It is expected that around two thirds of the world’s population will be living in cities by the year 2050. and so the need for traffic networks in urban areas will increase accordingly.

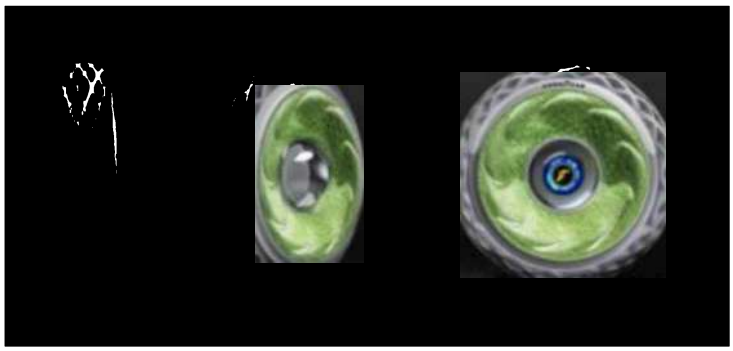

Figure 2: GoodYear's Oxygen tire

Electric vehicles are slowly but surely becoming a part of road traffic in countries like Macedonia, Croatia, Slovenia, Hungary and Romania. The use of these vehicles has yet to overcome many obstacles in Serbia. The first one being the lack of support from the state itself, considering that the price of these vehicles is considerably higher than the average in its class, and the second one being the lack of the infrastructure for charging those vehicles. In order to popularize the application of new technologies in Serbia, it is necessary for the state to encourage its citizens by providing tax allowances, loans or free parking for buying these vehicles as well as tax allowances and subsidies for companies willing to build the necessary infrastructure for the charging of electric vehicles. By being the first to support this endeavor, the Post Office of Serbia can become an example for other companies to strive for.

Israeli startup company has created a solution for the electric vehicle battery, so that the car can recharge battery without pluging in to the sistem energy grid. Representatives from the ElectroRoad suggest that the electric bands which they produce (Figure 3), can be integreded in all urban areas and high ways so they can wirelessly charge the vehicle enough, so they can get safely to the nearest charging station. Research studies have shown that driving distance of 1km on the road integraded with ElectricRoad band, can charge the car for the next 5 km of driving. Employs of ElectroRoad company think that this solution can be easily implemented using the alredy existing infrastructure of stopping lanes and in the cities the yellow signs on the road wich are reserved for the public transportation.

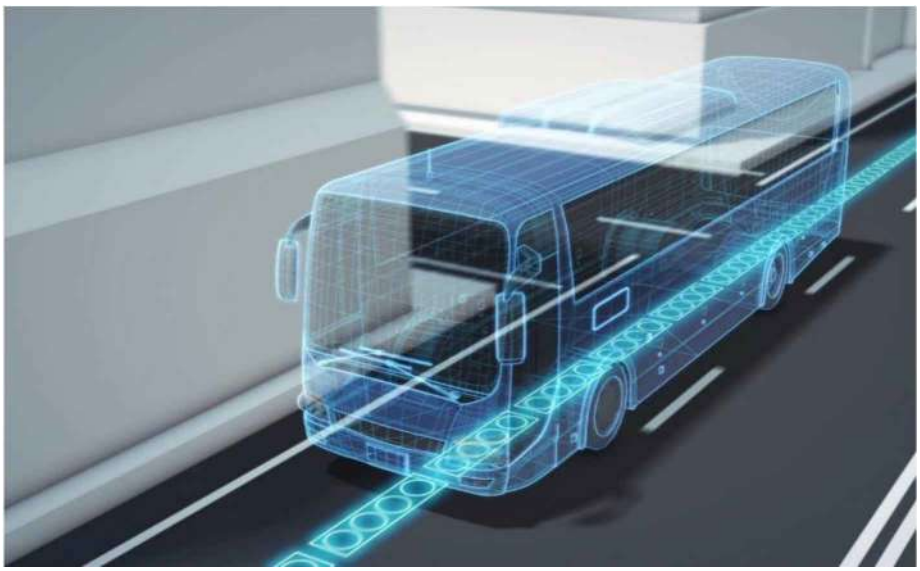

Figure 3 ElectRoad - Charge while you drive

5. CONCLUSION

Traffic means influence ecological problems in different ways and to varying degrees with minor or major consequences. In urban areas, the volume of traffic is increasing every day, which is in correlation with the increasing pollution, as well as the increase of noise in cities and residential areas. Housing settlements located just beside the roads where the traffic intensity is the greatest are the most at risk from pollution caused by traffic. In urban areas, the volume of all movements increases, as a result of the need for adequate accessibility and unlimited mobility of residents. Some of these trends lead to deterioration of the living environment, for this reason it is aimed at increasing the importance of the idea of sustainable

development, which refers to the development that promotes the long-term and ecological health of cities and settlements.

IoT is currently one of the most advanced technologies that can be found in daily life. Although we are at the very beginning of the development of IoT, the experience of pioneers in the application of this technology is promising and brings safe and solid advantages. By interconnecting and analyzing data coming from its large infrastructure, post offices, as well as other transport organizations, could reduce their costs, reduce the number of vehicles on the streets, reduce emissions, optimize their processes, and therefore better respond to user and market demands . That is precisely the goal of every successful company - meeting the requirements and needs of users and all participants in the process, while achieving optimal savings and profits through an environmentally conscious business.

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INFLUENCE OF FOREIGN DIRECT INVESTMENTS ON THE ENVIRONMENT

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Abstract: *The aim of this paper is to determine the influence of FDI on the environment. To get an insight how FDI affect the environment, the development of an enterprise is analysed, as well as the way how the reasons and opportunities for FDI even occur. The first instance in the process of the evolution of the enterprise is capital accumulation, in other words, transfer of the part of capital back to the production process. Accumulation of capital determines the importance of profit and validates the need for cost cutting in all spheres, including the protection of the environment. The aforementioned necessity is caused by competition taking action on the market, which forces the enterprises to constant growth and progress, otherwise, it disappears. Together with the enterprise growth, there come new opportunities, such as economies of scale, and when the country`s borders become too narrow for further growth, the enterprises reach for foreign investments. That is how the FDI occur and affect the country and the environment. The analysis of practical examples certifies that the enterprises are still guided by basic principles of concentration of the capital. Not only guided, but they also use their competition advantages, which they realised by growth and development of technologies, as the levers of power, in order to make even bigger profits, not paying attention to the consequences they leave behind. The whole process is caused by a special law of surviving on the market which justifies all the sources.*

Keywords*: accumulation of capital, free competition, cost efficiency, transnational corporations – TNC, foreign direct investments - FDI, pollution haven hypothesis – PHH.*

1. INTRODUCTION

Within globalisation processes, modern economic reality is written by the activities of the current key economic subjects - TNC. TNC have gone way beyond borders and exactly in the sense of FDI. Their power and their influence very often exceed the strength of many countries, even the most developed ones. That power comes from accumulation and concentration of sources for production and thus is reflected in the form of market shares. Besides, mainstream economics discarded theories of the countries` development through planned and state-controlled development. The actual answers to the development processes from the mainstream economics were FDI and TNC. Unlike the developed countries, this answer usually refers to underdeveloped countries, due to lack of capital assets. The problem is also deepened by undeveloped regulations, by which the developing countries would protect their economic interests and their environment. Faced with the shortage of capital assets and undeveloped regulatory rules, the underdeveloped countries represent a *fertile soil* for the investments that will not be within the *social* and *environmental* frame of business. If there is a question why corporations conduct business in such manner, the answer could be found in additional costs that such form of doing business most often causes. Apart from that, extraction industries are very big polluters and in the form of FDI they come to acquire raw materials needed. However, even that is not the whole answer and it is necessary to complete it with market regulations of ruthless competition and accumulation of capital, which played the key role in the enterprise`s growth and development, defining it even today. While the competition between large enterprises is gradually disappearing and a new form of competition is appearing, which is a competition between the countries. This competition between the countries happens in order to attract the holders of the fresh capital in the form of FDI, no matter the consequences they could leave behind.

2. TRANSFORMATIONAND DEVELOPMENT OF THE ENTERPRISE

In economics, a great deal of attention is paid to perfect competition, although the market economy is also aware of the other market structures. Perfect competition and monopoly represent extreme conditions on the market and a very rare occurrence in reality. Modern economic science has to face that fact and stop observing economic occurrences within narrow frame of perfect competition. It is important to mention that still, all market forms actually evolved from the frame of perfect competition, which is disappearing as the category from the practice with the enterprise development in more mature phases of capitalism. Therefore,

the development of the enterprise represents a starting point for the analysis of modern market functioning and subjects that dominate over it. In this process, profit is the key determiner of enterprise development that has to be realised at any costs (work exploitation and/or nature destruction/exploitation). Within the enterprise development in capitalism, capital accumulation represents the first stage of development. That is to say, within capitalistic way of production there appears a conflict of interest between numerous entrepreneurs (capitalists), in which each of them tends to take as much profit for themselves as they can. Faced with the free competition law, entrepreneurs are forced to modernise and perfect their sources for production in compliance with the advancement of science and technology (Lavčević, 1953).They realise their interests based on existing sources for production and/or by perfecting of the production process by using new, more improved production sources. Therefore, capitalism was also revolutionary at the beginning and thus it gave its brightest results. For that reason, *young* Marx introduces capitalism in Germany of that time in order to break up with the obsolete production relationships of feudalism (Lukács, 1976). Unlike other systems of doing business (slavery or feudalism), capitalism indeed brought about the greatest era of enlightenment and development to the mankind (Fiamengo, 1973). However, free competition upon which it is being developed, even then started developing in two ways. In the beginning, it was defined by a large number of competitors and it was based on work, knowledge and innovations that improved production processes (Velić, Cerović and Maradin, in press). Simultaneously, it is followed by another dimension of competition which is predatory and is based on concentration of capital. Ruthless competition implies that any stagnation in development processes for a capitalistic enterprise means its definite destruction by greater and competitively more capable enterprises (Velić, Cerović and Maradin, in press). Process of accumulation of the capital represents successive capitalisation of produced values surplus (Lavčević, 1953), i.e. a certain piece of appropriated value surplus turns into an additional production form of capital belonging to capitalistic enterprise. Capital accumulation growth leads to the second instance, which is an increase of capital concentration, namely, collecting even greater amount of both production sources and hired labour of the few. Concentration of capital assets and production through accumulation, i.e. capitalising of the values surplus enlarges both individual and entire social capital (Lavčević, 1953). Within this process, implementation of the new technologies and knowledge is crucial. However, they require more and more sources in realisation of the new production processes. The process of capital enlargement is complemented by centralisation of capital, i.e. by leaving individuality of already existing individual capitals by merging or their absorption by larger enterprise (Lavčević, 1953). This process within modern economic reality is getting a form of direct investments of merging – *mergers* (Salvadore, 2003) and annexation – acquisition. Merging represents joint appearance of two or more competitors on the market, whereas acquisition represents destroying and merging of capital of the lesser competitors. In the latter, competition represents the most efficient tool of enlargement of capital, because in the competitive game, the one whose labour productivity is higher wins - lower expenses, which is reflected in lower prices. In view of that, large enterprises realise far higher labour productivity (production of larger quantities of products reduces production costs per production unit - economies of scale), whereas smaller enterprises do not survive market battle and get *swallowed* by larger enterprises (Lavčević, 1953). The final way of centralisation of capital is the process of merging of independent capitals into large capitalistic enterprises, which gets the form of joint-stock, or holding companies (Lavčević, 1953). This form of capital enlargement represents an important progressive dimension as well, without which capitalism would develop with difficulties, and that is the occurence of limited liability in business. The significance of the process of capital enlargement Marx underlined with the sentence: *"Accumulate, accumulate! This is Moses and the Prophets"* (Marx and Engels, 1977). In other words, Marx (1977) wants to say: *"Save, save, i.e. turn the larger part of surplus value or product surplus into capital again"* (Marx and Engels, 1977). Globalised world of today marginalises labour and nature to a greater extent than Marx could have anticipated, and that is the reason why Santini (2007) considers his work unavoidable in solving growing problems of Man and Earth. Capital letters M and E refer to devising of coexistence between work and capital, since at the moment our planet is working against itself hand in hand with human activities (Santini, 2007). The aforementioned processes imply diverting attention to regulations in view of domestic enterprises as well as the FDI mergers and acquisitions. This implies that the enterprises will most likely be encouraged by cost efficiency to use lower environmental standards or lenient regulations. In regard with former analysis, primary work hypothesis is stated:

H1: The nature of free competence forces enterprises to do business which is constantly directed on cost cutting, including the costs of protection of the environment.

In the necessary process of improving and broadening of production the additional sources are key factor in order for production to be realised. For that reason, credits have an important role in functioning of the economy and credit instruments are more easily acquired by larger enterprises (Velić, Cerović and Maradin, in press). At a certain time of broadening of capitalistic production, the phenomenon of economies of scales appears, which is the basis for production in large enterprises, not only on the example of natural monopolies, but also in all other large serial production that is also used by TNC today. Caused by the imperative of growth which secures the survival on the market, all three processes of capital enlargement

affect the decrease of number of competitors and increase of production of the enterprise itself and market shares as well. These processes initially lead to governing over a certain branch of industry within national scope, i.e. to monopolies and oligopolies. It is important to mention that at this stage of development, competition may become especially risky, since the enterprises have grown and have too large organic content of capital, so the battle between the giants might cause enormous damage of failing (Velić, Cerović and Maradin, in press). However, this process does not stop on national level, but based on the same principles, continues on the international market. That is the reason why it is considered that former national monopolies and oligopolies, by leaving the scope of national economy, evolved into TNC (Stojanov, 2012). This is why this analysis is a starting point, since the monopolistic position on the market represents an aspiration of all capitalistic enterprises, because it enables security, survival and the most efficient way of necessary realisation of even larger profits. The same thing is noticeable in concentration of capital on the international market between corporate giants of today.

2.1. Principles of production according to microeconomic analysis

Going on with the former analysis from microeconomic perspective, an efficient production implies enterprises of a large scale, standardised production lines and a large number of products. Growing incomes of scale (economies of scale) form when the increase of all inputs leads to more than proportional increase production level (Samuelson and Nordhaus, 2010). Such production requires enormous sources of large enterprises, which confirms validity of the former analysis concerning the growth of the enterprise. Having defined the economies of scale, it is now necessary to tackle the logic of costs, more precisely to tackle an average fixed cost of the enterprise, which is relevant for the topic. Fixed cost divided by input gives the average fixed cost:

$$\mathbf{AFC} = \mathbf{FC}/\mathbf{q} \tag{1}$$

This equation implies that increase of production quantity **q** at constant fixed cost **FC** gives constantly failing curve of fixed cost (Samuelson and Nordhaus, 2010). In other words, if an enterprise sells more products, it can disperse its fixed costs on multiple units. Since the enterprise strives to profit, i.e. making money is their priority, companies survive by cutting costs in any way possible (within the law) (Stiglitz, 2009). The major idea of this way of production is production increase on the account of range income and dispersion of fixed costs on as many production units as possible. Furthermore, the enterprises that are able to realise the processes described are limited liability corporations, with a suitable management structure, which can attract large offers of private capital, produce a lot of similar products and join investors` risk (joint-stock company) (Samuelson and Nordhaus, 2010). This definitely implies that TNC also apply these and former principles in their functioning. Basic logic behind this way of doing business is cutting costs, since that means larger profit, and larger profit enables larger accumulation of sources for growth and survival on the market. If the same logic is applied between production costs and the costs caused due to environmental protection, it can be deduced that the enterprises will be more sensitive to increased environmental protection cost. Therefore, it can certainly be claimed that if costs can be avoided, they will be. The process of capital enlargement is a necessity defined by accumulation of the profit which is subsequently transferred back into the production, in order to realise the production based on the economies of scale principle and further development of the enterprise. Since the profit is determined by cost efficiency, cutting environmental protection costs is a natural and expected reaction of the enterprise in all development stages. Described principles and the logic of enterprises` growth confirm primary work hypothesis, meaning that the protection costs will be cut anyway, the additional reason would be that, for example, cutting environmental protection cost does not have an immediate opposite reaction as reducing of the salaries does.

2.2. Bearers of FDI – TNC

Within former analysis, the idea of corporations and their limited liability have been mentioned, but what are corporations in fact? Today`s multinational company is an enterprise which broadens its business within many countries in order to get closer to its clients, cheaper sources of production factors or competition (Lovrinović, 2015). TNC expand their business to all continents through enlarging their network of affiliates, branches, offices, distribution, clients and all other things connected to their activities, including production (Lovrinović, 2015). Corporation is an enterprise owned by many individual shareholders, which has legal individuality, so it is really *a person* who can buy, sell, borrow money, produce goods, provide services and make contracts on their behalf (Samuelson and Nordhaus, 2010). Corporations enjoy the benefits of the right of limited liability, under which the investment of each owner and his financial exposure are strictly limited to a specific invested amount of money (Samuelson and Nordhaus, 2010). In principle, shareholders control the company, while managers run the company and make business decisions. Limited liability has a great

advantage since it enables collecting of large amounts of capital, bearing in mind that each shareholder knows the most he can lose is his investment. On the other hand, limited liability may signify large expenses to society. A mining company can excavate gold and make an enormous profit for the shareholders, but it can also leave poisonous remnants from processed ore, which contains toxic substances like arsenic (Stiglitz, 2009). From both social and financial aspects, the costs of purifying such environmental problem may exceed the value of what is excavated. But, when the problem is notified and the government of the country where the corporation does business demands purification, the mining company declares bankruptcy. The problem is left to the society and its citizens who suffer both from destruction of the environment and purification costs (Stiglitz, 2009). This is validated by numerous examples from the practice, e.g. the explosion of Union Carbid factory in Bhopal, in 1984, which caused over 30 000 dead and 100000 sick people for which nobody was prosecuted for; oil spilling from Exxon Valdez ship, in 1989, with the given fine of $51,000 and 1000 hours of trash collecting for the skipper; oil spilling on the British Petroleum platform in the Gulf of Mexico scooped 180,000 square metres of the sea, with the $20 billion compensation for environmental damaging (Lovrinović, 2015). Although it is very difficult to find the perpetrator in these cases and penalties are in discrepancy with the performed damage, they are still considered as accidents. However, practice shows deviant behaviour of TNC in regular business too, therefore there is another definition of corporation, according to Stojanov (2013), who describes TNC and transnational banks as fundamental economic subjects of our time and mirror image of globalisation process. Their microeconomic principle of behaviour is the principle of growing incomes and falling costs. Furthermore, Stojanov claims that transnationalisation of world economy forms a global market, whose main characteristic is an imperfect competition with dominant oligopolistic morphology. In oligopolistic conditions large corporations are not only a price makers but a rule makers as well, i.e. the enterprises not only dictate the prices, but also make the rules of the *game* (Stojanov, Jakovac, 2013).The size of TNC represents a special comparative advantage (WWF-UK,1999). That very size gives certain power, so apart from demanding and charging the rent from exploitation, they even demand entrance barriers for other competitors, lower environmental standards and concessions, ergo, TNC become the rule maker in practice as well.

3. MOVEMENT TRENDS OF FDI - POLLUTION HAVENHYPOTHESIS (PHH)

Influences of FDI on the environment of a country are usually observed from the perspective of *pollution haven hypothesis* (PHH). PHH assumes that polluting industries will look for the appropriate ground for relocation of their sections in the countries with lower environmental standards and turn them into pollution havens (PH) (Copeland and Taylor, 2004). PHH also assumes that the industries like mining and raw material processing will be motivated to relocate their production where they will be relatively free to do business the way they see fit and will not have to pay purification cost for their activities (Farlex Financial Dictionary, 2012). For that reason, PHH is usually observed three-dimensionally:

- *Dirty production* transfer into underdeveloped countries with lower environmental standards,
- Toxic waste disposal from developed into underdeveloped countries,
- Excessive exploitation of resources of underdeveloped countries, e.g. oil/ore or forest exploitation (WWF-UK, 1999).

Literature that studies PHH always leaves some open space for the debate on micro-influences of FDI since it is difficult to identify and aggregate their negative influences and verify the hypothesis (WWF-UK, 1999). Apart from that, PHH is additionally blurred by enormous amount of FDI which goes between the developed countries with strict environmental standards. At the beginning of 2000, PHH was considered an urban myth, with no adequate empirical confirmations. There are two major arguments for such suppositions:

- Environmental standards do not represent sufficiently large costs to affect the decision on production relocation (Levinson and Taylor, 2008),
- Polluting industries are capital intensive and represent comparative advantages of highly industrialised countries which are difficult to relocate (Candau and Dienesch, 2017).

Reasons for transfer of industries between developed countries are: more developed infrastructure, larger market and better educated labour. On the other hand, the countries with bad and/or no regulations regarding environmental protection do not have afore-mentioned characteristics and they are governed by incompetent governments, which may cause even larger costs to the enterprise. According to Candau and Dienesch (2017), the debate on PHH was mostly based on data collected in the USA, whereas it was neglected in Europe and the rest of the world at the same time. However, entering of post communist countries of Europe, Russia and China in free capital flow makes PHH the attractive field of research again. Candau and Dienesch (2017) claim, that PHH is almost always followed by corruption, which blurs real results of the research. According to the research of Kolstad and Wiig based on a sample of 81 countries that received FDI in exploitation of natural resources in the period between 1996 and 2009, econometric analysis confirmed positive correlation between the increase of corruption and foreign investments in this

sector. Shaxson (2007) found similar evidence having exposed corruption of oil industries in Africa. Therefore, it can be concluded that the countries susceptible to corruption are considerably attractive to foreign capital in this area, since it enables making of huge profits, as well as that Stiglitz (2009) was also right with statements on inevitability of corruption, if it enables additional profits without any fines. In order to determine actual reasons why capital is moving and when it influences the environment in a negative way, it is necessary to classify movement trends of FDI, and these are: new markets, production platforms and search for resources (Aliyu, 2015). According to Esty and Gentry (1997), investments within first two categories are the least sensitive to growth of environmental standards. However, when FDI are in search for resources, it is considered that they can be sensitive to the change of law on protection of the environment (Aliyu, 2015). Movement trends of FDI should also be complemented with the search for low costs of: labour, doing business and production factors, which may be sensitive to growing environmental standards. This sensitivity is caused by growth of competition on the world market and growth of corporate power in global economics (Aliyu, 2005). On the other hand, modern economics characterised FDI as generators of development, which countries can really benefit from, regarding increase of production capacities, technological transfers, training of domestic enterprises and improvement of their export sector. However, are benefits of FDI real, is the question that is very difficult to answer, because companies tend to extract bigger part of the profit and that development is considerably slow. To attract and keep foreign investments, a lot of countries are ready to make more and more concessions (WWF-UK, 1999). Therefore, taking into account the previous analysis and movement trends of FDI, as well as conclusions of the previous hypothesis, second hypothesis is set:

H2: If the motive for transfer of industries is a search for resources or lower environmental standards, FDI will move in accordance with suppositions of PHH, since it is the necessity which results from concentration of capital and market competition.

3.1. Influence of FDI on the environment

Official viewpoint of *mainstream* economics on environmental influences of FDI is defined by following argumentation:

- Countries have comparative environmental advantages, i.e. countries with low income should use the opportunity to tolerate pollution and excessive exploitation of resources and set low standards in order to attract FDI.
- FDI increase the tendency for improvement of environmental standards, i.e. together with the development that comes with them, the population`s awareness of protection of the environment will also rise and performed damage will be restored.
- FDI possess and brings more developed and cleaner technologies from those which are used by local manufacturers, which is why it is important to attract foreign investments, in order to accelerate environmental performances of doing business in these countries (WWF-UK,1999).

During reconsideration of the economic development which is based on the aforementioned principles, there is a quotation from Business Week (02.08.1993.) on the subject of bearers of FDI – TNC and the economic growth: *"Free market and free trade in new global economic system are things which will end slow economic growth and high rate of unemployment in industrial world. This is what new economic order really is."* (Stojanov, 2012). Almost 25 years have passed since this euphoric boom of liberalism and the slow economic growth has not been ended yet. Nevertheless, it seems that apart from Asian tigers and China, other countries do not mark significant growth and development, whereas the differences between developed and underdeveloped countries deepen even more and are followed by rapid destruction of the environment. While the competition between enterprises is decreasing, mobility of the capital brought the competition for FDI even between the developed countries is intensified every day to such an extent that the developed countries compete in, for example, by lowering the income tax in order to attract and keep TNC but in more sophisticated industries. There is also a similar competition between the underdeveloped countries regarding lowering the environmental standards and labour rights. There are also practical examples in favour of these claims, especially in the extraction sector, for example, countries of Asian-Pacific region were competing in the middle of the 1990s in order to attract investors to the mining sector (copper, iron, gold, coal and aluminium). More precisely, in 1985, when the Philippine government cut concession costs through financial and technical agreements, investments started coming, and within a year, there were 16 FDI in this sector (Mining Policy Institute, 1998). The other example is Papua New Guinea and Indonesia, whose governments drastically lowered control over protection of the environment in the mining sector. All mining operations in this area did business under privileged conditions of minimum or no control (Mining Policy Institute, 1998). In Indonesia, all mining corporations got the immunity on environmental laws according to Contracts of Work (Mining Policy Institute, 1998). Facilitating or no laws on environmental protection caused very serious environmental damage. An imposing question arise: why do countries

tolerate this kind of behaviour and why do they compete? The answer to this question lies in the fact that extraction industries demand enormous investments and technologies, owned by large enterprises. Since very few countries have enough sources for investments to such extent. They are forced to indulge the demands of TNC, which is confirmed by previous claims that TNC have comparative advantages that enable them to become rule makers. However, it also partly confirms the second set hypothesis, because TNC were willing to invest in countries with lower environmental standards. For that reason, critics of globalisation, such as Hermann (1995), Gissinger and Gleditsch (1999), Kaplinsky (2000) and Shiva, (2004) describe TNC as the key active participants and winners of globalisation process that cause inequality and injustice, whereas Wettstein (2009) defines them as symbols of false promises of neo-liberal project (Giuliani and Macchi, 2013). According to Brecher and Costello, fall of wages, social and environmental conditions are the result of global production strategies of TNC, that lead the world towards the *"race to the bottom"* (Giuliani and Macchi, 2013; Stojanov, 2012). In favour of this debate also comes the announcement of the Philippine government in Fortune magazine from 1975: *"In order to attract the company like yours, we levelled the mountains, cut down the jungles, drained the marshes, redirected the rivers and relocated the villages, so that you can do your business more easily."* (Stojanov, 2012). The phrase *race to the bottom* is very often mentioned in researches connected to PHH, and the words of the Philippine government bear a special weight today. Indeed the liberalisation played a great role in global economic development if the results are aggregated. Productivity *per capita* rose from 614 to 4908 billion dollars in the period from 1970 to 1999 (WWF-UK, 1999). However, economic trends disguise the accumulation of social and environmental problems. The position of World wildlife fund – WWF is stated in favour of the penultimate claim, estimating that the world`s potable water supplies decreased for 50% for the period stated, that ecosystem of the seas deteriorated for 30% and that forest areas are reduced for 10%. In the same period of time, global energy consumption rose over 70%, together with the rise of greenhouse gases emission (WWF-UK, 1999). Furthermore, in the period between 1960 and 1994, proportion of income between 20 richest and poorest countries rose from 30/1 to 78/1(WWF-UK, 1999). These devastating numbers question the validity of *pollute now* and *clean up later* thesis, as well as the neoclassical thesis on faster convergence of countries to FDI, thus throwing the light on PHH again.

3.2. PHH Ghana case

According to Appiah-Kondau (2013) in Ghana case study, trade was a great factor in damaging the environment, which is reflected in uncontrollable exploitation of natural resources (ores, forests). Adoption of Economic Recovery Program in 1983 poured a lot of FDI into the mining sector in Ghana. Due to production growth out of this platform, Ghana adopted the Investment Promotion Act in 1994 (Solarin, Mulali, Al-Musah and Ozturk, 2017). In the period between 1990 till the end of 1999, mining sector in Ghana attracted over 3 billion dollars of foreign investments, i.e. 60% of total influx of FDI into the country (Appiah-Kondau, 2013). Foreign investment trend in mining in Ghana continued in 2000s as well, so in the period from enactment of recovery platform in 1983 to 2011, mining sector attracted 11, 5 billion dollars in total or 65% of total FDI into the country (Appiah-Kondau, 2013). However, market liberalisation and influx of FDI brought with them brisk energy consumption, a large mercury pollution (Hg) and degradation of soil. According to Aragón and Rud research (2014), agricultural land situated in regions where mining activities are performed becomes infertile. Decline in fertility of the agricultural land is not insignificant, since in the period between 1997 and 2005 the fertility decreased for about 40%. Solarin, Mulali, Al-Musah and Ozturk (2017), got to the result that for every 1% rise of FDI influx there is 0,026 % rise of CO_2 emissions into the atmosphere. Out of total CO_2 emission, energy production is responsible for 41 %, mostly by thermal production of energy (Solarin, Mulali, Al-Musah and Ozturk, 2017). Appiah-Kondau (2013), while testing Ph hypothesis based on two regressive equations, come to conclusion that FDI attracted by lenient environmental laws in Ghana contribute to larger CO_2 emissions and exploitation of forest potentials in the country. Solarin, Mulali, Al-Musah and Ozturk (2017) came to similar conclusions and claim that in case of Ghana, PHH is valid and that FDI increases CO_2 emissions, as well as that Ghana developed comparative advantages in polluting industries and that Ghana became PH. By confirming PHH on the Ghana case, second set hypothesis in this paper has been confirmed as well. Apart from Ghana example, the research of Sapkot and Bastol (2017) also confirms the hypothesis. Testing the PHH validity on the example of South America, they got the results that for every 1% of FDI increase, there is a pollution of 0,036%. Looking into emissions of CO_2 in China in the period between 1980 and 2012, Sun, Zhang and Xu (2017) using ARLD method came to the results that by increase of FDI influx by 1 %, CO_2 emission rises by 0,058%, which ultimately cements second hypothesis.

4. CONCLUSION

Enlargement of the enterprise is based on three intertwined processes: accumulation, concentration and centralisation of capital. Initial process of accumulation of capital is based on transfer of the part of capital

back to the production. During accumulation of adequate sources, a possibility for concentration and centralisation of capital is created. Since accumulation is defined by profit and profit is defined by costs, bearing in mind ruthless competition, enterprises are forced to reduce costs in all possible ways. Cutting the costs includes costs of environmental protection if it is legally possible. This process confirms first work hypothesis. Movement of capital in search for resources and lower environmental standards - PHH, is also based on the same principles of growing incomes and falling costs. If TNC are in search for resources and lower standards, their investments will be directed towards zones which are more lenient and where standards are lower. Besides, if TNC are large and strong enough, they will try to use their power in order to achieve their ultimate goal, regardless the consequences they leave behind. It is indeed confirmed on the example of extraction industries in Ghana and Asian-Pacific region, which empirically confirms second work hypothesis. It is important to mention that the process of moving of FDI towards PHH is not widespread yet, even if they are polluters, e.g. steel production is still kept in host countries of TNC, because it represents strategic interest (WWF-UK, 1999). Moreover, it is necessary to point out that aggregation of influx of FDI leads to yet inconclusive results, since the majority of FDI is motivated by conquering of new markets, hence the condition of motive in second work hypothesis. By growing environmental standards and laws, capital will be even more motivated to seek PH. More frequent positive results in testing the PHH validity, e.g. in Latin America and China speak in favour of that. It appears that in its practice TNC have support in theory with the principle: pollute first, clean up later, which the author of the paper does not approve of. This principle can endanger the fragile balance of ecosystems and cause irreparable consequences. Therefore, as much as the development and growth of the country are important, it is highly recommended that countries reconsider all possible negative consequences of FDI before they are accepted.

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INVESTMENT IN RENEWABLE ENERGY SOURCES - ANALYSIS AND ASSESSMENT OF JUSTIFICATION

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Abstract: *The question that is increasingly being posed in modern society is based on the strategic potential of electricity sources. We are witness to the fact that the last two decades have been marked by sudden climatic changes, and that in this period the average temperature on Earth has increased by 0.6 degrees, which is the highest temperature rise in the last thousand years. Of the total potential of renewable energy sources in the Republic of Serbia, 16.7% is the potential of solar energy, but far less is used. Although the potential of solar radiation is about 30% higher in the Republic of Serbia than in Central Europe, it is assumed that unused capacity has occurred due to insufficient investment activity in this area. For decades, solar energy is used to generate heat in terms of heating water, living space, and also for cooling, and its use is reflected in multiple advantages. It is a quiet, clean and reliable source of energy. Therefore, the subject of this paper will be the methodology for efficient management and evaluation of justification of investments in energy projects, shown on the concrete case of building a solar power plant on the territory of the city of Belgrade.*

Keywords: *project management, feasibility assessment, renewable energy sources, solar energy, energy*

1. INTRODUCTION

The management of projects in the field of energy has the main focus on renewable energy sources, more specifically solar energy and all benefits that the society expands to the realization of investment in electricity. This area of research is very important since energy is a strategic resource of developed and underdeveloped countries. A range of benefits that are often immeasurable for one community brings the growth of the energy sector that leads to the economic development and prosperity of a community. Natural resources are defined as renewable or non-renewable geological, hydrological and biological values that can be used directly or indirectly and have a real or potential economic value. (Lia, Ertesvag, & Zhao, 2013). Energy is characterized by the capacity to produce actions, to cause movement, to modify body temperature, or to transform matter, or to induce different changes (Jena & Misra, 2014). Today, several forms of energy are recognized, of which the most important are electric, chemical, thermal, radiation, mechanical and nuclear energy. In relation to the process of energy transformation, the basic forms of energy include sources and types of energy, and as forms appear: primary, secondary, final and useful energy.

All energy sources are divided into renewable and non-renewable energy sources (Sam Aflaki, 2016). The focus in this paper is the renewable sources that will take primacy over non-renewable sources in the coming years.

As the most important advantages of non-renewable energy sources, according to (Marković, 2010) are: constantly, better ability to adapt to needs, storage and transport in natural form, less investment for plant construction, converting and using and drive and maintenance.

It can definitely be noted that the listed benefits are most often benefits of the investor itself, if viewed from the perspective of the investor. The question arises as to which benefits of using such investments can bring to the wider community. Are there benefits for stakeholders who are not directly involved in the exploitation of projects? Can the realization contribute to the preservation of the environment, reducing air pollution, emissions of gases, reducing various diseases, etc.? Yes, The assumption is that projects using renewable energy can be exploited. One of the basic definitions of renewable energy sources is spending at the same speed as they are renewed. These energy sources are in nature and are renewed in whole or in part (Ilicak, 2014). According to the National Strategy for Sustainable Use of Natural Resources and Goods natural resources in the territory of the Republic of Serbia provide five basic functions: the function of the source, recipient function, circuit function, information function, recreational and other functions.

The functions just displayed show the role of electricity projects from the point of view of the community. The previous division can observe the strategies and goals that the projects could produce during their exploitation period. It is necessary to look at the different needs of people and to properly measure all the benefits that the project brings, taking into account the socially acceptable and necessary benefits (Kordik, Travniček, & Pavelka, 2015). The energy of the Sun, Wind, Sea and the oceans, biofuels and biomass represent non-renewable energy potentials on planet Earth. On the other hand, the basic non-renewable energy sources are fossil fuels, oil, gas and coal whose exhaustion is already very certain. Energy projects are characterized as investment with respect to the characteristics of long-term observation, complexity, large money investments necessary for the realization, resource consumption and the participation of a large number of stakeholders. The lifespan of these projects is twenty years and more, with extremely high initial investments (Zorita, Fernandez-Temprano, Garcia-Escudero, & Duque-Perez, 2016). Management itself is based on concepts that use appropriate methods of organization, planning and control in order to rationalize all necessary resources and coordinate the performance of the necessary activities. Addressing the topic of renewable energy in the Republic of Serbia is one of the necessary conditions for further survival of the energy industry as a heavy industry. Namely, all projects involving the exploitation of renewable energy sources are divided into several categories, with the main focus on reducing consumption and additional due to the production and distribution of electricity, often uncondemning all the benefits that the projects bring to the community (Kasa, Ramanathan, Ramasamy, & Kothari, 2016). In relation to the above, the idea of this paper is to present ways and different projects with a focus on renewable energy sources with the ability to identify and measure the advantages/benefits that their implementation brings. Below the following is the theoretical background of renewables that are increasingly replacing non-renewable energy sources, along with an example of an investment project that presents a perspective and exploitation of solar energy in a very picturesque manner, but from a socially acceptable point of view. A number of social goals can be identified in the realization, and they have a much greater benefit than the one that private investors themselves acquire. Therefore, the following chapters show energy efficiency, the possibility of solar energy exploitation and case studies presented through the Cost-benefit analysis, i.e. the method of economic analysis that compares and evaluates all the advantages and disadvantages of a particular enterprise. this analysis can be used for investment projects that deliver not only direct commercial effects that are quantitatively expressed, but also for projects that bring significant indirect and immeasurable effects. It often contributes to deciding between choices between different forms of resource use, and based on determining overall contributions to reaching ecological goals. It is precisely the aim of this paper to look at all the indirect goals of building a solar power plant using Cost Benefit analysis and cost-effectiveness of investments from the aspect of social assessment of projects. In addition, it also aims to demonstrate that investment in renewable energy sources will make breach in the area of unimpeded access to the private energy sector, reduce the level of pollution in the country, the foreign trade deficit of electricity, create new jobs and create a set of benefits both for the company and for individual investors. Preliminary paper points to the importance of using renewable energy sources and it is not intended for a specific group of people, but for everyone interested in topics of general social importance. Addressing the topic of renewable energy in the Republic of Serbia is one of the necessary conditions for further survival of the energy industry as a heavy industry.

2. ENERGY EFFICIENCY AND ENERGY POTENTIAL OF THE REPUBLIC OF SERBIA

In order to understand the realization of electricity projects, it is necessary primarily to overcome the theoretical concept of energy efficiency and the potential of the Republic of Serbia, since the project that is part of the case study of this work is precisely the implementation of the project in the territory of our country.

The sustainable energy system is an energy efficient way of producing and using energy, which aims to have as little harmful impact on the environment as possible. Sustainable development implies a concept of economic activity that is based on meeting the needs of society without jeopardizing the ability of future generations to meet their needs. Improving energy efficiency for industry means reducing energy consumption for the same production volume. In this regard, the increase in energy efficiency in the economy refers to the reduction of energy consumption for: the production of a product, service performed or some activity performed. The concept of energy efficiency should not be confused with the notion of energy savings, because savings often lead to reduction, and reduction to reduction of comfort, which is certainly not the goal of energy efficiency, and energy management (Li, Guo, & Huang, 2016). The task of the investor who decides to implement the project in the field of

energy is to select a project that will contribute to the reduction of negative impacts, all in the context of limited budgets and legal authorizations. The term non-renewable energy sources refers primarily to energy carriers created in the past and cannot be regenerated or produced again (Zikic, 2016). Most of the non-renewable energy sources refer to fossil fuels, fuels produced by anaerobic digestion of dead or dead organisms in the interior of the earth under the influence of high temperature and pressure, millions of years ago. The limitation of fossil fuel reserves and environmental problems caused by their exploitation have led to increased interest in renewable energy sources, primarily for solar and wind energy. The name renewable or durable, comes from the fact that energy is spent in an amount that does not exceed the speed it creates in nature (Zarcone, Brocato, Bernardoni, & Vincenzi, 2016). Below is a focus on solar energy, as one of the most commonly used renewable energy sources.

Solar energy is the energy of solar radiation that we observe in the form of light and heat that we receive from the largest source of energy on Earth, the Sun. Solar radiation is also responsible for the constant renewal of wind, sea currents, waves, water currents and thermal gradients in the oceans (Zikic, 2016). For decades, solar energy is used to generate heat in terms of heating water, living space, and also for cooling (Rajani & Pandya, 2016). Republic Serbia has a 30% higher solar radiation potential than central Europe, and the intensity of solar radiation is among the largest in Europe. The average daily energy of global radiation for a flat surface during the winter period ranges from 1.1 kWh/m2 in the north and 1.7 kWh/m2 in the south, and during the summer period between 5.4 kWh/m2 in the north and 6.9 kWh/m2 south. The use of solar energy is carried out with the help of built solar plants or solar power plants. Solar power plants are facilities in which solar energy is transformed into electric or thermal energy. It can be seen in the form of solar radiation that appears in the form of light and heat that we receive from the largest source of energy on Earth, the Sun. Solar radiation is also responsible for the constant renewal of wind, sea currents, waves, water currents and thermal gradients in the oceans. For decades, solar energy is used to generate heat in terms of heating water, living space, and also for cooling. The use of solar energy has multiple advantages. It is a quiet, clean and reliable source of energy. Due to the rising price of fossil fuels and raising awareness of the need for environmental protection, there is an increasing interest in the use of renewable sources, including solar energy (Kayser, 2016). The possibility of exploiting the solar potential, the increase in the consumption of energy by the population and Public Suppliers and the speed of construction of the solar power plant, lead to an increase in the number of projects that occur in the field of energy. Also, the low level of investment risk is an advantage, since the state is committed to the purchase of energy in the next 12 years, paying off to the investor a predetermined purchase price of energy. Previous readers are familiar with the basic concepts that solar energy and its exploitation provide, but the potential of the Republic of Serbia that enables the implementation of electricity projects, which will lead to realization of indirect effects, which are the core of this work, is summarized below. It is very important that the Republic of Serbia has significant potential in renewable energy sources, which, unfortunately, is still underused. One of the reasons for such a situation is insufficient investment activity. It is expected that in the next few years there will be major developments in this regard, given the latest step by the Government of the Republic of Serbia in the sense of accepting the decision of the Council of Ministers of the Energy Community on the promotion of renewable energy through the transposition of Directive 2009/28 / EC on renewable energy sources. With this decision, Serbia set an ambitious goal to increase the share of renewable energy in total final energy consumption to 27% in 2020 compared to the current average consumption of 21%. The largest share in the production of energy products in the Republic of Serbia in 2017 was the production of coal (41.63%). Imports of 53.23% in 2017 had oil and oil derivatives, while most of them exported electricity (46.19%). Within the final consumption in 2017, the highest amount of coal was spent in the household sector (39.18%); in the transport sector, oil derivatives were mostly spent (61.30%); Electricity was mostly spent in the household sector (52.58%), and natural gas in the industrial sector (70.67%).

Regarding the balance of electricity, the primary production in 2017 for solar energy amounted to 14,780 GW / h, while for hydroelectric energy it amounted to 8,730 GW / h.

In the Republic of Serbia, as the energy producers, the following entities with the stated market share appear: public company "Elektroprivreda Srbije" with a market share of 92.37%, importers of electricity with a share of 7.55%, privileged and temporarily privileged producers with a market share of 0.003% and other producers from renewable energy sources with a share of 0.08%.

Observing different types of solar power plants, the differentiation in the territory of the Republic of Serbia has been carried out as follows: solar power plants “on the ground”, solar power plants on facilities up to 30kW, solar plants on facilities from 30kW to 500kW.

The data of the Ministry of Mining and Energy indicates that there are currently 17 solar plants in Serbia at the moment. The first solution for the opening of a solar power plant was approved on 09.05.2012, after which the interest in solar energy and the possibility of establishing own plants has increased. The total installed power of the subdued electricity producers amounts to 5.340,00 kW, while the total installed power of the temporary producers of electricity is 660.00 kW. The number of solar plants on the facility up to 30kW is 154, that is, the total installed power of the reputed producers of electricity is 1.711,10 kW, while the total installed power of the temporary producers of electricity is 238.70 kW. In Serbia, solar power plants are installed on the facility from 30 kW to 500 kW and the current number is 21. The total installed power of privileged electricity producers is 1.504,10 kW, while the total installed power of the temporary producers of electricity is 495,90 kW. According to the latest available data, the total utilized solar energy potential for the production of electricity is 0.02056% of the miserable, while the production of heat is not used at all, although there is great potential. The next chapter is a case study with a description of the investment project for the construction of a solar power plant, with the main focus on the Cost benefit analysis and the overview of the indirect goals achieved through the implementation of the project.

3. THEORETICAL ASSUMPTIONS OF BENEFIT ANALYSIS

Cost-benefit analysis is one of the best approaches to evaluating projects of a broader social significance, that is, the focus of these analyzes is not only the effects that a particular project brings to the investor, but also the national community (Araujo, Almeida, Braganca, & Barbosa, 2016). In order to take into account all the effects, i.e. all social benefits and costs of the project, it is most often recommended to apply Cost-benefit analysis in the assessment of energy projects. Data analysis is a practical way to evaluate the eligibility of projects when it is important to look at the investment in the long term and broadly, in terms of causing effects to different people, industry and regions. Cost-benefit analysis is part of the European Union's cohesion policy since the 1990s, and is a compulsory part of the major project proposals since 2000. It is a useful instrument that should help European Union beneficiary countries to choose the best solutions and policies they will be applying for the necessary funds, and to distribute the funds to the European Commission in the best possible way. It also allows assessing the contribution of projects to the welfare of the country and the region, as well as the achievement of the objectives of the European Union defined in the framework of the Cohesion Policy. Such an analysis is usually defined as an activity that enables the inclusion and comparison of costs and benefits that some take into account the effects of a large number of financial, economic, social and other factors in order to assess the financial and economic viability of projects. The effects of all these factors need to be monetized (expressed in cash) in order to be mutually comparable. Economically profitable are only those projects that bring more benefits than costs, and it is recommended to select the one that brings the greatest benefits in terms of costs. The Cost and Benefit Analysis should help individuals and organizations that make decisions that are important to society, to use social resources more rationally (Li, Wei, & Zhou, 2014). Such decisions can be made by private entrepreneurs and socially responsible companies, as well as bodies of the state, regional and local administrations. That is, the analysis itself makes it possible to assess the feasibility and cost-effectiveness of the project proposal at an early stage in its development. A simple financial and economic analysis can point to the key weaknesses of the project proposal. These weaknesses would at some point, during the project's realization, become apparent without the Cost-benefit analysis, but the analysis should just help to avoid unnecessary waste of time and resources on projects that are not profitable.

4. INVESTMENT PROJECT FOR BUILDING A SOLAR POWER PLANT

There are differences in how to evaluate the justifiability of projects when they are designed to increase the general well-being of a community and private investor. Investors focused on realizing their own benefits are looking at the effects that the project brings in terms of profit and value addition. Previously, all advantages of using renewable energy sources have been made, but it is necessary, for the sake of clarity and full understanding, to present the process and possibilities of using Cost Benefit Analysis in identifying the indirect effects that one project can bring.

4.1 Basic information on project realization

For the purpose of rational use of electricity and reduction of greenhouse gas emissions (carbon dioxide, methane, nitrogen suboxide and fluorinated hydrocarbons), the project relies on the exploitation of renewable energy sources, which are primarily environmentally friendly and non-polluting (Yuksel, 2015). The investment relates to the construction of a solar power plant on a residential building in the Belgrade municipality of Vozdovac.

The total electricity produced is distributed to the network of the Public Supplier of the Republic of Serbia ("EPS Distribution"), but it is not significant to the investor who are the final consumers of the same. As the overall goal of the project is the generation of electricity over a period of 12 years and the realization of subsidized purchase price for investors, exploiting solar potential through the exploitation of a solar power plant. The period of exploitation of the project is planned for the next 13 years, that is, the period in which the investor sells the whole produced electricity to the Public Supplier, the company EPS Distribution (Zikic, 2016). To install a solar power plant, 81 solar modules and two 300W inverters will be used to convert electricity. The power plant has a maximum capacity of 20.41 kW, and falls into the first category of subsidized purchase prices (solar power plants on facilities up to 30 kW), within which the investor would generate 20.66 € cents for produced kW/h. The average annual production in the period of exploitation of the project is 30,494.05 kW/h, with the production in August, September, October, November and December, and in the last (12 years) since January, ending in July. The reason for this is to start investing in the realization of the project, that is, the construction and installation of a solar power plant itself.

The scope of the project was observed in relation to the realization of the overall project, i.e., production of electricity and further distribution to the Public Supplier. As the most important activities in the realization of the given project, the following occur: Creating a study of opportunities, preparation of a preliminary feasibility study for the construction of a solar power plant, preparation of the feasibility of the study, on the basis of which the final conclusions on the validity and justification of the realization of the power plant construction project will be made, collecting the technological documentation, construction of the plant and installation of the necessary equipment, connection on the electrical network and further sale of electricity.

Socio-economic analysis identified the main problems that can be minimized or completely eliminated through project implementation. The problem tree, which will be explained in a few sentences, is a tool used to display the main problem with all the sub-problems, causes, and consequences, while the goal tree is used to "positively reflect" the tree of the problem.

The main problem is the low degree of exploitation of the potential of solar energy by the exploitation of solar power plants. The consequences arising from this problem are the inability to meet the needs for electricity, the economic underdevelopment, the non-use of EU funds and the increase in air pollution, while the causes of the problem are a small number of privileged electricity producers, incomplete implementation of the EU Emission Reduction Directive and insufficient awareness of people on the need for exploitation of renewable resources.

The graphic in Figure 1 represent a tree of goals, which refers to a positive response to the problem tree. Namely, for identified problems, negative reflections of the current situation, through the goal tree are given ways to minimize and eliminate them.

4.2 Identification of the indirect effects of the investment project in the construction of a solar power plant

The assumption is that the above mentioned activities can be realized, but in addition to the main goal of the project, the focus will be on the indirect effects that can occur during the project realization. As, the main in-line objectives of the project realization are identified as follows: reduction of greenhouse gas emissions by 2%, exploiting solar potential as a renewable energy source, contribution to the implementation of Directive 2009/28 / EC on the promotion of renewable energy production (solar energy) and reduction of greenhouse gas emissions, to which the Republic of Serbia has committed itself to ratifying the Energy Community Treaty and reducing the number of people suffering from respiratory diseases (focus on adolescents) by 0.5% compared to the number of people with disabilities, due to the reduction of air pollution.

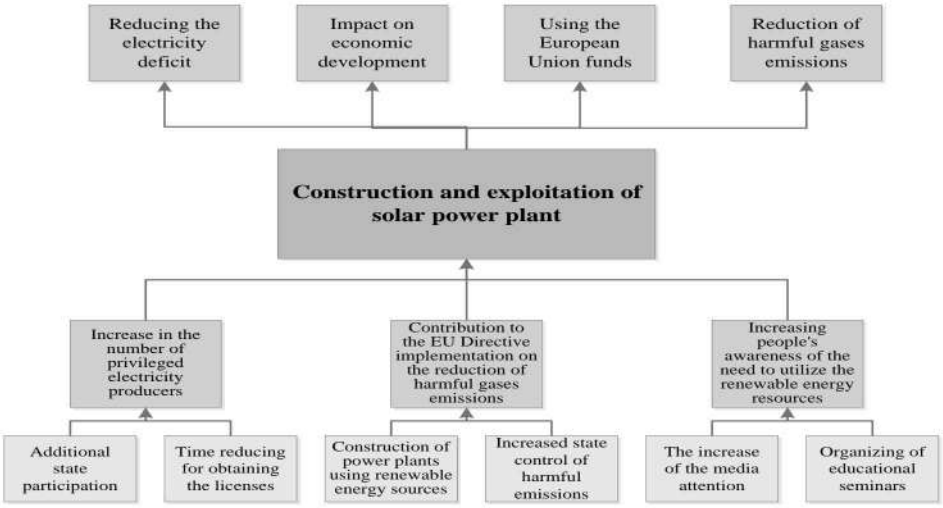

Figure 1: Goals tree

4.2.1 Reduction of emissions of greenhouse gases

During the realization of the project it is necessary to include additional socio-economic benefits arising from the implementation of the projects for the construction of a solar power plant. These are often common benefits, i.e. benefits at global level, caused by the reduction of greenhouse gas emissions affecting climate change on the ground (AlRafea, Fowler, Elkamel, & Hajimiragha, 2016). In order to evaluate this benefit, a standard priced price can be used, for example, to avoid the emission of harmful gases.

The following table shows the emission of non-radioactive gases in the production of electricity from different sources. This data is important for the economic analysis of the project because it can assess the benefits that would bring energy production through solar radiation.

Table 1: Emission of non-radioactive gases from conventional and renewable energy sources

Power plant type	CO_2 (mg/kWh)	NO_x (mg/kWh)	SO_2 (mg/kWh)	Solid particles (mg/kWh)
Coal/lignite	986.000	2.986	16.511	347
Oil	1.131.178	5.253	81.590	128
Natural Gas Turbine	560.000	1.477	152	34
Natural gas combined	450.000	756	152	6
Nuclear power plant	21.435	51	27	2
Hydro	22.696	23	33	5
Vetro	17.652	32	54	20
Solar (photovoltaic)	49.174	178	257	101
Biomass	58.000	1.325	76	269
Geothermal	18.913	280	20	0

The lack of project activity would cause further environmental pollution and the release of harmful gases into the atmosphere through the use of conventional sources would continue. Reducing the emissions of harmful gases is very important for the environmental aspects of the wider community because the effects of the emissions do not have an immediate but long-term and cumulative adverse effect. One of the objectives of the project is to reduce air pollution through reduced emissions of non-radioactive gases, indicated in the previous table. The amount of emitted gases to be saved equals the amount of gases that would be generated by the absence of project activity and the use of conventional sources for the production of electricity. The benefits that are obtained are calculated based on the differences in emissions using conventional sources. The emission of gases caused by the use of coal and oil, and on the other hand, solar energy is observed. The tables shown below show a comparative overview of the emission of four types of harmful gases (CO2, NOx, SO2, hard particles(soot)) in relation to the projected produced amount of electricity over the course of a century of exploitation.

The budget has determined that total savings would be 863.935,20 kg (by all categories of harmful gases), compared to the total amount of electricity produced. Based on "green certificates", each ton of emission reductions can be estimated at an average of 8 euros. The money-saving emission savings, using solar as opposed to conventional sources, amounts to a total of € 6,895.48.

Table 2: Emission of harmful gases in the production of electricity through solar energy during the project's exploitation period

Years of exploitation	0.year	1.year	2. yaer	3.yaer	4.yaer	5 yaer	6.yaer	7 yaer	8.yaer	9 yaer	10. yaer	11.yaer	12.yaer
Planned production (kWh)	13618,14	34573,16	34227,43	33885,15	33546,3	33210,84	32878,73	32549,94	32224,44	31902,2	31583,18	31267,35	20955,84
CO_2 (kg/kWh)	0,049174	0,049174	0,049174	0,049174	0,049174	0,049174	0,049174	0,049174	0,049174	0,049174	0,049174	0,049174	0,049174
NO_x (kg/kWh)	0,000178	0,000178	0,000178	0,000178	0,000178	0,000178	0,000178	0,000178	0,000178	0,000178	0,000178	0,000178	0,000178
SO_2 (kg/kWh)	0,000257	0,000257	0,000257	0,000257	0,000257	0,000257	0,000257	0,000257	0,000257	0,000257	0,000257	0,000257	0,000257
Solid particles (soot) (kg/kWh)	0,000101	0,000101	0,000101	0,000101	0,000101	0,000101	0,000101	0,000101	0,000101	0,000101	0,000101	0,000101	0,000101
Price (kg)	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008
Total broadcast (kg)	676,9577394	1718,632	1701,445	1684,431	1667,587	1650,911	1634,402	1618,058	1601,877	1585,858	1570	1554,3	1041,715
The total value	5,415661915	13,74905	13,61156	13,47545	13,34069	13,20729	13,07521	12,94446	12,81502	12,68687	12,56	12,4344	8,333718

Table 3: Emission of harmful gases in the production of electricity by using coal, during the project's exploitation project

Years of exploitation	0.year	1.year	2.year	3.year	4.year	5.year	6.year	7year	8.year	9.year	10.year	11.year	12.year
Planned production (kWh)	13618,14	34573,16	34227,43	33885,15	33546,3	33210,84	32878,73	32549,94	32224,44	31902,2	31583,18	31267,35	20955,84
CO_2 (kg/kWh)	0,986	0,986	0,986	0,986	0,986	0,986	0,986	0,986	0,986	0,986	0,986	0,986	0,986
NO_x (kg/kWh)	0,002986	0,002986	0,002986	0,002986	0,002986	0,002986	0,002986	0,002986	0,002986	0,002986	0,002986	0,002986	0,002986
SO_2 (kg/kWh)	0,016511	0,016511	0,016511	0,016511	0,016511	0,016511	0,016511	0,016511	0,016511	0,016511	0,016511	0,016511	0,016511
Solid particles (soot) (kg/kWh)	0,000347	0,000347	0,000347	0,000347	0,000347	0,000347	0,000347	0,000347	0,000347	0,000347	0,000347	0,000347	0,000347
Price(kg)	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008
Total broadcast (kg)	13697,72441	34775,21	34427,45	34083,18	33742,35	33404,92	33070,87	32740,17	32412,76	32088,64	31767,75	31450,07	21078,31
The total value	109,5817953	278,2016	275,4196	272,6654	269,9388	267,2394	264,567	261,9213	259,3021	256,7091	254,142	251,6006	168,6264

Table 4: Emission of harmful gases in the production of electricity by using coal, during the project's exploitation project

Years of exploitation	0.year	1.year	2.year	3.year	4.year	5.year	6.year	7.year	8.year	9.year	10.year	11.year	12.year
Planned production (kWh)	13618,14	34573,16	34227,43	33885,15	33546,3	33210,84	32878,73	32549,94	32224,44	31902,2	31583,18	31267,35	20955,84
CO_2 (kg/kWh)	1,131178	1,131178	1,131178	1,131178	1,131178	1,131178	1,131178	1,131178	1,131178	1,131178	1,131178	1,131178	1,131178
NO_x (kg/kWh)	0,005253	0,005253	0,005253	0,005253	0,005253	0,005253	0,005253	0,005253	0,005253	0,005253	0,005253	0,005253	0,005253
SO_2 (kg/kWh)	0,08159	0,08159	0,08159	0,08159	0,08159	0,08159	0,08159	0,08159	0,08159	0,08159	0,08159	0,08159	0,08159
Solid particles (soot) (kg/kWh)	0,000128	0,000128	0,000128	0,000128	0,000128	0,000128	0,000128	0,000128	0,000128	0,000128	0,000128	0,000128	0,000128
Price (kg)	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008	0,008
Total broadcast (kg)	16588,92362	42115,26	41694,11	41277,17	40864,39	40455,75	40051,19	39650,68	39254,17	38861,63	38473,02	38088,29	25527,34
The total value	132,711389	336,9221	333,5529	330,2173	326,9152	323,646	320,4095	317,2055	314,0334	310,8931	307,7841	304,7063	204,2187

It is important to note that there is a close connection between the production of electricity and the emission of harmful gases that the sources cause. According to the Agency for Environmental Protection in the last three years, the energy sector participates in the largest volume of emissions of polluting substances into the atmosphere.

4.2.2 Reducing the number of respiratory diseases

Respiratory diseases relate to breathing diseases, and the most common cause of the disease is the polluted environment in which individuals live. In the Republic of Serbia, the highest share in respiratory diseases affects asthma, which is due to excessively strong immune response to the presence of asthma driver. Asthma is a chronic inflammatory disease of the respiratory tract. In people with asthma, this inflammation is the cause of repeated episodes of playing in the chest, choking and coughing, both during the day, at night, and after physical fatigue. All these symptoms are the result of the increased response of the airways to various stimuli. As a result, there is a diffuse airway obstruction, which is a variable degree, and it is lost either spontaneously or under the influence of the drugs on the spread of the bronchi and/or steroids. Triggers are the most commonly different allergens that cause a patient to suffer from asymmetric changes or an asymmetric attack itself.

The causes of asthma are: pollen, low air quality caused by air pollution, weather, cold air, high or low humidity and even sudden changes in temperature can often aggravate asthma, smoking and passive smoking, animals with fur or hair

Nitrogen oxides, sulphur oxides, so-called ground-level ozone, which is not the primary pollutant, but occurs as a reaction of these compounds, in addition, it is poisonous and what dominates and what is so important is the so-called ultrafine particles that stand out from combustion, primarily diesel. There is a link between conventional and renewable energy sources and how they function with the degree of air pollution. The subject of this study is the need to point out the importance of using renewable energy sources, since they have a much smaller impact on air pollution and environment (Brown & Ulgiati, 2016).

4.3 Basic indicators of social profitability of realization

In order to identify and calculate indicators of the project economic viability, the starting point represents stretching economic project flow after years of exploitation, with consideration of the total inflow, outflow, direct material and immaterial investment costs, using conversion factors and presentation of direct social benefits. The main advantage of exploitation is to reduce the emissions of harmful gases into the atmosphere. The Table 5 also presents net effects that are the difference between inflow and outflow, and all subsequent budgets and conclusions are derived from it.

Table 5: The economic flow of the project after identifying and applying conversion factors

Р.Б	Ставке/Години	CF	0.год	1. год	2. год	3. год	4. год	5. год	6. год	7. год	8. год	9. год	10. год	11. год	12. год
1.	Приливи		2.864,70	7.406,19	7.466,86	7.528,25	7.590,36	7.653,19	7.716,75	7.781,05	7.846,10	7.911,90	7.978,44	8.045,75	12.388,62
1.1.	Укупни приход	0,9340	2.627,82	6.804,82	6.871,50	6.938,84	7.006,85	7.075,51	7.144,85	7.214,87	7.285,58	7.356,98	7.429,07	7.501,88	5.128,43
1.2.	Корист од смањења емисије штетних гасова	1,0000	236,88	601,37	595,36	589,41	583,51	577,68	571,9	566,18	560,52	554,92	549,37	543,87	364,51
1.5.	Остатак вредности	0,9600	-	-	-	-	-	-	-	-	-	-	-	-	6.895,68
2.	Одливи		32.510,38	264,04	1.269,10	1.085,38	893,40	1.740,86	483,13	264,04	1.312,12	264,04	264,04	1.312,12	154,02
2.1.	Укупна улагања	0,9742	32.400,36	-	-	-	-	-	-	-	-	-	-	-	-
2.2.	Директни материјални трошкови	0,8734	54,59	131,01	131,01	131,01	131,01	1.179,09	131,01	131,01	1.179,09	131,01	131,01	1.179,09	76,42
2.4.	Нематеријални трошкови	1,0000	55,43	133,03	133,03	133,03	133,03	133,03	133,03	133,03	133,03	133,03	133,03	133,03	77,60
2.5.	Обавезе према изворима финансирања	1,0000	-	-	1.005,06	821,34	629,36	428,74	219,09	-	-	-	-	-	-
2.6.	Нето ефекти (1-2)	-	-29.645,68	7.142,15	6.197,77	6.442,87	6.696,96	5.912,34	7.233,63	7.517,01	6.533,98	7.647,86	7.714,40	6.733,63	12.234,60

Table 6: Display for calculating the criteria that indicate the justification of the project from the social aspect

Year	Total investments	Benefit	Cost	Discount factor	PVI	PVB	PVC	NI
0	32.400,36	2.864,70	110,02	1,0000	32.400,36	2.864,70	110,02	2.754,68
1		7.406,19	264,04	0,9662		7.155,74	255,11	6.900,62
2		7.466,86	1.269,10	0,9335		6.970,40	1.184,72	5.785,68
3		7.528,25	1.085,38	0,9019		6.790,05	978,95	5.811,10
4		7.590,36	893,40	0,8714		6.614,56	778,55	5.836,01
5		7.653,19	1.740,86	0,8420		6.443,78	1.465,75	4.978,03
6		7.716,75	483,13	0,8135		6.277,58	393,02	5.884,56
7		7.781,05	264,04	0,7860		6.115,84	207,53	5.908,30
8		7.846,10	1.312,12	0,7594		5.958,42	996,44	4.961,98
9		7.911,90	264,04	0,7337		5.805,20	193,73	5.611,47
10		7.978,44	264,04	0,7089		5.656,07	187,18	5.468,89
11		8.045,75	1.312,12	0,6849		5.510,90	898,73	4.612,17
12		12.388,62	154,02	0,6618		8.198,58	101,93	8.096,65
	Total				**32.400,36**	**80.361,82**	**7.751,67**	**72.610,15**

The positive value of the criterion of economic net present value - ENPV (40,209.79 €) indicates that the project from the aspect of the company is profitable. The related project has more social benefits than costs and thus contributes to the increase in the welfare of the population, primarily the municipality of Vozdovac and beyond. The economic internal rate of return shows the rate at which the ENPV has the value of zero, and in terms of this project it is 19.41981%. A significantly higher economic rate of profitability than the social discount rate shows the project's economic viability. The cost-benefit ratio (CBR) is the ratio of the discounted benefits and costs of the project. The value obtained for the concrete project is 10.3670 and shows that the project is sustainable and that the present value of total benefits is greater than the present value of total costs and that the project is cost-effective from a socio-economic point of view. All indicators, both financial and social, indicate the justification for investing in the project of building a solar power plant under the patronage of "XXX" DOO from Belgrade.

5. CONCLUSION

In the end, it is already clear to everyone that there is no question of whether it is necessary to invest and use renewable energy sources, but the rather attention is on emphasis the economy viability and justification of investments in alternative energy sources. The issue that is very up-to-date in today's scenario is what is the timeframe for the return of funds in investments in the field of energy, as well as what benefits the realization of the project brings to both the investor and the wider community. The criteria have used to estimate are discounted cash flows are net present value, unit net present value, internal return rate, return period and social net present value. All these criteria have considered and indicated the justification of investments in the solar power plant construction and the invested capital return, related to the reference period, as well. The general conclusion being made is that a bunch of benefits for a wider social community is achieved through the use of renewable energy sources, whether it's about to the different type of energy applied. This study presents utilization of the solar energy, but the assumption is that both the use of wind energy, the exploitation of biomass or hydroelectric power makes a significant contribution to the community and human beings, while conserving nature and reducing harmful emissions into the atmosphere. The use of renewable energy sources will become a people's need in a very short period of time.

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PAPER AND MUNICIPAL WASTE MANAGEMENT IN THE REPUBLIC OF SERBIA AND EU PRACTICES

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Abstract: *This work reviews the state of things in the Waste Paper Management in Serbia and Countries in the Region; unexploited potentials, limitations, challenges and the particulars have been addressed. The main intention of this work is to raise people's awareness about the importance this issue has on the entire society as well as to demonstrate specific ideas to responsible institutions which develop strategies in this area for businesses and citizens alike. Additionally, this work will demonstrate the position of Serbia in regard to Countries in the Region and there is no question that in respect to Waste Paper Collection and Packaging Waste Collection, it significantly lags behind the EU member countries. The work highlights the segment of the Primary Collection of Municipal Waste, that has not yet been established in Serbia and represents the basis for further developments in this area, and certainly a great potential from both the ecological and economic aspect.*

Keywords*: waste paper, municipal waste, primary collection, recycling, European objectives and norms.*

1. INTRODUCTION

Waste paper, as one of the key, and by nature the most common components of the packaging waste has for years been taking the lead in the placement of the packaging waste in the secondary materials market both ecologically and economically. The graphic- paper market is experiencing a growing global expansion. The factories producing packaging paper are registering a sustained increase in this branch, production capacity of the finished goods is reached in over two months, which is unusual. It is well known that waste paper is a deficient raw material in the Packaging Waste Paper Market in Serbia as well as in the Region. This is best demonstrated by the fact that in the course of the last ten years many factories opened only in Europe (container board producers)and with considerable capacities, especially in Austria (Posch, Brudermann, Braschel & Gabriel, 2015). Consequently, the increased demand for the Production of Packaging Paper was created by the Manufacturers of Transport and Commercial Packaging (corrugated board producers) which are using precisely packaging materials as the basic raw material. The manufacturers of storage boxes have a continuously rapid growth in demand for their products. This increased growth can mostly be attributed to the development of Electronic Commerce. In addition to empowering the giants of this industry (Amazon, E-bay), a large number of new online trade portals offering online services have opened up and so this market continues to grow. Retail giants have also developed online grocery shopping. All those aspects contributed to the growing need for packaging (boxes). From a book ordered through Amazon, to a consumer basket in the commercial market, a box has become necessary for everything. That trend was a turning point in the Paper Industry and also greatly contributed to its expansion. One of the influences of this trend was an increase in the generation of packaging waste, especially waste paper. The generation of waste paper has been on an increase in the last 15 years. (Andersen, Larsen, Skovgaard , Mol, & Isoard, 2007).

Waste paper has been receiving an increasing attention and gaining an ever-expanding role by the generators of this raw material (trade chains, print shops, cardboard factories, other industries' manufacturers, etc.). The demand for waste paper (practically all its classes) has been on the increase, in the European market it has been record- breaking, especially in the last five years. This is best witnessed by the various stock exchange indexes (f.e.FOEX PIX) where prices of waste paper per ton recorded very high levels causing a real headache to the European Packaging Paper Manufacturers since the waste paper procurement accounts for over 40% of the factory's total costs (Sauvageau, & Frayret,2015). In this respect, this trend has interested all participants in the waste paper market (generators, collectors, dealers, recyclers, green-dot companies) to direct the focus of their attention to this fragment of packaging waste. Interest has flourished, the possession of waste paper means power. There is no problem in the sales of this fragment of packaging waste, it is merely essential to find the most profitable way of acquiring the volumes waste paper to procure. The growth expansion of the paper recycling industry is endless, and managing this strategic raw material is an issue of great importance for the economy of a country.

Altogether, waste paper is the most important raw material in the world for the paper and cardboard industry (Ervasti, Miranda & Kauranen, 2016).

Further in this work, a concise comparison of Municipal Waste Management in Serbia and our environment will be presented, that will clearly illustrate how many countries, primarily the member countries of the European Union have exploited their own capacities and raised awareness about the importance of collection and recycling to an entirely new level, and that in themselves represent a possible future steps Serbia could follow in order to find herself on this path.

2. BASIC HYPOTHESES AND METHODS

In this chapter it will be summarized the importance of waste paper collection in Serbia. Managing this fragment of packaging waste is of key importance for several reasons:

- Ecological:

Improvements to the Packaging Waste Management System in order to increase the amount of collected waste and reduce the amount of waste that ends up in the landfill. With continuous and adequate investing in the Packaging Waste Management System, it is expected that the National Objectives in this domain will be on an increase from year to year. Significant amounts of waste paper end up on local landfills mixed with organic waste. As such, they are not usable for recycling in paper and cardboard factories. On the other hand, the environment is being polluted with unnecessary waste that is in itself recyclable. It is important to point out that one of the main reasons for increased recycling is precisely because it is the best alternative to burning when it comes to the impact on global warming and acidification of the environment (Schmidt, Holm, Merrild, & Christensen, 2007).

- Economic:

The issue of waste paper sales in the domestic and foreign market is practically non - existent. There are two large waste paper recyclers on the Serbian Market that are forced to import waste paper in order to satisfy the production needs. Therefore, every additional collected ton of waste paper has a guaranteed placement in the Serbian Market, and the secret lies within collecting, that is, within exploiting the potential that the Serbian Market has to offer.

- Social:

For a contemporary Society, awareness about the importance of Environmental Protection is a prerequisite for sustainable development. It is very important to educate new generations about importance of the renewable materials that are the basis for the sustainable development of the Society / Country as well as for the preservation of its natural resources, flora and fauna. The educational system is crucial, especially as far as the waste paper is concerned (Hanan, Burnley, & Cooke, 2013). The waste paper used to be traditionally collected in various ecological actions (schools, recycling islands, green days, etc.), but the consciousness in our region has not taken root not in the least as in has in the countries of the EU. The primary selection of packaging waste is very underdeveloped in the territory of Serbia, and one of the causes for this is exactly the underdeveloped awareness of the society as well as the lack of adequate techniques. This is an issue of great importance for the Society and appropriate steps must be taken in resolving this issue.

- Integration with European Union:

One of the key chapters in European Integration is precisely Environmental Protection and Renewable Energy Sources. There are many norms that must be met in order for Serbia (and other Countries alike) to become a full member of the European Union. Just in the waste paper collection per capita, Serbia considerably lags behind the EU Member States. According to the European Union's Community Waste Strategy, various treatment and disposal methods have been altered to superior levels/ higher waste management hierarchy that implies (Koufodimos & Zissis, 2002):

  - prevention/reducing landfill waste,
  - the Methodology of Utilization of Waste and Recycled Materials,
  - reducing the burning of waste materials as the means of prevention of global warming

This new philosophy has been adopted by most industrialized countries and promotes Environmentally Safe Waste Management, while at the same time maximizing renewable sources/ energy resources. Therefore, the good work in this area represents a necessary component for the key segments of our Society and the Country and the efforts that need to be undertaken shall be multiply profitable.

2.1. Primary collection as a key solution

Collection of Municipal Waste represents the beginning as well as the key activity within the Recycling. Raising awareness of the people and the use of appropriate techniques for the Primary Sorting of the Municipal Solid Waste's main fractions (paper, foil, plastic, glass, other waste) is the basis for the use of Renewable Resources (Pires, Martinho & Chang, 2011). This system has not been adequately implemented in Serbia and almost all municipal waste that is generated in households ends up in local landfills, mixing with organic waste and becomes unusable. There is place for the waste paper, as well as for foil, plastic and glass in the domestic and foreign markets alike. If we were to draw conclusions from waste paper only, that instead of ending up in landfills could be collected and sold to domestic recyclers, the multiple benefits would be achieved (Rigamonti, Ferreira, Grosso & Marques, 2015):

- The lifespan of a landfill would extend and the domestic potential would be exploited,
- The amounts of collected waste paper would increase,
- Domestic recyclers would realize cheaper procurement (waste paper from domestic markets is always cheaper in comparison with the import price), hence, the domestic economy is accelerating and by it the import is reduced as well as the dependency on foreign suppliers.

It is becoming obvious that it is necessary to move in the direction of the development of the strategic projects that would offer Serbian population the possibility to select the household waste, motivate them for such tasks, in time essentially generate awareness of how important this issue is for them, for future generations, that in this way we are giving a chance to Sustainable Development. Apart from the technicalities (selection baskets etc), it is necessary to apply other means of motivation that would contribute to the expansion of this segment in an adequate way. There exist already elaborated methods that ware widely applied in the EU Member States, such as stimulating financial measures for households, various eco- actions, student and school organizations etc. Since the Early 90' many EU Countries had a well-regulated legislation that defined the obligations of the Households Waste Management (Dahlén, Vukicevic, Meijer, & Lagerkvist, 2007).

2.2. EU members as a good practice examples

The issue of municipal waste has been recognized as one of the key topics of Environmental Protection in the EU, bearing in mind that this applies to very large quantities generated in the EU. In 2011 alone, over 252 million of municipal waste was generated in EU Member States (Da Cruz, Ferreira, Cabral, Simões, & Marques, 2014). What are the results and examples of good practice when it comes to primary collection in EU member states (Seyring, Dollhofer, Weißenbache, Herczeg, McKinnon, & Bakas, 2015):

- Countries that have introduced mandatory separate collection of a particular municipal solid waste fraction have reached a high recycling levels of municipal waste. Primary collection significantly contributes and ensures the achievement of the objectives for the preservation of landfills.

- It is crucial that the technical infrastructure is expanded, as well is informing and motivating users of the system for this kind of collection. Also, a complete System of Municipal Waste Management requires significant investments and the technique must be carefully selected for each site (Ferrão, Ribeiro, Rodrigues, Marques, Preto, Amaral & Lopes, 2014).

- The percentage of recyclable materials increases when municipalities and local governments introduce a door-to-door system. These collection methods lead to the highest recycling achievements and the best quality recyclable materials. The costs of collecting such models are higher than other alternatives, but the collection rates and revenues are also higher, and as a result, the costs of treating such materials are certainly lower (Pires, Sargedas, Miguel, Pina & Martinho2017).

- Implemented systems with sealed separated containers have shown that it is not easy to both encourage the motivate the population to separate their waste and it results in a higher percentage of impurities. However, such systems have proven to be a very reasonable solution for certain fractions (eg. glass).

- Combined collection of recyclable materials is the practice in several member states and results in a reduction in costs, but on the other hand the quality of the collected renewable materials is thus significantly worse. Collecting a dual collection (f.e. plastic and metal) is an adequate way to reduce costs and maintain good material quality. However, mixing several fractions can lead to greater cross-contamination, so the recycling rate of such material from the recycler is considerably higher.

- When a separate collection of biodegradable materials is included in the door-to-door system, the entire sorting of dry recyclables is increased (and other fractions).

- Municipal Solid Waste Collection Centers have the potential to improve the overall recycling rate provided they have adequate space for sorting a large number of different fractions of renewable materials. Each collection center must be specifically adapted depending on the territory of the area for which it is competent (Ramos, Gomes, & Barbosa-Póvoa, 2014).

- The trend in Recycling Markets (Recyclers) will continue to move towards increase in the demands of higher quality materials and larger volumes, which is why adequate collection is of primary importance.

3. RESULTS REVIEW

The importance of the Collection of Packaging Waste with the emphasis on the necessity of Primary Collection (municipal waste) is demonstrated in the previous chapters. In this chapter, the position of Serbia (a comparison) will be demonstrated, according to the two determining factors in the Municipal Waste Management:

- The amount of generated / collected municipal waste (kg per capita)
- The amount of municipal waste that manages to be recycled (kg per capita)

Table 1: Municipal waste generated by the Country (kg/per capita) in the1995 - 2016 period (EUROSTAT, 2015)

	1995	2000	2005	2011	2016	Change (%) 1995-2016
EU-28	473	521	515	498	480	:
Belgium	455	471	482	456	420	-7,7
Bulgaria	694	612	588	508	404	-41,8
Czech Republic	302	335	289	320	339	12,2
Denmark	521	664	736	781	777	49,2
Germany	623	642	565	626	626	0,5
Estonia	371	453	433	301	376	1,3
Ireland	512	599	731	617	:	:
Greece	303	412	442	503	497	64,0
Spain	505	653	588	485	443	-12,3
France	475	514	530	534	510	7,3
Croatia	:	262	336	384	403	:
Italy	454	509	546	529	495	9,1
Cyprus	595	628	688	672	640	7,6
Latvia	264	271	320	350	410	55,1
Lithuania	426	365	387	442	444	4,2
Luxembourg	587	654	672	666	614	4,5
Hungary	460	446	461	382	379	-17,6
Malta	387	533	623	589	647	67,0
Netherlands	539	598	599	568	520	-3,6
Austria	437	580	575	573	564	29,0
Poland	285	320	319	319	307	7,9
Portugal	352	457	452	490	:	:
Rumania	342	355	383	259	261	-23,7
Slovenia	596	513	494	415	466	-21,8
Slovakia	295	254	273	311	348	18,1
Finland	413	502	478	505	504	22,1
Sweden	386	428	477	449	443	14,8
Great Britain	498	577	581	491	:	:
Iceland	426	462	516	495	656	36,9
Norway	624	613	426	485	754	-32,5
Switzerland	600	656	661	689	720	20,9
Serbia	:	:	:	**375**	**268**	:

In 19 out of 31 Countries (Member States of EFTA), the amount of generated municipal waste per capita has an increasing trend between the years 1995 and 2016.

This parameter speaks volumes about the current state of things in the Municipal Waste Management System, as well as reflecting the economic situation of the said country because the greater the collected/ generated municipal waste the greater the consumption, that is the purchasing power of the population.

As can be concluded from the attached table, Serbia significantly lags behind in this segment in comparison with EU member states. In 2016, the average generation or collection of municipal waste amounted to only 268 kilograms per capita. Apart from Romania, which also has an unresolved issue of Municipal Solid Waste Collection, Serbia is well below the European Average with a negative trend when the years 2011 and 2016 are compared.

Following is graphic representation that will be presented below (figure 1) which percentage of collected / generated municipal waste is recycled or reused. This data represents the key parameter of rounding up the municipal waste management process, since the essence and main objective is to reuse the waste from households that the population is sorting (the methods were discussed in previous chapters).

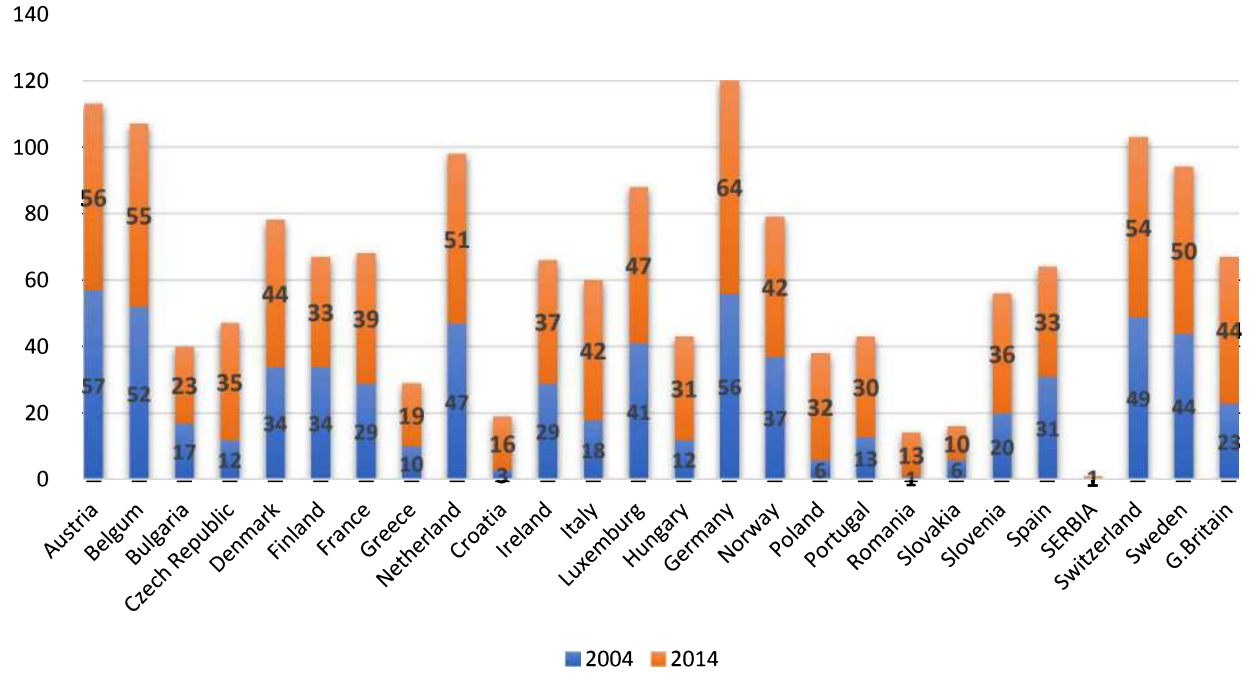

Figure 1: Municipal Waste recycled by the Country (kg/per capita) parable 2004/2014

From the attached Chart it can be concluded:

- Germany, Austria, Switzerland, Netherlands and Sweden are leading in the recycling of their municipal waste in 2014
- In general, 15 out of 32 EEA member countries, have increased the rate of Municipal Waste Recycling in the last 15 years.

In 2015, the European Commission has set out new Objectives for Municipal Solid Waste that account for 60% of recycling and preparations for reuse by 2025 and 65% by 2030 (Groot, Bing, Bos-Brouwers & Bloemhof-Ruwaard, 2014). In addition, new methods for reducing municipal waste that are deposited in landfills have been adopted.

Unfortunately, Serbia has virtually no Recycling of Municipal Waste, but essentially all municipal waste ends up at local landfills. This is a big problem for the State and Society.

Austria, Belgium, Denmark, Germany, the Netherlands, Norway, Sweden and Switzerland, minimize the amount of municipal waste to landfills. The benefits of this type of municipal waste management was addressed in Chapter 2.2.

When it comes to waste paper, this branch of packaging waste represents the largest amount collected on average in over 28 major European cities. Waste paper is the most important component of Municipal Waste (Rahman, Hussain & Basri, 2014). Waste paper has a long tradition in most cities, and a long history in the recycling process itself. In EU countries, paper is mostly collected by door-to-door collection systems, selection baskets that are later transported to collecting centers for municipal waste collected from citizens. As has been said in the introduction to this paper, waste paper has the highest rate of generation between all other fractions of packaging waste. Cities that have a successful waste paper collection system and recorded record highs are: Ljubljana, Tallinn, Helsinki, Riga and Berlin, which manage to collect more than 65% of generated paper / cardboard. (EUROSTAT, 2015), while in the territory of Serbia, the national target for 2016 is 42% and for 2017 it is 47%. For all fractions of packaging waste, the national goal of Serbia for 2016 is that the re-utilization rate reaches 44%, and for recycling 36% (Redžić & Misajlovski, 2016).

4.DISCUSSION

In general, the EU 2020 Strategy provides a guide to a sustainable society with the efficient use of resources. It sets goals and means for transforming the current economy, based on the intensive use of resources, to a new growth model for the efficient use of resources where municipal waste is again involved in the production process for the production of new products or raw materials (Expósito & Velasco, 2018)

The basic question that arises is how to approach the European Union Standards of Municipal Solid Waste and Paper Waste Management? Serbia has all the preconditions to be on an enviable level in this regard, especially when it comes to waste paper. There are two large recyclers in Serbia, with production capacities that exceed the generation of old paper on the domestic market, guaranteed placement and disposal / processing of waste paper has been solved. This is a huge advantage in comparison to the countries that do not have a domestic recycler (example: Montenegro) or countries whose processing / recycling capacity is less than the quantities generated in a given market (for example: Italy), and are forced to export their quantities to the markets where the need is greater than local generation.

This paper recommends to follow in the already familiar footsteps of EU Member States in relation to projects concerning the Primary Collection of Household Generated Municipal Solid Waste. This is the key to the solution of all the problems and it is precisely this question which the basis for further progress in the field of Municipal Solid Waste Management is. During this work, the benefits of investment to such a system were addressed. The return of investment from the economic side is certainly visible and observed from the Social and Environmental as well as sustainable development aspect, these projects are a necessity.

5. CONCLUSION

This paper presents a concise representation of trends in the EU regarding Waste Management, focusing on the Waste Paper, and addressing the current position of Serbia within this segment. Current results show that Serbia has a good predisposition to find itself in the company of successful countries on this issue, but the big disadvantage lies in the very foundation, which is the Primary Collection of Household Waste.

Many developed countries have recognized the importance of an organized Packaging Waste Collection System, focusing on the Primary Collection of Household Waste, the transport to collection and municipal centers, further treatment and recycling. The EU countries have exploited the potentials of the domestic market, set up the right methods that motivate the citizens, private and social sector, all stakeholders to follow the rules of the System and in doing so the entire chain benefits addressed in the Chapter 2 of this work. Already today, enviable results or records have already been recorded in the waste paper collection per capita, the coverage of the accumulation of waste paper in relation to its generation, to enviable levels of renewal of Package Waste Recycling that exceeds 60% in the EU countries. The Municipal Waste Management Systems have been practically brought to their impeccability. Achieved material and non-material benefits are priceless, for the economy and for the future generations. Process of change of some integrated way and awareness of the benefits of this issue are neither cheap not simple. Projects of this kind call for great financial investments as well as education of the citizens and all relevant participants. Primary Selection of Municipal Waste is a necessity and a predisposition if we are to make a move in the right direction.

Serbia is sooner or later waiting for a solution to solve the municipal waste management waste management as a precondition for European integration, only this time it is something we must recognize as a society on our own and make a choice from an economic point of view as well as ecologically a prerequisite for European integration, but this time something that we, as a society, should recognize and choose from, from the economic point of view, the point of view of environmental protection and sustainable development.

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