

DIGITALES ARCHIV

ZBW – Leibniz-Informationszentrum Wirtschaft
ZBW – Leibniz Information Centre for Economics

Plazibat, Bože (Ed.); Kosanović, Silvana (Ed.)

Conference Paper

CIET 2018 - Contemporary issues in economy and technology, Split 1-2 June 2018 : Conference proceedings

Provided in Cooperation with:

University of Split

Reference: (2018). CIET 2018 - Contemporary issues in economy and technology, Split 1-2 June 2018 : Conference proceedings. Split : University of Split, University Department of Professional Studies.

This Version is available at:

<http://hdl.handle.net/11159/2271>

Kontakt/Contact

ZBW – Leibniz-Informationszentrum Wirtschaft/Leibniz Information Centre for Economics
Düsternbrooker Weg 120
24105 Kiel (Germany)
E-Mail: [rights\[at\]zbw.eu](mailto:rights[at]zbw.eu)
<https://www.zbw.eu/econis-archiv/>

Standard-Nutzungsbedingungen:

Dieses Dokument darf zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden. Sie dürfen dieses Dokument nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, aufführen, vertreiben oder anderweitig nutzen. Sofern für das Dokument eine Open-Content-Lizenz verwendet wurde, so gelten abweichend von diesen Nutzungsbedingungen die in der Lizenz gewährten Nutzungsrechte.

<https://zbw.eu/econis-archiv/termsfuse>

Terms of use:

This document may be saved and copied for your personal and scholarly purposes. You are not to copy it for public or commercial purposes, to exhibit the document in public, to perform, distribute or otherwise use the document in public. If the document is made available under a Creative Commons Licence you may exercise further usage rights as specified in the licence.



CIET
2018

1-2 JUNE
Split

Contemporary issues in
economy & technology

CONFERENCE PROCEEDINGS

CIET 2018

1-2 JUNE
Split

Contemporary issues in
economy & technology

ORGANISER



PARTNERS



• SPONSORS • SPONSORS • SPONSORS • SPONSORS • SPONSORS • SPONSORS • SPONSORS • SPONSORS •

• PLATINUM •



• PLATINUM •



• GOLD •



• GOLD •



• GOLD •



• GOLD •



• GOLD •



• SILVER •



• SILVER •



• SILVER •



• SILVER •



• SILVER •



• SILVER •



• SILVER •



• SILVER •



• SILVER •



• DONORS • DONORS • DONORS • DONORS • DONORS • DONORS • DONORS • DONORS • DONORS •



ODVJETNIČKI URED
DRAGAN MIJOČ



ODVJETNIČKI URED
LJUBIČIĆ, VRDOLJAK I PARTNERI

We would like to thank all our
sponsors and donors

Without your generous
support

CIET
2018

1-2 JUNE
Split

Contemporary issues in
economy & technology

would not have been possible

PLATINUM SPONSORS



Building the future™





ERICSSON NIKOLA TESLA GROUP

ERICSSON

Ericsson Nikola Tesla is a leading provider of innovative ICT solutions and services in industry and society area and telecommunications. Being an associated company of the Ericsson Group, it supports modern ways of communicating. It is also Croatia's leading knowledge exporter through its Research and Development activities and Service Delivery Center.

The company's activities include marketing and sales, research and development, design of total communication solutions, services in multi-service and mobile networks area, including mobile Internet and complex system integration in all business areas. The company provides innovative solutions in health care, transport, state administration, municipal services and multimedia that constantly improve people's life and create new value. Having such business policy and strategy, Ericsson Nikola Tesla manages to ensure high quality and attractive jobs in ICT industry.



Tromont d.o.o. je privatna tvrtka osnovana 1995 godine u Splitu. Tijekom više od 20 godina iskustva tvrtka je izrasla u jednu od vodećih instalaterskih kompanija na našem području po kvaliteti izvedbe i ocjeni investitora.

Danas je tvrtka usmjerena na usluge u graditeljstvu, specijalizirajući se za projektiranje i izvođenje svih vrsta građevinsko-obrtničkih, termotehničkih, hidroinstalaterskih, sprinkler sustava, sustava tehničke zaštite i elektroinstalaterskih radova. Iskustvo posebno obuhvaća izgradnju poslovnih i proizvodnih objekata, turističkih objekata i trgovačkih centara.

Specijalnost tvrtke su kompletna rješenja po standardu design&build, posebno u području projektiranja i izvođenja instalaterskih radova.

Kontinuirano ulaganje u poboljšanje kvalitete proizvoda, projekata i usluga društva te ulaganje u edukaciju i usavršavanje kadrovske strukture sastavni su dio poslovne filozofije društva što je rezultiralo u uvođenjem ISO 9001, EN ISO 3834-3 i EN ISO 15085-2 standarda, čime je trajno povećana organizacijska učinkovitost te kvaliteta i pouzdanost isporučenih usluga.



Trgovina

U našoj maloprodaji i veleprodaji osim velikog izbora malih i velikih kućanskih aparata možete pronaći i rezervne dijelove za iste te potrošni materijal. Više od 20.000 različitih rezervnih dijelova čini ponudu Andabaka d.o.o. jednom od najboljih u Europi. Osim toga za većinu velikih kućanskih aparata dajemo 5 godina garancije.

Servis

Davne 1970. osnovan je Andabaka servis koji je sve ovo vrijeme na usluzi građanima Splita i Hrvatske, postavljajući normative usluge koje su prepoznale najbolje tvrtke u branši. Andabaka d.o.o. je centralni servis za Hrvatsku, Bosch i Siemens grupacije od 1993., kao i za Beko grupaciju od 2007. godine.

Dostava aparata

Redovita isporuka i uslužno osoblje najbolja su preporuka naše dostave.

GOLD SPONSORS

ALUKÖNIGSTAHL

ALUKÖNIGSTAHL d.o.o. obiteljska je firma, jedno od vodećih poduzeća na području prodaje i distribucije aluminijskih i čeličnih sustava na tržištu srednje i jugoistočne Europe.

ALUKÖNIGSTAHL d.o.o. dio je uspješnog međunarodnog koncerna ALUKONIGSTAHL KG, osnovanog prije 150 godina u Austriji, koji godišnje ostvaruje promet od 350 milijuna Eura. Prisutni smo u 15 zemalja, surađujemo s 18 društava te zapošljavamo 1000 djelatnika. Dugi niz godina stvaramo i nadograđujemo bazu kupaca kojih je danas preko 7000 te im stavljamo na raspolaganje 70.000 različitih artikala..

Rezultat je to iznimno visokog standarda kvalitete i stručnosti koje pružamo našim kupcima i partnerima u graditeljstvu.

IM-COMP

PRERADA I OBRADA STAKLA

SOUTH EAST EUROPE LEADER IN GLASS PROCESSING

Tvrtka IM-COMP osnovana je 1992. godine sa sjedištem u Čakovcu. Od obiteljskog poduzeća IM-COMP d.o.o je prerastao u jedno od vodećih tvrtki u jugoistočnoj Europi u obradi i oblikovanju stakla sa više od 120 zaposlenika. Već dvadeset godina IM-COMP pruža podršku klijentima u svakom segmentu prerade, obrade i oblikovanja stakla kroz kontinuirano usavršavanje proizvodnih i organizacijskih procesa, investiranje u novu tehnologiju, stvaranje i educiranje stručnjaka u staklarskoj industriji.

Primarne aktivnosti poduzeća

- Obrada i oblikovanje stakla
- Završni radovi u građevinarstvu

TERM@INAMIKA

TERM@INAMIKA

TERM@INAMIKA

CHIPOTEKA

ČULIĆ
ELEKTROCENTAR



VODOVOD I
KANALIZACIJA
S P L I T

A**P** ATESTI i PROCJENE
d.o.o.

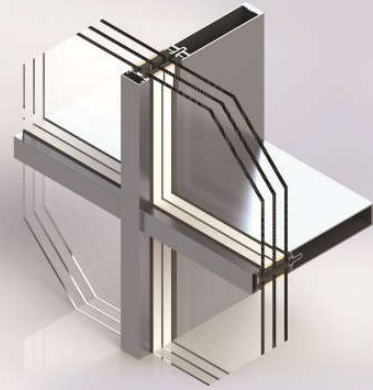
ZAŠTITA NA RADU • ZAŠTITA OD POŽARA
ZAŠTITA OKOLIŠA • OSPOSOBLJAVANJE

USKOČKA 1, 21217 KAŠTEL NOVI
TEL: 021 56 65 35 • FAX: 021 27 84 03
www.aipro.hr • info@aipro.hr

SILVER SPONSORS

F35**STAKLENA FASADA**

FEAL-ova fasada F35 je dizajnirana kao jedna od najtanjih fasada na tržištu. F35 je namijenjena projektima male ili srednje veličine gdje se zahtijevaju uski aluminijski ramovi i panoramski pogled.

FEAL**"KOVINOELEKTRA" d.o.o.**

21210 SOLIN, Matoševa 86A

OIB: 41734922786 PDV BR.: HR41734922786

e-mail: kovinoelektra@st.t-com.hr

Tel/Fax: 021/244-466, 021/244-423


EUR  **TIM**

D.O.O. ZA PROIZVODNJU I TRGOVINU
SINCE 1991.

promar
PROFIL CENTAR

Aluminijski profili
PVC profili
Okovi

PROMAR d.o.o.
Kninska 15, 21204 Dugopolje
tel.: +385 21 668 400
fax: +385 21 668 410
e-mail: info@promar-st.hr
www.promar-st.hr



UGOSTITELJSKA
OPREMA



D
O
N
O
R
S

ODVJETNIČKI URED
LJUBIČIĆ, VRDOLJAK
I PARTNERI

ODVJETNIČKI URED
DRAGAN MIJOČ



**SREDNJA
DALMACIJA**

Turistička zajednica
Splitsko-dalmatinske županije



KONZUM





UNIVERSITY OF SPLIT
University Department of Professional Studies

CIET
2018 | **1 - 2 JUNE**
Split
Contemporary issues in
economy & technology

CONFERENCE PROCEEDINGS

PDF on USB stick with full papers

Publisher:

University of Split
University Department of Professional Studies
Kopilica 5
21000 Split, CROATIA

For the Publisher:

Šimun Anđelinović, Rector
Ivan Akrap, Head

Editors-in-chief:

Bože Plazibat
Silvana Kosanović

Cover Design:

Jašo Vrdoljak, Bože Plazibat

Edition:

250 copies

ISBN 978-953-7220-29-7

CIP - Cataloguing in Publication
SPLIT UNIVERSITY LIBRARY

UDK 33(063),
62(063)

CIP zapis je dostupan u računalnome katalogu Nacionalne i sveučilišne knjižnice u Zagrebu pod brojem 000998182.

Copyright© University of Split,
University Department of Professional Studies, Split, 2018
All rights reserved.

No part of this publication may be reproduced, stored in retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the University of Split, University Department of Professional Studies.

ORGANISING COMMITTEE

- Bože Plazibat, Conference Chair (Croatia)
- Tomislava Pavić Kramarić (Croatia)
- Silvana Kosanović (Croatia)
- Tonko Kovačević (Croatia)
- Larisa Savga (Moldova)
- Mladen Mauher (Croatia)
- Raquel Susana Costa Pereira (Portugal)
- Victor Tavares (Portugal)
- Zlatko Jankoski (Croatia)
- Petra Jakaša (Croatia)
- Goran Ćorluka (Croatia)
- Vladimir Vetma (Croatia)
- Ivica Ružić (Croatia)
- Anita Krolo Crvelin (Croatia)
- Nada Roguljić (Croatia)
- Siniša Zorica (Croatia)
- Lada Reić (Croatia)

SCIENTIFIC COMMITTEE

- Affandy Affandy (Dian Nuswantoro University, Indonesia)
- Winton Afrić (University of Split, University Department of Professional Studies, Croatia)
- Pilar Alberola (Florida Universitaria, Spain)
- Boris Antić (University of Novi Sad, Serbia)
- Mercedes Aznar (Florida Universitaria, Spain)
- Susana Bernardino (Iscap Instituto Superior de Contabilidade e Administração do Porto, Portugal)
- Joanna Blach (University of Economics in Katowice, Poland)
- Domagoja Buljan Barbača (University of Split, University Department of Professional Studies, Croatia)
- Ivana Cindrić (University of Zagreb, Faculty of Teacher Education, Croatia)
- Mojca Čepič (University of Ljubljana, Faculty of Education, Slovenia)
- Goran Ćorluka (University of Split, University Department of Professional Studies, Croatia)
- Laura Diaconu Maxim (Alexandru Ioan Cuza University of Iasi, Romania)
- Monika Eisenhardt (University of Economics In Katowice, Poland)
- Ferhat Ćejvanović (Faculty of Economics Tuzla, Bosnia and Herzegovina)
- Luís Gomes (Iscap Instituto Superior de Contabilidade e Administração do Porto, Portugal)
- Agnieszka Hajdukiewicz (Cracow University of Economics, Poland)
- Iraj Hashi (Staffordshire University, United Kingdom)

- Andreea-Oana Iacobuta (Alexandru Ioan Cuza University of Iasi, Romania)
- Zlatko Jankoski (University of Split, University Department of Professional Studies, Croatia)
- Goran Karanović (University of Rijeka, Faculty of Tourism And Hospitality Management, Croatia)
- Ivan Kelić (University of Osijek, Faculty of Economics, Croatia)
- Silvana Kosanović (University of Split, University Department of Professional Studies, Croatia)
- Tonko Kovačević (University of Split, University Department of Professional Studies, Croatia)
- Umachandran Krishnan (Nelcast Ltd., India)
- Ivana Krsmanović (Technical College Čačak, Serbia)
- Mirko Marušić (University of Split, Faculty of Chemistry and Technology, Croatia)
- Andrei Maxim (Alexandru Ioan Cuza University of Iasi, Romania)
- Lyudmila Mihaylova (University of Ruse, Bulgaria)
- Davorka Mikulić (University of Split, Faculty of Economics, Business and Tourism, Croatia)
- Marko Miletić (University of Split, University Department of Professional Studies, Croatia)
- Sandra Mrvica Mađarac (College of Applied Sciences "Lavoslav Ružička" , Croatia)
- Tolu Olarewaju (Staffordshire University, United Kingdom)
- Emil Papazov (University of National And World Economy, Bulgaria)
- Jakob Patekar (Rochester Institute of Technology, Croatia)
- Tomislava Pavić Kramarić (University of Split, University Department of Professional Studies, Croatia)
- Petar Pepur (University of Split, University Department of Professional Studies, Croatia)
- Raquel Pereira (Iscap Instituto Superior de Contabilidade e Administração do Porto, Portugal)
- Danijela Perkušić Malkoč (University of Split, University Department of Professional Studies, Croatia)
- Damir Piplica (University of Split, University Department of Professional Studies, Croatia)
- Alexandru Pirjan (Romanian-American University, Romania)
- Smiljana Pivčević (University of Split, Faculty of Economics, Business and Tourism, Croatia)
- Bože Plazibat (University of Split, University Department of Professional Studies, Croatia)
- Ivana Plazibat (University of Split, University Department of Professional Studies, Croatia)
- Agnieszka Poczta-Wajda (Poznan University of Economics and Business, Poland)
- Srdjan Podrug (University of Split, Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Croatia)
- Gojmir Radica (University of Split, Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Croatia)
- Jasmina Rogulj (University of Split, University Department of Professional Studies, Croatia)
- Toma Rončević (University of Split, University Department of Professional Studies, Croatia)
- Larisa Savga (Trade Co-Operative University of Moldova, Moldova)
- Sanja Sever Mališ (University of Zagreb, Faculty of Economics and Business , Croatia)
- Manuel Silva (Iscap Instituto Superior de Contabilidade e Administração do Porto, Portugal)
- Claudia Stoian (Bobalca) (Alexandru Ioan Cuza University of Iasi, Romania)
- Alen Šimec (Zagreb University of Applied Sciences, Croatia)

- Victor Tavares (ISAG Instituto Superior de Administração e Gestão, Portugal)
- Oana Țugulea (Alexandru Ioan Cuza University of Iasi, Romania)
- Laszlo Vasa (Institute for Foreign Affairs and Trade, Hungary)
- Jelena Vidović (University of Split, University Department of Professional Studies, Croatia)
- Ruxandra Dana Vilag (Romanian-American University, Romania)
- Vanja Vitezić (University of Rijeka, Faculty of Tourism and Hospitality Management, Croatia)
- Monika Wieczorek-Kosmala (University of Economics in Katowice, Poland)

PROFESSIONAL COMMITTEE

- Arijana Burazin Mišura (University of Split, University Department of Professional Studies, Croatia)
- Ivana Čizmić (University of Split, University Department of Professional Studies, Croatia)
- Mario Dadić (University of Split, University Department of Professional Studies, Croatia)
- Gorana Duplančić Rogošić (University of Split, Faculty of Economics, Business and Tourism, Croatia)
- Radisav Đukić (Technical College Čačak, Serbia)
- Debra Ferdinand-James (The University of The West Indies, Trinidad and Tobago)
- Nikola Grgić (University of Split, University Department of Professional Studies, Croatia)
- Petra Jakaša (University of Split, University Department of Professional Studies, Croatia)
- Ivo Jerčić (University of Split, University Department of Professional Studies, Croatia)
- Igor Jurčić (HT Eronet, Bosnia and Herzegovina)
- Ivan Krasić (HT Eronet, Bosnia and Herzegovina)
- Maja Krčum (University of Split, Faculty of Maritime Studies, Croatia)
- Tino Kusanović (University of Split, University Department of Professional Studies, Croatia)
- Stjepan Marković (Eksergija J.D.O.O., Croatia)
- Ado Matoković (University of Split, University Department of Professional Studies, Croatia)
- Luka Mladineo (University of Split, University Department of Professional Studies, Croatia)
- Dijana Perkušić (University of Split, University Department of Professional Studies, Croatia)
- Ivica Ružić (University of Split, University Department of Professional Studies, Croatia)
- Visnja Troskot (University of Split, University Department of Professional Studies, Croatia)
- Vladimir Vetma (University of Split, University Department of Professional Studies, Croatia)
- Isabel Vieira (Iscap Instituto Superior de Contabilidade e Administração do Porto, Portugal)
- Ivo Vlastelica (Technical College Čačak, Serbia)
- Marko Vukasović (University of Split, Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Croatia)
- Marko Vukšić (University of Split, University Department of Professional Studies, Croatia)
- Nenad Vulić (University of Split, Faculty of Maritime Studies, Croatia)

Dear Colleagues,

At the University Department of Professional Studies, we offer multidisciplinary education in social and technical sciences. Our Department promotes three common values that aspiring students and future professionals should develop: sound professional knowledge base, foreign language competence and necessary IT training.

We encourage students to gain valuable experience from their studies by choosing to go on international exchange or/and participate in training programmes and professional development opportunities with local industries and businesses with whom we partner. This way, we try to make sure that, after completing the studies, students are well prepared for the next step in their professional career path.

Therefore, the proceedings you are reading contain both scientific and professional papers presented at the 3rd international scientific and professional conference entitled Contemporary Issues in Economy & Technology – CIET 2018, held in June 2018 in Split. Many of those papers are written in authorship with students and professionals in the field. In doing so, we had in mind the necessity and the opportunity to connect science and profession with business entities in order to achieve synergy effects.

This conference started 4 years ago. The beginning was rather modest, but the ambitions of the organisers were huge. That is the reason why the conference has become larger and more relevant over time. The topics that this conference deals with are focused on issues that occupy attention of the scientists as well as of professionals from all over Europe who came here to exchange experience and work together.

Therefore, it is necessary to point out our partner institutions in organising this conference: ISCAP - Porto Accounting and Business School, ISAG - European Business School, UCCM – Trade Co-operative University of Moldova and TVZ – Zagreb University of Applied Sciences.

The proceedings would not be possible without the time and energy devoted by the members of the organising committee, reviewers and students/volunteers. Furthermore, special gratitude is intended to a great number of sponsors and donors who generously supported this event.

Finally, I would like to express my gratitude to all of you who have contributed with your scientific and professional papers to the publication of the proceedings and thus enriched the scientific thought and practice.

Split, June 2018

Head of the University Department of Professional Studies

Ivan Akrap, senior lecturer

Editorial Welcome

It is a great pleasure to welcome you to the USB edition of scientific and professional proceedings published from the 3rd biennial international conference entitled CONTEMPORARY ISSUES IN ECONOMY & TECHNOLOGY - CIET 2018 - which was held from 1 -2 June, 2018 in Split, Croatia.

The University Department of Professional Studies, University of Split, Croatia, together with partners from Trade Co-operative University of Moldova, Polytechnic of Zagreb, Croatia, The Porto Accounting and Business School (ISCAP) and European Business School (ISAG), both from Porto, Portugal, had a great privilege to have hosted such a prestigious event in the beautiful city of Split.

The conference provided an excellent forum for discussion by students, lecturers and professors in the areas of finance and economy, entrepreneurship, tourism and trade, electrical engineering, information technology, mechanical engineering, as well as interdisciplinary approaches to teaching and learning.

Furthermore, a double-blind reviewed selection of presented scientific (26) and professional papers (51) in the above mentioned fields can be found on this USB stick with assigned ISBN and UDK numbers as well as CIP data prepared by the University Library of Split.

On behalf of all the members of the organising committee, I look forward to welcoming you to the pages of this USB.

Editor-in-chief

Dr. Boze Plazibat



CIET | Split
2018

CONTENTS



SCIENTIFIC PAPERS

Track 1: Finance & Accounting

- ID_16 *Petra Jakaša; Branko Sorić*
The influence of banks' assets quality on capital adequacy S - 1
Sergiu Porcescu; Larisa Savga; Alexandru Stratan
- ID_25 The research and innovation strategy for smart specialisation - a new
strategic approach for an innovation-based economic development of the S - 8
Republic of Moldova
Tomislava Pavic Kramaric; Anđela Paštar Krnčević; Marko Miletic
- ID_64 Influence of bancassurance on non-life insurance sector performance – S - 20
Case of selected European countries
Renata Kožul Blaževski
- ID_95 Influence of the government final consumption expenditure and the final S - 30
consumption expenditure of households and NPISH on economic growth
in Republic of Croatia – VAR model

Track 2: Tourism, Trade and Entrepreneurship

- ID_2 *Sandra Mrvica Mađarac; Slađana Brajević; Višnja Bartolović* S - 42
Application of mobile apps in stores
Ivana Plazibat; Sanda Renko
- ID_5 The effect of ageing on consumers' preference for particular atmospheric S - 51
elements
- ID_7 *Slađana Brajević; Antonija Roje; Ivan Brajević* S - 61
Entrepreneurial zones in Split-Dalmatia County
Zvonimir Stamenov; Ivana Jadric; Martina Petrovic
- ID_14 Analysis of the sport consumer behavior and identification of a niche and S - 70
tourism market opportunities for extreme athletes in Croatia
- ID_28 *Andriy Popovych* S - 82
Substitution of different risk management strategies in agriculture
Simion Moraru; Elena Graur; Irina Cosnicean; Tatiana Baran
- ID_30 The evolution of European management as a support in the development S - 95
of the Moldovan governing system
Agnieszka Hajdukiewicz
- ID_31 The role of commercial diplomacy in promoting and facilitating S - 107
international business
Jelena Stupalo; Goran Ćorluka
- ID_53 Prerequisites for adequate tourism valorization of cultural resources S - 119
Blazenka Knezevic; Petra Skrobot; Mia Delic
- ID_63 Brand loyalty of younger adults in beer retail shopping - Case of Croatia S - 125
Lyudmila Mihaylova; Emil Papazov; Ismail Bilgi
- ID_74 Evaluation model of internal control activities in industrial enterprises S - 138

ID_82	<i>Vedrana Musinov; Goran Ćorluka</i> Reception operations in ports of nautical tourism	S - 149
ID_84	<i>Laura Diaconu Maxim; Andrei Maxim</i> Traditional versus low-cost airlines' passengers. A study on Iasi airport	S - 156
ID_91	<i>Andreea-Oana Iacobuta</i> Public policies and entrepreneurship development in Romania	S - 168
ID_101	<i>Oana Țugulea; Mădălina Ferchiu; Claudia Stoian (Babălca)</i> A particular analysis of consumer behaviour of products in decline phase	S - 178
ID_105	<i>Maria Antónia Rodrigues; Inês Veiga Pereira</i> The fit between marketing high education and required skills for marketing practice	S - 189
ID_106	<i>Alice Trindade; Ana Pinto Borges; Elvira Vieira</i> Consumer behaviour and its impact in the intention to return to the wine event	S - 206

Track 3: Electrical Engineering, Information Technology and Mechanical Engineering

ID_46	<i>Leonidas A. Papakonstantinidis; Igor Jurcic</i> Eight key fields analysis (EKF) and the 3-pole (win-win-win) challenges for mobile telecommunication	S - 220
ID_55	<i>Luka Tomasovic; Mateo Cobanov; Josip Music; Barbara Dzaja</i> Comparing virtual and augmented reality: In which one would you like to live in?	S - 233
ID_59	<i>Davor Mrsić; Marko Vulić; Nenad Vulić</i> Loading factors within the strength calculation procedure for involute marine gears with parallel axis	S - 245
ID_65	<i>Igor Nazor; Karmen Klarin</i> Using Croatian qualification framework and organizational growth model to help SME's specify job qualifications	S - 257

Track 3: Interdisciplinary Teaching and Learning

ID_52	<i>Silvana Kosanović</i> Implementing project work in an ESP classroom	S - 269
ID_66	<i>Ivana Čizmić; Jasmina Rogulj</i> Individual variables and English language performance	S - 280

PROFESSIONAL PAPERS

Track 1: Finance & Accounting

- ID_13 *Branko Sorić; Magdalena Gustin* The construction sector at the Zagreb stock exchange (ZSE) P - 292
- ID_19 *Ivica Filipović; Marijana Bartulović; Toni Šušak* Accounting and legal aspects of clearing P - 300
- ID_37 *Tatiana Sandutsa; Galina Caraganciu* Insurance market of Moldova: Problems and trends of development P - 308
- ID_39 *Dumitru Girdea; Elena Fuior; Ion Maxim* Tax adjustment in dynamic global development P - 315
- ID_45 *Jasenska Bubić; Magdalena Gustin* Prediction of corporate (non)success through financial statements P - 327
- ID_48 *Luka Mladineo; Ružica Olujić* Hotels in the system of valued added tax P - 336
- ID_50 *Dijana Perkušić; Dijana Šimunović* Tax treatment of acquisition and costs of using personal vehicles from 1 January 2018 P - 344
- ID_71 *Ana Bratinčević; Perinka Paleško; Mia Perica* Tax - acknowledged costs and tax deduction for buying a vehicle through reforms P - 355
- ID_75 *Jelena Vidović* Limitations in cash transaction for business subjects P - 360
- ID_88 *Mario Dadić; Ante Radas; Jelena Odža Radas* Implementation of balanced scorecard model in a manufacturing company P - 366
- ID_98 *Lucija Laća Lakoš; Ana Laća* The inequality of income distribution in the Republic of Croatia between 2010. and 2016. P - 377

Track 2: Tourism, Trade and Entrepreneurship

- ID_15 *Anita Krolo Crvelin; Laura Marasović* Human resource accounting P - 389
- ID_24 *Mercedes Aznar* Tourism contribution to cultural heritage P - 397
- ID_38 *Andrei Maxim; Laura Diaconu Maxim* Corporate social responsibility and sustainable development in China P - 409
- ID_47 *Irina Cosnicean; Mariana Hîrzob; Irina Raevskaia* Ensuring the quality management system in small and medium enterprises - a way to increase national economic security. P - 421
- ID_102 *Claudia Stoian (Bobâlcă); Andreea Lupu; Oana Țugulea* Attributes that define store image – A comparative perspective P - 431

ID_104	<i>Ivan Akrap; Slavko Buotić</i> Legal protection of trade secrets	P - 440
ID_107	<i>Rossella Del Prete</i> Cultural heritage tourism as a factor in the production of economic and social capital	P - 447

Track 3: Electrical Engineering, Information Technology and Mechanical Engineering

ID_8	<i>Ivan Andrić; Roko Miše; Eduard Škec</i> Analysis of voltage drops and protection range when connecting a large consumer to the electrical grid	P - 459
ID_9	<i>Mateo Hrgović; Ivan Vrljičak; Igor Gabrić; Zlatko Jankoski</i> Net efficiency of a parabolic dish concentrator	P - 469
ID_10	<i>Dean Dereani; Mikela Jozić</i> Modification of the Cemex cement plant control system	P - 476
ID_11	<i>Igor Jurčić; Krishnan Umachandran; Valentina Della Corte; Giovana del Gaudio; Vasudeva Rao Aravind; Debra Ferdinand-James</i> Industry 4.0: Unleashing its future smart services	P - 487
ID_17	<i>Siniša Zorica; Lada Reić; Marinko Lipovac; Sandra Antunović Terzić</i> Implementation of Alfresco's document management software into University institution	P - 498
ID_18	<i>Marinko Lipovac; Siniša Zorica; Lada Reić; Sandra Antunović Terzić</i> Computer customization and protection in a computer classroom using the features of an operating system	P - 509
ID_22	<i>Mirko Lovricevic</i> Migrating user data to a new Debian server	P - 521
ID_23	<i>Vedrana Cvitanić; Ivana Dumanić; Maja Kovačić; Mohsen Safaei</i> Analytical and numerical simulations of cylindrical cup deep drawing for DCo6 sheet sample	P - 527
ID_26	<i>Frane Vlak; Nedjeljko Marušić; Vedrana Cvitanić; Ado Matoković</i> Zip line structural analysis	P - 537
ID_41	<i>Vjekoslav Tvrdić; Srdjan Podrug; Igor Šuljić; Bernard Matić</i> Hydraulic hybrid vehicle configurations and comparison with hybrid electric vehicle	P - 548
ID_43	<i>Dražen Kustura; Tomislav Matić; Frane Vlak; Stipe Perišić</i> Three axis force load cells comparative analysis	P - 557
ID_44	<i>Ado Matoković; Bože Plazibat</i> A short review of calculation of normal and shear stresses in a cantilever thin-walled bar with asymmetric open cross-section	P - 563
ID_54	<i>Ivo Jerčić; Nenad Prizmić</i> Design of energy efficient fishing winch systems	P - 571
ID_57	<i>Mikela Jozić; Vjekoslav Zrno; Slobodanka Jelena Cvjetković</i> Creating smart cities	P - 583
ID_58	<i>Mikela Jozić; Zdravko Jadrijević</i> Marine energy	P - 593
ID_68	<i>Nikola Grgić; Jelena Ružić; Ivica Ružić</i> Development of application model for blockchain data analysis	P - 604

ID_77	<i>Joško Smolčić; Perica Perković; Filip Perković; Tonko Kovačević</i> Design and implementation of 3D printers for application in education	P - 612
ID_78	<i>Marko Meštović; Luka Tomasović; Marija Jelović; Tonko Kovačević</i> Internet of things platform for environmental monitoring	P - 623
ID_79	<i>Ante Botica; Tonko Kovačević; Silvano Jenčić; Siniša Zorica</i> ZigBee wireless sensor network for indoor air quality monitoring	P - 633
ID_83	<i>Toma Rončević; Haidi Božiković</i> Pronoun disambiguation problem	P - 646
ID_86	<i>Ivica Lovric; Marija Blazevic; Vjekoslav Zrno; Slobodanka Jelena Cvjetkovic</i> Design of small power solar system	P - 651
ID_99	<i>Roko Rogulj; Predrag Đukić; Tonko Kovačević; Marko Vukšić</i> Design and usage of CNC mill	P - 661
ID_100	<i>Nikola Padovan; Marko Srdarev; Predrag Đukić; Tonko Kovačević</i> Design and manufacturing of a robotic hand	P - 674
ID_103	<i>Ante Kiso; Vjekoslav Zrno; Jelena Cvjetković</i> Managing distributive transformers	P - 682

Track 4: Interdisciplinary Teaching and Learning

ID_12	<i>Petra Grgičević Bakarić; Katarina Krnić</i> The indicative and the subjunctive mood in subordinate adverbial clauses in Italian and German	P - 689
ID_20	<i>Marijana Jurisic; Ivana Vodogaz</i> Making mistakes is absolutely correct	P - 701
ID_27	<i>Linda Martić Kuran; Katarina Blažević Miše; Slobodan Brezak; Nikola Blažević</i> Organization identity in higher education institutions in the Republic of Croatia	P - 712
ID_49	<i>Nataša Uzelac; Marta Alić</i> Empathy - is it measurable and teachable?	P - 724
ID_60	<i>Stjepan Knežević; Zlatko Norac; Jelena Ružić; Natko Bajić</i> Use of the optical mouse in teaching experimental Physics	P - 736
ID_70	<i>Sofia Capatina; Nicolae Silistraru</i> The interconnection between pedagogical principles and accounting principles in the accounting teaching and learning	P - 748
ID_73	<i>Gorana Duplančić Rogošić; Sonja Koren</i> Researching plagiarism in higher education – case of first-year students at selected HEIs	P - 756
ID_89	<i>Siniša Zorica; Bože Plazibat; Arijana Burazin Mišura; Nada Roguljić</i> Detecting and solving unfair working schedule using math	P - 773
ID_90	<i>Elena Ciortescu</i> Challenges in teaching business English – Understanding media messages	P - 782
ID_96	<i>Ivica Luketin; Nada Roguljić</i> Data science in social context – help from physics and statistics	P - 788

CIET | **Split**
2018 | **Track 1**

Finance & Accounting

The Influence of Banks' Assets Quality on Capital Adequacy

Petra Jakaša

University Department of Professional Studies, Split, Croatia
pjakasa@oss.unist.hr

Branko Sorić

University Department of Professional Studies, Split, Croatia
bsoric@oss.unist.hr

Abstract The aim of this paper is to investigate the influence of assets quality on capital adequacy in European banks. Assets quality is measured with non-performing loans ratio (NPL ratio) and with coverage ratio of NPLs which are two independent variables in this research. The loan is considered non-performing when more than 90 days pass without the borrower paying the agreed instalments or interest. NPL ratio is calculated as portion of NPL in total loans. NPL coverage is portion of non-performing loans covered with value adjustments. Analysed data included aggregated data for 19 European countries. As European Central Bank (ECB) reported, the distribution of NPL has been highly unequal among EU countries since the start of the crisis. Toward the end of 2016 the average rate of non-performing loans in EU is slowly decreasing but once again in unequal paces among countries, so authors wanted to investigate the impact of NPL ratio and its coverage on capital adequacy. Authors expect that both non-performing loans ratio and coverage ratio will have negative influence on capital adequacy. The thesis will be tested with statistical methods.

Key words: *assets quality, capital adequacy, banks' assets, non-performing loans*

1. Introduction

Major position in total banks assets are loans. Accordingly, loans quality mostly determines quality of total banks assets and strongly influence capital adequacy. Minimal capital adequacy is set by the regulators. Bank regulators aim to pertain financial stability of banks and prevent banks' infections and wide panic. Banks with higher capital adequacy will be more capable of sustaining unexpected losses than those banks with lower capital levels. Given the fact that capital adequacy is calculated as a ratio between capital and risk weighted assets, any deterioration of loan quality induces owners to increase capital in order to maintain satisfactory capital adequacy level.

Banks capital is structured based on its quality. Accordingly, total capital comprises of tier 1 capital (basic capital) and tier 2 capital (supplementary capital).

Common equity tier 1 (CET1) is the highest quality equity and provides long term stability.

Common equity tier 1 capital ratio is calculated as ratio between CET1 and risk-weighted assets. Regulatory minimum of CET1 ratio determined by EU Regulation 575/2013 is 4,5%.

Total tier 1 includes above described Common equity tier 1 (CET1) and Additional tier 1 equity. Additional tier 1 capital includes instruments that are not common equity but are eligible to be included in tier 1 according to the regulatory demands.

Total tier 1 capital ratio is calculated as sum of Common equity tier 1 and Additional tier 1 capital divided by risk weighted assets. EU Regulation 575/2013 defines that financial institutions must keep their Total tier 1 capital ratio at minimum of 6% at all times.

Tier 2 capital is supplementary capital which provides additional security and stability and is used to absorb losses when Tier 1 capital isn't sufficient to do so. Supplementary capital includes equity instruments and subordinated loans which do not meet criteria to be recognized in tier1 capital, but comply with criteria for recognition in tier2 capital according to the valid regulations. This capital includes also share premium on mentioned instruments and other positions defined by the regulations.

Tier 2 capital ratio is calculated as a ratio between supplementary capital and total risk weighted assets.

Total capital is a sum of Tier 1 and Tier 2 capital and total capital ratio is a ratio between total capital and risk weighted assets. EU Regulation 575/2013 defines that all credit institutions must keep total capital ratio at 8% at all times and supplementary tier 2 capital is used to fulfil this requirement when necessary.

In addition to these mandatory minimums of capital ratios, Croatian credit institutions also have to provide protection layer for securing the capital of minimum 2,5% of Tier 1 capital which is used as protection in case of crises. Also, credit institutions must keep additional layer of capital for structure system risk and at the moment it is set to minimum of 1,5% of Tier 1 capital according to the Decision of Croatian national bank.

2. Literature Overview

Beck and other (2013) used three bank assets quality indicators: maturity matching, loan loss provisions and non-performing loans. In their research they compared assets quality of Islamic and conventional banks and concluded that Islamic banks are less efficient, but have better quality of assets and are better capitalized.

Popek Biškupec and Lešić (2013) in their paper named Impact of bad loans on the capital adequacy of banks in Croatia point out that indicators show that the Croatian banking system is one of the most stable ones in Europe. If stability and liquidity indicators of Croatian banks are very good, it is unclear why there are so many economic problems in that same system. Analysis of banks balance sheet, asset quality and receivables point to the conclusion that the financial system may not be so stable. The problem is that a part of Croatian banks' assets is deteriorated by bad loans. Banks' stability generated from capital adequacy is statistically very good, but the authors point out that such level of capital adequacy is not real. Their research shows that unrealistic capital adequacy comes from assets revaluation. The authors used CAR and VAR method in their research and they concluded that realistic capital ratio is 5-6% lower than presented.

Ugoani (2016) points out that bad loans are those which don't generate income. The loan is considered bad or non-performing when principal or interests are due more than 90 days. However, the author highlights that cash flow and total credit worthiness are much more important than the fact whether the loan is past due or not.

Michael and others (2006) indicate that non-performing loans have main influence on poor performance of the bank.

Italian author Cucinelli (2015) in her paper "The impact of non-performing loans on bank lending behaviour: evidence from the Italian sector" observed a sample of 488 Italian banks in the period from 2007 to 2013. The author concluded that credit risk has negative influence on banks behaviour, showing that increased credit risk leads to lower banks activities. Credit risk is measured with non-performing loans ratio and with loan loss provision ratio.

Authors Isik and Bolat (2016) in their paper “Determinants of non-performing loans of deposit banks in Turkey” researched an empirical sample of 20 Turkish deposit banks for the period from 2006 to 2012. Using the dynamic panel model, authors concluded that higher capital and loan loss provision significantly increase non-performing loans ratio.

3. Selection of Variables

While analysing literature and statistical data regarding European banks performance published by European banking authority (EBA) and European Central Bank (ECB) the authors decided to research the impact of assets quality on banks’ capital adequacy. Information published by European Central Bank (ECB) show that distribution of non-performing loans ratio is unequal among European countries. By the year end 2016, and in the first quarter of 2017 portion of non-performing loans is decreasing but once again in unequal pace among countries. Non-performing loans coverage with specific provisions on aggregated level increase at the end of 2016 and in the first quarter of 2017, while by third quarter of 2017 it slightly decreased. These indicators significantly differ among countries, where some countries show continues increase of this indicator, while others show continuous decrease.

Total capital and total tier 1 capital increased on aggregated level in all observed periods with somewhat more intensive increase in third quarter 2017, while among countries these indicators differ both in level and in trend direction.

Because of the observed differences among countries, the authors wanted to research the influence of assets quality on bank’s capital.

Non-performing loans ratio (NPL ratio) and non-performing loans coverage ratio (NPL coverage ratio) are used as indicators of assets quality and they are therefore used as independent variables in statistical models. Banks classify loan as non-performing when principal or interests are 90 days past due.

Independent variable “NPL ratio” shows the percentage of non-performing loans in total loans and is calculated as ratio between non-performing loans and total loans.

Independent variable “NPL coverage ratio” shows percentage of provisions on non-performing loans and is calculated as a ratio between non-performing loans provisions and total non-performing loans.

Dependent variables in this research are Total capital ratio “TC ratio” and Tier 1 capital ratio “T1 ratio”. Data for both dependent variables are taken directly from statistical data published by European central bank (ECB).

Total capital ratio is calculated as ratio between total capital and risk weighted assets, while Tier 1 ratio is calculated as a ratio between Tier 1 capital and risk weighted assets.

Since reclassification of loan in NPL (when it is 90 days past due) increases risk weight to 150%, the authors expect that increase of NPL ratio will have negative impact on capital ratio through increased risk weighted assets.

The authors expect that increase of NPL coverage ratio will have negative impact on capital ratios directly through financial result (profit/loss), despite the fact that increase of provisions can partially bring positive effect on capital ratios trough decrease of risk weight.

4. Methodology and Results of Empirical Research

Empirical research includes analysis of panel data. Characteristic of panel data analysis is that it allows analysis over time and over geographical variable.

The considered sample comprises of 19 European countries and the statistical analysis included data over 4 time periods, starting from last quarter 2016 until third quarter 2017.

For the purpose of this paper authors used statistical data of European banks published by European central bank (ECB). Data published by ECB are generated from COREP and FINREP reports, and for observed sample and time period it included data for 114 significant banks aggregated on the country level. For each bank in the sample, reporting is always considered at the highest level of consolidation. Possible limitation of data quality is that banks may submit unaudited end-of-financial-year figures and that banks may resubmit data for previous quarter after the cut-off date so figures may differ.

Statistical model with random effect is used to test influence of independent variables “NPL ratio” and “NPL coverage ratio” on dependent variables “TC ratio” and “T1 ratio”. The advantage of random effect model is valuation of variables’ influence independent from time.

Data analysis was done with statistical software STATA 12.

Table 1 Descriptive statistics

Variable		Mean	Std. Dev.	Min	Max	Observations
tc_r	overall	.1856768	.0301101	.1206436	.2440475	N = 68
	between		.0300559	.1313225	.2334671	n = 17
	within		.0066112	.1723232	.208297	T = 4
npl_r	overall	.1059651	.12744	.0139874	.4705427	N = 68
	between		.1299773	.0149129	.4660935	n = 17
	within		.0101633	.0801692	.1444603	T = 4
npl_cr	overall	.4039523	.0970792	.2465316	.6422824	N = 68
	between		.0982233	.2549536	.6341599	n = 17
	within		.0144408	.3619563	.4474504	T = 4

Variable		Mean	Std. Dev.	Min	Max	Observations
t1_r	overall	.1668773	.0311296	.1140009	.2309873	N = 68
	between		.031061	.1241285	.2158834	n = 17
	within		.0068892	.1529322	.1895013	T = 4
npl_r	overall	.1059651	.12744	.0139874	.4705427	N = 68
	between		.1299773	.0149129	.4660935	n = 17
	within		.0101633	.0801692	.1444603	T = 4
npl_cr	overall	.4039523	.0970792	.2465316	.6422824	N = 68
	between		.0982233	.2549536	.6341599	n = 17
	within		.0144408	.3619563	.4474504	T = 4

Sources: authors

Average “TC ratio” (total capital ratio) in observed countries in observed time is 18,57% with average deviation of 3 p.p.. TC ratio is in range from 12,06% to 24,40%. Among observed countries there is a difference which is in average 3,01 p.p., and moves in range from 13,13% to 23,35%.

Average “T1 ratio” (tier 1 capital ratio) in observed countries in observed time is 16,69% with average deviation of 3,11 p.p.. T1 ratio is in range from 11,40% to 23,10%. Among observed countries there is a difference which is in average 3,1 p.p., and moves in range from 12,41% to 21,59%.

Observation excluded two countries because their information is suppressed for confidentiality reasons.

Use of random effect model is tested with Hausman test.

Table 2 Hausman test

	— Coefficients —		(b-B) Difference	sqrt(diag(v_b-v_B)) S.E.
	(b) ef	(B) er		
npl_r	-.0601198	-.0715631	.0114433	.0807757
npl_cr	-.0465548	-.0853193	.0387645	.0448873

b = consistent under Ho and Ha; obtained from xtreg
 B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(2) = (b-B)'[(v_b-v_B)^(-1)](b-B)
 = 0.75
 Prob>chi2 = 0.6878

Source:authors

Empirical value p of 68,78% points to conclusion that the random effect model is appropriate.

Table 3 Correlation matrix

	tc_r	npl_r	npl_cr
tc_r	1.0000		
npl_r	-0.4096*	1.0000	
npl_cr	-0.5069*	0.3529*	1.0000

	t1_r	npl_r	npl_cr
t1_r	1.0000		
npl_r	-0.1788	1.0000	
npl_cr	-0.4529*	0.3529*	1.0000

Source:authors

Correlation matrix presented in table 3 shows that there is statistically significant and negative relation between movement of TC ratio and movements of NPL ratio and NPL coverage ratio. Also, there is statistically significant and negative relation between movement of T1 ratio and movements of NPL ratio and NPL coverage ratio. Correlation between NPL ratio and NPL coverage ratio is statistically significant, positive and weak which diminishes a possibility of multicollinearity in the model. The random effect model is used.

Table 4 Statistical panel model – influence on total capital ratio “TC ratio”

Random-effects GLS regression		Number of obs	=	68
Group variable: zemljaid		Number of groups	=	17
R-sq: within	= 0.0168	Obs per group: min	=	4
between	= 0.3223	avg	=	4.0
overall	= 0.3069	max	=	4
corr(u_i, x)	= 0 (assumed)	wald chi2(2)	=	7.29
		Prob > chi2	=	0.0261

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
tc_r					
npl_r	-.0715631	.0446715	-1.60	0.109	-.1591176 .0159914
npl_cr	-.0853193	.0469621	-1.82	0.069	-.1773633 .0067247
_cons	.2277249	.0196627	11.58	0.000	.1891868 .266263
sigma_u	.02592844				
sigma_e	.00766216				
rho	.91968628	(fraction of variance due to u_i)			

Source:authors

This model shows that there is statistically significant influence of “NPL coverage ratio” on total capital ratio (“TC ratio”). As shown in the table above “NPL coverage ratio” coefficient is -0,0853 which means that increase of this variable for 1% affects decrease of total capital ratio for 8,53%.

The influence of “NPL ratio” on total capital ratio is not statistically significant since empirical value p exceeds significance level of 10% as can be seen from the previous table.

Table 5 Statistical panel model – influence on Tier1 capital ratio (“T1ratio”)

Random-effects GLS regression		Number of obs = 68			
Group variable: zemlajaid		Number of groups = 17			
R-sq: within = 0.0234		Obs per group: min = 4			
between = 0.1996		avg = 4.0			
overall = 0.1905		max = 4			
corr(u_i, X) = 0 (assumed)		wald chi2(2) = 4.60			
		Prob > chi2 = 0.1005			
t1_r	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
np1_r	-.0295109	.0489822	-0.60	0.547	-.1255143 .0664925
np1_cr	-.0963534	.0503437	-1.91	0.056	-.1950251 .0023184
_cons	.2089266	.0212612	9.83	0.000	.1672553 .2505978
sigma_u	.02912302				
sigma_e	.00794667				
rho	.93070393	(fraction of variance due to u_i)			

Source: authors

This model shows that there is statistically significant influence of “NPL coverage ratio” on tier1 capital ratio (“T1 ratio”). As shown in the table above “NPL coverage ratio” coefficient is -0,0963 which means that increase of this variable for 1% affects decrease of tier1 capital ratio for 9,63%.

Influence of “NPL ratio” on tier1 capital ratio is not statistically significant since empirical value p exceeds significance level of 10% as can be seen from previous table.

5. Conclusion

Banks capital ensures financial stability with its ability to absorb potential losses and banks use their capital to mitigate their exposure to risk. Due to the importance of capital in banks European regulations define minimum capital levels which banks must ensure at all times with a clear aim of preserving financial stability of banks and financial system in whole.

Given the fact that the majority of banks’ assets refers to loans, their quality reflects quality of total banks assets and its exposure to risk. Therefore, it is obvious that assets quality is in direct relation with capital levels, so the authors researched what is the influence of non-performing loans and their provision on capital ratios.

Empirical research comprised of aggregated data for 19 European countries, with analysis of data over 4 time periods. Statistical models were set on the expectation that increase of a percentage on non-performing loans will have negative impact on capital ratios through increase of risk weighted assets. Also, statistical models were set on the expectation that increase of non-performing loans coverage will have negative impact on capital ratios directly through financial result (profit/loss). This negative impact is expected to be stronger than the possible positive effect increased provision may bring on capital ratios through decrease of risk weight.

Statistical analysis concluded that non-performing loans coverage has statistically significant negative impact on both total capital ratio and tier 1 capital ratio. Increase of NPL coverage for 1% affects decrease of tier 1 capital ratio for 9,63% and decrease of total capital ratio for 8,53%. Relation is, as expected negative, and there is stronger influence on tier1 capital ratio than on total capital ratio which is probably the reflection of different structure of each capital level, but this will be the subject of research in future papers.

Statistical analysis also concluded that there is negative relation between non-performing loans ratio and capital ratios, as expected, however the influence is not statistically significant.

REFERENCES

Beck, T., Demirgüç-Kunt, A., & Merrouche, Q. (2013), Islamic vs. conventional banking: business model, efficiency and stability. *Journal of Banking & Finance*, 37, 433 – 447. Retrieved March 10, 2018, from <http://dx.doi.org/10.1016/j.jbankfin.2012.09.016>

Cucinelli, D. (2015), The impact of non-performing loans on bank lending behaviour: evidence from the Italian sector. *Eurasian Journal of Business and Economics* 2015, 8(16), 59 – 71. Retrieved March 15, 2018, from www.ejbe.org/EJBE2015Vol08No16p059CUCINELLI.pdf

Credit institutions act, *Official gazette No. 159/13,19/15, 102/15, 15/18*

Croatian National Bank Decision implementing the part of Regulation (EU) No 575/2013 pertaining to the valuation of assets and off-balance sheet items and the calculation of own funds and capital requirements, *Official gazette No.160/2013*

Croatian National Bank Decision on amendments to the Decision implementing the part of Regulation (EU) No 575/2013 pertaining to the valuation of assets and off-balance sheet items and the calculation of own funds and capital requirements, *Official gazette No. 140/2015*

Croatian National Bank Decision on amendments to the Decision implementing the part of Regulation (EU) No 575/2013 pertaining to the valuation of assets and off-balance sheet items and the calculation of own funds and capital requirements, *Official gazette No. 113/2016*

Croatian National Bank Decision on capital buffers and capital conservation measures, *Official gazette No.08/2014*

Croatian National Bank Decision on the amendments to the Decision on capital buffers and capital conservation measures, *Official gazette No.24/2018*

Isik, O.; Bolat, S., (2016), Determinants of non-performing loans of deposit banks in Turkey, *Journal of Business, Economics and Finance-JBEF*, Vol.5(4). Retrieved March 15,2018, from <https://www.researchgate.net/publication/312145119>

Michael, JN., Vasanthi, G., & Selvaraju, R. (2006). Effect of non-performing assets on operational efficiency of central-cooperative banks. *Indian Economic Panorama*, Vol.16 (3), pp 33-34&39. Retrieved March 15,2018, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1735329

Popek Biškupec, P., Lešić, Z. (2013): Impact of bad loans on the capital adequacy of banks in Croatia. *DIEM: Dubrovnik International Economic Meeting*, Vol.1. No.1. Retrieved March 15,2018, from <https://hrcak.srce.hr/161440>

Regulation (EU) No. 575/2013 of the European parliament on prudential requirements for credit institutions and investment firms and amending regulation (EU) no 648/2012, 2013. *Official Journal of the European Union*. Retrieved September 5, 2017, from <http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32013R0575&from=HR>

Ugoani, J (2016), Nonperforming loans portfolio and its effect on bank profitability in Nigeria. *Independent journal of management & production (IJM&P)*, Vol.7, No. 2. Retrieved March 15,2018 from <https://ssrn.com/abstract=2787950>

The Research and Innovation Strategy for Smart Specialisation - a New Strategic Approach for an Innovation-Based Economic Development of the Republic of Moldova

Sergiu Porcescu

Knowledge Hub Moldova, Chisinau, Republic of Moldova
sergiu_porcescu@knowledgehub.md

Larisa Savga

Trade Co-operative University of Moldova, Chisinau, Republic of Moldova
savga.larisa@gmail.com

Alexandru Stratan

National Institute for Economic Research, Chisinau, Republic of Moldova
alex_stratan@yahoo.com

Abstract. The elaboration and implementation of the National/Regional Innovation Strategy for Smart Specialisation (RIS 3) has become an important component of the cohesion policy for 2014-2020 programming period and an ex-ante condition for the EU countries in accessing structural funds.

In its aspirations for the European integration (the Republic of Moldova signed the RM-EU Association Agreement in 2014) and opting for the penetration into the single community market, the Republic of Moldova faces challenges generated by the necessity to ensure the country's economic competitiveness and sustainable growth. This ambitious goal can be achieved through a broad process of innovation, reconsidering the R&D system, changing the paradigm of economic development. An effective solution to this is RIS3.

The opportunity to develop RIS3 for the Republic of Moldova has been mentioned in several national and European documents. This process was initiated recently in Moldova (2016) with support of the Joint Research Centre of the EC, being at the initial stage of its development.

The paper highlights the importance of the Smart Specialisation Strategy (S3) and the impact this process can have on the economic restructuring and growth, emphasizes the peculiarities and advantages of S3, analyzes the economic and research potential of the Republic of Moldova, characterizes the current situation of the S3 process in the country, the challenges it faces and the actions to be followed in order to develop the Smart Specialisation Strategy in Moldova.

Key words: *smart specialisation strategy, innovation, research*

1. Introduction: Smart Specialisation – a New Concept for a Place Based Innovation Strategy

Research, Development and Innovation (RDI) are of particular importance in achieving the transformation of the one's national economy into a smart, sustainable and inclusive economy. These activities can significantly contribute to the improvement of national, international competitiveness and economic growth. A key element in achieving this goal is the Smart Specialisation Strategies (S3).

These strategies are successfully implemented for several years already in the EU member states (moreover, countries from the EU neighborhood or even Latin America are currently considering S3 as a strategic framework for regional innovation ecosystems). The

impact of their implementation is significant, contributing to an efficient access and use of European structural and investment funds, enhancing the synergy between different (national and regional) policies and boosting public and private sector investments.

The concept of smart specialisation (S3) has been embedded and has become a key element of the European Union's cohesion policy, being considered an effective tool in delivering a European strategy for smart, sustainable and inclusive growth.

For the Republic of Moldova the elaboration and implementation of the Smart specialisation strategy are particularly important, due to the fact that the concept of *smart specialisation* supports the reorientation of RDI policies towards those research activities that provide results with economic relevance, which, for a country with still a low level of investments (both public and private) in these areas is quite relevant.

The implementation of the smart specialisation concept and strategy at the national and/or regional level in the Republic of Moldova would facilitate the process of economic transformation based on the valorization of the existing innovative potential of the country and of each region, stimulating the trans-regional cooperation on this dimension. An enormous effort is needed from all the stakeholders around Quadruple Helix (business, academia and HEIs, authorities, civil society) to raise awareness of the S3 importance and to make Smart specialisation strategy a part of innovative economic development policies in the Republic of Moldova.

2. Smart Specialisation – From the Policy Concept to Implementation

As defined in the Regulation no.1303/2013, Article 2, paragraph 3 (Regulation, 2013), smart specialisation represents the national or regional innovation strategies that set priorities in order to ensure competitive advantage by developing and matching the strengths of Research and Innovation with business needs for addressing emerging opportunities and market developments in a coherent manner, avoiding duplication and fragmentation of efforts; a smart specialisation strategy may take the form or be included in the national or regional Research and Innovation policy framework. The Organization for Economic Co-operation and Development (OECD) uses the same notion to describe an industrial and innovation framework for regional economies that aims to illustrate how public policies, framework conditions, but especially R-D-I investment policies, can influence the economic, scientific and technological specialisation of a region and, consequently, productivity, competitiveness and economic growth (OSCE, 2013).

The concept was originally developed by the „Knowledge For Growth” high level Expert Group (Foray, Paul, & Hall, 2009), convened in 2005 at the initiative of European Commissioner for Research, Janez Potočnik, to get advised on: the contribution that knowledge can have on sustainable growth and prosperity, policies for promoting the creation, dissemination and use of knowledge, and the role that various actors can play in stimulating a knowledge society. Instead of top-down approaches to policy making, the members of the Expert group suggest an "entrepreneurial discovery" process that can reveal where a country or region is achieving the best results in terms of science and technology. In this learning process, entrepreneurs are most likely to have the main roles in discovering promising areas of specialisation. Later on, one of the authors of the concept, Dominique Foray, explained the difference between *Smart Specialisation and Smart Specialisation Strategy (RIS3)* - the first notion expresses a diversification process through the local concentration of resources and competencies on a number of new areas that represent the possible ways of transforming productive structures, while the second concept means the implementation of a political process designed to facilitate this dynamic when it is not taking place spontaneously. An essential condition for the smart specialisation process is the

existence of a long-term vision among decision-makers, as well as the various actors involved, including business and academia.

In the context of these considerations, but also based "on-the-ground" evidence from the European member states/regions that have demonstrated sustainable economic growth following investments in research and innovation activities (mainly innovation leaders according to the Innovation Union Scoreboard), the concept was incorporated into the European Cohesion Policy (2014-2020 budget cycle) in order to stimulate regional economic transformation.

As a result, in 2010 the European Commission adopted the Communication to the European Parliament and Council "*Regional Policy contributing to smart growth in Europe 2020*", calling on Member States to develop Smart Specialisation Strategies. Being included as an ex-ante conditionality under the 2014-2020 Cohesion Policy, RIS3 became the foundation for investment in research and innovation through the European Regional Development Fund. More recently, the importance of further development of the concept is mentioned in the Commission Communication to the European Parliament and Council "*Strengthening Innovation in Europe's Regions: Strategies for resilient, inclusive and sustainable growth*" from 18.07.2017, where the S3 role is emphasized and the next reforms in the field are pointed out.

Resuming various definitions and contexts in which the term is used, it could be said that the S3 concept focuses on:

- identifying the unique features and strengths of each country/region,
- identifying the competitive advantages of each country/region,
- identifying cognitive specialisations, most appropriate for their innovation potential,
- involving enterprises, research centers and universities, which collaborate to identify the most promising areas of specialisation,
- co-opting stakeholders and resources around a vision centered on excellence in the developing the respective field.

The European Commission's Joint Research Center has developed, in 2012, the Guidelines for Research and Innovation Strategies for Smart Specialisation (Guide to Research, 2012), which contains the steps and methodology for developing these strategic planning documents. According to the guidelines, the main steps for RIS 3 design are the following:

- analysis of the regional context and potential for innovation;
- ensuring participation and ownership;
- elaboration of an overall vision for the future of the region;
- identification of priorities;
- definition of coherent policy mix, roadmaps and action plan;
- integration of monitoring and evaluation mechanisms.

However, beyond the horizontal programs needed to improve framework conditions and general capabilities, the central purpose of smart specialisation is the *prioritization process*. The resources are to be concentrated in specially selected areas related to certain types of technology, disciplines, subsystems within a sector or intersections of different sectors (Foray & Goenega, 2013).

Smart Specialisation implies an improvement in the allocation of public funds to research, development and innovation activities in order to increase competitiveness, productivity and growth mainly through entrepreneurial activities. These strategies can be seen at the national or regional levels as a combination of innovation and industrial policy elements based on a bottom-up approach (entrepreneurial discovery process), flexibility in

implementation and transparency. RIS3 aims to foster experimentation in existing and new business areas and niches and to adapt the policy mix according to the results of these experiments (flexibility). At the same time, the continuous process of smart specialisation involves making difficult choices, as for example the decisions to stop the funding for some projects and activities or to allocate resources to stimulate emerging technologies.

3. Main Challenges in Implementing Regional/National Innovation Strategies for Smart Specialisation

In the context of assessing the success of the European Cohesion Policy, several studies, both qualitative and quantitative, have been carried out in order to identify differences in the smart specialisation approach for regions/countries with advanced economies and those less developed. Such a study, based on the analysis of 6 documents (RIS3 strategies) prepared by the less developed regions (GDP per capita below 75% of the EU average) and 6 strategic documents submitted for peer review by more developed regions (GDP per capita higher than 90% of the EU average) found out that for the less developed regions, the major challenge was to achieve, through RIS3, a better link between business and R&D institutions, as well as with universities.

Another issue faced by less developed regions in the RIS3 implementation phase is the funding of strategy's activities, both from public and private resources, an issue that derives from a more general problem - R&D funding in general. Other key challenges mentioned are the lack of skills in technology management and international marketing and the governance of the strategy that lacks formal institutional mechanisms to ensure its application. Analyzing the impact of Smart specialisation on economies in the Central and Eastern Europe (Kroll, 2017) concludes that the broad analysis of the current situation regarding entrepreneurial discovery processes supports the intuitive assumptions gained from anecdotal evidence (due to the recent launch of RIS3 strategies) mentioned by the literature. While political efforts seem to support the processes of entrepreneurial discovery already taking place in a number of countries in Central Europe, the RIS3 policy agenda has not yet been translated into entrepreneurial practice in many peripheral regions, particularly in Eastern Europe (Kroll, 2017).

At the same time, the issues/challenges arising from the RIS3 strategies of more developed regions are related to SMEs and the need to diversify their own economy (Rotaru, 2015).

As suggested by D. Foray, for developing economies co-invention could be also a solution. For the countries like Republic of Moldova, adopting ICT technologies (or any other generic technology) in order to improve operational efficiency or product quality in a particular industry or service sector represent a good starting point, due to the fact that co-creation of ICT applications also involves research and development, design and redesign - meaning a series of knowledge-based activities. Within Smart specialisation therefore there is no clear division of labor between knowledge producers and its users. Typically, regions facing economic problems have a relatively greater need to develop innovation processes while facing a lower capacity to absorb and use development funds. Training of human capital and infrastructure investment are still critical to promoting development in these regions.

But in order to get rid of this "middle income trap" and to provide innovative programs and platforms, these regions also need to develop more robust innovation systems, involving collaboration, stakeholder involvement, upgrading the research infrastructure, supportive environments for start-ups and SMEs, well connected educational systems. However, the main impediment in the development of such platforms and systems remains the weak institutional and governance capacity¹ (Muscio, Reid & Rivera Leon, 2015).

4. Moldova's Research and Innovation Potential in the International Context

In the last decade the innovation activity in the Republic of Moldova has shown some dynamic. According to the report of the National Patent Office (AGEPI Raport anual, 2016), 311 patent applications were applied in 2016 (7.2% more than in 2012) and 192 titles of protection were issued (4.3% more than in 2012). Most of the applications - 58%, were submitted by the organizations from the field of science and innovation, and only 2% were applied by the business sector.

As it was said already, although there was an increase in this area, according to the innovation potential criteria, Republic of Moldova scores are lagging behind many other states. According to World Bank data (The World Bank [WB]. Patent applications, residents, n.d.), in 2015 Moldova registered 64 patent applications per one million population, while in other countries this index was many times higher (Romania - 975, Finland - 1289), the average indicator at the level of the European Union being 99418 applications.

Analyzing the positioning within international rankings, it should be mentioned that according to the World Intellectual Property Organization, within the *Global Innovation Index* (GII, 2017), Moldova was on the 44th position out of the 141 monitored countries in 2015 (in 2012 it ranked 50th among the 140 countries in the ranking, this year being the index of innovation efficiency over one unit). The Republic of Moldova managed to be the first in the category of countries with gross national income below the average in terms of the number of inhabitants.

At the same time, based on other studies, the Global Competitiveness Report (GCR, 2016) shows that the Republic of Moldova, according to the *Global Competitiveness Index*, was on the position 100 out of 138 countries in the world ranking for 2016 (decreasing by 16 positions compared to 2015), Moldova being attributed to *the category of economies based on the exploitation of the production factors, being at the first (out three) stage towards an innovation-based economy*. In the ranking of countries according to their innovation capacity, Moldova ranked 124th position (with a score of only 2.5 out of 7).

Undoubtedly, innovation capacity depends on the performance and resources of the R&D field and on the ability of the business sector to absorb innovations.

Looking to the resource input to the Republic of Moldova's R&D system, first of all in terms of *human resources*, shows a regretfully decreasing trend. Thus, in 2016 in the research and development activity were involved 4734 persons (out of which 3210 researchers - or 67.8%) compared to 5114 in 2010 (researchers - 63.4%) and 5315 persons in 2008 (National Bureau of Statistics, n.d.).

During the last two decades, in parallel with pronounced trend of internal researchers migration (to other fields of activity), as well as external one, the trend of human potential "aging" is noticed. In 2016, the share of researchers aged over 65 was 20.6%, while in 2010 it was 16.6%. Young researchers between the ages of 25-34 and up to 25 were 24.2% (2016) and 26.0% (2010) respectively. It is estimated that this trend will increase in the future due to the emigration of talented young people abroad, diminished attractiveness of the researcher's career and financial constraints.

The analysis of the *distribution based on scientific disciplines* reveals that most of researchers are concentrated in natural sciences - 35.6% of all researchers in 2016, followed by engineering and technology with a proportion of 14.5%. At the same time, there is a tendency for diminishing the share of researchers in the field of engineering and agricultural sciences, which obviously has a negative impact on the development and deployment of innovative high tech solutions for the economy.

R&D investments are another important factor for a research-based economic development that needs to be sustained by joint efforts of the public and private sectors. Expenditures on R&D have been unevenly developed since the 1990s, being constantly in times of crisis. Thus, in 1990, the percentage of GDP allocated to this area was about 0.73%; in 2004 it was around 0.22%, increasing in 2008 up to 0.7% of GDP. In the following years, this index had a decreasing trend, accounting around 0.37% in 2014 and 0.27% in 2016, although according to national policy documents the target was to reach 1% of GDP allocations from the state budget for the research and development sphere in 2020.

For the promotion of R&D activities by the units working in this area, 445.3 million lei were spent in 2016 (in 2010 - 291.8 million lei), 88% of them being used by the public institutions (in 2015 - 85%, and in 2010 - 91.5%). Thus most of the R&D activities are carried out in the public sector. The involvement of the private (business) sector in research and innovation is very low.

Compared to other countries, R&D spending in our country is many times lower (both in terms of GDP percentage and in absolute values). Thus, while in the Republic of Moldova expenditures for R&D were around 0.37% of GDP in 2014, in other countries this index varied around 1% (Poland - 0.94%, Lithuania - 1.01 %) or 2% (Slovenia - 2.39%), while in others it was below or even above 3% (Germany - 2.87%, Austria - 2.99%, Denmark - 3.08%, Finland - 3,17%). The average figure for the EU Member States was 2.04% of GDP (WB. Research and development expenditure (n.d.)).

In these underfunding conditions and reduced investment in the R&D area from public sources, the private sector is, in fact, out of the scope, although the research results are mostly addressed to the real sector of the economy. According to the Global Competitiveness Report 2016-2017 (CCR, 2016), following the R&D expenditures index, Moldova ranks 135 (out of 138 countries included in the ranking), registering a score of only 2.2 points (from 7 points). Although some policy documents are mentioning certain conditions and tools for facilitating the creation and deployment of innovative businesses (introduction of innovation vouchers, state programs to support start-ups, investment schemes for innovation, such as risk capital and "business angels", etc.), yet the existing system does not encourage the attraction of R&D investment from the business sector, and these instruments are not yet widely implemented.

The development of R&D has a direct impact on economic growth. If we report investments in R&D, innovations to economic development then this relationship is obvious. In the Republic of Moldova GDP per capita in 2016 amounted 1900 USD, this index being almost five times lower than in Romania (9474 USD per capita), 6.5 times lower than in Poland, 9.2 times lower than in Estonia and 23.3 times lower than in Finland. The average in EU countries was at the value of \$ 32058.8 per capita in 2016 (WB. GDP per capita, n.d.).

It is clear from the above that, on the one hand, the national economy has the potential to produce innovative results and, on the other hand, that R&D products have a low degree of applicability in the real economy of the country and lack the impact on the economic growth.

The modest financing of the R&D sector, the mostly public funding of this field, the very limited involvement of the private sector, in particular of entrepreneurs in the R&D activities and subsequently into innovation, the maintenance of the traditional financing scheme, without taking into account the regional specificities (internally and externally), results in the fact that the emerging priorities and areas that can bring added value on the basis of innovativeness, become marginalization factors of economic development.

The causes of such a situation are multiple. One of these are the deficiencies of the R&D development policies, economic development policies at national and sectoral level, as well as the interactions between them and their interaction with the mechanisms and factors of economic growth based on innovation.

Another key issue is the efficiency of the R&D activity, *the implementation of research results in the real sector of economy*. The rate of innovations application within the Moldovan economy is reduced, largely due to the low level of collaboration between the research and the business environment. According to the Global Competitiveness Report 2016-2017 (GCR, 2016), as to the index of collaboration between universities and industry in the field of research and development, the Republic of Moldova held a lower ranking position - 133 out of 138 evaluated countries. The national innovation policy, as mentioned by some authors, is centralized and focused on supporting the application of internally developed innovation, but not on the needs of domestic enterprises. At the same time, technological transfer and improvement of technological absorption capacities by national enterprises are less taken into account by national policies.

At the same time, there is an insufficient connection between the fields of education and research, as well as imbalances between the training of specialists in the higher education institutions and the needs of the real economy. Under such conditions, it is very difficult to provide businesses with staff that have an adequate level of knowledge and skills capable of promoting and implementing innovations and, above all, of generating innovations, especially in high-tech sectors. This is one of the main reasons for the low innovation capacity of domestic companies, which ultimately has a bad impact on the competitiveness of the national economy. According to the index of absorption of technologies by companies, Moldova is on 112 position in the ranking of 2016-2017 years (GCR, 2016).

In view of the above, researchers (Cuciureanu, 2014), as well stakeholders from the business sector, conclude that research is not yet embedded in an efficient innovation system, and rather exists separately from economy and education. For these reasons, innovation and the link between R&D and the entrepreneurial sector is considered a critical element for the Republic of Moldova.

In such a context, it is imperative to reconsider the research-development-innovation system, to identify the opportunities for economic transformation based on innovation and to change the paradigm of economic development. An effective solution in this respect is the implementation of the Smart Specialisation concept (S3).

5. Pilot Project to Implement Smart Specialisation Principles Within Moldovan Context

Although the existence of a Smart Specialisation Strategy is not a conditionality for non-EU countries, as in the case of Member States, the Joint Research Center of the EC, via the S3 Platform, has launched a pilot project to assist Serbia, the Republic of Moldova and Ukraine in preparation for RIS3 (S3 beyond EU, 2017).

In the case of our country, at the level of the macroregions we are part of, smart specialisation is becoming more and more recognized as a priority. For example, the EU Strategy for the Danube Region mentions smart specialisation, specifically, as a milestone for achieving the objectives of Priority Area 7 (Knowledge Society). The Eastern Partnership countries (Armenia, Azerbaijan, Belarus, Georgia, Moldova, Ukraine) and the EU have set as an objective that at least one of the six participating countries should develop a RIS3 strategy by 2020 (Eastern Partnership, 2016). The opportunity to develop such a strategy for the Republic of Moldova was also mentioned in the report of the team of foreign experts assessing the Moldovan research and innovation system in 2015-2016, under the Horizon 2020 Policy Support Facility (Peer Review of the Moldovan Research and Innovation, 2016). One of the recommendations from the report advocates a better integration of research and innovation policy into the overall economic policy strategy; improving the synergies between

research and innovation strategies, and strengthening the prioritization by increasing stakeholder's involvement.

While under the impact of the Globalization consequences and the reconfiguration of value chains, most government's interventions focus on social policies such as unemployment or continuous training of workers, smart specialisation certainly provides an opportunity to promote a dynamic economic process that accelerates change, mitigating the negative effects of technological advancement and Globalization on some states, on employment and traditional industries, by building new ways of renovation and growth (OECD, 2013).

In the case of the Republic of Moldova, the existence of several strategic documents (the authors analyzed at least 4 of them) with unconvergent and narrowed at their own fields of action priorities, can lead to a diffusion of resources already limited, and, in the absence of a critical mass in important areas for the modern economy will result in a limited impact of interventions and public investment.

Of course, in the context of the decision to implement a process of smart specialisation, it should be mentioned that advanced economies have a tradition of developing strategies for territorial innovation and economic development, while countries in transition from centralized planning to market policy do not usually have such an experience. In this case, there is sometimes the practice of imitating the priorities and economic practices of advanced countries. Kleibrink et al. (2017) suggest in this case a trajectory for transition countries to avoid the widespread trapping of poorly defined innovation policies by modernizing and changing their industrial policies in line with ideas integrated into the concept of innovation strategies for smart specialisation RIS3:

(1) building a validated "competence center" to provide a comprehensive analysis of the respective economic structure and to coordinate the process of smart specialisation;

(2) begin with a strong economic area on the basis of which stakeholders will engage with government bodies to define common priorities and actions (domain experimentation);

(3) proceed with a region to experience different approaches at sub-national level (territorial experimentation);

(4) the process focuses initially (at the policy mix stage) on short-term measures (non-R&D measures), while major exploration programs remain for the long-term (Kleibrink, Larédo & Philipp, 2017).

Since 2016, a series of actions have been initiated and carried out in the Republic of Moldova in order to raise awareness about the concept and importance of smart specialisation, the impact of smart specialisation strategies on economic growth and resource efficiency, regional development. Thanks to the support of the EC Joint Research Center several seminars were organized (S3 Design Learning Workshop, 2016): a group of local experts was set up and involved in the evaluation activities of the status quo in the area of research-development-innovation and economic development policies; the mapping of the economic, innovation and research potential of the Republic of Moldova was done by foreign experts.

The first step in developing a smart specialisation strategy is the analysis of the national/regional context and the potential for innovation. In this respect, with the support of the JRC S3 Platform, involving international experts and with the support of the local S3 task force, in order to identify the strong points and the potential of the business, innovation and research areas, the mapping and identification of the regional potential of the Republic of Moldova was carried out. The results were presented at the national conference "Smart Specialisation - the Engine of Republic of Moldova's Economic Growth", organized within Moldova Business Week (October 6, 2017). Summarized priority economic areas of Moldovan regions (according to the current statistical indicators) are presented in Figure 1.

As can be seen from Figure 1, there are differences between the development region of Chisinau and the rest of regions. For the Chisinau development region the identified priority industries are ICT, paper and chemical products, equipment, furniture; clusters that could be developed are those in business, marketing, design and advertising services, and emerging industries target advanced packaging and creative industries. In other regions agriculture and the food processing industry are highly within the list of priority economic areas.

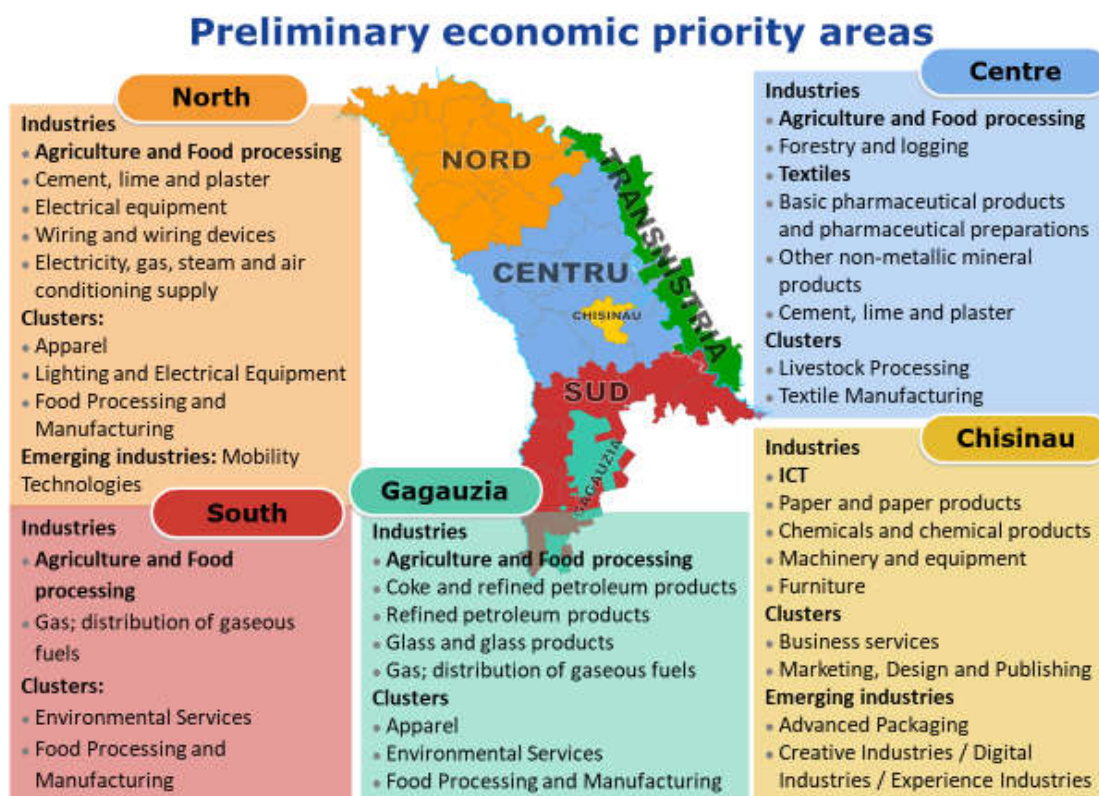


Figure 1 Mapping of the economic and innovation potential of the Republic of Moldova and priority areas of economic development (Joint Research Center, 2017)

The next step in the process of developing an intelligent development strategy is the *entrepreneurial discovery process* in which smart niches of specialisation specific to each region will be identified. It is an important exercise for our country in order to move from fragmented priorities and objectives to economic transformation priorities, based on the effective use of innovation potential and investments.

For the successful development and implementation of the smart specialisation strategy in the countries with no experience in this field, including in the Republic of Moldova, the experts consider necessary to meet some essential conditions:

- the existence of political will, commitment and consensus on the viability and necessity of a smart specialisation exercise,
- the allocation of sufficient institutional and governance capacities to ensure interaction mechanisms between relevant stakeholders from research, higher education, the business sector and public authorities (if coordination structures are missing, they need to be established or created on the basis of existing institutions and teams)
- developing analytical and implementing capacities of the R&D policies; including the RDI from the business sector, as well as improving research and innovation policy and implementation standards (The Role of Smart Specialisation, 2016).

All these preconditions still have to be discussed and agreed among the main stakeholders involved in the R&D administration. As there is a running reforms process of the R&D policies in Moldova, including changes within the institutional framework (a National R&D Agency will be created under the Government, the responsibility for the S&T state policy was transferred to the Ministry of education, culture and research, a new national research program is under preparation), this could be a proper moment for taking over the Smart Specialisation principles.

6. Conclusions

Smart specialisation represents an innovative approach that aims to boost economic growth by enabling each country/region to identify and develop its own competitive advantages. By involving in a bottom-up manner a wide variety of stakeholders - authorities, academia, business spheres and the civil society, smart specialisation process stimulates the creation of a shared vision about own strengths and potential growth opportunities, is building trust and collaborative networks among them.

Facing the resource scarcity, Republic of Moldova needs to prioritize the investments from the state budget, in the same time identifying the place of its economy within the international value chains. Having in place an Association Agreement with EU (with a Deep and Comprehensive Free Trade Agreement as a part of it), Moldovan Government should heavily invest in the competitiveness of the domestic economy. As the experience of other countries show – innovation is an important pillar in this regard.

Smart specialisation will contribute to the science-business dialog, and, hopefully, to the synchronization of the business needs with scientific offer, by concentrating the potential of both sectors in exploring the specialisation niches. In our case, the process is as important as the result – the traditions of elaborating strategic documents in a top-down manner, or by a small group of experts are still common in the Republic of Moldova, thus having a S3 strategy elaborated in a participative manner, with evidence-based priorities identified during an entrepreneurial discovery process would be already an achievement.

Nevertheless, there is a need for governmental involvement and ownership – final decision on prioritization, funding allocations and overall coordination – should be part of the general policy setting.

Concluding, it could be mentioned that smart specialisation should be perceived as a tool for structural transformation of Moldovan economy, using research and innovation in order to boost the traditional niches of economic specialisation, or identifying new niches with high added value.

REFERENCES

1. AGEPI Raport anual (2016). Retrieved March 10, 2018, from http://www.agepi.md/sites/default/files/bopi/ra_2016.pdf#page=11
2. Cuciureanu, Gh. (2014). Cercetarea din Republica Moldova: de la conștientizarea problemelor la abordarea lor adecvată? (2014). Revista de politica științei și scientometrie, 3(4), 290-297.
3. Danube-INCO.NET (2016). The Role of Smart Specialisation in the EU Enlargement and Neighbourhood Policies. Retrieved February 16, 2018, from https://danube-inco.net/object/document/18737/attach/0_D5_29_S3_role_in_the_EU_EN_policies-FINAL.pdf
4. Eastern Partnership – Focusing on key priorities and deliverables, Joint Staff Working Document (2016). Retrieved January 15, 2018, from https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/near-eeas_joint_swd_2016467_0.pdf

5. Foray D. & Goenega X. (2013). The goals of smart specialisation. S3 Policy Brief Series no.01. Retrieved March 12, 2018, from http://antonioviader.com/pdfs_preview/userupload/toni/JRC%20IPTS%20Goals%20of%20S3.pdf
6. Foray, D., Paul, A., & Hall, D. (2009, June). Smart specialization – the concept, Knowledge Economists Policy Brief No. 9.
7. Guide to Research and Innovation Strategy for Smart Specialisation (2012). Luxembourg: Publication Office of the European Union.
8. Joint Research Center (2017). Mapping of economic, innovative and scientific potential in the Republic of Moldova. Report prepared by Hugo Hollanders, Maastricht University. Presented at Moldova Business Week, on October 6, 2017. http://mbw.md/ro/schedule/main_07/ Moldova Business Week, 2017. http://mbw.md/ro/schedule/main_07/
9. Kleibrink, A., Larédo, P. & Philipp, S. (2017). Promoting innovation in transition countries: A trajectory for smart specialisation. EUR 28638 EN. Luxembourg: Publications Office of the European Union.
10. Kroll, H. (2017). The challenge of smart specialisation in less favored regions. Working Papers Firms and Regions. No. R1.
11. Muscio, A., Reid, A. & Rivera Leon, L. (2015). An empirical test of the regional innovation paradox: Can smart specialisation overcome the paradox in Central and Eastern Europe? *Journal of European Economic Policy Reform*, 18 (2).
12. National Bureau of Statistics (n.d.). Research and development activity in 2016. Retrieved January 23, 2018, from <http://www.statistica.md/newsview.php?l=ro&idc=168&id=5604>
13. OECD (2013). Innovation driven growth in regions: The role of smart specialisation. Paris: Organization for Economic Cooperation and Development. Retrieved February 11, 2018, from <http://www.oecd.org/innovation/inno/smart-specialisation.pdf>
14. Peer Review of the Moldovan Research and Innovation system (2016). Horizon 2020 Policy Support Facility. Retrieved January 29, 2018, from <https://rio.jrc.ec.europa.eu/en/library/horizon-2020-policy-support-facility-peer-review-moldovan-research-and-innovation-system>
15. Regional Policy contributing to smart growth in Europe 2020 (2010). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee. Retrieved March 11, 2018, from http://ec.europa.eu/regional_policy/sources/docoffic/official/communic/smart_growth/comm2010_553_en.pdf
16. Regulation No.1303 of the European Parliament and of the Council laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund and laying down general provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund and the European Maritime and Fisheries Fund and repealing Council Regulation (EC) No 1083/2006. (2013). Retrieved December 13, 2017, from <https://ec.europa.eu/digital-single-market/en/news/regulation-eu-no-13032013-european-parliament-and-council>
17. Rotaru, I. (2015). Smart Specialisation in the less advanced regions. What are the key challenges? Retrieved March 10, 2018, from http://cse.uaic.ro/eurint/proceedings/index_htm_files/EURINT2015_ROT.pdf
18. S3 beyond EU (2017). Retrieved January 16, 2018, from <http://s3platform.jrc.ec.europa.eu/s3-beyond-eu>
19. S3 Design Learning Workshop (2016). Retrieved March 12, 2018, from <http://s3platform.jrc.ec.europa.eu/-/s3-design-learning-workshop?inheritRedirect=true&redirect=%2Fhome%3FCFID%3D6e0aaa01-7d1f-4a7e-b9a3-497d00acd405%26CFTOKEN%3D0>

20. Smart Specialisation programmes and implementation (2013). Luxembourg: Publication Office of the European Union.
21. Strengthening Innovation in Europe's Regions: Strategies for resilient, inclusive and sustainable growth (2017). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee. Retrieved March 12, 2018, from http://ec.europa.eu/regional_policy/sources/docoffic/2014/com_2017_376_2_en.pdf
22. The Global Competitiveness Report 2016–2017 (2016). Geneva: World Economic Forum. Retrieved February 20, 2018, from http://www3.weforum.org/docs/GCR2016-2017/05FullReport/TheGlobalCompetitivenessReport2016-2017_FINAL.pdf
23. The Global Innovation Index (2017). Retrieved February 20, 2018, from <file:///C:/Users/utilizator4/Downloads/gii-full-report-2017.pdf>
24. The World Bank. GDP per capita (n.d.). Retrieved January 17, 2018, from <https://data.worldbank.org/indicator/NY.GDP.PCAP.CD>
25. The World Bank. Patent applications, residents (n.d.). Retrieved January 17, 2018, from <https://data.worldbank.org/indicator/IP.PAT.RESD>
26. The World Bank. Research and development expenditure (n.d.). Retrieved January 17, 2018, from <https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS>

Influence of Bancassurance on Non-life Insurance Sector Performance – Case of Selected European Countries

Tomislava Pavić Kramarić, PhD

University of Split, University Department of Professional Studies, Split, Croatia, tpavic@oss.unist.hr

Anđela Paštar Krnčević,

Croatia osiguranje d.d., Split, Croatia, apastar1979@gmail.com

Marko Miletić, PhD

University of Split, University Department of Professional Studies, Split, Croatia,
mamiletic@oss.unist.hr

Abstract: Bancassurance is becoming increasingly important distribution channel in the insurance markets. Therefore, the authors wanted to find out if and in what direction bancassurance affects non-life insurance industry performance measured with sales profitability. The analysis is conducted on the case of selected European countries, i.e. on the sample of Croatian, Slovenian, Spanish and Portuguese insurance industries using aggregate data for the period 2009-2015. The analysis is conducted using static panel analysis. Control variables used in the model comprise of market share, size based on gross written premium, insurance premium growth, losses growth and share of reinsurance. The results showed that bancassurance does not play an important role in determining non-life insurance sector profitability whereas size and non-life gross written premium growth have statistically significant and positive influence on performance. Moreover, reinsurance has an adverse effect on performance.

Key words: *bancassurance, non-life insurance industry performance, static panel analysis*

1. Introduction

The term bancassurance can be defined in a number of ways. It can relate to the cooperation between banks and insurers, to bank-affiliated insurance companies with banks having a strong influence on insurance companies by means of a minimum of 20% ownership stake (Spotorno, Moro and Anderloni, 2016) or it can simply denote selling arrangements between banks and insurers. However, according to Benoist (2003) bancassurance is more than merely a method of distributing insurance products but it is a worldwide movement that is steadily breaking down the traditional barriers between different businesses of providing financial products and services.

Distribution of insurance products through the branch network of banks both banks and insurers saw as a way of increasing their profits. Increased competition in the banking sector has forced banks to seek new activities that would help enhance their performance while insurers could take advantage of lower distribution costs, due to the availability of their banking partners' distribution networks (Spotorno, Moro and Anderloni, 2016). As stated in Application Paper on Regulation and Supervision supporting Inclusive Insurance Markets (IAIS, 2012, p. 10) sales and servicing in an insurance industry is challenging suggesting access to insurance markets using a diverse range of intermediaries including bancassurance. Furthermore, Falautano and Marsiglia (2003) emphasize that the different financial intermediaries are in the middle of an extensive change process that has affected both product policies and service and distribution

models adding that those changes are linked to developments in: regulations, technologies and in consumption and needs to be satisfied.

Motives for the use of bancassurance are that banks perceive it as a means of the diversification of services (Stankovic, Petrovic and Vojvodic-Miljkovic, 2016) and as a source of extra fee income since the distribution commissions paid by the insurer represent a source of profits for the banks (Benoist, 2002). On the other hand, insurers are looking to acquire ready-made distribution networks allowing them to reach a larger number of clients making distribution costs lower than through agent networks (Benoist, 2002). At the same time, clients receive better pricing and high-quality services (Fields, Fraser and Kolari, 2007).

Since the benefits of bancassurance for both banks and insurers as well as for the customers are often cited in the literature, the authors wanted to find specific empirical conclusion on the issue. Therefore, the authors will focus on bancassurance as a distribution channel of insurance companies with the aim of investigating the influence of bancassurance on insurance industry performance. The analysis focuses on four EU countries, i.e. Croatia and Slovenia, representing “new”, and Spain and Portugal representing “old” EU member states. Spain and Portugal, similar to Slovenia and Croatia, were chosen to represent “new” EU member states as two neighbouring countries with similar level of development of their insurance market measured with share of premium in GDP as well as with premium per capita. Specifically, according to Country data on insurance provided by Insurance Europe, in 2015 share of premium in GDP in Portugal and Spain amounted to 6.72 and 5.13 respectively, while the premium per capital amounted to 1163€ and 1187€ respectively. Furthermore, significant development of bancassurance at the beginning of 2000 started in these countries of southern Europe.

As shown in Figure 1 bancassurance as a distribution channel is gradually gaining importance in the insurance industries in the observed countries.

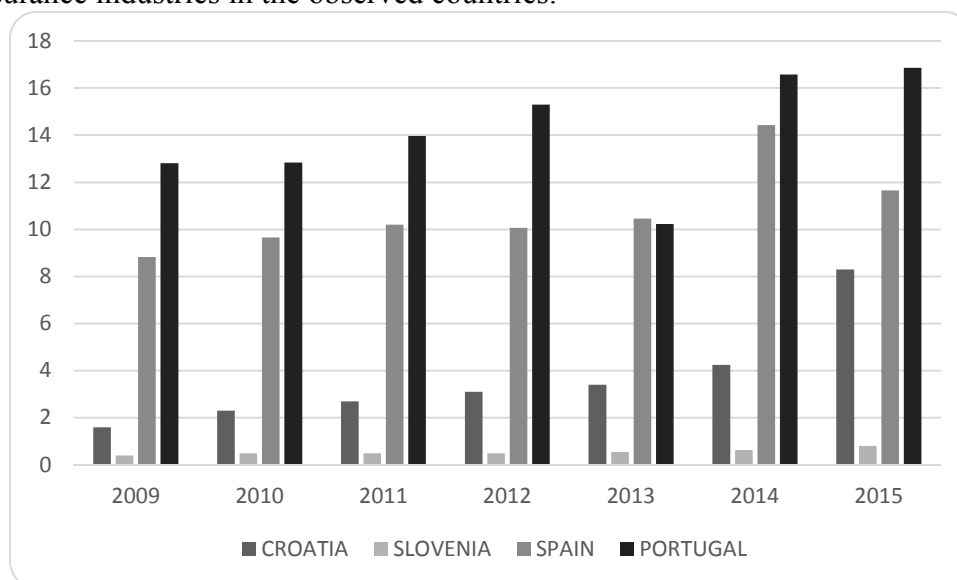


Figure 1 Share of bancassurance in the insurance markets of selected EU countries in 2009 – 2016 Period

Source: Insurance Europe, European insurance industry database, Non-life Insurance for 2009 – 2016 period, <https://www.insuranceeurope.eu/insurancedata> [1 March 2018]

Similarly to the dynamics of the share of bancassurance, the number of employees in insurance companies has been stable in the first part of the observed period. However, as the share of bancassurance started to increase the number of employees in insurance sectors started to decrease. This is specifically true for Portuguese insurance industry suggesting that new sales

channels such as bankassurance may result in a reduction of the number of employees in insurance.

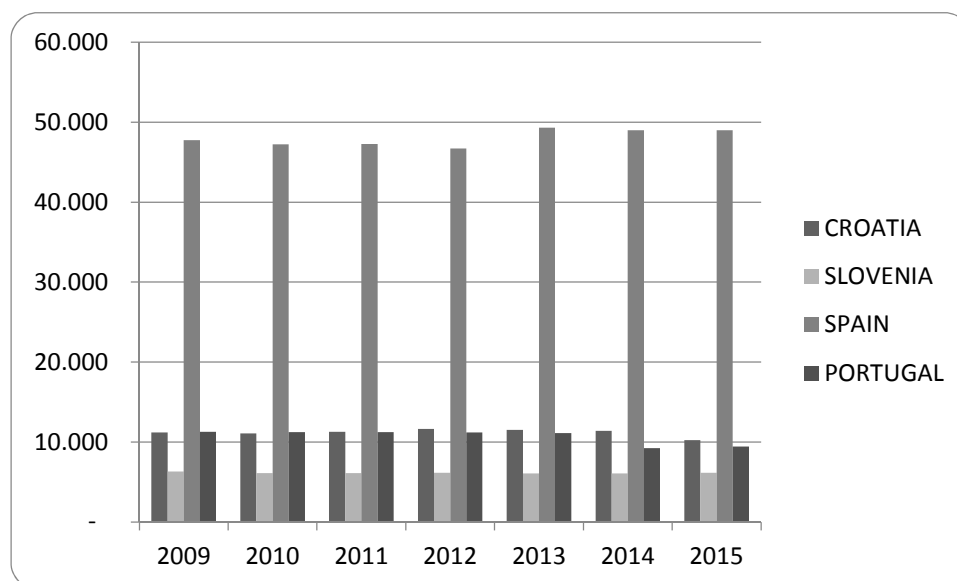


Figure 2 Number of Employees in the Insurance Industry of selected EU countries in 2009 – 2016 Period

Source: Insurance Europe, European insurance industry database, Non-life Insurance for 2009 – 2016 period, <https://www.insuranceeurope.eu/insurancedata> [6 March 2018]

The rest of the paper is structured as follows. After the introductory part of the paper, literature review presenting relevant papers in the field follows. The third section deals with sample of the analysis and describes variables being used in the model. Methodology and empirical findings are given in fourth section. The paper concludes with concluding remarks.

2. Literature Review

Bancassurance has been developing rapidly all over the world. Although there are many papers emphasizing the benefits of bancassurance in the banking sector, there is scarce body literature on the influence of bancassurance on insurers' performance.

In this section the authors deal with the previous research from the insurers' perspective of view.

Clipici and Bolovan (2012) as well as Kumar and Kumar Pandey (2013) in their paper discuss from the theoretical point of view about comparative advantages of the bancassurance for both banks and insurers as well as about evolution of bancassurance in Europe whereas the latter relate to Indian insurance distribution.

Spotorno, Moro and Anderloni (2016) analysed profitability of Italian life insurers regarding their bank affiliation. The authors also examined the impact of product mix and distribution costs in both bank affiliated and traditional insurers on their performance measured with return on equity and operating performance. Furthermore, the analysis compares the results of the period before and after the great financial crisis that started 2008. The research was conducted by observing 105 Italian traditional and bank affiliated insurers in the period from 2003 to 2013 considering a life insurer to be bank affiliated if one or more banks owned at least 20% of its common shares. Multivariate regression analysis conducted for the whole period observed despite of the dependent variable used showed that the bank affiliation variable coefficient had

positive and significant influence on performance. However, in the crisis period being bank affiliated did not entail any advantage while in the pre-crisis years it did not show significant effect on performance.

Stankovic, Petrovic and Vojvodic-Miljkovic (2016) analysed bancassurance perspective in the Republic of Serbia. Specifically, the authors analysed the advantages and disadvantages of this sales channel and compared it with the experiences of other countries where this model is already present on the market for a longer period of time. Moreover, the authors examined variations in both life and non-life insurance premiums charged through bancassurance and other distribution channels using correlation analysis. High correlation coefficient values indicate a strong linear correlation between all insurance premiums, regardless of the distribution channel and savings. However, this correlation did not reveal whether there was a causal relationship between the observed variables, therefore the causality test, i.e. the Granger cointegration test was used. The results showed no causal relationship of the observed variables. The authors also conducted a survey sending 2,500 questionnaires to insured persons. The respondents reported a lack of media advertising for sale through bank channels, and 78.2% of them considered that there must be solid and constant advertising for bancassurance that will shape the decision on the use of bank channels to buy insurance. The authors summarize that bancassurance in the Republic of Serbia is not used enough because the share of premiums is very low according to other sales channels concluding that synergic effects might become one of the premium growth generators.

Novovic-Buric, Kascelan and Vujosevic (2015) in their work tend to show the current direction of banks entering the insurance market in Montenegro as well as to point out the prospects and problems of development of bancassurance. In order to analyze the potential of bancassurance, a survey using questionnaires was conducted among employees of banks and insurance companies. More than 50% of respondents considers this type of cooperation positive to both bank and insurance company due to commission income and premium growth respectively. However, the key economic factor that slows down the growth of bancassurance in Montenegro is the low purchasing power of citizens, along with two no less important factors: trust in financial institutions and customers not being interested in. The survey revealed that banks mostly sell insurance primarily related to loan insurance. Furthermore, the bank's information system malpractice has been found out as well as inadequately educated bank officials and their objection that the additional service they provide was not adequately rewarded. The authors conclude that, in order to achieve revival of the bancassurance, it is essential to motivate and educate employees in the banking sector as well as to work together in planning sales and marketing of the products. In this way demand and prospects for such financial services will increase.

Fields, Frasser and Kolari (2007) tried to get the answer whether the bancassurance is sustainable model for financial companies since legislative restrictions have prevented the development of this model in the United States. The authors have investigated whether bancassurance increases the price of shares and whether the type of risk associated with a company changes. In order to prove that, they analysed 129 mergers between banking and insurance companies of U.S. and non-U.S. companies in the period 1997-2002. From this study, they concluded that the bancassurance had slightly positive effect on assets increase of bidders, regardless of whether it is a bank or an insurance company. In their analysis, the authors used the case study method and multivariate analysis. The survey gave answers to the questions and showed that the financial markets react positively to the announcement of mergers in

bancassurance. They also point out that bidders are more important to increase the cash flow than to reduce the business risk itself.

3. Data Sample and Description of Variables

Variables used in the analysis were selected based on relevant theory and literature taking into account the availability of data. Since the data on share of bancassurance were not publicly available for majority of insurance companies operating in the selected insurance markets, the analysis is conducted on the aggregate level.

Data for the analysis were calculated using the data from European (re)insurance federation called Insurance Europe while the data regarding share of reinsurance for Croatian non-life insurance market were obtained from regular publications of Croatian Financial Services Supervisory Agency.

As dependent variable, sales profitability ratio (SAP) has been used. It is calculated as after tax annual profits over gross written premium in a specific year multiplied by 100. This approach has been also applied by Akotey et al. (2013) and Kozak (2011).

Share of bancassurance (SOB) variable has been included in the model to test whether this distribution channel plays significant role in determining insurance sector profitability as well as to test its direction. As share of bancassurance is gaining more importance in distribution channels in Croatia, we expect bancassurance to positively influence performance. This is confirmed by Tunay (2014) whose results of the econometric analysis using dynamic panel data techniques show bancassurance practices increase profitability of both insurance companies and banks in Turkey.

Since the size of the market or a company can be calculated on different grounds, the authors have opted to use non-life gross written premium. Therefore, the size variable (SIZE) is calculated as natural logarithm of non-life gross written premium. The common sense implies that larger firms are more profitable, therefore, we might expect the size to positively affect performance. As stated by Hardwick (1997), larger insurers perform better because they can realize operating cost efficiencies through increasing output and economizing on the unit cost of innovations. Furthermore, Adams and Buckle (2003) add that larger insurers can effectively diversify their assumed risks and react more quickly to changes in market environments. However, the same authors, citing Pi and Timme (1993), note that financial performance could be contrariwise related to company size since it often becomes more difficult for owners to efficiently and effectively monitor managers as company grows. Furthermore, financial performance could be negatively affected in large organizations due to the diseconomies of scale.

Variable market share (MS) is calculated as non-life gross premium written in a particular country over total non-life gross premium written in total EU insurance market. As stated by Pervan, Ćurak and Marijanović (2012) market share is frequently positively related with the profitability due to economies of scale and scope and consequently cost advantage. We predict a positive impact of market share variable on insurance sector profitability as found by the above mentioned authors.

Gross written premium growth rate (**GWP_GR**) is calculated as percentage change in premiums i.e. as $\frac{GWP_t - GWP_{t-1}}{GWP_{t-1}} * 100$. The authors expect that an insurance industry with increasing premiums should experience improved performance. However, Chen and Wong (2004) citing Kim et al. (1995) state that rapid growth of premium volume is one of the causal factors in insurers' insolvency. Specifically, they explain that being excessively preoccupied with growth can lead to self-destruction as other important goals might be ignored that is

especially true during an economic downturn. Therefore, the influence of this variable is ambiguous.

Claims growth rate or claims volatility (**CLAIMS_GR**) is calculated as $\frac{gross\ claims_t - gross\ claims_{t-1}}{gross\ claims_{t-1}} * 100$ and it is introduced in the model expecting that claims growth might reduce profits. This is in accordance with findings from Pervan et al. (2012) and Malik (2011) who all found negative relationship between loss ratio and profitability. Furthermore, Akotey et al. (2013) has also found negative relationship of claims payments with the underwriting profit and the total net profit.

With the aim of investigating how premium ceded to reinsurance influences performance variable share of reinsurance (**SHARE_RE**) was introduced in the model. As stated by Spotorno, Moro and Anderloni (2016) it proxies for actuarial risk management skills. It is calculated as ratio of premium ceded to reinsurance to total gross written premium multiplied by 100. Insurance is usually termed a risk transfer or rather risk spreading mechanism. In order to accept risk, all insurers require the capacity, but the capacity is limited by the capital they possess. By accessing the greater capital resources of the reinsurance market, insurers can accept risks in their entirety, being secured in the knowledge that the excess of risk can be passed to a reinsurer (Thoyts, 2010). However, reinsurance is always done at a certain cost, therefore, negative influence of this variable on performance might be expected. The stated is in accordance with Lee (2014) and it has been proven by Burca and Batrîncea (2014).

4. Methodology and Empirical Analysis

The data taken for the survey are defined on a yearly basis for the period from 2009 to 2015. Descriptive statistics of dependent and independent variables explained in Section 3 are given in Table 1.

Table 1 Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
SAP	28	4.532907	8.25123	-12.099	16.8208
SOB	28	7.263214	5.77152	0.4	16.86
MS	28	2.194376	3.04403	0.17523	8.2494
SIZE	28	8.122257	1.38377	6.63075	10.3499
GWP_GR	28	-1.285682	3.2987	-9.7792	7.77705
CLAIMS_GR	28	-9.52086	25.8964	-100	6.19019
SHARE_RE	28	16.93381	7.02062	9.27212	31.3241

Source: authors' research based on data from statistic software STATA

A correlation matrix of independent variables is given in Table 2. As it can be seen from the table, a multicollinearity problem occurs between two variables, with collinearity coefficients above 0.7. Multicollinearity problem occurs between market share (**MS**) and size (**SIZE**). Therefore, variable market share (**MS**) was omitted from further analysis.

Table 2 Correlation Matrix

	SOB	MS	SIZE	GWP_GR	CLAIMS_GR	SHARE_RE
SOB	1.0000					
MS	0.4111	1.0000				
SIZE	0.6019	0.9520	1.0000			
GWP_GR	0.0987	0.0820	0.1594	1.0000		
CLAIMS_GR	-0.0188	0.1829	0.1357	-0.4227	1.0000	
SHARE_RE	0.6188	-0.3426	-0.0832	0.0274	-0.1301	1.0000

Source: authors' research based on data from statistic software STATA

For the purpose of econometric data analysis, static balanced panel data analysis was employed. Model (1) forms the basis of our estimation.

$$Y_{it} = c + \sum_{k=1}^K \beta_k X_{it}^k + \varepsilon_{it} \tag{1}$$

$$\varepsilon_{it} = z_i + u_{it},$$

where:

- Y_{it} is the profitability of an insurance market i at time t , with $i = 1, \dots, N$; $t = 1, \dots, T$ presented with sales profitability (**SAP**).

If the error terms do not have constant variance, they are heteroscedastic. If the heteroscedasticity is present, the standard errors are biased which can lead to bias in test statistics and confidence intervals. To test the presence of heteroscedasticity Breusch-Pagan test for heteroscedasticity was employed in research. Result of Breusch-Pagan tests is shown in Table 3.

Table 3 Tests for heteroscedasticity

Test	chi2	p-value
Breusch-Pagan	1.27	0.2598

Source: authors' research based on data from statistic software STATA

Results of Breusch-Pagan test for heteroscedasticity showed that heteroscedasticity was not present. After examining the multicollinearity problem and heteroscedasticity, static panel with fixed effects and static panel with random effects were used in research. Table 4 shows the results of models with both random and fixed effects. As it can be seen from the Table 4, model with random effects is statistically significant at 1% level. In addition, Hausman test was performed and results showed that model with random effects is more suitable than the model with fixed effects.

Table 4 Empirical findings

	RE model	FE model
SOB	-0.0723147 (0.3337911)	-0.3213492 (0.7203358)
SIZE	2.95331*** (1.122798)	-10.99357 (32.37092)
GWP_GR	-0.5049617* (0.2870549)	-0.42768 (0.3942095)

CLAIMS_GR	--0.0358682 (0.036652)	-0.0356123 (0.0395168)
SHARE_RE	-0.8167075*** (0.2193272)	-1.090001* (0.620307)
constant	-6.090152 (10.14916)	113.7285 (271.9804)
Model p value	0.0000	0.3466
R2 within	0.2307	0.2400
R2 between	1.0000	0.0109
R2 overall	0.7777	0.0032
Hausman test	chi = 0.29 p value = 0.9978	

*, **, *** Statistically significant at the; 10%, 5%, 1% level, respectively. Standard error are between parentheses.
Source: authors' research based on data from statistic software STATA

The data in Table 4 show that bancassurance does not affect performance of non-life insurance sector in selected countries as well as claims growth rate. However, size measured on the basis of gross written premium, non-life gross written premium growth rate and share of reinsurance play an important role in determining sales profitability. Specifically, size variable has positive influence on performance, while gross written premium and share of reinsurance adversely affect profitability.

The positive influence of variable size based on non-life gross written premium on performance is supported by findings of Ahmed, Ahmed and Usman (2011). Furthermore, variable size, although measured in terms of total assets, proved to positively influence profitability of Ukrainian insurers (Hrechanuik, Lutz and Talavera, 2007). Similar is the case with Singapore and Malaysian insurance sector for which Chen and Wong (2004) have also found positive impact of size on performance as well as Malik (2011) for Pakistani insurers.

The negative influence of gross written premium growth rate is aligned with the expectations and findings of Spotorno, Moro and Anderloni (2016) who, citing Swiss Re (2011), noted that companies that want to grow rapidly might sacrifice profits in the short term in order to establish themselves in the market. The similar findings are obtained by Hrechanuik, Lutz and Talavera (2007) where gross written premium growth rate negatively influenced profitability of Spanish and Ukrainian insurers. However, Ahmed, Ahmed and Usman (2011) found this variable to be insignificant.

Furthermore, as shown in Table 3, share of reinsurance negatively influences performance supporting the view by Shiu (2004) stating that, although reinsurance dependence increases operational stability by lowering retention level, it reduces potential profitability.

5. Concluding Remarks

Bancassurance, observed as distribution channel of insurance products, has been gaining importance in the observed countries over the years. Therefore, the authors wanted to explore its influence on profitability of insurance sector in the Republic of Croatia, Slovenia, Spain and Portugal in the 2009-2015 period measured with sales profitability. With this aim, the authors employed static panel analysis with size based on non-life gross written premium, market share,

gross written premiums growth rate, claims growth rate and share of reinsurance, acting as control variables. The results reveal no statistically significant influence of bancassurance on performance of insurance industries covered by the analysis. However, size positively and statistically significantly influences performance whereas gross written premium growth rate and share of reinsurance significantly and negatively affect performance suggesting that being overly occupied with growth has negative consequences as well as being overly reinsurance dependant.

The authors are aware that more research has to be done in order to investigate this issue more thoroughly. For example, new control variables might be included in the analysis and most importantly, if data availability allows, company-wise analysis might be beneficial. Furthermore, the existing sample might be extended including more countries in the analysis.

REFERENCES

1. Adams, M., & Buckle, M. (2003). The determinants of corporate financial performance in the Bermuda insurance market. *Applied Financial Economics*, 13(2), 133-143.
2. Ahmed, N., Ahmed, Z., & Usman, A. (2011). Determinants of performance: a case of life insurance sector in Pakistan. *International Research Journal of Finance and Economics*, 61(1), 123-128.
3. Akotey, J. O., Sackey, F. G., Amoah, L., & Manso, R. F. (2013). The financial performance of life insurance companies in Ghana. *The Journal of Risk Finance*, 14(3), 286-302.
4. Benoist, G. (2003). Bancassurance: The New Challenges. *The Geneva Papers on Risk and Insurance*, 27(3), 295 – 303.
5. Burca, A., & Batrîncă, G. (2014). The Determinants of Financial Performance in the Romanian Insurance Market. *International Journal of Academic Research in Accounting, Finance and Management Sciences*, 4(1), 299-308. Retrieved March 23, 2018, from http://hrmars.com/hrmars_papers/Article_34_The_Determinants_of_Financial_Performance.pdf
6. Chen, R., & Wong, K. A. (2004). The Determinants of Financial Health of Asian Insurance Companies. *The Journal of Risk and Insurance*, 71(3), 469-499.
7. Clipici, E., & Bolovan, C. (2012). Bancassurance – Main Insurance Distribution and Sale Channel in Europe. *Scientific Bulletin – Economic Sciences*, 11, 54 – 62.
8. Croatian Financial Services Supervisory Agency, Statistics on Insurance Companies for 2009 – 2016 period. Retrieved March 6, 2018, from <http://www.hanfa.hr/publikacije/statistika/>
9. Falautano I., & Marsiglia E. (2003). Integrated Distribution of Insurance and Financial Services and Value Creation: Challenges Ahead. *The Geneva Papers on Risk and Insurance*, 28(3), 481-494.
10. Fields, L. P., Fraser, D. R., & Kolari, J. W. (2007). Is Bancassurance a Viable Model for Financial Firms?. *The Journal of Risk and Insurance*, 74(4), 777-794.
11. Hardwick, P. (1997). Measuring cost inefficiency in the UK life insurance industry. *Applied Financial Economics*, 7(1), 37-44.
12. Hrechanuik, B, Lutz, S., & Talavera, O. (2007). Do the Determinants of Insurers' Performance Differ in "Old" EU, the "New" EU and Outside?. *Working paper*, Retrieved March 28, 2018 from <http://www.webmeets.com/files/papers/earie/2007/155/ins-glt-earie.pdf>

13. Insurance Europe, European insurance industry database, Non-life Insurance for 2009 – 2016 period. Retrieved March 1, 2018 from <https://www.insuranceeurope.eu/insurancedata>
14. International Association of Insurance Supervisors – IAIS, Application Paper on Regulation and Supervision supporting Inclusive Insurance Markets, October 2012, 1 – 35.
15. Kozak, S. (2011). Determinants of profitability of non-life insurance companies in Poland during integration with the European financial system. *Electronic Journal of Polish Agricultural Universities*, 14(1), 1 – 9.
16. Kumar, S. A., & Kumar Pandey, S. P. (2013). Bancassurance: New Dawn in Indian Insurance Distribution. *The Journal of Insurance Institute of India*, p. 98 – 108.
17. Lee, C. (2014). The Effects of Firm Specific Factors and Macroeconomics on Profitability of Property-Liability Insurance Industry in Taiwan. *Asian Economic and Financial Review*, 4(5), 681 – 691. Retrieved March 23, 2018 from <http://search.proquest.com/openview/195f0616ab0120efde2cc02bb864321e/1?pqorigsite=gscholar&cbl=1786341>
18. Malik, H. (2011). Determinants of insurance companies profitability: an analysis of insurance sector of Pakistan. *Academic Research International*, 1(3), 315-321.
19. Novovic Buric, M., Kascelan, V., & Vujosevic, S. (2015). Bancassurance Concept from the Perspective of Montenegrin Market. *Economic Review – Journal of Economics and Business*, XII (2), 62-74.
20. Pervan, M., Curak, M., & Marijanovic, I. (2012). Dynamic panel analysis of Bosnia and Herzegovina insurance companies' profitability. *Recent Researches in Business and Economics*, 158-163.
21. Shiu, Y. (2004). Determinants of United Kingdom General Insurance Company Performance. *British Actuarial Journal*, 10, 1079-1110.
22. Spotorno, L., Moro O., & Anderloni, L. (2016). Bank affiliation influence on life insurers' performance before and after the financial crisis, *Journal of Economics and Management*, 26(4), 5 – 33.
23. Stankovic, J. Z., Petrovic, E., & Vojvodic-Miljkovic, N. (2016). Reality and Prospects of Bancassurance as an Insurance Sales Channel in the Republic of Serbia. *Teme*, 1327-1348
24. Thoyts, R. (2010). *Insurance Theory and Practice*, London: Routledge
25. Tunay, N. (2014). Bancassurance Applications in Turkey and its Dynamic Effects of Turkish Banking and Insurance Sectors. *Journal of BRSA Banking and Financial Markets*, 8(1), 35 – 62.

Influence of the Government Final Consumption Expenditure and the Final Consumption Expenditure of Households and NPISH on Economic Growth in Republic of Croatia – VAR Model

Renata Kožul Blaževski

University Department of Professional Studies, University of Split, Split, Republic of Croatia
rkozulb@oss.unist.hr

Abstract. The Gross domestic product is one of the main indicators of economic growth. According to the expenditure approach, components of the Gross domestic product are the final consumption expenditure, the gross capital formation, the exports of goods and services and the imports of goods and services. The final consumption consists of the government final consumption expenditure and the final consumption expenditure of households and non-profit institutions serving households (NPISH) expenditure. Since the final consumption expenditure has significant influence on the Gross domestic product of Republic of Croatia, it is important to investigate relationship between government final consumption expenditure, the final consumption expenditure of households and NPISH and economic growth in Republic of Croatia. This study empirically investigates the dynamic relationships between the government final consumption expenditure, the final consumption expenditure of households and NPISH and the gross domestic product in Republic of Croatia. Quarterly data for the government final consumption expenditure, the final consumption expenditure of households and NPISH and the gross domestic product from 2000 to 2017 are analysed using unrestricted vector autoregressive (VAR) model.

Key words: *government final consumption expenditure, final consumption expenditure of households and NPISH, gross domestic product, unrestricted vector autoregressive (VAR) model*

1. Introduction

The Gross domestic product is a measure for the economic activity and it is calculated by expenditure or production approach. According to the expenditure approach, the Gross domestic product is sum of following factors: the final consumption expenditure, the gross capital formation, the exports of goods and services and the imports of goods and services.

The final consumption expenditure, as one of the components of the Gross domestic product according to the expenditure approach, has significant influence on the Gross domestic product of the Republic of Croatia. For example, in 2017 final consumption was 77% of the Gross domestic product of the Republic of Croatia. Since the final consumption consists of the government final consumption expenditure and the final consumption expenditure of households and non-profit institutions serving households (NPISH) expenditure, it is important to investigate relationship between government final consumption expenditure, the final consumption expenditure of households and NPISH and economic growth in the Republic of Croatia.

In this paper the dynamic relationships between the government final consumption expenditure, the final consumption expenditure of households and NPISH and the gross domestic product in Republic of Croatia is explored using unrestricted vector autoregressive (VAR) model.

The paper is divided in four chapters. The first chapter is the introduction. An overview of the relevant literature is given in the second chapter and data and methodology are presented in the third chapter. In the fourth chapter, the results of empirical research are presented and main conclusions are drawn in the fifth chapter.

2. Literature Review

There is a series of empirical studies that cover issue of relationship between components of the Gross domestic product according to the expenditure approach and economic growth.

The influence of final consumption and gross investments on the evolution of Romania's Gross Domestic Product is investigated by Anghelache, Manole and Anghel (2015) and they conclude that Romania's Gross domestic product is significantly influenced by changes in final consumption and gross investment. Dumitrescu, Anghel, Anghelache (2015) present a model designed to outline some of the Gross domestic dependences, on the case of Romanian economy. The study is based on the VAR methodology. A correlation between the Gross domestic product, private and public consumption, through a multiple regression model is investigated by Anghelache, Manole and Anghel (2015). The model explains the influence of the two types of consumption on the evolution of the Gross domestic product.

Mahmud and Ahmed (2012) examine public-private consumption relationship for Bangladesh economy through the lens of economic theories using the cointegration and error correction model. Their conclusion is that household consumption is unrelated with government consumption decision in the long-run.

Koitsiwe, Adachi (2015) empirically investigate the dynamic relationships between mining revenue, government consumption, exchange rate and economic growth in Botswana. Among others, the results show that government consumption is caused by mining revenue and economic growth.

The relation between foreign direct investment, economic growth and export in Slovakia in the period 2001-2010 is analysed by Szkorupova (2014) and a positive impact of foreign direct investment and positive impact of export on the Gross domestic product is detected. Sever, Drezgić and Blažić (2011) analyse the relationship between government budget spending and the effect on the growth and the structure of the Gross domestic product of Croatia from 1994 to 2008. A fundamental conclusion of that research is that the budget expenditures have not adequately affected the Gross domestic product growth. Bilas, Bošnjak, and Franc (2015) examine the relationship between Gross domestic product and exports of goods and services in Croatia between 1996 and 2012. The research results confirm unidirectional Granger causality from the exports of goods and services to Gross domestic product.

For a panel of EU countries from the Eastern Europe including Croatia Motofei (2017) pursue the evolution of the main indicator of the national economies, the dynamics of Gross domestic product per capita, and the components of the Gross domestic product, grouped according to the expenses method, all these factors seen as vectors of economic growth. Conclusion is that the main factor that contributes to the formation of the Gross domestic product, for all economies taken into consideration, is the final consumption expenditure of households and NPISH. The least significant share in the Gross domestic product is associated, for all countries, to the foreign trade balance.

3. Data and Methodology

In the analysis of influence of the government final consumption expenditure and the final consumption expenditure of households and NPISH on economic growth in Republic of Croatia, quarterly data over the period 2000Q1 – 2017Q4 is used (Figure 1). The date is

obtained from the web site of the Croatian Bureau of Statistics. Variables analysed in the study are: GDP - the Gross domestic product by expenditure approach, GFCE – government final consumption expenditure and HFCE - final consumption expenditure of households and NPISH. Variables are expressed at constant prices of the previous year with linking to the referent year (2010 = 100). All the variables are in million HRK.

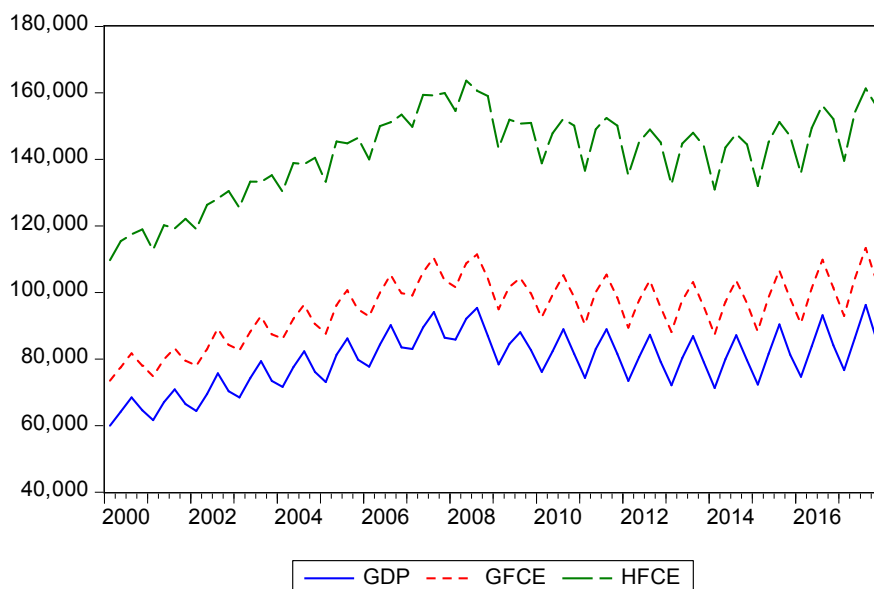


Figure 1 The Gross domestic product by expenditure approach, government final consumption expenditure and final consumption expenditure of households and NPISH over the period 2000Q1 – 2017Q4. (Prepared by author according to data from the Croatian Bureau of Statistics.)

Since the quarterly data is used, it is necessary to analyze time series in terms of seasonality. As can be seen from Figure 1, all time series have seasonal patterns. In order to seasonally adjust data CENSUS X12 method is used. Also, to stabilize variance logarithmic transformation is applied. Seasonally adjusted and logarithmic transformed time series are denoted as LGDP, LGFCE and LHFCE

To investigate relationships between the government final consumption expenditure, the final consumption expenditure of households and NPISH and the gross domestic product in Republic of Croatia unrestricted vector autoregressive (VAR) model proposed by Sims (1980) is applied.

The VAR model provides a multivariate framework where each variable is allowed to depend on its past realizations and on the past realizations of all other variables in the system (Enders, 2010). The following reduced-form of VAR is used

$$X_t = A_0 + A_1 X_{t-1} + A_2 X_{t-2} + \dots + A_k X_{t-k} + \varepsilon_t, \quad (1)$$

$X_t = [X_{1t} \ X_{2t} \ \dots \ X_{nt}]'$ is n - dimensional vector of potentially endogenous variables, A_0 is n -dimensional vector of intercept terms, A_1, A_2, \dots, A_k are (n, n) matrices of coefficients, k is the lag length, and ε_t is n - dimensional vector of error terms.

In order to build an appropriate model, all variables that are used in analysis must be stationary. The presence of a unit root in the variables is tested using following unit roots tests: Augmented Dickey-Fuller (1979) ADF test and Elliot-Rothenberg-Stock (1996) DF-GLS test. The null hypothesis under the ADF test and DF-GLS test is that variable has unit root. After establishing the order of integration of the variables, the existence of a long-term

equilibrium relationship between variables of interest is investigated by applying the cointegration test developed by Johansen (1988). Johansen methodology consists of two statistical tests, namely the Trace test and the Maximum Eigenvalue test. If the variables are cointegrated vector error-correction VECM model should be estimated.

The choice of lags number for VAR model is determined by the error minimization criterion given by the following five criteria: sequential modified LR test statistic, Final prediction error, Akaike information criterion, Schwarz information criterion and Hannan-Quinn information criterion. Ordinary least squares method is used to estimate the parameters of VAR model. After constructing the model, adequacy of the model is checked. The serial correlation, normality and heteroskedasticity of the residuals are tested.

In order to conclude whether past values of one variable affect another variable in the current period Granger causality test (multivariate) is applied. These test results also indicate the directions of causal relationships between variables (Granger, 1969) and are used to determine order of variables in model.

The impulse response function (IRF) and variance decomposition (VD) as innovation accounting techniques are applied to interpret the results of estimated model. The impulse response function determines the dynamic effect of each variable to shocks of others in the system, while the variance decomposition shows the contribution of the variance in the forecast error for each variable to shocks to all variables in the system (Enders, 2010).

4. Empirical Results

Empirical analysis starts by accounting for the presence of a unit root in the variables. Augmented Dickey-Fuller ADF unit root test and Elliot-Lothman-Stock DF-GLS unit root test are employed (including constant without trend and constant with trend). The results at levels and first differences are presented in Table 1 and Table 2. The lag length in all tests is chosen based on Schwarz information criterion.

Table 1 Results of ADF unit root test

Variables	ADF test					
	Constant without trend			Constant with trend		
	Test statistic	Lag length	Probability	Test statistic	Lag length	Probability
Level						
LGDP	-2.5444	2	0.1097	-2.1407	2	0.5142
LGFCE	-1.2352	0	0.6548	-1.2961	0	0.8809
LHFCE	-3.1637**	1	0.0265**	-2.5515	1	0.3034
First difference						
LGDP	-3.5241**	1	0.0101**	-3.7799**	1	0.0236**
LGFCE	-7.9096*	0	0.0000*	-7.9071*	0	0.0000*
LHFCE	-5.7544*	0	0.0000*	-6.1429*	0	0.0000*

Notes: *, ** denote the rejection of the null hypothesis of non-stationarity of variable at 1% and 5% levels, respectively.

The results of ADF test indicate that at the conventional levels of significance the null hypothesis of non-stationarity could not be rejected for all variables at the level, except for variable LHFCE. In the case of variable LHCE (when constant without trend is included), the null hypothesis of non-stationarity could not be rejected at the 5% level of significance (Table 1). For the first difference of variables null hypothesis of non-stationarity should be rejected for all variables at the conventional levels of significance, exception is the first difference of

variable LGDP. In case of first difference of variable LGDP null hypothesis of non-stationarity should be rejected at 5% level of significance (Table 1).

Table 2 Results of DF-GLS unit root test

Variables	DF-GLS test			
	Constant without trend		Constant with trend	
	Test statistic	Lag length	Test statistic	Lag length
Level				
LGDP	-0.2675	2	-1.2909	2
LGFCE	0.4843	0	-1.3045	0
LHFCE	-0.1183	1	-1.1054	1
First difference				
LGDP	-3.2844*	1	-3.5643**	1
LGFCE	-7.9600*	0	-8.0126*	0
LHFCE	-5.7913*	0	-6.0379*	0

Notes: *, ** denote the rejection of the null hypothesis of non-stationarity of variable at 1% and 5% levels, respectively.

According to the results of DF-GLS test, the null hypothesis of non-stationarity could not be rejected for all variables at the level and at the conventional levels of significance. For the first difference of variables null hypothesis of non-stationarity should be rejected for all variables at the conventional levels of significance, except in the case of first difference of variable LGDP (when constant with trend is included) when null hypothesis of non-stationarity should be rejected at 5% level of significance (Table 2).

The results of both unit root tests implies that all variables are non-stationary at the level but that first difference of variables are stationary. Therefore, it can be concluded that variables LGDP, LGFCE and LHFCE are integrated of the order one, that is $I(1)$.

Since the order of integration for variables LGDPE, LGFCE and LHFCE is one, the existence of a long-term equilibrium relationship among them is explored. Johansen cointegration test is applied.

Table 3 Selection of lag length for Johansen cointegration test

Lag length	LR	FPE	AIC	SC	HQ
0	-	2.70e-09	-11.21723	-11.11770	-11.17790
1	495.7306	1.19e-12	-18.94016	-18.54204*	-18.78284
2	24.61244	1.04e-12	-19.08459	-18.38788	-18.80929*
3	19.53795*	9.64e-13*	19.16075*	-18.16546	-18.76746

Notes: * indicates lag order selected by the criterion at 5% significance level

The results of Johansen cointegration test are very sensitive to chosen lag length. Therefore, unrestricted VAR model at levels is estimated and based on sequential modified LR test statistic (LR), Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC) and Hannan-Quinn information criterion (HQ) appropriate lag length for Johansen cointegration test is chosen. Results of information criterions are presented in Table 3. Sequential modified LR test, Final prediction error and Akaike information criterion suggest lag length 3, while Schwarz information criterion suggests lag length 1 and Hannan-Quinn information criterion (HQ) suggests lag length 2. For Johansen

cointegration test, lag length 3 is chosen based on the results of majority information criterions.

Johansen cointegration test consists of the Trace test and the Maximum Eigenvalue test. Table 4 reports the results of Johansen cointegration test. Both test indicates no cointegration at the 0.05 significance level. Thus, it can be concluded that variables LGDPE, LGFCE and LHFCE are not cointegrated.

Table 4 Results of Johanson cointegration test

Trace test				
Hypothesized number of cointegrating equation(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Probability
None	0.214454	26.99901	29.79707	0.1016
At most 1	0.134102	10.58539	15.49471	0.2383
At most 2	0.011612	0.794209	3.841466	0.3728

Maximum Eigenvalue test				
Hypothesized number of cointegrating equation(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Probability
None	0.214454	16.41362	21.13162	0.2016
At most 1	0.134102	9.791184	14.26460	0.2260
At most 2	0.011612	0.794209	3.841466	0.3728

Since there is no long-term equilibrium relationship between variables and variables are integrated of the order one, VAR model (1) of the first differences of variables is estimated. Vector X_t in VAR model (1) is defined as

$$X_t = [\Delta LGDP_t, \Delta LGFCE_t, \Delta LHFCE_t]' \quad (2)$$

$\Delta LGDP_t$ is first difference of the gross domestic product, $\Delta LGFCE_t$ is first difference of the government final consumption expenditure and $\Delta LHFCE_t$ is first difference of the final consumption expenditure of households and NPISH. All variables in model (2) are potentially endogenous and indicate the corresponding growth rates.

Table 5 Selection of lag length for VAR model (2)

Lag length	LR	FPE	AIC	SC	HQ
0	-	1.75e-12	-18.55717	-18.45681	-18.51757
1	40.08565*	1.20e-12*	-18.93739*	-18.53596*	-18.77900*

Notes: * indicates lag order selected by the criterion at 5% significance level

In order to determine optimal lag length for VAR model (2) error minimization criterion given by sequential modified LR test statistic, Final prediction error, Akaike information criterion, Schwarz information criterion and Hannan-Quinn information criterion is applied.

The results of five criterions are given in Table 5 and all of them suggest that lag length 1 should be chosen for VAR model (2).

Table 6 Estimation of VAR model (2)

Variables	$\Delta LGDP_t$	$\Delta LGFCE_t$	$\Delta LHFCE_t$
Constant	0.002979 (0.00147) [2.03028]	0.002632 (0.00186) [1.41582]	0.002240 (0.00175) [1.28283]
$\Delta LGDP_{t-1}$	-0.141313 (0.15198) [-0.92978]	0.410346 (0.19258) [2.13079]	0.150752 (0.18087) [0.83350]
$\Delta LGFCE_{t-1}$	-0.035307 (0.09660) [-0.36548]	0.076652 (0.12240) [0.62622]	0.115970 (0.11496) [1.00879]
$\Delta LHFCE_{t-1}$	0.514074 (0.13719) [3.74722]	-0.228477 (0.17383) [-1.31437]	0.230515 (0.16326) [1.41198]

Notes: Standard errors in () and t-statistics in []

VAR model (2) is estimated and the results are presented in Table 6. After estimation of VAR model, adequacy of model is analysed. Statistical tests for the residuals are used to test the serial correlation, normality and heteroskedasticity of the residuals and the results are presented in Table 7. VAR residual serial correlation LM tests indicate that the null hypothesis (proposing no serial correlation of the residuals at lag order h) should not be rejected until lag 12. Based on Jarque-Bera (J-B) normality test, the null hypothesis (proposing normality of the residuals) should be rejected. Heteroskedasticity of the residuals is tested with White test, results of the test indicate that null hypothesis (proposing homoskedasticity of the residuals) should be rejected. The diagnostic results imply that VAR model should be extended as the distributional properties of the residuals are not normal. Also, heteroskedasticity testing results suggest the application of a multivariate GARCH model for the series.

Table 7 Results of residual diagnostic tests

Dependent variable	Test statistic	Probability
Correlation LM Test at lag order 12	3.023932	0.9633
Jarque-Bera (J-B) normality test	254.0722	0.0000*
White Heteroskedasticity Tests: No Cross Terms	62.43120	0.0041*
White Heteroskedasticity Tests: Includes Cross Terms	101.8201	0.0001*

Notes: * denote the rejection of the null hypothesis at 1% level.

Beside analysis of residuals, roots of AR characteristic polynomial should be checked in order to verify stability of the VAR model, (Lütkepohl, 1991.) VAR model is stable if absolute values of all parameters of AR characteristic polynomial are lesser than one (Bahovec &

Erjavec, 2009), that is if inverse roots of AR characteristic polynomial lie inside unit circle. As can be seen from Figure 2 estimated VAR model satisfies the stability condition.

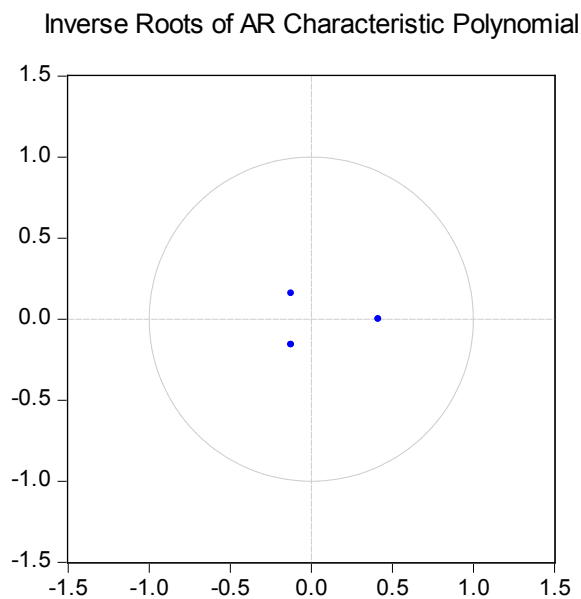


Figure 2 Inverse roots of AR characteristic polynomial

In order to investigate the causal relationship between the variables of the system, multivariate Granger causality test is applied and the results are presented in Table 8.

Table 8 Results of multivariate Granger Causality test

Dependent variable	$\Delta LGDP_t$	$\Delta LGFCE_t$	$\Delta LHFCE_t$	Joint significance
$\Delta LGDP_t$	-	0.7148	0.0002*	0.0008*
$\Delta LGFCE_t$	0.0331**	-	0.1887	0.1000
$\Delta LHFCE_t$	0.4046	0.3131	-	0.4758

Notes: values in the table are probabilities; *, ** denote the rejection of the null hypothesis of no causal effect from X to Y at 1% and 5% levels, respectively

According to the results of multivariate Granger Causality test for $\Delta LGDP$ as dependent variable null hypothesis of no causal relationship could not be rejected for $\Delta LGFCE$, but it should be rejected for $\Delta LHFCE$ at the conventional levels of significance. For $\Delta LGFCE$ as dependent variable and at the 5% level of significance, null hypothesis should be rejected for $\Delta LGDP$ but for $\Delta LHFCE$ it could not be rejected. In the case when $\Delta LHFCE$ is dependent variable null hypothesis should be rejected for $\Delta LGDP$ and for $\Delta LHFCE$ at the conventional levels of significance. So, it can be concluded that there is a univariate causal relationship between $\Delta LGDP$ and $\Delta LHFCE$, and also between $\Delta LGDP$ and $\Delta LGFCE$, and there is no causal relationship between $\Delta LHFCE$ and $\Delta LGFCE$. Also, none of the variables in the model do not Granger cause $\Delta LHFCE$, that is variable $\Delta LHFCE$ is exogenous variable in the model. Final conclusions based on multivariate Granger Causality test are: changes in GDP growth rate have direct effect only on $GFCE$ growth rate while changes in $HFCE$ growth rate have direct effect only on GDP growth rate and changes in $GFCE$ growth rate do not cause changes in GDP growth rate or in $HFCE$ growth rate.

The dynamics of the variables is investigated applying decomposition of variance and impulse response function. In obtaining decomposition of variance and impulse response function Cholesky decomposition is used to orthogonalize the innovations. Cholesky decomposition assumes certain ordering of variables. Ordering of variables is chosen based on results of Granger causality test, since the results of innovation accounting techniques can be influenced with ordering of variables. Decomposition of variance and impulse response function are applied in following ordering of variables: $\Delta LHFCE$, $\Delta LGDP$, $\Delta LGFCE$ and the results are presented in Table 9.

Table 9 Decomposition of variance results

Variance decomposition of $\Delta LGDP$				Variance decomposition of $\Delta LGFCE$		
Period	$\Delta LGDP$	$\Delta LGFCE$	$\Delta LHFCE$	$\Delta LGDP$	$\Delta LGFCE$	$\Delta LHFCE$
1	56.35	0.00	43.65	1.04	96.50	2.46
2	45.05	0.15	54.80	6.20	91.47	2.33
3	44.37	0.61	55.03	6.23	90.62	3.15
4	44.23	0.61	55.16	6.23	90.59	3.18
5	44.21	0.61	55.18	6.23	90.58	3.19
6	44.20	0.61	55.18	6.23	90.58	3.19
7	44.20	0.61	55.18	6.23	90.58	3.19
8	44.20	0.61	55.18	6.23	90.58	3.19

Variance decomposition of $\Delta LHFCE$			
Period	$\Delta LGDP$	$\Delta LGFCE$	$\Delta LHFCE$
1	0.00	0.00	100.00
2	0.60	1.30	98.10
3	0.70	1.36	97.94
4	0.70	1.37	97.93
5	0.71	1.37	97.92
6	0.71	1.37	97.92
7	0.71	1.37	97.92
8	0.71	1.37	97.92

Notes: Cholesky ordering $\Delta LHFCE$, $\Delta LGDP$, $\Delta LGFCE$.

The results of variance decomposition of GDP growth rate suggest that at 1 step ahead of time horizon, it is largely explained by itself with 56.35%, followed by $HFCE$ growth rate with 43.65%. The explanatory power of GDP growth rate on itself declines to 44.23% at 4 step ahead of time horizon, while $HFCE$ growth rate and $GFCE$ growth rate gain more explanatory power with $HFCE$ growth rate explaining 55.16% of GDP growth rate variation at 4 step ahead of time horizon. The results of variance decomposition of $GFCE$ growth rate shows that at the 1 step ahead of time horizon, it is largely explained by itself with 96.50% followed by $HFCE$ growth rate with 2.46% and GDP growth rate with 1.04%. The explanatory power of $GFCE$ growth rate on itself declines and at the 4 step ahead of time horizon it is 90.59%, while $HFCE$ growth rate and GDP growth rate gain more explanatory power, with $HFCE$ growth rate explaining 3.18% and GDP growth rate explaining 6.23% of $GFCE$ growth rate variation at 4 step ahead of time horizon. The variance decomposition of $HFCE$ growth rate shows that $HFCE$ growth rate is mostly explained by its own shock. At 1 step ahead of time horizon $HFCE$ growth rate explains 100% its variation, the explanatory

power declines and at 4 step ahead of time horizon 97.93% of variance is explained by its own shock, followed by *GFCE* growth rate with 1.37% and *GDP* growth rate with 0.70%.

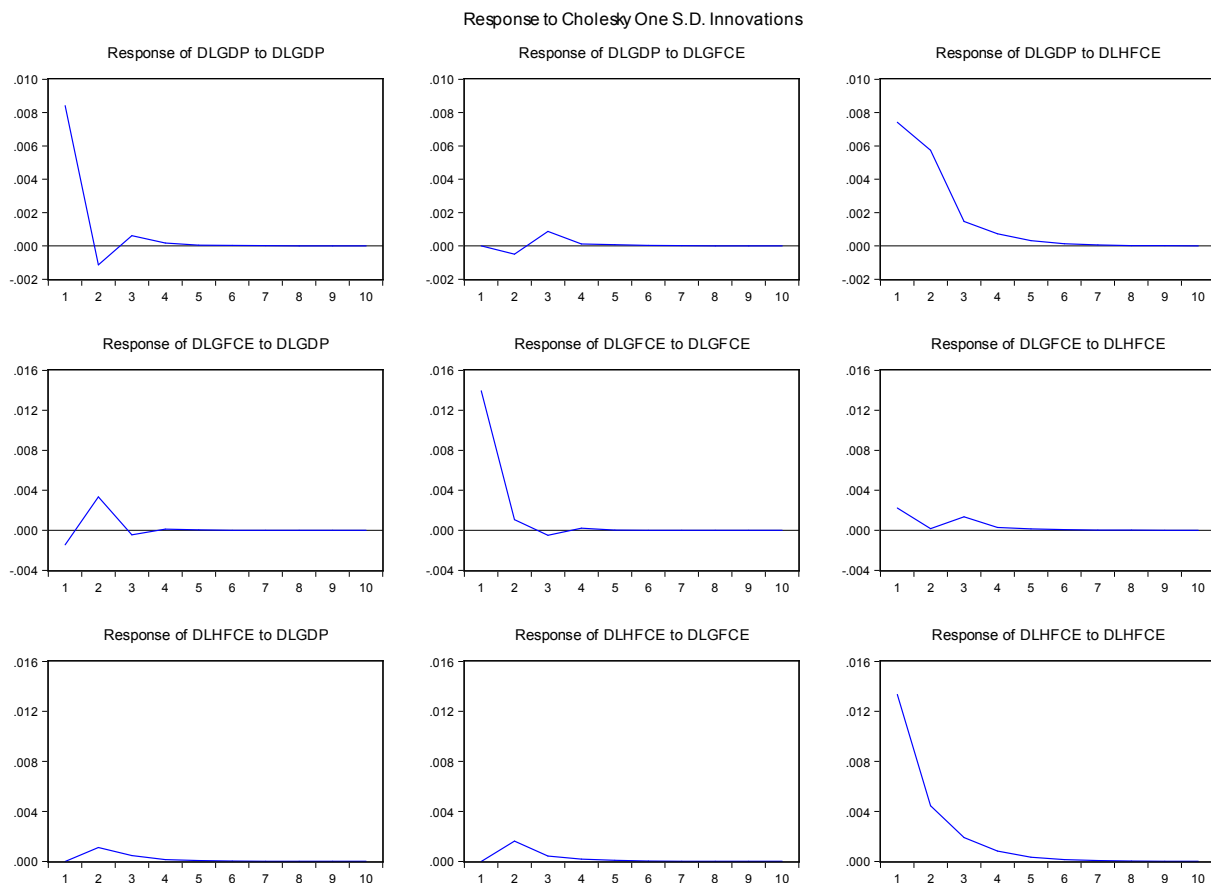


Figure 3 Results of impulse response function

For the purposes of the impulse response function, a response in a variable is defined as being reaction of at least one standard deviation. The results of impulse response function are presented in Figure 3.

From the graphs in the first row of Figure 3 the response of *GDP* growth rate to shock in *GFCE* growth rate and *HFCE* growth rate can be seen. *GDP* growth rate responds negatively to a shock in *GFCE* growth rate at the second quarter, then positively at the third and fourth quarter and after that impact disappears. Respond of *GDP* growth rate to a shock in *HFCE* growth rate is positive from the first to the sixth quarter and after that, impact vanishes. The second row presents the response of *GFCE* growth rate to shock in *GDP* growth rate and *HFCE* growth rate. *GFCE* growth rate responds negatively to a shock in *GDP* growth rate at the first quarter, then positively at the second quarter and again negatively at the third quarter, after that impact disappears. Respond of *GFCE* growth rate to a shock in *HFCE* growth rate is positive from the first to the fifth quarter and after that, it disappears. The last row presents the response of *HFCE* growth rate to shock in *GDP* growth rate and *GFCE* growth rate. *GDP* growth rate and *HFCE* growth rate shocks lead to positive effect in *HFCE* growth rate from the second to the fourth quarter, impact vanishes after that.

The results of innovation accounting techniques indicate that shock to *GDP* growth rate has short run effect on *GFCE* growth rate, while effect on *HFCE* growth rate is not significant.

Further, shock to *HFCE* growth rate has short run effect on *GDP* growth rate, while effect on *GFCE* growth rate is not significant. Shock to *GFCE* has no significant effect on *GDP* growth rate or on *HFCE* growth rate.

5. Conclusion

The final consumption, as component of the Gross domestic product, has significant influence on the Gross domestic product of Republic of Croatia as an indicator of economic growth. In this paper, dynamic relationship between components of the final consumption expenditure, that are government final consumption expenditure and final consumption expenditure of households and non-profit institutions serving households expenditure (NPISH), and the Gross domestic product is empirically investigated. Unrestricted vector autoregressive model (VAR) is estimated, Granger causality is tested and innovation accounting techniques are applied to interpret results of estimated VAR model.

Based on multivariate Granger Causality test, it can be concluded that changes in the Gross domestic product growth rate have direct effect only on government final consumption expenditure growth rate while changes in final consumption expenditure of households and NPISH growth rate have direct effect only on the Gross domestic product growth rate. Further on, changes in government final consumption expenditure growth rate do not cause changes in the Gross domestic product growth rate or in final consumption expenditure of households and NPISH growth rate. The results of variance decomposition and the impulse response function indicate that shock to the Gross domestic product growth rate has short run effect only on government final consumption expenditure growth rate and that shock to final consumption expenditure of households and NPISH growth rate has short run effect only on the Gross domestic product growth rate. Shock to government final consumption expenditure growth rate has no significant effect on the Gross domestic product growth rate or on final consumption expenditure of households and NPISH growth rate.

Results of empirical analysis implies that final consumption expenditure of households and NPISH had positive influence on economic growth, while influence of government final consumption expenditure on economic growth is not significant. On the other hand, economic growth has impact only on government final consumption expenditure.

Economic growth of Republic of Croatia can be further investigated by including in empirical analysis other components of the Gross domestic product such as the gross capital formation, the exports of goods and services and the imports of goods and services.

REFERENCES

1. Anghelache, C., Manole, A. & Anghel, M. G. (2015). Analysis of final consumption and gross investment influence on GDP – multiple linear regression model. *Theoretical and Applied Economics*, Vol. XXII, No. 3(604), Autumn, pp. 137-142.
2. Anghelache, C., Manole, A. & Anghel, M. G. (2015). The analysis of the correlation between GDP, private and public consumption through multiple regression. *Romanian Statistical Review Supplement, Romanian Statistical Review*, vol. 63(8), August, pp. 34-40. Retrieved February 25, 2018 from http://www.revistadestatistica.ro/supliment/wpcontent/uploads/2015/09/RRSS_08_2015_A02_en.pdf
3. Bahovec, V. & Erjavec, N. (2009). *Uvod u ekonometrijsku analizu*. Zagreb: Element.
4. Bilas, V., Bošnjak, M. & Franc, S. (2015). Examining the Export-led Growth Hypothesis: The case of Croatia. *Naše gospodarstvo*, Vol. 61, No. 3, pp. 22–31.
5. Croatian Bureau of Statistics, Retrieved March 02, 2018 from www.dsz.hr
6. Dickey, D. A. & Fuller, W. A. (1979). Distribution of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association*, Vol. 74, pp. 427-431.

7. Dumitrescu, D., Anghel, M. G. & Anghelache, C. (2015). Analysis Model of GDP Dependence on the Structural Variables. *Theoretical and Applied Economics*, Vol. XXII, No. 4(605), Winter, pp. 151-158.
8. Elliot, G., Rothenberg, T.J. & Stock, J. (1996). Efficient tests for an autoregressive unit root. *Econometrica*, Vol. 64, pp. 813-836.
9. Enders, W. (2010). *Applied Econometric Time Series*. London: John Wiley & Sons, Inc.
10. Granger, C. W. J., (1969.) Investigating causal relation by econometric and cross-sectional method. *Econometrica*, Vol. 37, pp. 424-438.
11. Johansen, S., (1988). Statistical Analysis of Cointegration Vectors. *Journal of Economic Dynamics and Control*, Vol. 12, pp. 231-254.
12. Koitsiwe, K. & Adachi, T. (2015). Relationship between mining revenue, government consumption, exchange rate and economic growth in Botswana. *Contaduría y Administración*, Vol. 60 (S1), October-December, pp. 133-148. Retrieved February 20, 2018 from https://ac.els-cdn.com/S0186104215000480/1-s2.0-S0186104215000480-main.pdf?_tid=d4fbba6d-70ff-4b32-87af-ec46bb0d8800&acdnat=1523695836_340d3444b7a0348531dcb63803eccc9
13. Lütkepohl, H. (1991). *Introduction to Multiple Time Series Analysis*. New York: Springer-Verlag.
14. Mahmud, M. N. & Ahmed, M. (2012). Government expenditure and household consumption in Bangladesh through the lens of economic theories: an empirical assessment. *MPRA Paper*, No. 36035. Retrieved February 25, 2018 from <https://mpra.ub.uni-muenchen.de/36035/>
15. Motofei, C. (2017). Vectors of economic growth in the eastern area of the EU. *Theoretical and Applied Economics*, Volume XXIV, No. 1(610), Spring, pp. 215-226.
16. Sever, I., Drezgić, S., & Blažić, H. (2011). Budget spending and economic growth in Croatia. Dynamics and relationships over the past two decades. *Zbornik radova Ekonomskog fakulteta Rijeka*, Vol. 29, No. 2, pp. 291-331.
17. Sims, C. A. (1980). Macroeconomics and reality. *Econometrica*, Vol. 48, pp. 1-48.
18. Szkorupova, Z. (2014). A causal relationship between foreign direct investment, economic growth and export for Slovakia. *Procedia Economics and Finance*, Vol. 15, pp. 123-128 Retrieved February 20, 2018 from <https://www.sciencedirect.com/science/article/pii/S2212567114004584>

**CIET
2018**

**Split
Track 2**

**Tourism, Trade and
Entrepreneurship**

Application of Mobile Apps in Stores

Sandra Mrvica Mađarac

College of Applied Sciences "Lavoslav Ružička" in Vukovar, Vukovar, Republic of Croatia
smrvica@vevu.hr

Slađana Brajević

The University Department of Professional Studies at the University of Split, Split, Republic of Croatia
brajevic@oss.unist.hr

Višnja Bartolović

College of Slavonski Brod, Slavonski Brod, Republic of Croatia
Visnja.Bartolovic@vusb.hr

Abstract. In the context of globalization and large-scale competition on the market, commercial enterprises are forced to apply innovative solutions to sustain their businesses and increase their profits. One of the possible innovative solutions is the introduction of mobile applications in stores. The mobile phone has ceased to be a device intended only for communication with other people, and today its application is manifold. Mobile applications have found their purpose in the trading business through the application of new business models: for promotions and coupons via text messages, product notifications, bid analysis of the competition, etc. These are just some of the uses of mobile apps that can influence buyers' decisions. Hence, mobile applications, i.e. the trade companies that use them, make it easier for the buyers to purchase products, keeping the buyers updated at the same time. Sales via mobile applications have an increasing share in the realized sales, and is becoming ever more simple and more accessible due to an increased use of smart phones. Furthermore, it consists of only a few steps and requires much less time to conduct a purchase. The paper analyses the trends regarding the use of mobile applications in the trade business and some types of mobile applications.

Key words: *innovative solutions, mobile applications, trends in the trade business*

1. Introduction

According to estimates presented by Business Insider's research department, by 2020 mobile commerce will reach 284 billion USD in USA only, accounting for 45% of total e-commerce sales in the US (Meola, 2016). These forecasts indicate that businesses in the sector of commerce will need to start offering online solutions of increasingly high quality to their customers. Those companies which have still not adopted the practice, or are not implementing it sufficiently, will have to adapt to the digital age. If they fail to do so, their survival in the market will be compromised due to the absence of business digitalization. An increasing number of experts in the professional community are starting to express the view that business operations will either become digitalised, or will perish.

Some of the main indicators showing that a company is not using new technologies adequately are: the minimal use of the Internet as a modern technology; obsolete sales automation system; lack of market automation; and the absence of models which inform the decision-making process of the company's marketing department (Kotler, 2006b; 115).

The purpose of this paper is to identify key activities and trends that contribute to the integration of marketing and sales by using mobile apps, exemplified by the selected companies and their

marketing and sales strategies. Konzum and Lidl retail stores have been selected for the practical analysis section of this paper, as they apply two different retail concepts and have a strong market share in the Republic of Croatia (Konzum) and strong growth rates (Lidl).

2. The Age of Electronic Marketing and Digitalization

In his book *How to Create, Win, and Dominate Markets*, Kotler claims that "the main purpose of marketing is demand management, the skills needed to manage the level, timing, and composition of demand." (Kotler, 2006a; 9).

He anticipated that personal computers and the Internet would bring "incredible changes in buying and selling behavior" (Kotler, 2006a; 10). According to Goldman Sachs' forecasts for 2018, customers will spend 625 billion USD using mobile device apps (Krumins, 2015).

In the electronic marketing era, orientations are changing: companies are becoming increasingly focused on managing client portfolio so as to better understand consumer behavior, their individual needs and messages. It is crucial to choose a market niche well and to adapt to clients and their needs (Kotler, Keller, Martinović, 2014). For this purpose, companies use tools like Google Analytics to establish a two-way communication with customers in the form of active dialogue, unlike the monologue that was used in the past.

Furthermore, the Omnichannel Sales Integration is part of the up-and-coming digital enterprise within the industry 4.0 (Schrauf, Bertram, 2016).

The question is how to achieve high-quality communication with customers and how to increase the client loyalty rate. According to technology experts, this can be achieved either by using mobile retail applications or via retail e-commerce web pages that are customized for mobile browsers. Both approaches are considered effective by the experts. A website that is optimized for mobile users is considered, according to the experts, a more useful product search tool, while mobile apps have a stronger impact on customer loyalty (Fieldnation, 2015).

According to the Report on the Worldwide Status of Digitalization (Kunić, 2017) some of the following findings crucial for the study of this topic can be observed:

- 2,56 billion users worldwide use social media (a 30% increase in comparison with the same period last year);
- the percentage of Internet users has increased by 10% in comparison with the previous year, and the number of mobile phone users has increased by 5%;
- the Asia-Pacific is one of the world's most significant areas (in terms of the number of internet users), with more than 54% of global users;
- the number of mobile social media users in the EU is 340 million.

What is crucial for all these regions is the fact that "the use of mobile Internet is on the rise, access speeds are increasing, as well as the frequency of use, and mobile devices used to access the Internet are becoming more diverse (Kunić, 2017).

With regard to online shopping, an interesting piece of data from the aforementioned report is that 1.61 billion users are buying online with an annual increase of 9% (each user spends an average of 1.189 USD a year).

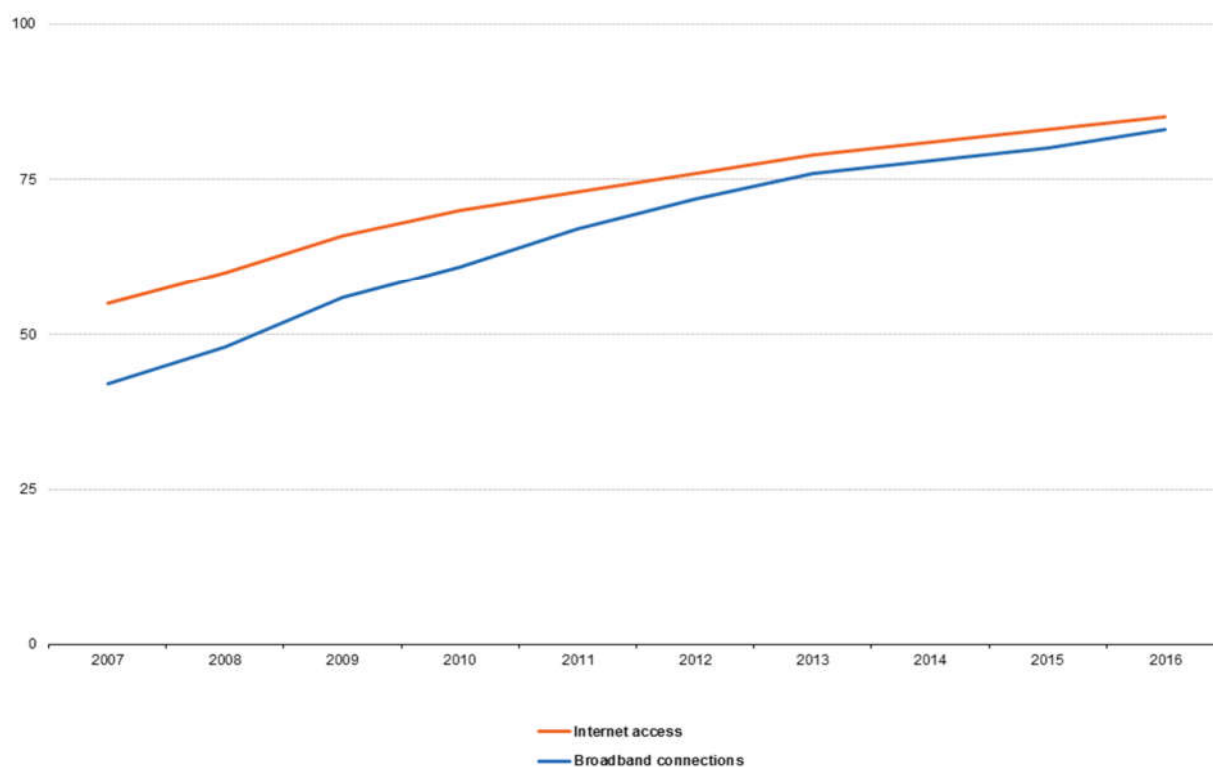
When it comes to social networks like Facebook, it is worth mentioning that it is being used by as many as 85% of mobile users, 64% of which are using it almost on a daily basis (Kunić, 2017).

The development of a new cyber market offers new opportunities and tools for marketing. Marketing has become "a distinctive way of thinking and acting of individuals, business groups, small and medium-sized enterprises, companies, corporations, business and non-profit institutions that participate in the exchange of all kinds of values on the market" (Ružić, Medić,

Andrić, 2005). The trend of development and use of mobile applications ensures the expansion of m-commerce, and this important role is also attributed to m-marketing, ultimately resulting in the development of m-economy. Mobile marketing relies on mobile phones and PDA (Personal Digital Asisstants) devices (Ružić, Medić, Andrić, 2005).

Digital marketing has become an imperative of success, implaying "implementation of marketing campaigns through digital channels (Internet, e-mail, mobile phone)" (Ružić, Medić, Andrić, 2005).

Mobile marketing is mostly used to promote products (catalogs, flyers, short daily promotional activities). In this way, marketing yields successful campaign and sales results of products advertised in this way. The quality of infrastructure, internet access and broadband Internet connectivity in households become crucial issues. Figure 1. shows household trends towards internet access and broadband internet connectivity, according to Eurostat data for the European Union (Eurostat, 2017).

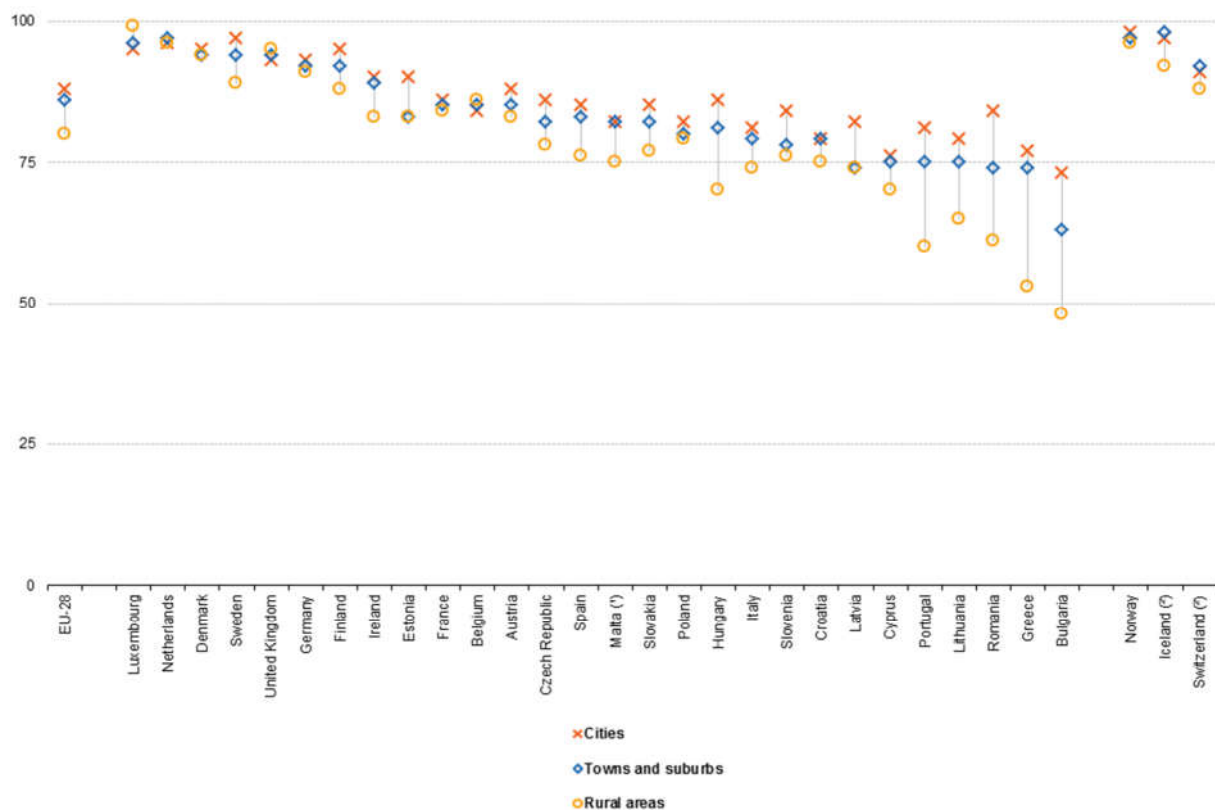


Source: Eurostat (online data codes: isoc_ci_in_h and isoc_ci_it_h)

Figure 1 Internet access and broadband internet connectivity in households, EU-28, 2007 – 2016 (% of all households) (Source: Eurostat, 2017.)

According to Figure 1, the share of households that have Internet access in the EU-28 group has reached 85%.

Although the period from 2011 to 2016 was characterised by a significant increase in total number of households that have Internet access, significant differences are present in households' access to Internet with regard to the degree of urbanization (the most recent data from 2016), as shown in Figure 2.



Note: ranked on overall internet access.
 (*) Rural areas: low reliability.
 (*) 2014.
 Source: Eurostat (online data code: isoc_ci_in_h)

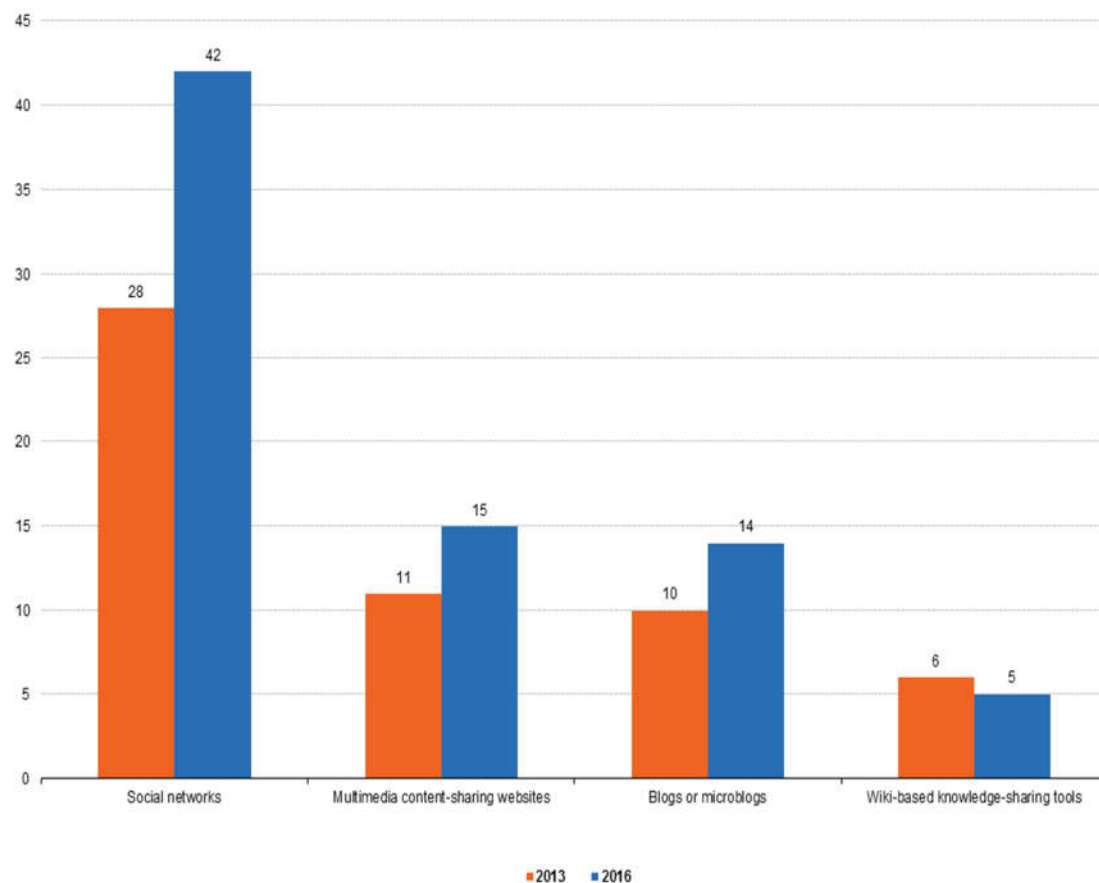
Figure 2 Internet access in households with regard to the degree of urbanization, 2016 (% of all households) (Source: Eurostat, 2017.)

3. Managing Integrated Marketing Channels in the Retail Industry

According to data collected by Eurostat for the European Union (Eurostat, 2017), several trends can be noticed:

- the speed of Internet connectivity is increasing (from 30 to 100 Mb/s);
- there is a significant increase in the use of social networks for business purposes, multimedia content and blogs / microblogs.

Figure 3. shows the aforementioned participation rates and ratios



Source: Eurostat (online data code: isoc_cismt)

Figure 3 The use of social media by companies with regard to the type of social media, EU-28, 2013 and 2016 (% of enterprises) (Source: Eurostat, 2017.)

Retail trade is one of the most dynamic areas of economy. According to Zahra (Digital Pulse, 2017), the habits of consumers in the retail sector are changing rapidly. The impact of the digital age is most strongly felt in the change of consumer habits in the retail sector. As much as 77% of CEOs in retail industry are expressing concern about changes in consumption and consumer behavior in the retail sector. Zahra (Digital Pulse, 2017) estimates that, unless the level of digitalization is constantly improved, systems will lose customers that will be difficult to bring back or make up for. For example, the Chinese company Alibaba exceeded the American Walmart in sales through online shopping and became the brand with the largest sales volume in the world, even though it has no physical retail stores. The Amazon store with no sales staff is an example of new sales concepts in the retail sector, that customers are already ready for. All over the world, online shopping is growing significantly faster than conventional retail (Digital Pulse, 2017). This trend was anticipated by domestic and foreign retail chains, of which companies Konzum and Lidl have been selected for the practical analysis section of this paper, as two dissimilar retail concepts with a strong market share in the Republic of Croatia (Konzum) and significant growth rates (Lidl).

According to Zahra, these are some of the most important trends that will continue to develop in the forthcoming period (Digital Pulse, 2017):

- smartphones have become the preferred buying tool (online sales on the so-called "Black Friday" in the US accounted for 25% of all online transactions via smartphones)
- omnichannel retail will remain a retail strategy in the upcoming period;

- shopping in a physical store will undergo changes due to the changes of consumer behavior, which increasingly correlates with the digital age; therefore, the role of the physical space and its potential use for different purposes (logistic, improvement of customer experience and similar) will be re-examined and reduced;
- retail advertising will have to be a lot "smarter" and "socially useful" to bypass ad blockers, as over 30% of users have ad blockers, and as many as 40% are thinking of installing them. Therefore, it is necessary to create such advertisements that consumers will enjoy and be happy to share on social network sites;
- social influence on online shopping decisions has increased: as much as 67% of consumers have declared that reading reviews and comments has a positive effect on their shopping behavior and purchase decisions;
- personalization of shopping experience is brought about by the fact that customers want a personalized shopping experience and an online offer created according to their preferences (age, gender, origin, local customs, etc.). Digital retailers can meet this requirement by using advanced analytics that take customer profiles into account and anticipate their needs, allowing retailers to efficiently create their offers and marketing campaigns;
- automated services and chatbots will keep improving thanks to artificial intelligence. Chatbots can be used for placing orders, while drones, apart from doing stocktaking in complex warehouses like those of Amazon, can also deliver food (e.g. Domino's Pizza).

The use of smartphones as payment devices is mostly influenced by specific regional features. For example, Germans prefer to use cash, unlike people in other European countries. According to a survey conducted in Germany and published by Price Waterhouse Coopers, approximately 55% of Germans are using or are planning to use a mobile device as a payment tool, even though they are satisfied with the existing payment methods (Beutin, Schadbach, 2017; 3).

Although various mobile payment technologies are available, there are still no clear mobile payment standards, which causes confusion among users of this type of service. The following has been observed in the aforementioned consumer survey (Beutin, Schadbach, 2017; 6):

- consumers want national mobile payment standards, such as standardized credit or debit cards; otherwise, a multitude of different online and m-payment solutions confuses them;
- more than 40% of consumers agree that mobile payment is useful if it is related to a product or service that is being promoted within an app (this payment method is also called "in-app payment");
- 79% of users in the survey responded that their data security and protection were the most important;
- 57% of users mentioned ease of use and speed of mobile payment (short registration process without unnecessary obstacles, short payment process) among the top three criteria;
- customers would be more willing to use in-app payment if more attractive products were offered and if user experience was flawless.

4. Case-Study Based on the Example of Selected Retail Applications in Konzum and Lidl Retail Companies

Through the use of mobile apps of various retail chains, mobile devices also serve as a quality marketing tool for promoting and improving retail sales results.

According to available research information published by Beutin and Schadbach (2017), about 46% of respondents do not recognize the advantages of mobile payment methods (Beutin,

Schadbach, 2017; 11). PayPal, Amazon Payment, Paydirekt, Google Wallet, and SOFORT are among the best-known online payment providers (Beutin, Schadbach, 2017; 13).

Konsum and Lidl retail chains have been selected for this case study.

Konsum was selected because it is the largest retailer in Croatia in terms of market share, and Lidl because it is a retail company operating in Croatia with strong revenue growth rates, whose concept of service largely differs from that of Konsum.

Konsum has its own "K" application which is linked to their online store. In addition to the "Klik" online shop, it is possible to purchase items through the Konsum Mobile Application and through the Konsum "Klik", as well as by using Drive-in and Pick-up services. Konsum's mobile application (second-level e-commerce) supports marketing activities and increases sales. The registration process is very simple, and the consumer can search current discount sales, or browse the entire product range which is divided into several commodity groups according to the category management settings.

Once the customer has signed in, he or she can buy items under his / her user name, select the delivery method (place, time and any potential notes for the driver), complete payment, as well as use MultiPlusCard programme coupons by filling in the MultiPlusCard number, thus collecting bonus points or using the previously acquired benefits from the aforementioned programme. The available payment methods are cash (payment upon delivery), credit cards, debit cards (American Express, Diners Club, MasterCard, Visa). Agrokor employees can pay with the MultiPlusCard if their card has been registered for payment, with a Konsum coupon and with a Konsum gift coupon (Konsum klik, 2018).

As far as marketing activities are concerned, they are implemented within several marketing products:

- According to product categories (defined according to the principles of Category Management): What's New, Health Corner, Moms and Babies, Pets, Fruit and Vegetables, Eggs and dairy products, and other categories;
- Special Offers;
- Today's Special;
- Monthly Theme;
- Konsum Catalogue;
- thematic leaflet (currently trending, for example: Mehrzer, Toys, seasonal assortment).

Customers can see each marketing activity in real time, as well as view the product, place an order and arrange delivery, and pay using the available payment methods.

According to the data from their website, delivery is available only in some geographic areas, mainly in major cities such as the city of Zagreb and its surroundings, Samobor, Velika Gorica, Zaprešić, Dugo Selo, Brdovec, Karlovac and its surroundings, Rijeka, Opatija, Split and Osijek and its surroundings (Konsum Klik, 2018). The app uses cookies to improve user experience.

Lidl's retail application uses the first-level e-commerce platform. The app allows users only to keep track of the current marketing campaigns. Product purchase and delivery is not possible.

Lidl's marketing campaigns are visible through this app, related to the following marketing products (Mobile app Lidl, 2018):

- Lidl top 3
- Lidl super 5
- Seasonal leaflet (tools, sweets, Easter, bicycles, leisure time, textile, pets, fish and sea food),
- Lidl Market
- Thursday's Finest
- Super Weekend

- The world of flowers.

Permanently promoted products:

- Baking goods
- Local flavours

Lidl uses applications that help improve future user experience, such as Google Analytics & Adjust, as they monitor consumer activities for the purpose of compiling activity reports and related analyses. These tools are used to improve advertising campaigns implemented via mobile devices. Some of the tools are: IDFA (Identifier for Advertising) or Android-Advertiser-ID, IP and MAC address, HTTP header, device imprint (access time, country, language, local settings, operating system and operating system version, and app version).

Table 1 Konzum and Lidl mobile apps' features (Source: compiled by the authors of the paper)

Element	Konzum app	Lidl app
The level of m-application	Browsing the overall offer and selected thematic activities	Only the selected themed activities can be browsed
Placing orders	Possibility of ordering products from marketing activities and other products through the app	Ordering through the app is not possible
The presence of advanced analytics	Advanced analytics tools are actively used	Advanced analytics tools are actively used
Loyalty programme	Embedded in transactions	No Loyalty programme
Product delivery	Possibility of product delivery by the retailer only in a limited sales area	No delivery options available from retailer
Marketing activities	The app sends notifications on current marketing activities	The app sends notifications on current and upcoming marketing activities

5. Conclusion

In the digital age, trends are changing: in the past, the focus was placed on the product, while today it is on the consumer and consumer portfolio management, ensuring loyalty and visibility of marketing campaigns. For this purpose, companies use tools like Google Analytics to establish a two-way communication with customers in the form of active dialogue, unlike the monologue that was used in the past.

Therefore, the Omnichannel Sales and Marketing Integration is part of the up-and-coming digital enterprise within the industry 4.0. According to the available data, strong trends have been identified worldwide, and it is estimated that 2.56 billion users are using social media. There are 340 million mobile users of social media in the EU alone, 64% of which are using the social networking sites almost on a daily basis via mobile devices.

A crucial trend can be observed, reflected in the fact that the use of mobile Internet is on the rise, access speeds and the frequency of use are increasing, mobile devices used to access the Internet are becoming more diverse, there is an increase in Internet connection speeds (from 30 to 100 Mb/s), and social networks are being used for business purposes, multimedia content and blogs.

Smartphones are becoming the preferred buying tools, and omnichannel retail will continue to develop in the following period as a retail strategy, while retail advertising will have to become more effective in order to bypass ad blockers. Customers want a personalized shopping experience and an online offer created according to their preferences (age, gender, origin, local

customs, etc.). Digital retailers can meet this requirement by using advanced analytics that take customer profiles into account, allowing retailers to create a more efficient retail strategy.

Based on the case study of Konzum and Lidl retail chains and their m-applications, differences in app usage levels have been observed. Konzum's mobile app offers a broad range of services, from browsing the current marketing actions to reviewing a wide range of commodities divided into categories. The app offers a variety of delivery / pick-up options, uses advanced analytics tools and allows various payment options.

Lidl's mobile app is more focused on marketing activities as a support to sales. It also uses advanced customer analytics, but without other benefits for customers (no delivery, online orders, loyalty programmes, or payment in installments).

According to the information presented above, there is a trend of digitalization of the retail sector, that other retail chains in the Republic of Croatia will have to adopt. Marketing activities serve as a strong support to sales activities, and its benefits and strategies can be identified through examples of m-applications of selected retail systems.

REFERENCES

1. Beutin, N., Schadbach, D. (2017). *Mobile Payment Report 2017*. Dusseldorf, Germany: Price Waterhouse Coopers.
2. Digital Pulse (2017). Retail Trends 2017: What is digital's impact on the retail sector?. Retrieved February 20, 2018, from <https://www.digitalpulse.pwc.com.au/retail-trends-2017-paul-zahra/>
3. Eurostat (2017). Statistical data about digital economy and society. Retrieved February 19, 2018, from http://ec.europa.eu/eurostat/statisticsexplained/index.php/Digital_economy_and_society_statistics_-_households_and_individuals/hr
4. Konzum klik (2018), Retrieved March 10, 2018, from <https://www.konzum.hr/klik/#/>
5. Kotler, Ph. (2006a). *How make, occupy and manage the markets*. Zagreb, Republic of Croatia: Poslovni dnevnik MASMEDIA.
6. Kotler, Ph. (2006b). *Ten deadly marketing sins*. Zagreb, Republic of Croatia: Binozza Press.
7. Kotler, Ph., Keller, K. L., Martinović, M. (2014). *Marketing Management*, 14. Zagreb, Republic of Croatia: Mate d.o.o.
8. Krumins, C. (2015). M-Commerce : The Growth Of An Online Shopping Revolution. Retrieved February 18, 2018, from <https://thehub.smsglobal.com/m-commerce>
9. Meola, A. (2016). The Rise of M-Commerce: Mobile Shopping Stats & Trends. Retrieved February 17, 2018, from <http://www.businessinsider.com/mobile-commerce-shopping-trends-stats-2016-10>
10. Mobile app Konzum, TrgPlay, Retrieved February 19, 2018.
11. Mobile app Lidl, TrgPlay, Retrieved February 19, 2018.
12. Ružić, D., Medić, M., Andrić, B. (2005). *E-marketing in Croatia*. XIX. Congress Cromar „Marketing Paradigms for 21. century“. Zagreb, Republic of Croatia: Cromar.
13. Schrauf, S., Bertram, Ph. (2016). Industry 4.0: How digitization makes the supply chain more efficient, agile, and customer-focused. PwC. Retrieved February 20, 2018. from <https://www.strategyand.pwc.com/reports/industry4.0>
14. Fieldnation (2015). The Mobile Revolution: eCommerce Apps vs. Websites for Retail. Retrieved February 20, 2018, from <https://www.fieldnation.com/blog/the-mobile-revolution-an-ecommerce-app-vs-website-for-retail>

The effect of ageing on consumers' preference for particular atmospheric elements

Ivana Plazibat

University of Split, University Department of Professional Studies, Kopilica 5, Split, Croatia
iplazibat@oss.unist.hr

Sanda Renko

University of Zagreb, Faculty of Economics and Business, J.F.Kennedy 6, Zagreb, Croatia
srenko@efzg.hr

Abstract. The old consumers are the only age group that is actually growing. They present a significant opportunity for retailers to direct more of their efforts at satisfying the needs. Some of the features which are targeted for the elderly include wider checkout lanes, larger signage and clearer price tags, call buttons around the stores, etc. Those elements form the part of the store atmosphere that suits the elderly market and draws older consumers toward purchase. The purpose of this paper is to find out whether retailers have provided an effective response to the aging consumer market by constituting an appropriate retail stores atmosphere and manipulating the elements such as colour, lighting, signage, etc. It has been explored in a study on the sample of Croatian consumers in order to understand what atmospheric cues some ageing groups of consumers consider important for purchasing fast moving consumer goods, with particular attention on the elderly consumers.

Key words: *retail, elderly consumers, store atmosphere*

1. Introduction

Population ageing is an important area of concern with significant implications on many industries. There are predictions that the segment of old consumers will grow by more than one-third in the next 15 years, and that by 2047 there will be more people older than 60 than younger than 15 worldwide (Walker and Mesnard, 2011). Therefore, many studies have been conducted to improve ageing people's quality of life from multiple perspectives such as public service, transportation services, health and retailing (Stewart, et al, 2014). Having in mind that the old consumers are among the most heavily polarised of groups, this market segment requires increased research effort necessary to accurate information about how to satisfy them. The purpose of this paper is to investigate the way in which retailers have recognized the potential of this market. As the world of retailing has changed unimaginably for the elderly during their lifetime, from the self-service phenomenon, internet retailing, mobile retailing, various retail strategies, etc., the paper is focused on a specific area of retail business - the store atmosphere and its elements that retailers use to communicate to old customers. In doing so, the paper begins with a short theoretical background with relevant work on shopping behaviour of older consumers, and an explanation of main dimensions constituting retail stores atmosphere that can meet the expectations of that segment. Although there is a vast of literature on older shoppers, it is mainly focused on developed countries (Yin et al., 2017). Thus, in order to overbridge that gap in research noticed by Yin et al. (2017), the impact of ageing on consumers' preference for particular atmospheric elements has been explored in the context of Croatia - one of the Southeast European emerging countries with the total population belonged to *Type 4 – very old age*. In 2011, there were 62% more old people than children in Croatia (Nejasmic and

Toskic, 2013), making the elderly market well worth of the research effort. Finally, a discussion of the theoretical and managerial implications, including limitations of the study and directions for future research are presented.

2. Literature Review on Shopping Behaviour of the Elderly

The substantial growth in the segment of older adults is expected in the next two decades (Zniva and Weitzl, 2016). Walker and Mesnard, (2011) explain this demographic shift as an “agequake” and identified its five major trends: i) birth rates are falling; ii) people are living longer; iii) people are staying healthy longer; iv) people are wealthier; and v) people are working longer. There are vast of literature highlighting and discussing the importance of the older customers’ shopping behaviour (Yin et al, 2013; Thompson et al, 2011; Meneely et al, 2009). Literature review revealed two streams of literature about the behaviour of the elderly as consumers. The first one is related to understanding the heterogeneous nature of a mature market, since there are numerous age (Pettigrew et al., 2004) and lifestyle (Oates et al., 1996) segments within the senior category that can result in a diversity of shopping preferences. The elderly segment has experienced a decline in appetite, food intake and dietary adequacy (Hare et al., 2001) as well as a decreasing ability to taste and smell, chewing difficulties and limited dexterity.

There are some characteristics that differentiate older customers’ shopping habits from those of younger customers, such as decreased price sensitivity, preferences for quality products, a tendency to make joint buying decisions and greater levels of store loyalty (Kohijoki, 2011). Angell et al. (2014) classify older grocery shoppers based upon the different levels of importance that they give to various store image factors when deciding on store choice. The other group of works on older customers’ shopping behaviour examine their attitudes towards the retail environment. Samli and Palubinskas (1972) discover that the elderly usually shop near their homes generally because they do not have their own transportation. They also found store loyalty to prevail--especially where store management can offer some advices. This is especially important for elderly consumers who have experienced some difficulties in shopping (Kelly and Parker, 2005) such as poor eyesight which can cause problems with reading labels, especially foreign packets and checking prices in grocery stores. Walker and Mesnard (2011) point out that old shoppers think they are inadequately served by retailers, that they face difficulties in navigating large stores, with too many hard to reach products on shelves, while label, prices and directions in stores are hard to read. There are works about the importance of accessibility for the elderly (measured by distance to the store, availability of car parking, store opening times, and perceived accessibility) (Ross, 1982; Meneely et al., 2009). Kelly and Parker (2005) analyse poor mobility problems which create difficulties in walking and navigating around stores, and reaching goods on shelves, and conclude that retailers involved in the grocery sectors have to be aware of the needs of the elderly and to prepare sufficiently for them.

The fact is that old people enjoy shopping, not only as a necessity but also as a social and leisure experience. Wilson et al. (2004) point out social aspects of the shopping experience (Wilson et al., 2004), because shopping can provide older consumers with exercise and entertainment (Tongren, 1988), particularly those who feel lonely. Therefore, retailers have been facing challenges with the elderly often shop alone due to lack of family or neighbourly assistance (Kelly and Parker, 2005). Dunn and Morgan (2001) warn about growing popularity of new delivery channels that are not an adequate solution for the elderly, because they need personal assistance in locating products within the store. With respect to personal selling, Lambert (1979) found older people wanting better treatment from store personnel--more patience and courtesy and willing to pay higher prices for shopping in such stores (Gelb, 1978). Ross (1982) characterizes shopping behaviour of older persons as: 1) more apt to pay cash for what they buy,

2) more apt to save and redeem savings stamps, 3) more apt to shop for specials (among males only), 4) less apt to use credit cards for extended payment purposes, 5) less apt to buy on impulse, 6) more apt to make up a list before shopping, and 7) more apt to check prices.

3. Holistic Character of the Store Atmosphere

Store atmosphere is the combination of the store's physical characteristics, such as architecture, layout, signs and displays, colours, lighting, temperature, sounds and smells which together create an image in the customer's mind (Levy and Weitz, 2012). Kotler and Keller (2006) point out that consumers purchase a total product, consisting of not simply the physical item but also the packaging, after-sales deal, advertising, image and – most importantly – the atmosphere of the store. From the text above we can conclude that the retail store atmosphere is a multi-dimensional concept comprising the store's physical characteristics, such as architecture, layout, signs and displays, colours, lighting, temperature, sounds and smells (Levy and Weitz, 2012) and that all those elements are highly interrelated and work together synergistically to affect consumers (Olahut et al., 2012). As store atmosphere significantly influence consumers in-store behaviour in a way that consumers might not be aware, very often retailers use it to control their customers. Accordingly, a store has a planned atmosphere that suits the target market and draws consumers toward purchase (Kotler and Keller, 2006). Customers prefer to shop at stores whose specific attributes are congruent with the lifestyles and expectations of consumers. Engel et al. (1995) found that elderly consumers indicated comfortable environment, physical and financial security, and easy access in stores as three qualities important to them during shopping. Angell et al. (2014) identified the importance of having a navigable layout for the elderly, while Lumpkin et al. (1985) point out the role of in-store seating areas for those who found shopping a physically difficult activity. In their study Meneely et al. (2009) were discussing about the influence of reachable shelf heights and wider aisles on the shopping experiences of the elderly. In accordance with Billings (1990) it is evident that senior consumers respond to more than just the core product or service being offered when making purchase decisions.

Following the assumption of Massara (2003), Mower et al. (2012), and Teller and Dennis (2012) about holistic character of the concept of atmosphere, we could identify three categories of atmospheric variables that interact with each other to influence customers' pleasure and arousal in the store environment: i) variables of the external environment, ii) variables of the interior of the store, and iii) human variables. The first group of variables includes the storefront, entrances, display windows, building architecture, the surrounding area, and parking (Newman and Cullen, 2002; Turley and Milliman, 2000), but there are limited research efforts investigating some effects of external variables on shopping behaviour (e.g. Cornelius et al., 2010; De Nisco and Warnaby, 2013; Oh and Petrie, 2012; Olahut et al., 2012). The second group of variables includes lighting and colour, scents and sounds, temperature, cleanliness, displays, signs, layout, music, etc. There is a wide range of literature on the effects of the interior atmospheric cues on customer behaviour, from studies on the influence of music (e.g. Bailey and Areni, 2006; Dube and Morin, 2001; Grewal et al., 2003; Yalch and Spangenberg, 2000), scent and odour (e.g. Banat and Wandebori, 2012; Morrin and Ratneshwar, 2000; Peck and Childers, 2008), lighting and colours (e.g. Ellis and Ficek, 2001; Babin et al., 2003, Chebat and Morrin, 2007; Hulten et al., 2008), layout (e.g. Bohl, 2012; Countryman and Jang, 2006), to the impact of displays (e.g. Banat and Wandebori, 2012). The third group of variables considers the human interaction with employees or other customers, that literature considers important in the creation of the store atmosphere (Heide and Grønhaug, 2006; Massara, 2003; Turley and Milliman, 2000). The literature considers the physical store environment, service staff, checkouts, parking access, receiving value for money, accessibility of products on shelves, and the availability of food products in appropriate (smaller) sizes as areas of retailers' activities

associated with ageing (Dychtwald, 1997; Goodwin and McElwee, 1999; Hare, 2003; Moschis et al., 2004), but for the elderly mostly human variables have proven to be of the primary importance among other atmospheric cues (Pettigrew et al., 2005). Namely, older consumers should get extra help when needed, because if you can make people feel important, they are going to come back (Solomon, 2006, p. 352). They also need a place to sit and rest while shopping (Beliavskaia, 2007; Mason and Bearden, 1979).

4. Research Method

A study on the sample of Croatian consumers was conducted in order to understand what atmospheric cues some ageing groups consider important in shopping with particular focus on the elderly consumers. A snowball sampling technique was used (time period October 2017–January 2018) because this technique is particularly useful in hard-to-reach population (Atkinson and Flint, 2001). Accordingly, respondents are sampled and then asked to help identify other respondents to sample and this process continues until enough samples are collected (Dusek et al., 2015). Table 1 summarizes the profile of the 355 respondents who participated in the research. As can be seen from Table 1, for the purpose of this study we focused on the “basic” dimensions that portray the respondents’ profile, namely gender, age, and education, with the percentages that indicate a satisfactory level for the purpose of this study.

Table 1 Respondents’ profile

	Percentage
<i>Gender</i>	
Female	58.2
Male	41.8
<i>Age (Years)</i>	
-25	20.8
26-40	20.6
41-55	20,7
56-	37.9
<i>Education</i>	
Unfinished Elementary	0
Elementary	11.2
3 years-High school	39.6
Secondary/High	37.6
College/University	11.6

Research instrument was created on the basis of the pertinent literature on store atmospherics (e.g. Baker et al., 2002; Berman and Evans, 2010; Chen and Hsieh, 2011; McGoldrick, 2002; Summers and Hebert, 2001; Turley and Milliman, 2000). Besides questions devoted to demographics of the sample, research instrument also consisted of 20 statements related to customer evaluation of store atmospheric cues and their respond to particular atmospheric cues in a store (measured by the relationship between store atmospheric cues and customer’s purchasing decisions). A five-point Likert-type scale (from 5=strongly agree to 1=strongly disagree) was used to investigate attitudes of respondents related to each statement. Moreover, in order to find out the rating of store atmosphere among other store attributes (such as price, product range & quality, services, location, personnel) direct evaluation of store attributes by respondents was required (1 = the most important store attribute, to 6 = the least important store attribute).

The collected data were analyzed using SPSS. Except from descriptive statistics calculations, testing the reliability with Cronbach's Alpha coefficient was conducted. The value of 0.78 and 0.72 respectively, suggested very good internal consistency reliability for scales used in this research (the recommended standard of 0.7 has been suggested by Nunnally (1978)). In order to find out the difference in consumers' preference for particular atmospheric elements related to age groups one-way ANOVA and Tukey post hoc test were performed. The conventional significance level of 0,05 was used.

5. Results and discussion

Table 2 shows the results of the direct evaluation of store attributes, and the rating of store atmosphere among other store attributes. As expected, price has the highest average score for all ages. Moreover, the atmosphere of a store is at the bottom of Table 2 for all ages. In such a way, we agreed with Dunne et al. (2002) who point out retailers' prices as specific atmospheric cues. The possible explanation of such rating lies in lower standard of living in Croatia which implies the price superiority. However, old respondents gave higher rating for location (mean =3.42) then for services (mean=3.50) due to the importance of accessibility for the elderly (Meneely et al., 2009)

Table 2 The rating of store attributes

<i>Rank</i>	<i>Attribute</i>	<i>Mean (all respondents)</i>	<i>St. dev. (all respondents)</i>	<i>Mean (old respondents)</i>	<i>St. dev. (old responders)</i>
1	Price	2.03	1.450	2.08	1.522
2	Product range & quality	3.23	1.732	3.32	1.760
3	Services	3.48	1.488	3.50	1.526
4	Location	3.50	1.388	3.42	1.947
5	Personnel	4.45	1.599	4.33	1.614
6	Atmosphere	5.54	1.525	5.49	1.586

(1=the most important attribute; 6=the least important attribute)

The analysis of the statements related to the store atmospheric (Table 3) shows that general interior variables, such as cleanliness of the store, layout and display are very important for respondents in general. According to Table 3, surrounding area and available parking are external variables that have impact on customers' decision to purchase in a particular store. In other words, Croatian consumers prefer variables related to convenience and ease access to the store. It is in accordance with the findings of De Nisco and Warnaby (2013) who found the link between store exterior and repeated patronage intentions.

Table 3 Top atmospheric cues

<i>Item</i>	<i>Mean</i>	<i>St. deviation</i>
Cleanliness of the store space	4.40	0.775
Displaying the merchandise in the store	4.24	0.882
Cleanliness and engagement of the store personnel	4.30	0.868
Product displays on the shelves	4.21	0.922
Price displays	4.03	1.030
Layout and circulation through the store	3.85	1.144
Parking availability	3.78	1.497
Pleasant scents	3.74	1.083
Surrounding area	3.12	1.259
Lighting and colours combination	3.26	1.517

Then, one-way ANOVA was conducted to explore the difference in consumers' preference for particular atmospheric elements across different age groups. There was a significant difference in almost all important atmospheric cues across four age groups: cleanliness of the store space

[F(3, 352) = 3.27, p = 0.021]; displaying the merchandise in the store [F(3, 352) = 5.55, p = 0.001]; cleanliness and engagement of the store personnel [F(3, 350) = 3.44, p = 0.016]; product displays on the shelves [F(3, 350) = 10.49, p = 0.000]; price displays [F(3, 352) = 2.94, p = 0.033]; layout and circulation through the store [F(3, 351) = 4.52, p = 0.004]; pleasant scents [F(3, 351) = 4.32, p = 0.005]; surrounding area [F(3, 349) = 4.62, p = 0.003]. However, age groups do not differ in rating of parking availability and lighting. Following the purpose of this study, post hoc comparisons using the Tukey HSD test was conducted because the results from the one-way ANOVA did not indicate which of the four age groups differ from one another. Post hoc comparisons using the Tukey HSD test indicated statistically significant difference in evaluating cleanliness of the store space between the age group (Gp 41-55yrs) and respondents older than 56yrs, where the age group “older than 56yrs” reported higher mean score (M = 4.48, SD = 0.76) than the age group (Gp 41-55yrs) (M = 4.38, SD = 0.75). Statistically significant difference in evaluating displaying the merchandise in the store is evident between the age group (Gp 26-40) (M = 4.08, SD = 0.96) and the age group “older than 56yrs” (M = 4.35, SD = 0.77). Moreover, Tukey HSD test indicated statistically significant difference in evaluating cleanliness and engagement of the store personnel between the younger and the older age group. Again, the older respondents (the age group “older than 56yrs”) reported higher mean score (M = 4.39, SD = 0.82) than the age group (Gp 26-40) (M = 4.19, SD = 0.90). Concerning the difference in evaluating product displays on the shelves as one of the atmospheric cues, statistically significant differences between all age groups are evident, and the age group “older than 56yrs” reported the highest mean score among others (M = 4.39, SD = 0.78). Additionally, statistically significant difference in evaluating layout and circulation through the store between the age group (Gp less than 25yrs) and respondents older than 56yrs was found. Again, the older respondents (the age group “older than 56yrs”) showed higher mean score (M = 3.99, SD = 1.09) than younger ones (Gp less than 25yrs) (M = 3.65, SD = 1.22). Concerning the difference in evaluating pleasant scents, statistically significant differences between the age group (Gp 26-40) (M = 3.55, SD = 1.01) and the age group “older than 56yrs” (M = 3.87, SD = 1.09). Finally, the Tukey HSD test indicated statistically significant difference in evaluating surrounding area between the age group (Gp 26-40yrs) and respondents older than 56yrs, where the age group “older than 56yrs” reported higher mean score (M = 3.27, SD = 1.23) than the age group (Gp 26-40yrs) (M = 2.89, SD = 1.19).

The results presented emphasised several aspects of the older consumers` preference for particular atmospheric elements reported in the literature (Pettigrew et al., 2005): adequate access to and within the store, in-store amenities, the courtesy and efficiency of staff, convenient product location. This is in line with Kelly and Parker (2005) and Walker and Mesnard (2011) who consider products availability, price displays, layout and easy circulation through the store more important for the elderly than other age groups due to their poor mobility problems which create difficulties in walking and navigating around stores, and reaching goods. Accordingly, we are not surprised that this age group of respondents significantly did not differ from others in evaluating parking availability and lighting and colours combination in the store, because literature suggests that the elderly prefer to avoid traffic congestion and to make purchases near their homes (Samli and Palubinskas, 1972), and that very often they have problems with poor eyesight (Kelly and Parker, 2005).

6. Conclusion

In the light of growing market segment of the elderly it is important for retailers to understand their heterogeneous nature and use the potential of this market. There are lots of elements that retailers can build their competitive strategy on, but this study was focused on the retail atmosphere as the silent sales person (Reddy and Reddy, 2012). Particularly, the purpose of this study was to investigate the preference of the older consumers for some atmospheric cues and

the difference between them and other age groups. The study on the sample of Croatian consumers highlighted the importance of price among other store attribute and the general neglecting of atmosphere. More detailed analysis on several atmospheric cues discovered that the segment of older consumers significantly differ from younger market segments in a way that senior consumers reported higher mean scores for all investigated atmospheric cues besides parking availability and lighting. The explanation lies in the fact that the elderly usually shop near their homes generally because they do not have their own transportation or they prefer convenience rather than traffic congestion. Concerning lighting, due to difficulties that they have with eyesight the elderly do not pay so much attention for lighting and colours combination. The paper improves the knowledge on challenges of Croatian retailers' activities associated with ageing related to simple adjustments to enhance the shopping experience for elderly consumers.

However, similar to any research, this study provides some useful findings but it has some limitations which have to be taken into account through future researches. First, the study was conducted outside of the store environment, and it was difficult to recall customers' emotional responses to a particular atmosphere. Additionally, there are various atmospheric cues included in the questionnaire design, but the examination of their interaction is missing. Finally, a qualitative research method is suggested to be included, because it could be more adequate for this mature market segment that still would like to feel "important".

REFERENCES

1. Angell, R. J., Megicks, P., Memery, J., Heffernan, T. W. (2014). Older shopper types from store image factors, *Journal of Retailing and Consumer Services*, 21(2), 192-202.
2. Atkinson, R., and Flint, J. (2001). Accessing hidden and hard-to-reach populations: Snowball research strategies. *Social Research Update*, 33.
3. Babin, B.J., Hardesty, D.M. and Suter, T.A. (2003). Colour and shopping intentions: The intervening effect of price fairness and perceived affect, *Journal of Business Research*, 56, 541-551.
4. Bailey, N. and Areni, C.S. (2006). When a few minutes sound like a lifetime: Does atmospheric music expand or contract perceived time?, *Journal of Retailing*, 82 (3), 189-202.
5. Baker, J., Parasuraman, A., Grewal, D. and Voss, G.B. (2002). The Influence of Multiple Store Environment Cues on Perceived Merchandise Value and Patronage Intentions, *Journal of Marketing*, 66 (April), 120-141.
6. Banat, A. and Wandebori, H. (2012). Store Design and Store Atmosphere Effect on Customer Sales per Visit, *PSRC - Planetary Scientific Research Center Proceeding of the 2nd International Conference on Business, Economics, Management and Behavioural Sciences*, Oct., 13-14, Bali, Retrieved June 30, 2017, from: <http://psrcentre.org/images/extraimages/1012545.pdf>.
7. Beliavskaia, O. (2007). The future is getting older so be prepared, Thesis, Umeå Business School Department of Business and Administration, Retrieved September 07, 2017, from: <http://www.diva-portal.org/smash/get/diva2:140592/fulltext01.pdf>
8. Berman, B. and Evans, J.R. (2010). *Retail Management: A Strategic Approach*, 11th ed., Pearson Education, Inc., Prentice Hall, Upper Saddle River, New Jersey.
9. Bohl, P. (2012), The effects of store atmosphere on shopping behaviour – A literature review, *Corvinus Marketing Studies*, 1, Retrieved June 30, 2016, from: http://unipub.lib.uni-corvinus.hu/669/1/CMT_2012-1.pdf
10. Chebat, J.-C. and Morrin, M. (2007). Colors and cultures: exploring the effects of mall decor on consumer perceptions, *Journal of Business Research*, 60 (3), 189-196.
11. Chen, H.-S. and Hsieh, T. (2011). The effect of atmosphere on customer perceptions and customer behaviour responses in chain store supermarkets, *African Journal of Business Management*, 5 (24), 10054-10066.
12. Cornelius, B., Natter, M. And Faure, C. (2010). How store front displays influence retail store image, *Journal of Retailing and Consumer Services*, 17, 143-151.

13. Countryman, C.C. and Jang, S. (2006). The effects of atmospheric elements on customer impression: the case of hotel lobbies, *International Journal of Contemporary Hospitality Management*, 18 (7), 534-545.
14. De Nisco, A. And Warnaby, G. (2013). Shopping in downtown. The effect of urban environment on service quality perception and behavioural intentions, *International Journal of Retail & Distribution Management*, 41 (9), 654-670.
15. Dube, L. and Morin, S. (2001). Background music pleasure and store evaluation Intensity effects and psychological mechanism, *Journal of Business Research*, 54, 107-113.
16. Dunn, S. and Morgan, V. (2001). Barriers to Access to Essential Services, *Independent Research Solutions, Northern Ireland*, Office of the First Minister & Deputy First Minister in Kelly, F.M. and Parker, A.J. (2005). Study of Retail Accessibility for Older People: The Elderly Poor and their Access to Grocery and Financial Services in Dublin, The Centre for Retail Studies, University College Dublin, Ireland, Retrieved June 01, 2017, from: http://www.combatpoverty.ie/publications/workingpapers/2005_CRS_TheElderlyPoor&AccessToRetailServices.pdf
17. Dunne, P.M., Lusch, R.F. and Griffith, D.A. (2002). *Retailing*, 4ed, South-Western, Thomson Learning, SAD.
18. Dusek, G. A., Yurova, Y. V., & Ruppel, C. P. (2015). Using social media and targeted snowball sampling to survey a hard-to-reach population: A case study. *International Journal of Doctoral Studies*, 10, 279-299. Retrieved from <http://ijds.org/Volume10/IJDSv10p279-299Dusek0717.pdf>
19. Dychtwald, M.K. (1997). Marketplace: riding the wave of population change, *Journal of Consumer Marketing*, 14 (4), 271-86.
20. Ellis, L. and Ficek, C. (2001). Colour preferences according to gender and sexual orientation, *Personality and Individual Differences*, 31, 1375-1379.
21. Engel, J. F., Blackwell, R. D., and Miniard, Paul W. (1995). *Consumer Behavior*. (8th ed.). Orlando: The Dryden Press.
22. Gelb, Betsy D. (1978). Exploring the Gray Market Segment, *MSU Business Topics*, 1, 41-46.
23. Goodwin, D.R. and McElwee, R.E. (1999). Grocery shopping and an ageing population: research note, *International Review of Retail, Distribution and Consumer Research*, 9 (4), 403-9.
24. Grewal, D., Baker, J., Levy, M. and Voss, G.B. (2003). The effects of wait expectations and store atmosphere evaluations on patronage intentions in service-intensive retail stores, *Journal of Retailing*, 79, 259-268.
25. Hare, C. (2003). The Food Shopping Experience: A Satisfaction Survey of Older Scottish Consumers, *International Journal of Retail and Distribution Management*, 31(5), 244-255.
26. Hare, C., Kirk, D., and Lang, T. (2001). The Food Shopping Experience of Older Consumers in Scotland: Critical Incidents, *International Journal of Retail and Distribution Management*, 29, 25-40
27. Heide, M. and Grønhaug, K. (2006). Atmosphere: Conceptual Issues and Implications for Hospitality Management, *Scandinavian Journal of Hospitality and Tourism*, 6 (4), 271-286.
28. Hulten, B., Broweus, N. and van Dijk, M. (2008). *Sensory Marketing*, Palgrave Macmillan.
29. Kelly, F.M. and Parker, A.J. (2005). Study of Retail Accessibility for Older People: The Elderly Poor and their Access to Grocery and Financial Services in Dublin, The Centre for Retail Studies, University College Dublin, Ireland, Retrieved June 01, 2017, from: http://www.combatpoverty.ie/publications/workingpapers/2005_CRS_TheElderlyPoor&AccessToRetailServices.pdf
30. Kohijoki, M.A., (2011). The Effect of Aging on Consumer Disadvantage in Grocery Retail Services Among the Finnish Elderly, *Journal of Retailing and Consumer Services* 18 (2011), 370-377.
31. Kotler, P. and Keller, K.L. (2006). *Marketing Management*, 12th ed, Pearson Education, Inc., Upper Saddle River, New Jersey.
32. Lambert, Z.V., (1979). An Investigation of Older Consumers' Unmet Needs and Wants at the Retail Level. *Journal of Retailing* 55 (4), 35-57.

33. Levy, M. and Weitz, B.A. (2012), *Retailing Management*, 8th ed., McGraw-Hill/Irwin, NY.
34. Mason, J. B. and Bearden, O. W. (1979). Satisfaction/Dissatisfaction with Food Shopping Among Elderly Consumers, *Journal of Consumer Affairs*; 13 (2), 359-369.
35. Massara, F. (2003). Store atmosphere: still a fledgling art, *ECR Journal*, 3 (2), 47-52.
36. McGoldrick, P. (2002). *Retail Marketing*, McGraw-Hill Education, London.
37. Meadow, H.L., Cosmas, S.C. and Plotkin, A. (1981). The Elderly Consumer: Past, Present, and Future, *Advances in Consumer Research*, Vol. 08, eds. Kent B. Monroe, Ann Arbor, MI : Association for Consumer Research, 742-747.
38. Meneely, L., Burns, A. and Strugnell, C. (2009). Age associated changes in older consumers retail behaviour, *International Journal of Retail and Distribution Management*, 37(12), 1041-1056.
39. Moschis, G.P., Curasi, C. and Bellenger, D. (2004). Patronage motives of mature consumers in the selection of food and grocery stores, *Journal of Consumer Marketing*, 21 (2), 123-133.
40. Morrin, M. and Ratneshwar, S. (2000). The effects of retail store environment on retailer performance, *Journal of Business Research*, 49, 167-181.
41. Mower, J.F., Kim, M. And Childs, M.L. (2012). Exterior atmospherics and consumer behaviour: Influence of landscaping and window display, *Journal of Fashion Marketing and Management*, 16 (4), 442-453.
42. Nejasmic, I. and Toskic, A. (2013). Starenje stanovništva u Hrvatskoj–sadašnje stanje i perspektive, *Hrvatski geografski glasnik*, 75/1, 89 –110.
43. Newman, A.J. and Cullen, P. (2002). *Retailing: environment & operations*, Thomson Learning, London
44. Nunnally, J.C. (1978). *Psychometric theory*, McGraw-Hill, New York.
45. Oates, B., Shufeldt, L. and Vaught, B. (1996). A psychographic study of the elderly and retail store attributes, *Journal of Consumer Marketing*, 13 (6), 14-27.
46. Oh, H. and Petrie, J. (2012). How do storefront window displays influence entering decisions of clothing stores?, *Journal of Retailing and Consumer Services*, 19, 27-35.
47. Olahut, M.R., El-Murad, J. and Plaias, I. (2012). Store atmosphere: Conceptual Issues and It's Impact on Shopping Behaviour, International Conference "Marketing – from information to decision", 5th Edition, 317-343.
48. Peck, J. and Childers, T. (2008). If it Tastes, Smells, Sounds, and Feels Like a Duck, then it must be a ...: Effects of sensory factors on consumer behaviours, 193-219, in Haugtvedt, C.P., Herr, P.M. and Kardes, F.R. (Eds.), *Handbook of Consumer Psychology*, Psychology Press, New York.
49. Pettigrew, S., Mizerski, K. and Donovan, R. (2005). The three "big issues" for older supermarket shoppers, *Journal of Consumer Marketing*, 22/6, 306–312.
50. Pettigrew, S., Mizerski, K. and Donovan, R. (2004). Segments within segments: younger and older seniors' expectations of financial planning services, *Journal of Research for Consumers*, 7, 341-350.
51. Reddy, B.K. and Reddy, J.S. (2012). Atmospherics: a silent sales person in organized retailing, *International Journal of Sales, Retailing and Marketing*, 1 (1), 23-29.
52. Ross, I. (1982). Information processing and the older consumer: Marketing and public policy implications, *Advances in Consumer Research*, 09, 30.-39., Retrieved from: <http://www.acrwebsite.org/search/view-conference-proceedings.aspx?Id=5897>
53. Samli, A. C. and Palubinskas, F. (1972). "Some Lesser Known Aspects of the Senior Citizen Market - A California Study," *Akron Business Review*, 3, 47-55.
54. Solomon, M. R. (2008). *Consumer Behavior: buying, having and being*, 8 ed., Prentice Hall, New York.
55. Stewart, J., Crockett, R., Gritton, J., Stubbs, B. and Pascoe, A. (2014). Ageing at Home? Meeting Housing, Health and Social Needs, *Journal of Integrated Care*, 22, (5/6), 242-252
56. Summers, T. and Hebert, P. (2001). Shedding Some Light on Store Atmospherics: Influence of Illumination on Consumer Behaviour, *Journal of Business Research*, 54, 145-150.

57. Teller, C. and Dennis, C. (2012). The Effect of Ambient Scent on Consumers' Perception, Emotions and Behaviour – a Critical Review, *Journal of Marketing Management*, 28 (1/2), 14-36.
58. Thompson, J.L., Bentley, G., Davis, M., Coulson, J., Stathi, A. and Fox, K.R. (2011). Food shopping habits, physical activity and health-related indicators among adult aged ≥ 70 years, *Public Health Nutrition*, 14(9), 1640–1649
59. Tongren, H.N. (1988). “Determinant behavior characteristics of older consumers”, *Journal of Consumer Affairs*, Vol. 22 No. 1, 136-57.
60. Turley, L.W. and Milliman, R.E. (2000). Atmospheric effects on shopping behaviour: A review of the experimental evidence, *Journal of Business Research*, 49, 193-211.
61. Walker, M. and Mesnard, X., (2011). What Do Mature Consumers Want?, Global Business Policy Council, A.T.Kearney, Inc., Retrieved July 30, 2017, from: https://www.atkearney.de/documents/856314/1214204/What_Do_Mature_Consumers_Want.pdf/2fab37a7-0c6a-4d9f-aba8-8cbd433f3920
62. Wilson, L.C., Alexander, A. and Lumbers, M. (2004). “Food access and dietary variety among older people”, *International Journal of Retail & Distribution Management*, Vol. 32 No. 2, 109-22.
63. Yalch, R. and Spangenberg, E. (2000). The Effects of Music in a Retail Setting on Real and Perceived Shopping Times, *Journal of Business Research*, 49, 139-147.
64. Yin, Y., Song, Q. and Ranchhod, A. (2017). An exploratory study of older customers' holistic supermarket shopping experience in China, Design Management Academy Conference: Research Perspectives on Creative Intersections, Retrieved September 01, 2017, from: https://eprints.soton.ac.uk/410419/1/DMA_2017_Yuanyuan_Yin_Final.pdf
65. Yin, Y., Pei, E., and Ranchhod, A., (2013). The shopping experience of older supermarket consumers, *Journal of Enterprise Information Management*, 26(4), 444 – 471
66. Zniva, R. and Weitzl, W. (2016). It's not how old you are but how you are old: A review on aging and consumer behaviour, *Management Review Quarterly*, vol. 66, iss. 4, 267–297; DOI 10.1007/s11301-016-0121-z

Entrepreneurial Zones in Split-Dalmatia County

Sladana Brajević, senior lecturer

University Department of Professional Studies
University of Split, Croatia
brajevic@oss.unist.hr

Antonija Roje, lecturer

University Department of Professional Studies
University of Split, Croatia
ababic@oss.unist.hr

Ivan Brajević, mag. iur.

ivan.brajevic@inet.hr

Abstract. The term entrepreneurial infrastructure refers to a network of public and private sector institutions that support the development of entrepreneurship. The need to facilitate and expedite the development of entrepreneurship has resulted in the establishment of various support institutions and an extensive legislative infrastructure which represents the basic prerequisite for a continuous entrepreneurial activity in any country. Entrepreneurial infrastructure consists of business incubators, entrepreneurship centres, technology parks, entrepreneurial zones, free zones, development agencies, and clusters. They all share a common goal – strengthening of entrepreneurship and development of private initiatives in all spheres of economic life. Entrepreneurship and small businesses need incentives and legal security that perpetuate the processes of forming new economic entities, accompanied by the use of new knowledge and technologies. This paper will provide an overview of entrepreneurial zones in Split-Dalmatia county, and of the benefits that these zones provide to entrepreneurs who operate within the said zones, and will present an analysis of the legal regulations of the Republic of Croatia underpinning the development of entrepreneurial zones.

Keywords: *entrepreneurial zones, entrepreneurial infrastructure, legislative framework of the Republic of Croatia, entrepreneurship, Split-Dalmatia county*

1. Introduction

Well-developed market economies recognize entrepreneurship as a generator of the development of national economy. The rate of entrepreneurial activities depends on the strength of entrepreneurial framework and its conditions (Levie and Autio, 2008.) In order to develop and affirm itself, entrepreneurship requires appropriate support and infrastructure. Research suggests that small firms have a much larger share in job creation than is their share in stocks of jobs (Davidsson et al., 1998).

Entrepreneurial infrastructure in the Republic of Croatia includes entrepreneurial zones and entrepreneurship support institutions, and the main issues regarding their definition and organization are regulated by the Entrepreneurial Infrastructure Improvement Act (the Official Gazette, 2013). Numerous measures and activities for improving the development of economy have been successfully implemented through cooperation among the national and local government, scientific and education institutions, and private sector. The purpose of improving entrepreneurial infrastructure is to enhance economic growth and establish a stimulating business environment that will contribute to a balanced regional development of the Republic

of Croatia, a quicker progress of entrepreneurship, and an increase in investment and employment.

The entrepreneurship support institutions include: development agencies, entrepreneurial centres, business incubators, business accelerators, business parks, science and technology parks, and centres of competence.

As a part of the comprehensive entrepreneurial infrastructure, entrepreneurial zones are defined as infrastructurally equipped areas designated for specific types of entrepreneurial activity. The main feature of entrepreneurial zones is that they allow entrepreneurs to jointly use the infrastructurally equipped and organized space; by doing their business within an entrepreneurial zone they can rationalize their business and use the available resources in the entrepreneurial zone along with other users. Entrepreneurial zones should be equipped with energy, communal, transport and communication infrastructure, as well as with entrepreneurship support institutions.

This paper will provide an outline of entrepreneurial zones in Split-Dalmatia county, as well as of the legal framework required for the establishment and development of entrepreneurial zones.

2. Entrepreneurial zones in Split-Dalmatia County

Entrepreneurial zones are areas which meet the long-term needs of entrepreneurs for a space in which to conduct their business, allow a joint use of infrastructure and facilitate networking among entrepreneurs. Entrepreneurial zones are characterized by a concentration of small and medium-sized businesses.

An entrepreneurial zone should be equipped with energy infrastructure (electricity, public lighting, gas, etc.), communal infrastructure (water supply, sewerage, drainage, etc.), transport infrastructure (access roads, roads within the zone, parking and loading ramps, etc.) and communication infrastructure (telephone network, internet, etc.). Entrepreneurial zones should provide stimulating working conditions for entrepreneurs by allowing them to use common infrastructure and strengthen their social capital.

In Croatia, the main purpose of establishing entrepreneurial zones was to increase employment and allow a more balanced development of Croatian regions (Lončar, 2008).

Entrepreneurial zones can be classified according to their size, type of activity, and the intensity of activation of the available area (the Official Gazette, 2013). Based on their size, entrepreneurial zones are divided into: micro zones (up to 10 ha), small zones (10 to 50 ha), medium-sized zones (50 to 100 ha), and large zones (more than 100 ha). According to the type of activities, entrepreneurial zones are divided into: production and processing zones, logistics and distribution zones, and mixed service zones. According to the intensity of activation of the available area, entrepreneurial zones can be divided into inactive zones (the available area occupancy rate is 0%), zones in the initial activation (the degree of activation is less than 33%), medium-active zones (the degree of activation is 33 to 66%) and fully active zones (the degree of area activation is 66% or more).

Split-Dalmatia county occupies the central part of the eastern Adriatic coast, stretching from the municipality of Marina to the municipality of Gradac. It also encompasses the islands of Brač, Hvar, Vis, Šolta, Drvenik, and the Dalmatian hinterland with the towns of Sinj, Imotski and Vrgorac. The capital of the county is the city of Split which, according to the Croatian Bureau of Statistics (DZS, 2011) has the population of 188.694 people. The area of 4.572 km² (around 8% of Croatia's territory) houses 463.676 inhabitants (approximately 10% of Croatia's population), 19% of which are employed, according to the recent data.

According to the Comprehensive Registry of Entrepreneurial Infrastructure (Ministry of Entrepreneurship and Crafts, 2018), the following support institutions are active in the territory of Split-Dalmatia county: five entrepreneurship centres, two centres of competence, two local development agencies, one county development agency, five entrepreneurship incubators, one technology park and seven entrepreneurial zones.

The first organized activities regarding the preparation and construction of entrepreneurial zones began in 2004, when the County adopted the Programme for Encouraging the Construction of Entrepreneurial Zones for the period 2004–2007. The most recent Programme was adopted for the period 2013–2016, and it contains data on 37 entrepreneurial zones. According to the Programme, the zones have been divided into three categories: the zones of strategic importance for the County (9 zones), smaller zones predominantly focused on service activities (13 zones) and zones in the initial activation stage (15 zones).

Approximately 420 million dollars have been invested into entrepreneurial zones of Split-Dalmatia county. The largest amount, almost 70%, was invested by the units of local self-government; around 9% derives from county investments, 16% from state investments, and the remaining approximately 5% from the investments by general partnerships. The spatially largest complex of entrepreneurial zones in Split-Dalmatia county, with around 180 million kunas of investment, is located in the municipality of Dugopolje. Entrepreneurial zones in the territory of Split-Dalmatia county contain 222 active companies, employing a total of 5.663 people, with the Dugopolje entrepreneurial zone accounting for 3.200 employees (Report on the conducted revision of efficiency of establishing entrepreneurial zones in Split-Dalmatia county and investing in their equipment and development, 2014).

3. Legal framework for the establishment and development of entrepreneurial zones

Entrepreneurial infrastructure is established and managed by units of local and regional self-government and other legal entities based in the Republic of Croatia, that are registered for activities that improve the development of entrepreneurial infrastructure. The Entrepreneurial Infrastructure Improvement Act (the Official Gazette, 2013) regulates the issue of defining entrepreneurial infrastructure and its form in Croatia. According to this law, entrepreneurial infrastructure is a spatially specific form of performing various entrepreneurial activities. Entrepreneurial infrastructure is defined as a system of entrepreneurship support institutions and entrepreneurial zones. The Entrepreneurial Infrastructure Improvement Act (the Official Gazette, 2013) precisely defines all institutions that support entrepreneurship: development agencies, entrepreneurship centres, business incubators, entrepreneurship accelerators, business parks, science and technology parks, and centres of competence. The literature documents the impact of government regulations, the availability of resources, and public policies in enabling and facilitating entrepreneurship (Eckhardt and Ciuchta, 2008; Lee et al., 2004; Minniti and Levesque, 2008; Verheul et al: 2002). A favourable environment of regional and local institutions contributes to the removal of administrative, technical, financial and other barriers that new entrepreneurs face (Delić et al., 2012). The support system for entrepreneurial zones consists of three types of grants: infrastructure grants (which support the construction of energy, utility, transport and communication infrastructure), grants that strengthen competitiveness (aimed at entering new markets and attracting investors), and education grants (which support the strengthening of entrepreneurial competencies) (the Official Gazette, 2013).

In order to enhance direct domestic and foreign investment and to increase competitiveness of Croatian economy, activities aimed at improving the legal framework for encouraging and promoting investments are being continuously implemented. The Investment Promotion Act (the Official Gazette, 2015) is in full compliance with the EU ‘acquis’ regarding national and regional investment support. In the Republic of Croatia, domestic and foreign investors have

equal treatment, rights and obligations. Investors have the opportunity to use non-repayable grants and tax reliefs for their investment projects. All investors who invest into production and processing activities, development and innovation activities, business support activities and high value-added activities are eligible to receive support from the Republic of Croatia. For most entrepreneurs, the most attractive available measures are tax reliefs, i.e. lower corporate tax rates or corporate tax exemption. The maximum intensity of the support is 25%, 35% or 45% of the total investment cost, depending on whether the investment project is carried out by a small, medium-sized or large business (a company or a trade subject to corporate tax). The amount and the method of allocation of grants is defined in the annual programmes for encouraging entrepreneurship and crafts, i.e. for encouraging regional development, adopted by the Government of the Republic of Croatia following a proposal of the ministry competent for entrepreneurship and crafts, i.e. for regional development and European Union funds (the Official Gazette, 2015).

Pursuant to Article 12 of the Entrepreneurial Infrastructure Improvement Act (the Official Gazette, 2013), grant beneficiaries as entities in the entrepreneurial infrastructure are required to submit the necessary data on entrepreneurial zones to the Comprehensive Registry of Entrepreneurial Infrastructure.

To reduce the cost of establishing entrepreneurial zones, units of local self-government should give precedence to the lands owned by the units of local self-government or by the Republic of Croatia when identifying the locations for entrepreneurial zones, because in this way the costs of land purchase are avoided. Land for entrepreneurial zones can be obtained by purchase from private owners, expropriation of private land owners, on the basis of a gift agreement, as well as pursuant to an official decision by a competent ministry on allocating the land from a forest management area for a fee determined by the Croatian Forests Ltd., pursuant to the provisions of the Forestry Act (the Official Gazette, 2014). Pursuant to provisions specified in Articles 51 and 51.a of the Forestry Act (the Official Gazette, 2014), the Government of the Republic of Croatia, i.e. the body authorised by it, can allocate a specific forest land owned by the Republic of Croatia from the forest management area and transfer the ownership to the unit of local self-government for the purpose of constructing an entrepreneurial zone. The procedure of land allocation is initiated upon request submitted by the unit of local self-government on the basis of a land division study based on the urban design plan of the entrepreneurial zone.

The duration of the above-mentioned procedures has a strong impact on the possibility of entrepreneurial zones to achieve their purpose, making it difficult to attract investors to the entrepreneurial zones and frequently resulting in investors withdrawing and ceasing to implement the activities they planned to conduct in the entrepreneurial zones.

Pursuant to the Decree on Granting Properties Owned by the Republic of Croatia (the Official Gazette, 2013), the construction of entrepreneurial zones is important for the development of Croatian economy. According to the Strategy for Management of the Property Owned by the Republic of Croatia (the Official Gazette, 2013), it is necessary to consolidate the land designated for entrepreneurial zones in order to attract more serious domestic and foreign investors who require large areas equipped with communal infrastructure. Units of local self-government have concluded land sale agreements with entrepreneurs which prevent the property from being expropriated or encumbered for a certain number of years from the contract conclusion date, and contain other provisions aimed at protecting the public interest in the event of land sale.

4. Research methodology and findings

The purpose of this research was to meet research objectives, explore the benefits of the existing infrastructure, and understand and explore the benefits for investors.

The structured questionnaire method was applied. In our research, closed type questions were used, as they yield answers which are easier to code and quicker to analyse. Using Google Docs, we created a form which represents the basis of our online survey. Having created the form, we sent it as a direct e-mail to the members of our target group. The target group of respondents who can best provide the information we need are the business zones in Split-Dalmatia county. Preparations for the analysis of business zones in Split-Dalmatia county also included desk research, and audio scripts that contained a large number of questions significant for the research also proved to be highly valuable for the analysis. Respondents were contacted by e-mail.

The structured questionnaires include 4 questions each. The measuring instrument (questionnaire) for this research consisted of a set of questions that the respondents were asked to answer and express their agreement/disagreement with the proposed statements, whereby the Likert measurement scale of five degrees was used (1- not at all; 2 – very little; 3 – some, 4 – much, 5 – completely).

Research database was compiled in accordance with the database on entrepreneurial zones administered by the Croatian Chamber of Economy on its website. According to the Croatian Chamber of Economy (2018), there are 9 active entrepreneurial zones in Split-Dalmatia county, to whom we sent our questionnaire.

Also, our survey was conducted in a very sensitive period, between December 2017 and January 2018, when most Croatians use their annual leaves, which we took into consideration and adjusted our questionnaire so that it can be easily filled in on a mobile phone or tablet. Of 9 questionnaires that were sent, 7 were returned, representing a response rate of 78%, which can be accepted as relevant in social surveys (Fombrun and Rindova, 1998).

Entrepreneurial zones which have filled in our questionnaire and which underwent further statistical analysis are the following:

(1) Bristovača-Trištenica Entrepreneurial Zone

The business zone is exceptionally well planned and positioned, and its development is of great importance both for the municipality of Primorski Dolac and for the revival and further development of the neighbouring municipalities of Prgomet, Lećevica and a part of Šibenik–Knin County. The business zone covers 49,34 hectares of land, and is planned as a self-standing zone in which the following construction is permitted: production and service facilities, warehouses, offices, hospitality facilities and other supporting facilities. During the first construction phase of the zone, the following communal utilities were completed: water supply and hydrant network was laid, sewage and storm water network was built, sidewalks and green areas were built, and public lighting installed; plots have been planned; one TS 10-20/0,4 KV power substation was built, and low- and medium-power networks were laid; telecommunication installations were installed, county road ŽC 6091 Plano-Perković was reconstructed, and horizontal and vertical signalization was set. The business zone is divided into 13 plots, which consist of a total of 70 parcels extending from 1600 m² to 16000 m², with the possibility of joining them into larger plots. Until now, seven parcels have been sold.

(2) Čaporice-Trilj Entrepreneurial Zone

Located next to the A1 Highway (Zagreb-Split-Dubrovnik), 20 km from the main motorway entrance to the city of Split and 35 km away from the city centre, Čaporice-Trilj Entrepreneurial Zone covers an area of approximately 50 ha. The zone is located 35 km from the international airport of Split and 35 km from the railway station and sea port in Split. Completely equipped

in terms of infrastructure, with communal reliefs for the zone users, the zone is focused on industry and service activities.

(3) Kosore (Vrlika) Entrepreneurial Zone

The zone is located next to the D1 motorway (Split-Sinj-Zagreb), 85 km from the international airport of Split, 73 km from the sea port in Split and 32 km from the railway station in Knin. Distance from A1 highway (Zagreb-Split-Dubrovnik) is 53 km from the Šibenik entrance/exit, and 55 km from the Split entrance/exit. Kosore (Vrlika) entrepreneurial zone covers an area of almost 35 ha. Completely equipped in terms of infrastructure, the zone is focused – besides clean production and manufacturing activities – on commercial and service activities.

(4) Podi West Entrepreneurial Zone

Located next to the A1 highway (Zagreb-Split-Dubrovnik), at the main motorway entrance/exit to the city of Split and 12 km away from its centre, the Podi West (Dugopolje) entrepreneurial zone covers an area of almost 100 ha and is a part of the integrated entrepreneurial zones in Dugopolje. The zone is located next to the D1 motorway (Split-Sinj-Zagreb), 25 km from the international airport of Split and 17 km from the railway station and sea port in Split. Completely equipped in terms of infrastructure, the zone is focused, besides clean production and manufacturing activities, on commercial and service activities.

(5) Ratac Entrepreneurial Zone

PPUO Postira is defined as an area designated for economic and business purposes in Ratac, occupying an area of about 5.1 hectares. It is located in the south-west of Postira, south of the Ž6161 county road, which is also the access road to the zone itself. A new access road with a total length of about 450 m was built from the county road to the Ratac area. The future activities include the construction and commissioning of a sardine canning factory in 2013.

(6) Ravča Entrepreneurial Zone

Ravča zone is located north and south of the D62 state road, right next to the Ravča intersection on A1 Highway, 300 meters away from the entrance. With its ideal geographic location and excellent traffic connection, the zone allows a fast flow of goods, products and inputs. The envisaged ferry port in Drvenik is only 10 km away from the zone, the port of Ploče is 30 km away, and the vicinity to the state border with Bosnia and Herzegovina (10km) is an additional advantage for those entrepreneurs whose business activities are based on cross-border placement or procurements of goods, input and services.

(7) Zlopolje Entrepreneurial Zone

Located next to the road connecting the town Vis, Milna and Rukavac, 3 km away from the centre of the town of Vis, it occupies a total surface of almost 6.5 ha. The zone is completely equipped in terms of infrastructure, and is focused, besides clean production and manufacturing activities, on commercial and service business activities.

Table 1: Entrepreneurial zones in Split-Dalmatia County

NAME OF THE ZONE	Existing infrastructure					
	Road access	Electricity	Sewage	Water	Gas	Telecommunications
Bristovača-Trištenica Business zone	yes	yes	yes	yes	yes	yes
Čaporice-Trilj Economic Zone	yes	yes	yes	yes	yes	yes
Kosore (Vrlika)	yes	yes	yes	yes	no	yes

Entrepreneurial zone						
Podi West	yes	yes	yes	yes	yes	yes
Ratac Economic Business zone	yes	yes	yes	yes	no	yes
Ravča Economic Zone	yes	yes	yes	yes	no	yes
Zlopolje	yes	yes	yes	yes	no	yes

Source: Research Findings (January 2018.)

Table 2: Entrepreneurial zones in Split-Dalmatia County

NAME OF THE ZONE	TOTAL SIZE IN m ²	PRICE PER m ² (min)	PRICE PER m ² (max)	NUMBER OF EXISTING COMPANIES
Bristovača-Trištenica Business zone	493.400	Sales: 5,0 €	Sales: 5,0 €	7
Čaporice-Trilj Economic Zone	500.800	Sales: 4,0 €	no maximum	14
Kosore (Vrlika) Entrepreneurial zone	350.000	Sales: 2,7 €	public procurement	9
Podi West	958.6	Sales: 30€	Sales: 50 €	10
Ratac Economic Business Zone	51.000	Sales:0€	Sales:0 €	1
Ravča Economic Zone	680.000	Sales: 3 €	Sales: 3 €	5
Zlopolje	65.000	No answer	No answer	No answer

Source: Research Findings (January, 2018.)

Table 3: Entrepreneurial zones in Split-Dalmatia County

NAME OF THE ZONE	Benefits for investors
Bristovača-Trištenica Business zone	(1) Spatial and Urban Design plans accepted; attractive construction land, sales price (5,0€); (2) Communal contribution fee of 3,00 €/m ³ ; (3) Utilities of 0,5 HRK/m ² for production activities, and 1 HRK/m ² for other activities; (4) Built infrastructure (phase I); (5) High environmental standards, including the construction of a biological wastewater filter; (6) Possibility of connecting to the Bosiljevo-Dugopolje gas pipeline. For all potential investors, other benefits on the local, regional and national levels are provided: (1) Exemption from payment of communal charges during the first four years: 100% in the first year, 75% in the second year, 50% in the third year, and 25% in the fourth year. Other benefits: (1) Instalment payment of municipal communal contributions: 50% immediately, and the rest is payable in several instalments; production facilities – exemption from payment of the communal contribution; (2) Tax incentives for foreign investments (Investment Promotion and Development of Investment Climate Act, the Official Gazette No. 111/12); (3) Incentives for employment and self-employment.
Čaporice-Trilj Economic Zone	Communal reliefs for zone users
Kosore (Vrlika) Entrepreneurial zone	(1) Communal relief for zone users; (2) Communal fee is free; (3) Communal charge is free for the first 3 years.
Podi West	(1) Tax reliefs and (2) Communal reliefs for zone users
Ratac Economic Business zone	(1) Tax reliefs and (2) Communal reliefs for zone users

Ravča Economic Zone	(1) Tax reliefs; (2) Exemption from the unitary fee; (3) First year of business operation: -100%; second year of business operation: -75%; third year of business operation: -50%; fourth year of business operation: -25%.
Zlopolje	No answer

Source: Research Findings (January, 2018.)

5. Conclusion

Entrepreneurial zones are an important part of entrepreneurial infrastructure, because infrastructurally equipped areas provide conditions for establishment and development of new businesses that will stimulate economic growth and employment of population living in passive areas, therefore also reducing the differences in the economic development between different parts of the Republic of Croatia.

In order to attract investments, entrepreneurs are offered a number of benefits for conducting business in entrepreneurial zones, such as tax reliefs (lower tax rates or corporate tax exemption), complete or partial exemption from communal contributions, communal fees and company tax for a specific period of time.

Furthermore, it is necessary to ensure legal security and facilitate administrative procedures for those who invest in entrepreneurial zones. Some land sale agreements do not contain provisions which specify what the purchased land will be used for nor do they allow the protection of public interests in the event of land sale. Therefore, it is necessary to incorporate such provisions in land sale agreements, aimed at protecting public interests and the purpose for which entrepreneurial zones have been established.

Having analysed entrepreneurial zones in Split-Dalmatia county, we can conclude that the analysed zones are fully equipped in terms of infrastructure, with varying levels of entrepreneurial activity. Entrepreneurs are offered a number of benefits, such as partial or total exemption from communal fees for the first three years of conducting business, tax reliefs and a low property prices, as well as a clear land ownership structure. The analysed entrepreneurial zones are designated for the development of production and service activities. The potential for development of entrepreneurial zones in Split-Dalmatia county, and hence for the development of entrepreneurship itself, is significant, but previous investments in the equipment and development of entrepreneurial zones have not been sufficiently efficient. Certain zones are active, fulfilling their primary purpose, whereas most of them are still only envisaged in spatial plans.

The research itself is limited in several aspects. It is difficult to conduct an analysis of the effectiveness of these entrepreneurial zones because different names for the same entrepreneurial zones are used in the draft, official and legal documents. Entrepreneurial Infrastructure Registry, available on the web page of the Ministry of Entrepreneurship and Crafts (2018), records and systematizes only those stakeholders of the entrepreneurial infrastructure in the Republic of Croatia that are or intend to be beneficiaries of grants, incentives and benefits approved by the government bodies responsible for awarding grants, incentives and benefits. It does not contain the data on all existing entrepreneurial zones in Split-Dalmatia county or in Croatia. It is therefore necessary to establish an information system which will consolidate various services of the units of local self-government, the County, chambers and other competent institutions, and form a unique database on entrepreneurial zones. Vertical information linkages would allow the collection, processing and storage of data on investments into equipment and development of entrepreneurial zones. In this way, the data would be consolidated, updated and easily available. Further research should focus on collecting data about the number of enterprises and employees over time, and about the satisfaction of the entrepreneurs that conduct their business in those entrepreneurial zones.

REFERENCES

- Davidsson, P., Lindmark, L. and Olofsson, C. (1998). Smallness, Newness and Regional Development. *Swedish Journal of Agricultural Research*, vol. 28 (1), pp. 57-71.
- Delić, A., Alpeza, M. and Oberman Peterka, S. (2012). Uloga poduzetničkih potpornih institucija u razvoju gospodarstva Istočne Hrvatske – Slučaj osječkog Centra za poduzetništvo. In *Proceedings of the 1st International Scientific Symposium Economy of Eastern Croatia – Yesterday, Today, Tomorrow*, pp. 32-42.
- Državni zavod za statistiku (2011). Popis stanovništva 2011. Retrieved January 13, 2018, from <https://www.dzs.hr/hrv/censuses/census2011/censuslogo.htm>.
- Eckhardt, J.T. and Ciuchta, M.P. (2008). Selected variation: the population-level implications of multistage selection in entrepreneurship. *Strategic Entrepreneurship Journal*, vol. 2 (3), pp. 209-224.
- Fombrun, C.J. and Rindova, V. (1998). Reputation Management in Global 1000 Firms: A Benchmarking Study. *Corporate Reputation Review*, vol. 1 (3), pp. 205-212.
- Hrvatska gospodarska komora (2018). Poduzetničke zone Splitsko dalmatinske županije. Retrieved January 02, 2018, from: <https://www.hgk.hr/zupanijska-komora-split/poduzetnicke-zone>.
- Izješće o obavljenoj reviziji učinkovitosti osnivanja i ulaganja u opremanje i razvoj poduzetničkih zona na području Splitsko – dalmatinske županije, Republika Hrvatska, Državni ured za reviziju, Područni ured Zadar. (2014). Retrieved January 10, 2018, from <http://www.revizija.hr/izvjesca/2014/rr-2014/revizije-ucinkovitosti/osnivanje-i-ulaganje-u-poduzetnicke-zone/poduzetnicke-zone-na-podrucju-splitsko-dalmatinske-zupanije.pdf>.
- Lee, S. Y., Florida, R. and Acs, Z.J. (2004). Creativity and entrepreneurship: a regional analysis of new firm formation. *Regional Studies*, vol. 38 (8), pp. 879-891.
- Levie, J. and Autio, E. (2008). A theoretical grounding and test of the GEM model. *Small Business Economics*, vol. 31 (3), pp. 235-263.
- Lončar, J. (2008). Industrijske, slobodne i poslovne zone – pojam, značenje i faktori lokacije. *Geoadria*, vol. 13 (2), pp. 187-206.
- Ministry of Entrepreneurship and Crafts (2018). Register of entrepreneurial infrastructure. Retrieved January 10, 2018, from Ministry of Entrepreneurship and Crafts: <http://reg.minpo.hr/pi/public/#>.
- Minniti, M. and Lévesque, M. (2008). Recent developments in the economics of entrepreneurship. *Journal of Business Venturing*, vol. 23 (6), pp. 603-612.
- Official Gazette (2013). Uredba o darovanju nekretnina u vlasništvu Republike Hrvatske, Zagreb: Narodne novine d.d., 123/11, 129/11 i 127/13.
- Official Gazette (2013). Zakon o unaprjeđenju poduzetničke infrastrukture. Zagreb: Narodne novine d.d., 93/13, 114/13, 41/14.
- Official Gazette (2014). Zakon o šumama, Zagreb: Narodne novine d.d., 140/05, 82/06, 129/08, 80/10, 124, 10, 25/12, 68/12, 148/13 i 94/14.
- Official Gazette (2015). Zakon o poticanju ulaganja, Zagreb: Narodne novine d.d., 102/15.
- Verheul, I., Wennekers, S., Audretsch, D. B. and Thurik, R. (2002). An eclectic theory of entrepreneurship: policies, institutions and culture. In: Audretsch, D. B., Thurik, R., Verheul, I., Wennekers, S. (Eds.), *Entrepreneurship: Determinants and Policy in a European – U.S. Comparison*. Kluwer Academic Publishers, Norwell, MA, pp. 11-82.

Analysis of the Sport Consumer Behavior and Identification of a Niche and Tourism Market Opportunities for Extreme Athletes in Croatia

Zvonimir Stamenov, student
Aspira University College, Split, Croatia
zvonimir.stamenov@aspira.hr

Ivana Jadrić, v. pred.
Aspira University College, Split, Croatia
ivana.jadric@aspira.hr

Martina Petrovic, pred.
Aspira University College, Split, Croatia
martina.petrovic@aspira.hr

Abstract. Contemporary development of tourism, as well as sports, has increased the possibilities in which they create new touristic products together. A healthy way of life, draws attention to the more frequent sporting lifestyle and thus travelling motivated by sports. When we add increasingly desirable adrenaline content actively sought by young people, as well as the saturation of classical sports, we realize that there is a growing demand for the content offered by extreme sports. This paper analyzes the characteristics of sports consumers, with particular emphasis on extreme sports and its users. For the purpose of analyzing the characteristics of extreme athletes, as well as supply and demand for this specific type of sport, a two-part study was conducted. With the first, online questionnaire survey, the attitudes of tourist agencies and other creators of extreme sports offerings were surveyed in order to register the offer for this profile of tourists. Subsequently, a second questionnaire was created to analyze the characteristics and reasons for the travel of extreme athletes and to create their classical profile. 288 respondents participated in the survey, of which 103 tourism subjects (who answered the first questionnaire) and 185 extreme athletes (who answered the second survey questionnaire). Research has shown that tourism subjects are increasingly aware of the strengths of tourists of this profile and plan to increase the content adapted to their needs. On the other hand, it provided us with concrete guidelines for creating the profile of extreme athlete tourists.

Key words: *sports consumer, extreme sport, selective forms of tourism, tourist offer.*

1. Introduction

The time we live in is rapidly changing. On the other hand, consumer needs are rapidly changing in terms of all aspects of demand as well as sports. It is believed that the occurrence and growth of extreme sports is in fact a reflection of the characteristics of today's time (Hudson, 2003). Sport has a special role in a modern society that goes far beyond mere fun (Kahle, 1996). Its meaning for the development of individuals and societies is unquestionable, and the positive effects of this segment of human activity turn it into a serious business. With the growth of a fast-paced lifestyle, people today are encouraged to turn more towards themselves and their health. Since sporting and sporting life is one of the assumptions of a healthy man, it is clear that sport enters into all the other societal pores. Today we are witnessing an exceptionally large number of participants in sports activities, only in the UK sports activities involve 75% of adults, and in Japan 72% (Funk, 2011). Important aspect,

then, becomes a journey in which the main motive is to engage in sporting activity. A new element of tourism business is getting on importance: sport tourism. In this paper, the authors will deal with the contemporary form of sport tourism that is becoming more and more effective. It's about extreme or active sport. It will be considered who are really extreme sports consumers, how much is their journey due to developed extreme sport and whether there is a need on the one hand, and the basis for the development of extreme tourism in Croatia, on the other.

Particularly, participation in extreme sports, sometimes called adventure sports, action sports or even individualistic sports, has vastly increased in the last 20 years (Puchan, 2005). However, there is a question why such phenomenon appears? The key role in the increase of these types of sports can be attributed to the influence of the media and to the development of new technologies that make it easier for people to participate in relatively risky sports activities (Rauter and Topič, 2011). Of course, one must take into consideration that in extreme sports it is about a specific type of consumer who decides on sports activities based on the main reason of pleasure and satisfaction (Higham, 2005). Sociology studies and leisure sociology research often point to inequalities in the availability of opportunities to participate in a wide range of leisure experiences due to the gender, race and social class among others (Gibson, 2010). Based on everything stated above, a new selective form of tourism is being developed, which drags the entire sports industry and the accompanying industries for the production of sports aids.

In order to better understand the phenomenon of the growing tourist market of extreme sports, it is necessary to understand what extreme sports really are. After the theoretical background, we should analyze whether it is really a growing market and a niche with the great potential. Also, it is necessary to analyze extreme sports consumers, their habits and preferences. Finally, in order to suggest the development of the phenomenon itself, it is necessary to analyze the current state of extreme sports in the current tourist market.

2. Literature Review

2.1 Characteristics of extreme sports consumers

Consumer behavior is the key to creating a product (Horner and Swarbrooke, 2016). As stated by Solomon (1996), it is a process in which an individual or group chooses, purchases, uses and disposes a particular product, service, idea or experience to meet their needs or desires. When sporting consumers are analyzed, the definition becomes a little more concrete, depending on the type of product that these consumers consume. When it comes to a sports consumer, it is important to emphasize that it is only the journey through which the consumer passes that matters, not the result, regardless of whether the consumer in the sporting activity is participating or is the observer, he is definitely involved solely because of the experience (Funk, 2011). Although the difference in destination selection and other features is certainly present when we distinguish between active participants and passive observers (Higham, 2005). Why is it important to analyze sports consumers at all? Due to the fact that informing consumers about demographics, psychography and behavior in sports, it allows sport retailers to come up with a comprehensive picture of their targeted segment on the sport market (Sport Sector Analysis Report, 2004, Ko et al 2008). Therefore, the fact of numerous studies of the characteristics of sports consumers is not surprising. Specifically, when analyzing the phases that a sports consumer pursues in the planning of a specific trip for sporting content, they could be divided into several phases: the stimulating phase, the decision phase, the preparatory phase, the travel phase, the return phase and the evaluation phase (Kurtzman and Zauhman, 2005). Each phase needs to be identified in order to provide the consumer of extreme sports with needed information at certain phase. If, however, the sports branch in

which are the mentioned sports consumers is to be concretized, then some consumer characteristics specific to the sports they are dealing with could be laid out. When it comes to extreme sports, there is often a reason why someone is engaged in a sport that is in the verge of danger. Although some authors point out that extreme athletes are seen negatively in the society, such as those who unnecessarily risk and question their health and life (Brymer and Oades, 2007), other authors say the experience of dealing with extreme sports creates positive psychological experiences that change states of consciousness such as changes in perception of time and increases the level of sense consciousness. For those who deal with extreme sports, the ability to overcome their daily experience is a greater motivation and inspiration than experiencing short-term excitement by risking the pursuit of these sports (Brymer and Mackenzie, 2017). It is interesting that most sportsmen dealing with this type of sport are realistic and fully aware of all the risks that these sports activities carry within themselves, what many authors consider to be an interesting subject for further research in a psychological sense (Reil, 2005). Furthermore, a survey conducted on a sample of 253 respondents (Ko and sur. 2008) shows that this is about highly motivated sports consumers who are not afraid to risk in life. In the research (Oliver, 2006) it was proved that the most common reason for dealing with extreme sports activities is hedonism and personal satisfaction. The implications of this research suggest that it is extremely important to think about how to create a special experience for participants because it is dominant in the overall feeling of satisfaction at the end, significantly more than the location where extreme sports are taking place. Also, it is important to point out that in the overall sense of satisfaction of extreme sports participants the way of grouping is also very important. According to Rauter and Topic (2011), not every extreme sport is equally dangerous. Namely, the difference lies in personal perception of danger, as individuals perceive in different ways where the limit of danger and extremity is. A survey of 277 respondents in Turkey has confirmed that the largest number of extreme sportsmen are mainly male and in an individual type of sport such as kitesurfing, windsurfing, paragliding, snowboarding, snowkiting, rock climbing, rafting, kayaking etc. (Ceylan and sur, 2015). The reason the hypothesis is that it is mainly about "male" sports lies in the fact that it is more about physically demanding sports in contrast to some other sports (Rauter and Doupona, 2011). The authors also see the reason in the fact that men have a stronger desire for success, and are more confident than women in sports abilities. The important fact stemming from this research is that most of the respondents in this research are informed via the Internet (59.5%), and over the television (26%). Other media are relatively irrelevant to the mentioned group. Another confirmed assumption is that most athletes dealing with extreme sports are highly educated. In their research, 67.9% of respondents completed some degree in higher education (undergraduate, graduate, doctorate). So, most of them are highly educated people, but also people who deal with some of the better-paid jobs. Even 68.8% of the respondents in this research are those who are in managerial positions, people who are the owners of their business, and those who are currently in the field of graduate education, which would mean that they are striving for jobs that will enable them a high standard of living. The 2008 study in Israel (Prizam et al., 2008) shows that athletes who are highly motivated to travel in search of the feeling of experiencing something different and new are prepared to spend more money to engage in adventurous and risky sporty extreme tourist adventure.

Gibson (2010) states in his article that the highest rate of participation in this type of sport are people 25-34 years old with household income of 50 000 to 74 999 dollars. He also emphasized that white men, men with higher levels of education and income are more likely to remain actively involved in sports after the stated age limit, especially in individual sports.

As a rule, he states that the general characteristics of active sports tourists are as follows:

- More likely to be male
- Affluent individuals
- College educated
- Willing to travel long distances to participate in their favourite sports c
- Likely to engage in active sport tourism well into retirement
- Tend to engage in repeated activity i.e. not a 'one-off' vacation

2.2 Extreme sport as a selective form of tourism

During the 70s of the last century, selective forms of tourism (Rabotić, 2012) have emerged as a type of tourism that appears to counterbalance the mass tourism. The most important feature of selective tourism is the establishment of tourists in the focus of exploration and design of offers and tourist products. In such profiled tourism, the tourist becomes the main subject identified by his name and surname (Luković, 2008). Sports tourism is defined by the World Tourism Organization (2010) as specific travel outside the customer's usual environment for either passive or active involvement in sport where sport is the prime motivational reason for travel. Sport tourism includes travel to participate in a passive (e.g. sports events and sports museums) or active sport holiday (e.g. scuba diving, cycling, golf), and it may involve instances where either sport or tourism is the dominant activity or reason for travel (Ritchie & Adair, 2010). In modern times, selective forms of tourism become more diverse and offer their consumers a wider range of customized products. One of these selective forms of tourism that is increasingly changing and evolving is sport tourism. As mentioned by Klaus and Maklan (2011), in some countries, sport can make up to 25% of all tourist revenues. According to the British Tourist Board and the English Tourist Board, 20% of tourist trips have a sporting character. Sport is an integral part of every culture and, often viewed as a separate activity, is inextricably linked to tourism. However, it is very important to emphasize how the perspective changes when it comes to touristic travelling motivated by sports. Now the center should not be a destination with its contents, but the sporting event itself and its accompanying contents (Williams, 1996). It is generally recognized that there are three broad categories of sports tourism: watching sporting events, visiting sports related attractions, and active participation (Gibson, 2010). How do sporting tourists behave numerous authors have also been analyzing, some of which had already stated in 1976 that sporting tourists are generally more informed, better educated and more active in their holiday than classic tourists (Schreiber, 1976).

As one of the topics of sport tourism, this article is particularly concerned with extreme sports tourism. Over the years, sport and physical activity are constantly being adapted, redesigned, or even created from scratch. Often the main cause of these innovations is combustion or abandonment among participants who experience more major activities when sport loses its pleasure for them (Cohen and Peachey, 2014). Action or extreme sports are more academic phrases for alternative sports - "activities that ideologically or practically give alternatives to major sports and sports values" (Rinehart, 2000). The concept 'adventure sport', as used in this essay, covers a relatively broad field of sports or physical activity. It includes sports that are labeled 'alternative', 'extreme', 'X', 'gravity', 'lifestyle' and 'action' sport. There are no clear boundaries between these sports (Breivik, 2010). Some authors point out that extreme sport has emerged as a symbol of a postmodern society in which people seek new activities to explore their boundaries (Puchan, 2005). When we look at the global sporting tourism market, it is difficult to estimate its financial value because it is quite close to the global tourism market and a separate sporting market, but it is certainly a rising market with higher financial value (Higham, 2005).

To understand more clearly which sports are extreme sports, you need to get acquainted with the division of extreme sports. Extreme sports can be divided in a variety of ways, but here we decide to divide them by the type of movement on the surface - skating sports (surfing, windsurfing, wakeboarding...) and rolling (mountain biking, rallying, motocross). After that division, they are divided according to the required equipment for the sport, i.e. extreme sports that need a vehicle (car, motorcycle, bicycle, skateboard...) and extreme sports that do not require any vehicle (free climbing, parkour, canyoning,...). Extreme sports for which a vehicle needs to be used are further divided into sports requiring a motor vehicle (rallying, motocross...) and sports that do not require a motor vehicle (mountain biking, windsurfing, sailing...) (Tomlinson, 2004). According to this division, it is easier to define the areas where certain sports will run, as well as the necessary equipment and infrastructure that will enable safe dealing with these sports.

It is important to mention a research on extreme sports made near Croatia that was conducted in 2011 in Slovenia. The author's wish was to analyze extreme sports, the most popular extreme sports and to compare demographic characteristics with conclusions from the classic sporting consumer of extreme sports (Rauter and Topič, 2011). Research has shown that a large number of respondents deal with a particular type of extreme sports, 63.1% extreme athletes are still mostly male and the most popular sports in Slovenia are biking, hiking, or climbing and running. Most of the motives which inspire extreme athletes are the fun, relaxation and attractiveness of the extreme sport itself.

3. Empirical Research

3.1 Instrument, procedure and sample

This paper analyzes the characteristics of sports consumers, with particular emphasis on extreme sports and its users. For the purpose of analyzing the characteristics of extreme athletes, as well as the supply and demand for this specific type of sport, a two-part study was conducted. With the first, online questionnaire survey the attitudes of tourist agencies and other creators of extreme sports offerings were surveyed in order to register the offer for this profile of tourists. The second questionnaire used extreme athletes' answers, across the Earth, to create a classic profile of an extreme tourist to track their demand. It was also created online and forwarded to numerous websites and forums that bring together extreme sports enthusiasts. It was created to analyze the characteristics and reasons for the travel of extreme athletes and to create their classical profile. A total of 288 respondents' answers were collected, out of which 103 responses were from the creators of the tourist offer and 185 from the extreme athletes.

For the purpose of researching the offer in the Republic of Croatia and the demand for, i.e. the creation of an extreme tourist profile, two survey questionnaires were used as an instrument of research. Both were forwarded online, using Google docs to create an online questionnaire for the period from 15 August to 15 September 2017. The e-mail data base of tourist agencies, sports centers, private renters and other persons employed in tourism was created based on the personal databases of various tourist entities, the Split Tourist Community and the Association of Croatian travel agencies. They were asked to fill the first survey questionnaire to record the offer which Croatia gives to extreme athletes. The questions were created based on previous theoretical research and were arbitrarily shaped. The issues should be gained insight into the offer that tourist companies have for extreme athletes, how many arrangements they offer for that segment, how many extreme athletes stay on their journeys, how much they spend on travel, etc.

Another questionnaire filled by extreme athletes was also created on the basis of presented theoretical knowledge, referring to the analysis of extreme tourists as consumers. The goal was to find out how many trips a year the extreme athletes are going to go, how long they travel, what accommodation they use, how much they spend on travel, how far they travel for sport etc. Taking into account the globalization aspect of tourism and in order to make the research of the characteristics of extreme athletes more credible, the 185 athletes' responses dealing exclusively with extreme sports and filling in this survey questionnaire come from all over the world. Instruments and hypotheses were set up based on the information provided in the research review.

How many responses have been collected from which geographic location is shown in the graph. The blue column represents the respondents from the Republic of Croatia, the next orange column represents Western European respondents, gray from North America, yellow from Eastern Europe, light blue from Australia and Oceania while the green column is a tag for other countries.

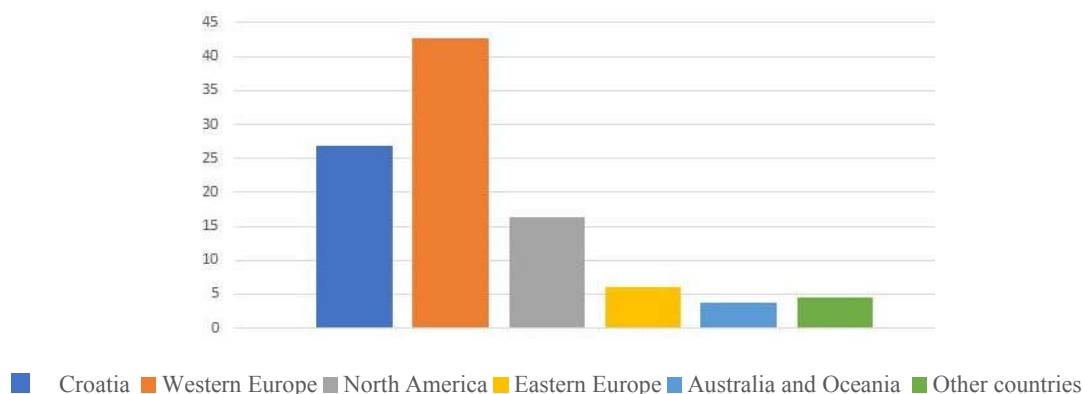


Figure 1 Geographical location analysis of survey participants

The rise of adventurous or extreme sports is seen by some authors as a parallel development and reflection of modern society. As such, they represent opposition and protest against certain aspects of modern societies, but it can also be said that they express key ideas in modern and postmodern society such as individualism, technology, self-realization and transcendence (Breivik, 2010). Therefore, we conclude that in the modern society we have the awareness of tourist subjects about the importance of implementing extreme sports content in the basic offer and the ever greater realization of the same. Also, many authors claim that adventure or extreme tourism is one of the major niche segments in the tourism industry (Naidoo and sur,2015) with an estimated annual growth of over 15 percent. Adventure tourism has grown significantly in recent years, becoming a major niche within the special interest tourism sector, and is said to be the fastest growing outdoor tourism market sector (Wiliams and Soutar, 2009). Based on the above, hypothesis H1 is set.

H1: The tourism market is experiencing growth in extreme sports and sees its niche for the development of specialized tourist-sporting products.

As authors already mentioned above, adventure tourism consumers tend to be young, educated, affluent, active thrill seekers who spend significant sums of money in their pursuit of adventure. Adventure travellers are often demanding and discerning consumers while on holiday, and often travel to some of the most remote, extreme environments of the world to satisfy their needs for emotional highs, risk, challenge, excitement, and novelty (Wiliams and Soutar, 2009). Following mentioned and numerous researches on the profile of extreme athlete tourists (Rauter and Doupona, 2011) where it is stated that athletes specializing in

extreme sports are generally educated and more gifted. Also some authors claimed that they have higher income (Gibson 2010), so the hypothesis of H2 is set.

H2: Extreme athletes are of better financial solvency and are more willing to spend on their travel than classic tourists.

3.2 Results of research related to tourism offer of extreme sports in the Republic of Croatia

At first it was analyzed how many of these tourist agencies and other tourist entities in their tourist offer have contents related to extreme sport. Data were obtained according to which 68.4% of respondents in their offer had certain content customized for extreme athletes.

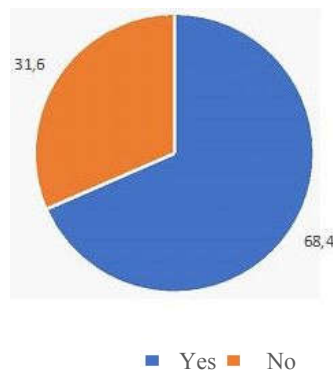


Figure 2 Offers content related to extreme sports

Furthermore, it was observed in which price categories the price of arrangements related to extreme sports moves. The analysis found that the largest number of subjects (42.8%) offer arrangements put in the category up to € 1000 for arrangements, while only 14.28% of the agencies have arrangements that exceed the price of € 1000 in their offer (Figure 3).

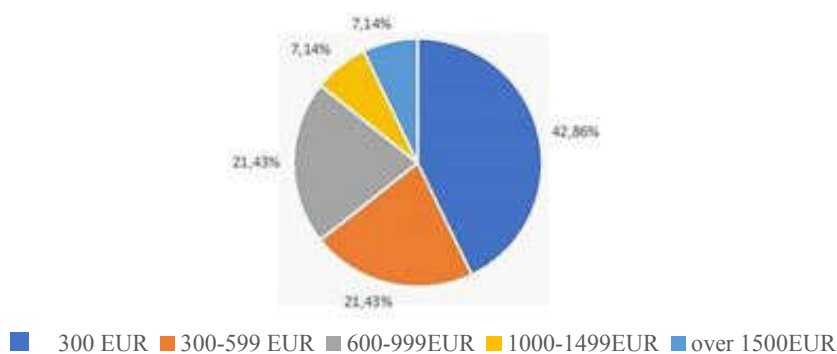
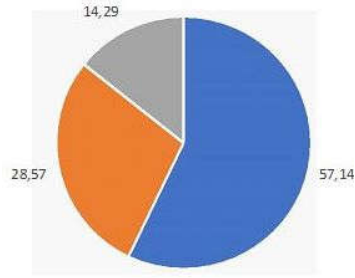


Figure 3 Price arrangements for the packages of extreme sports

Also, 100% of surveyed subjects recognized that it is necessary to include extreme sports in a tourist offer. Among them as much as 75% of the agencies plan to include new sports in the offer next year, of which they plan to have 72% new arrangements which they want to put into the price category up to 600 €.

Below it is analyzed on the part of tourist entities, how much time they estimate that extreme athletes on average remain in tourist facilities and use extreme sports content (Figure 4).



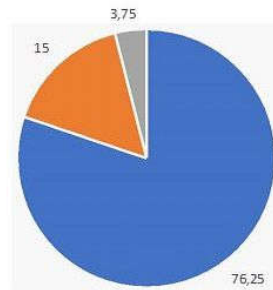
■ under 3 days ■ 4-7 days ■ over 7 days

Figure 4 Period of time extreme athletes spend in tourist facilities

The largest number of respondents of this profile, 57.14%, usually stay for up to 3 days using extreme sports contents, while 28.57% stay for 4-7 days.

3.3 Research results related to tourist demand for extreme sports

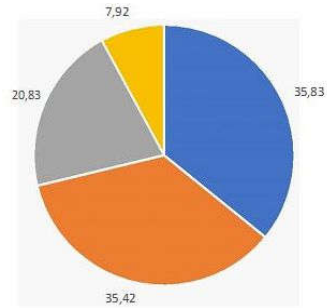
After an insight into the thinking of tourist subjects about the offer of extreme sports, an analysis of the profile of extreme athlete tourist was made. In the following view we can see that most sports tourists, in the vast majority of 76.25%, travel several times a year for the purpose of extreme sports. If we compare this data to average travel time of 4-7 days, we can conclude that the usual number of tourists who are dealing with extreme sports spend up to 14 days per year on travel, and maybe even more. This is an interesting information for all those involved in extreme sports content. It is also important to analyze how often extreme athletes decide to travel. From Figure 5 it is clear that the largest number of athletes, 76.25% are reluctant to travel several times a year, 15% once a year, and only 3.75% travel less often.



■ several times a year ■ once a year ■ less than once a year

Figure 5 How often extreme athletes travel

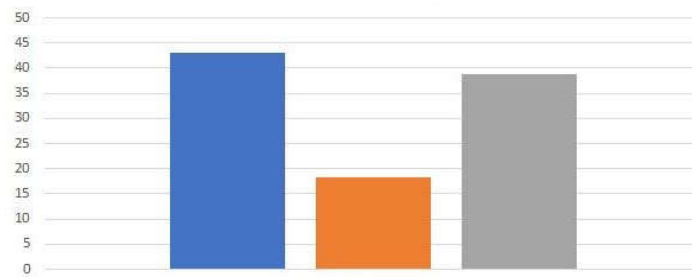
According to their responses, the average duration of travel is similar to the response provided by tourist entities. Extreme athletes have estimated that their travel usually lasts for 3 days, after which they travel for 4-7 days. Rarely does the travel last more than seven days. In the analysis of accommodation used in their travels it is evident that both hotels and private accommodation are equally attractive. Following them, camps are also attractive and frequent in the use of accommodation capacities during a tourist sporting stay.



■ hotels ■ private accommodation ■ camp ■ other type

Figure 6 Type of accommodation used on the travels

Furthermore, the geographical distance that extreme athletes are willing to accept in order to fulfill their desire for extreme sports was analyzed.



■ within the state ■ in the circle of neighbouring countries ■ distant route (plane, 1500 km +)

Figure 7 Extreme athletes' readiness for distance travel involving extreme sports

As can be seen from the viewpoint, the largest number of respondents (over 40% of them) prefer to use content in their own country, but if they choose to travel it will be more common across Earth than just in the circle of neighbouring countries.

4. Disclaimer and Conclusion

Selective tourism attracts specific groups of guests and their characteristics. Apart from the willingness to allocate greater financial resources to get what they are seeking is that in a certain way the enjoyment of a selective type of sport carries the gathering of people who are linked to the same desires and needs, who have the same affinities, and often live in a similar way that connects them further. In this way a subculture of athletes of a selective sport is created. As we are witnessing an increasing range of sports and increasing of the number of athletes specializing in separate sports, active sports tourism is a huge niche for the development of the tourist market in the future, and, also in this way, the travels motivated by various selective and extreme sports (Hudson, 2003). Through the research conducted in this paper it has been pointed out that athletes are willing to pay more than average tourists and go on frequent travel trips if they meet their needs for adrenaline and hedonism. This type of athlete deals with extreme sports also because of the fact that they are more likely to indulge in the enjoyment of sporting activities and less burdened by results (Oliver, 2006). Klaus and Maklan (2011) have stressed in their research that the reasons for dealing with extreme sports are actually multi-dimensional mixture of the following elements: satisfaction and hedonism, personal advancement, social interaction, efficiency, and surreal sense. Such allegations serve us to develop the profile and the concept of a classic extreme athlete. In the first part of the

research carried out in this paper the hypothesis H1 states that tourists and creators of tourist offer of extreme sports in the Republic of Croatia are aware of the rise of extreme sports as a selective tourist product, and that they already have certain specialized contents which they certainly plan to increase in the future (75% of agencies plan to include new extreme sports in the offer next year). Based on the facts above, it can be concluded that the tourism market is experiencing the growth of extreme sports and a niche for the development of specialized tourism and sports products can be noticed, and that hypothesis H1 can be accepted. In the second part of the research in this paper it has been confirmed that it is mainly about athletes of medium or higher financial solvency, since 90.3% of respondents reported having their own equipment for extreme sports, which is extremely expensive equipment. In addition to the fact, 28.6% of the respondents spend between 1.500 and 2.000 € (~ 10.000 - 15.000 kn), while 13.8% of the respondents spend more than 2.000 € per year only on the equipment for doing these sports. A similar situation with these consumers is when it comes to excursions for extreme sports. Even 34.8% of respondents are willing to spend between 1,000 and 1,500 euros (~ 7,500 - 10,000 kn) on a trip for these sports. Adding to this the information that it is about people who often make such journeys (even 76.9% of respondents) more times a year, we can conclude that they are consumers of medium or higher financial solvency. Furthermore, when a comparison is made that it is mostly about travels lasting 3 to 7 days, it is clear that daily spending ranges between 2,500 kn - 3 333 kn for three days, or 1071 kn - 1428 kn for seven days in destination. According to the data on average tourist spending in Croatia, the GFK states that it amounts to 66 EUR per day (Novi list, 2017), from which it is possible to conclude that tourists whose arrival is motivated by extreme sports are better in the average daily consumption than the classic tourists. We can conclude that hypothesis H2 can be accepted. Based on the above, it can be concluded that the experience in Croatia and other receptive tourist countries has shown that investment in the development of sport tourism contributes to the improvement of the overall quality of tourism (Bartolucci et al., 2013).

On the basis of theoretical and research settings presented in this paper it can be concluded that the recommendations for tourism subjects are that there is a great niche in extreme sports tourism that has a very large potential for development. Tourists whose travels are motivated by extreme sports have a great need for travel and are willing to spend more. Because of this, the managerial implication for this study is to expand and adjust the offer in the direction of extreme sport, especially if we consider the fact of extreme sports as a growing part of the tourism industry. The limitation of this research was that it did not analyze the controversial motives of dealing with extreme sports, which would provide a good theoretical background. Also, a survey of tourist offer for extreme athletes has been conducted only in Croatia and it is possible to extend it as far as possible and compare it with the results of research in another country. It is also possible to do benchmarking with a successful example of good practice in some other country. Recommendations for future research go in the direction of separation of tourist entities during the survey, to know exactly which entities have the potential in this niche.

REFERENCES

- Bartolucci, M, Škorić, S, Šindilj, M. (2013), Modeli organizacije i kvaliteta sportsko-rekreacijskog turizma u Istri, 22. *Ljetna škola kineziologa Republike Hrvatske*, lipanj 2013, pp 86-92
- Breivik, Gunnar (2010), Trends in adventure sports in a post-modern society; *Cultures, Commerce, Media, Politics*, 13:2, 260-273
- Brymer E., Houge Mackenzie S. (2017) Psychology and the Extreme Sport Experience. In: Feletti F. (eds) *Extreme Sports Medicine*. Springer, Cham

- E. Brymer, L.G. Oades (2007), Extreme Sports A Positive Transformation in Courage and Humility; *Journal of Humanistic Psychology*, Volume: 49 issue: 1, page(s): 114-126
- Ceylan, Merve; Akcakoyun, Fahri; Mutlu, Vedat (2015), An examination of anger levels of the individuals doing extreme sport, *Turkish Journal of Sport and Exercise*, Vol 17, No 1 (2015)
- Cohen, Adam; Peachey, Jon Welty (2015), Quidditch: Impacting and Benefiting Participants in a Non-Fictional Manner; *Journal of Sport and Social Issues* 2015, Vol. 39(6) 521–544
- Funk, Daniel, C. (2011), *Consumer Behaviour in Sport and Event: Marketing Action*; New York, Routledge
- Gibson, J., Heather (2010), Active sport tourism: who participates?, *Leisure Studies*, Volume 17, 1998 - Issue 2
- Higham, James (2005), *Sport Tourism Destinations: Issues, Opportunities and Analysis*, Elsevier Butterworth-Heinemann, Oxford, Great Britain
- Horner, Susan; Swarbrooke, John (2016), *Customer Behaviour in Tourism*, Third Edition, Routledge, New York, 2016
- Hudson, Simon (2003), *Sport and Adventure Tourism*, The Hawort Hospitality Press, New York
- Kahl, L. R., Kenneth, M. K. and Gregory, M. R. 1996. A Functional Model of Fan Attendance Motivations for College Football. *Sport Marketing Quarterly*, V(4): 51–61.
- Klaus, Phil; Maklan, Stan (2011); Bridging the gap for destination extreme sports: A model of sports tourism customer experience, *Journal Journal of Marketing Management*, Volume 27, 2011 - Issue 13-14: Academy of Marketing Conference 2011 - Marketing
- Ko, Yong Jae; Park, Hyewon; Claussen, Cathryn L. (2008), The effects of sport involvement, sponsor awareness and corporate image on intention to purchase sponsors' products, *International Journal of Sports Marketing & Sponsorship*, Volume/Issue Vol. 9, No. 2, January 2008
- Kurtzman, Joseph; John, Zauhar (2005); Sports tourism consumer motivation; *Journal of Sport Tourism* 10(1), 2005, Pages 21-31 | Published online: 12 Dec 2006
- Luković, T. (2008.), Selektivni turizam, hir ili znanstveno-istraživačka potreba, *Acta turistica nova*, Vol.2 No.1 Lipanj 2008., str.51-74
- P. Naidoo, P.; Ramseook-Munhurrumb, P.; Seebalucke, N.V., Janvier, S. (2015), Investigating the motivation of baby boomers for adventure tourism, International Conference on Strategic Innovative Marketing, IC-SIM 2014, September 1-4, 2014, Madrid, Spain, *Procedia - Social and Behavioral Sciences* 175 (2015) 244 – 251
- Potrošnja turista u Hrvatskoj: <http://www.novilist.hr/Vijesti/Hrvatska/Koliko-trose-strani-turisti-u-Hrvatskoj-Uvjerljivo-najsire-ruke-su-Rusi>; Januar 15, 2018.
- Olivier, S. (2006). Moral dilemmas of participation in dangerous leisure activities. *Leisure Studies*, 25(1), 95-109.
- Puchan, H. 2005. Living 'extreme': Adventure sports, media and commercialisation. *Journal of Communication Management*, 9(2): 171–178.
- Pizam, Abraham; Reichel, Arie; Uriely, Natan (2008), Sensation Seeking and Tourist Behavior, *Journal of Hospitality & Leisure Marketing*, 9:3-4, 17-33, DOI:10.1300/J150v09n03_03
- Rabotić, B. (2012.), Selektivno oblici turizma, Visoka turistička škola strukovnih studija; http://www.visokaturisticke.edu.rs/skripte/selektivni_novo/predavanje1.pdf; Januar 14, 2018.
- Rauter, Samo, Doupona Topič, Mojca (2011.), Perspectives of the Sport-oriented Public in Slovenia on Extreme Sports, *Kinesiology* 43(2011) 1:82-90
- Reil, M. (2005). The effect of sensation seeking and morality salience on risk-taking behavior in scuba divers, Doctoral Disertation, New York: Faculty of the Political and Social Science of the New School.
- Rinehart R. (2000). Emerging/arriving sport: Alternatives to formal sports. In Coakley J., Dunning E. (Eds.), *Handbook of sports studies* (pp. 504-519). London, England: Sage.
- Ritchie, Brent; Adair, Daryl (2002), The Growing Recognition of Sport Tourism, *Current Issue in Tourism*, ISSN: 1368-3500 (Print) 1747-7603, 5:1, 1-6, DOI: 10.1080/13683500208667903

Schreiber, R. (1976) Sports interest, A travel desnition. The Travel Research Association 7th Annual Conference Proceedings, pp. 85–7, Boca Raton, Florida, 20–23 June.

Solomon Michael R. (1996), Consumer Behavior: Buying, Having, and Being, Prentice-Hall, 1996

Tomlinson, Joe (2004), Extreme Sports: In Search of the Ultimate Thrill, Hove: Firefly Books Ltd.

Williams, A. (2006). Tourism and hospitality marketing: fantasy, feeling and fun. *Management*, 18(6): 482–495.

Wiliams, P., Soutar, G.N. (2009), Value, satisfaction and behavioural intentions in an adventure tourism context, *Annals of Tourism Research*, Vol. 36, No. 3, pp. 413–438, 2009

World Tourism Organisation (2010); <http://media.unwto.org/sites/all/files/pdf/finalannualreportpdf.pdf>, Januar 15, 2018.

Substitution of Different Risk Management Strategies in Agriculture

Andriy Popovych

Institute of Agroecology and Environmental Management, Kyiv, Ukraine
apopovych@kse.org.ua

Abstract. The increased use of natural resources and the development of specialized agricultural production led to increased vulnerability of ecosystems to environmental stresses, volatility of crop yields and market fluctuations which highlights the issue of risk management. There is a wide range of strategies to reduce risks in agriculture however their arbitrary application can only create further uncertainty. The choice of risk management instruments in agricultural production depends on the main players in the market such as producers, governments, banks, insurance companies. The subject of risk management tools substitution arise when different decision making bodies introduce their favourite strategies without taking into consideration the actions of other market participants. The empirical analysis in developing the main lines of risk reduction and improving the efficiency of agricultural production suggests that some strategies are substitutive while the others are complementary. The selection of the alternatives is largely dependent on the functional and organizational structure of financial and credit relations in agricultural sector while the major problem is the lack of coordination between all acting parties because of which it is not always possible to obtain the first best solution. Using the data on criteria for determining the category of borrower by banks and indicators for assessing the creditworthiness of agricultural producers based on specific features of the external and internal environment it is possible to suggest methodology for development of more effective risk management system as well as banking credit, insurance scheme and state support for agricultural production.

Key words: *agriculture, risk management, insurance, government subsidies*

1. Introduction

The risk is an inherent characteristic of agriculture especially when land, water and other natural resources became overused in the course of development of specialized agricultural production technologies. As a result ecosystems of rural territories became extremely vulnerable to environmental stresses as well as to volatility of production which in recent decades has been much greater than that experienced by other industries (Keogh, 2012).

The sustainable development of agro-industrial sector in a market environment is impossible without adapting to the risks, which are largely associated with the natural, socio-economic, technical and technological and macroeconomic conditions. Agriculture risk arises from climatic and weather variability, diseases and pests and other factors influencing the level of production. Compared to other industries farmers experience a higher degree of production risk than other sectors of the economy and it is expected that this tendency will further increase with climate changing in important agricultural regions (Loch et al., 2012).

Ignoring risk factors and refusing to develop risk management can lead to impossibility of sustainable development not only for individual agricultural producers but also for agrarian sector and for countries' economy as a the whole for a number of reasons. Firstly, it is the volatility of incomes of agricultural enterprises, especially the risk of catastrophic losses, which can pose a serious threat to the well-being of commodity producers and their departure from the business.

Secondly, the duration of the production cycle in agriculture raises the magnitude of errors in estimating price expectations, when an incorrect assessment of the market situation can lead to a significant shortfall in the expected income. In turn, a decrease in the solvency of agricultural enterprises and their employees causes a reduction in demand for both the means of production and consumer goods, which may ultimately lead to imbalances in a country's trade balance and growth of non-performing assets.

Thirdly, the lack of risk management at the macroeconomic level, which forces individual commodity producers to increase the sustainability of their own production systems at the expense of their own resources and reserves, can objectively reduce the return on resources. Moreover, the refusal to produce "risky" products can lead to increased dependence on imports and weakening of a country's food security.

Fourthly, the presence of risks associated with agricultural production hinders the creation of an effective system for lending to the agrarian sector. Since the risks significantly increase the likelihood that rural entrepreneurs will not be able to repay loans leads to viability of banking structures lending to farmers can be seriously undermined by insolvent debtors, especially in unfavourable years when simultaneously the bulk of producers will not be able to repay the debt.

Therefore, the principal objective of the agricultural risk management is to enhance viability of agro-industrial sector of the economy as whole and individual agribusinesses through strengthening, expanding and facilitating the development and implementation of new risk protection instruments. There are several ways to reduce exposure to the risk such as the distribution of risk between participants, insurance, self-insurance, hedging, marketing and others. The application of those measures is justifiable both in complex and individually since they pursue the same goal of reducing the negative impact of risky events on the agriculture production process.

This system of support for agricultural risk management should be based on the interaction of the three main actors in the agricultural market: agribusinesses, insurance companies and governments. The systemic nature of this risk influences how it is managed by farmers and farm businesses, industry, government and the commercial insurance sector (Kimura & Antón, 2011). The different strategies include the range of policies that can be implemented either by government or by companies that have income from insurance operations to reduce the agricultural industry's exposure to risk, to assist to cope with adverse outcomes associated uncertainty with commodity prices, exchange rate fluctuations and access to international markets.

The aim of this study is to investigate the issue of substitution of those risk management instrument and its impact on the risk protection in agriculture. It is hypothesised that the consequences of using the different risk management practices have a lot to do with the specific features of the agricultural producers as indicated by their credit score ratings. The writing follows simple layout of first providing the theoretical background, then presenting the results of quantitative analysis, completed by short discussion and finalised by conclusions.

2. The Basic Strategies for Risk Management in Agriculture

In the modern economic and technologic environment there are several methods for managing the main types of agricultural risks. The range of potential instruments that help to regulate risks in the agribusiness as well as to increase the efficiency of producing and economic performance includes the diversification of activities, investments, deposit and loan portfolios, marketing activities, the use of strategic planning tools and self-insurance mechanism (Kang & Mahajan, 2006). Such measures as insurance, government regulation, diversification, hedging and other tools and activities are universal and can be used in the risk management practice in

many agricultural regions, taking into account natural factors, soil-climatic conditions, cultivated crops, etc. Those agricultural risk management strategies may be undertaken privately, implemented by government and provided by the market (Diaz-Caneja et al., 2009). The strategies aimed at reducing risks can be divided into two main groups: strategies for reducing risks of agricultural enterprise and strategies for transferring and sharing risks with other economic entities. The first group includes such risk management tools as diversification of products and production methods, maintaining sufficient inventories, creating reserves, selecting products and methods of production with the least exposure to risks and shortened production cycles, finding additional sources of income, etc. Risk transfer strategies and risk sharing include contract manufacturing, marketing contracts, hedging in futures and options markets or participation in mutual funds and insurance.

There are many different risk protection methods in agriculture that are widely discussed both in academic literature and in business practice. For the purpose of this study several of them that may be considered as the main ones are chosen as presented in Table 1.

Table 1 Risk Management Methods in Agriculture

	Farmers	Markets	Government
Risk Reduction	Technology Choice Diversification Off-farm income Reserves of Liquidity	Risk management education and training	Agricultural Subsidies Macroeconomic Policies Disaster Prevention and Relief Social Programs
Risk transferring and sharing	Borrowing Vertical Integration Self-insurance Mutual Funds	Forwards Futures Options Insurance	Tax System Levelling Market-price Support Insurance Premium Subsidies

Diversification of production is most basic technique available to farmers allowing finding optimal combinations of various activities and thereby minimizing the set of internal risks and increasing the sustainability of production. However, diversification of products often brings the reduction of the overall risk at the expense of lower income.

Vertical integration introduced into the practice of agricultural producers helps to reduce the risks associated with changing the quantity and quality of input resources or output products. The formation of agro-holding companies that unite enterprises of various sectors of the agro-industrial complex makes it possible to remove some of the problems associated with price risks in both agricultural enterprises and the processing industry as well as reduces the financial risks of enterprises that are members of agro-holdings.

Mutual funds created on a private initiative can be viewed as professionally managed specific payment schemes aiming at distributing or transferring risks between groups of producers who are willing to take joint responsibility for risk management. Mutual fund is in that sense is a special type of insurance in which participants tend to be the owners of the insurer's assets.

Self-insurance, in essence, is insurance carried out inside the enterprise. The main feature of self-insurance is the ability to promptly overcome the temporary difficulties of financial and economic origin by forming stocks of raw materials, materials and components, reserve funds, and crisis situations plans of actions. The popular form of self-insurance is stabilization reserve which consists of separate accounts to which farmers periodically transfer certain amounts of money.

Increasingly popular form of risk management in agriculture is the use of forward contracts. Forward contracts involve the payment for goods at a predetermined price before delivery and sometimes even before the production of goods. Using this method of selling their products, agricultural enterprises minimize their losses coming from undesirable fluctuations in future prices in the market. The only risk of choosing in favor of forward contracts is the production risk whereas if contract is abandoned the enterprise will face both production and price risks. It should be noted that in practice, agricultural enterprises normally can choose mixed strategy, i.e. the one part of the products is sold through forward contracts, and the other in the market for cash.

Hedging, another powerful market based risk transferring and sharing tool, has already become widely used by managers of agricultural enterprises. The main task of hedging is to protect the entrepreneur from adverse changes in the market conditions in the future. The technique of hedging implies undertaking certain action to reduce or compensate for the exposure to risk by entering special types of market instruments such as futures or options. A narrower objective of such agreements is to make a profit due to favourable changes in the price of options and futures contracts.

Agro-insurance or insurance of agricultural risks is in essence a comprehensive insurance of agricultural crops. The main objective of agricultural risk insurance is partial or full compensation to the farmer of crop loss as a result of adverse natural or weather phenomena such as drought, hail or hurricane, as well as fire. Agricultural insurance helps to manage risks in the supply chain of agricultural products, contributes to the stabilization of farmers' incomes and attraction of investments to agriculture.

The second objective of insurance is to improve the financial position of the agricultural producer in terms of its creditworthiness. Credit organizations of all types - banks, credit unions, private individuals - give preference to the agricultural producer, who has a guarantee of maintaining a certain level of income in the event of natural disasters and loss of crops. In addition, insurance can be used as collateral for bank loans.

Insurance against the agricultural production risks is an important element of the system of financial and credit support for agricultural producers. However, in itself, agricultural insurance without state support is not able to provide adequate protection to agricultural producers (Miranda & Glauber, 1997).

The financial participation of governments in agricultural insurance programs is conditioned by the need to maintain the profitability of agricultural production, which in turn increases the investment attractiveness of the industry and prevents the outflow of resources from it in the long term. Subsidizing the insurance premium is intended to increase the incomes of farmers more than to manage risks in agricultural production (Goodwin, 2001). It also contributes to abating of social, political and interethnic tensions in society.

The agricultural insurance program with state participation is an instrument of the governmental agrarian policy and the main mechanism for financial protection of agricultural producers. Moreover, subsidizing the insurance premium does not affect economic efficiency and equity (Skees, 1999).

Subsidizing the insurance premium reduces the financial burden on agricultural producers and serves as an incentive to increase in the area under insured crops (Goodwin et al., 2004). The

increases in subsidies induce farmers to adopt higher levels of coverage on land already enrolled (O'Donoghue, 2014).

The publically provided risk management support influences farmers' decisions through insurance or risk-reducing effect and wealth effects when increases in average income affect farmers' responses to risk by influencing their attitudes to risk (Hennessy, 1998). Therefore, by affecting the wealth of farmers, who tend to be averse to risk, agricultural support payments can alter farmers' attitudes to risk and make them significantly less averse to risk (Koundouri et al., 2009).

The governmental programs for improvement of the mechanism of financial recovery of agricultural producers usually include such economic instruments as subsidies for procurement and commodity interventions in agricultural markets as well as collateral transactions, taking into account the conjuncture of domestic and world agriculture markets. The state also plays a big role in managing agricultural risks by providing legislature for the development of agricultural insurance or the derivatives market, improvement of the taxation system, customs and tariff regulation. The legal framework for those measures is a more effective way for stabilizing the incomes of agricultural producers than direct financial assistance granted to producers in certain adverse years in the form of loans, subsidies, tax reliefs and debt write-offs, deferred payments and direct cash compensation.

The government intervention in markets to address inefficiencies in operating of markets and institutions as well as on equity or distributional grounds can incur costs and create economic distortions. Particularly government policies can 'crowd-out' market solutions and reduce the incentives for agribusiness to manage risk privately. (Antón, 2009). As a result the private agricultural insurance market can be stifled by government support policies and agricultural insurance systems is to remain quasi-market in nature due to its profound relying on government subsidy.

The government's agricultural policy is likely to hamper the use of market-based tools. However, intervention by government can incentivise the development of private risk markets by providing subsidies to reduce associated costs (e.g. subsidies on insurance premiums), or by compelling their use by mandated insurance cover (Coble & Barnett, 2008).). The changes to current premium subsidies have the potential to alter producers' reliance on crop insurance to help mitigate farm risk (O'Donoghue, 2014).

Apart from the fact that the market-based solutions are often more efficient at managing risk than those that are provided by governments the costs of dealing with agricultural risks are borne ultimately by the taxpayer rather than by agricultural businesses. On the contrary, farmer private activities, using a mix of measures at farm and market levels, effectively contribute to risk management and also reduce the need for government support. As the level of government support for agricultural insurance becomes large the efficiency of premium subsidies turn out to be declining since the benefit per unit of expenditure falls as the size of the subsidy increases, as additional risks become increasingly more expensive to insure (Mahul & Stutley, 2010).

The significant government involvement in agricultural insurance markets through subsidies in insurance premiums or the direct provision of insurance can discourage farmers from taking private actions to manage risks by directly providing protection against risks. Interventions by government can alter the incentives for farmers to act privately to manage risk and significantly affect farmers' production choices and responses to risk (Coble & Barnett, 2008). Without or with the low level of agricultural support farmers become highly sophisticated in the use of commodity derivatives (Antón, 2009, Alizadeh & Nomikos, 2005).

The greater variability in commodity prices of agricultural production and the absence of government price supports to protect farmers from risk make them look for the alternatives (Kimura & Antón, 2011). The use of hedging through futures markets is lower in those

countries that has modest level of government support and rises when reforms are introduced and both subsidies and price volatility increased (Palinkas & Székely, 2009).

Both agricultural commodity producers, interested in getting protection at a low cost, and the government, interested in creating stable conditions for the work of the country's agrarian sector, gain from the introduction of risk management. But there exist serious inconsistency between them in the struggle for the limited resources necessary to achieve the goals set in the strategy for risk protection.

The fundamental contradiction in the development of strategies to reduce risks in agriculture among the main players in the market such as agricultural commodity producers, governments, banks, insurance companies is for the way and priority of realization of programs and the resource potential. The different visions of different stakeholders for strategic preference generate inefficiency in the choice of risk management instruments and their application.

Risk reduction and risk transferring and sharing are usually complementary when taken by the same agents while usually contradict when taken by different decision making bodies. At the same time, the existence of contradictions of economic interests is objective, and therefore it is possible to use it in the interests of the sustainable development of agricultural sector in the process of forming a mechanism for motivating and implementing the risk management measures.

The manifestation of contradictions in the actions of main institutional stakeholders such as agriculture entrepreneurs, government, business community, and commercial banks is in arbitrary application of modern risk control systems when they introduce their favourite strategies without taking into consideration the actions of other market participants. Consequently, the process of making the strategic administrative decisions is often single-handed which determines the leading factor in its ineffectiveness. There is a wide range of managerial decisions which contradicts interests of other stakeholders and leads to the emergence of inflexibility and ambiguity of risk management tools which only aggravates insecurity. Moreover, there have been substantial improvements in the coverage levels and products available in recent years but in the future the decisions of policy makers may largely depend on increasingly scarce budgetary resources (Paggi, 2016).

The incongruity between the strategies that often manifest itself in the absence of administrative, strategic control over selection of the alternatives by other parties brings forth the subject of risk management tools substitution with negative conclusion about the results of risk management activity by agribusiness. In fact the risk management strategies do not have to replace each other every time. Because each of them has its own advantages and limitations each method provides protection on only a part of the main lines of risk phenomenon in question while for a comprehensive protection number of methods should be used. In majority cases improving the efficiency of agricultural production requires usage of several different ways of risk management that complement each other.

Formulating risk management strategies requires taking into account of the whole risk setting faced by farmers and the impact of government actions on farmers' exposure and responses to risks. Due to considerable level of relations between most strategies and tools to manage agricultural risk it is necessary to take holistic approach when assessing risk management tools in agriculture (Antón, 2009).

At the same time, the modern functional and organizational structure of with the aim of increasing the productivity of their work on the qualitatively different and mutually complementary financial and credit relations in agricultural sector which suggests that some strategies are substitutive while the others are complementary. While developing risk reduction methods that are not competitors, but rather tools that in one instance complement one another while in the other substitute, it is not always possible to formulate correct and accurate solution.

3. Scoring Technique and Data

The scoring is a generally accepted methodology for the assessment and rating of borrowers when applying for a loan. The use of credit scoring systems allows using opportunities for development in a timely and consistent manner the profile of an applicant and at the same time to keep risks at an acceptable and manageable level. If a credit institution correctly and adequately uses credit scoring it gets an effective competitive advantage to maintain and improve its position in the of agricultural credit market (World Bank, 2012).

In order to evaluate of the activities and estimate financial condition of the agricultural commodity producer commercial banks developed the system of indicators that reflect the state of the enterprise from an economic point of view and show the company's compliance with certain criteria. The quantification of criteria is dependent on the industry, region and size of the enterprise while the size of the enterprise is indirectly determined by absolute indicators.

In the analysis of the creditworthiness of borrowers banks calculate a significant number of different indicators refining each other and giving additional information about the financial condition of the potential borrower. For different reporting periods an assessment of the changes in the calculated parameters from one reporting period to another allows to conclude trends in their development.

The evaluation of the creditworthiness of an enterprise in the agrarian sector is carried out by groups of valuation indicators and based on data from the client's reporting forms and other submitted documents, information from the bank's divisions and from external sources and on the basis of information obtained as a result of the conversation with the client. The refined system of indicators for determining the ability of agricultural producers to meet obligations requires the calculation the following groups' indicators: absolute indicators, indicators of financial stability, indicators of solvency, indicators of profitability and indicators of business activity.

The assessment of the property position and structure of agricultural producers' assets and liabilities usually includes the composition of property, liquidity, financial stability, accounts receivable, accounts payable, the ratio of accounts receivable and accounts payable. The evaluation of the effectiveness of the client includes profitability, turnover and evaluation of the business performance such as client's credit history.

Each indicator in the group is awarded a score from 1 to 5, with each score having the following meaning: 5 points - "excellent, optimal for lending"; 4 points - "well-satisfactory"; 3 points - "unsatisfactory"; 2 points - "critical"; 1 point - "is not liable to credit" or "the necessary information is not available and expert evaluation cannot be issued." The evaluation of the whole group of indicators is calculated by multiplying the score for each indicator by the weight of the indicator in the group. The final assessment of the client's creditworthiness is determined by multiplying the final score set for each group by the group's weight in the formation of the client's credit rating.

The more objective measurement of the creditworthiness of agricultural producers also requires conducting a study of their financial condition in the "horizontal" plane assessing the trends in the activity of agricultural producers. For this purpose, the coefficients are calculated for the client's credit history in other banks, the turnover of the client's bank accounts, the use of the bank's services by the client in addition to the credit risk holders, the client's shareholders, the client's management level, on the market, the customer's dependence on major buyers and suppliers, the quality of the documents provided by the client.

The data used for this study were obtained from "The project of development of agricultural insurance in Ukraine" (2007 – 2015) of International Finance Corporation of the World Bank in partnership with the Canadian International Development Agency (IFC Agri-Insurance

Development Project). The database consists of 1610 selected entries during the years 2012 – 2013 in the form of cross-sectional data distributed across the all region of the country. As a rule only one (usually the first) entry is used for the same applicant for the bank loan.

The main coefficients that used for calculation of the credit rating score include: coefficient of independence, loan-to-equity ratio, general coefficient of coverage, intermediate coefficient of coverage, absolute liquidity ratio, profitability of sales, profitability of core activities, turnover of short-term accounts receivable in days (in dynamics), turnover of short-term accounts payable in days (in dynamics), turnover of circulating assets in days (in dynamics), ratio of short-term accounts receivable and short-term accounts payable. The values of coefficients correspond to certain values in points. The final rating is obtained by summing up the weighted rating score obtained from the balance sheet data.

The process of lending to the agricultural sector by commercial banks is also influenced by procedural issues. When determining the subject of lending, banks, as a rule, distinguish borrowers by certain categories: small, medium, large business, as well as individual entrepreneurs. The classification of customers to a specific category is carried out on the basis of assessing the compliance of the legal status, quantitative and qualitative indicators of financial and economic activity, credit history and business volumes. One of the indicators, the size of the land bank in possession can be interpreted as such an indicator.

Additionally, the banks give quantitative evaluation to the number of characteristics of the agricultural enterprise, which are not included in the general credit score but influence the final decision. Several of them can be interpreted as the indicators of risk management such as participation in the governmental program on subsidising the insurance premiums (Insurance Subsidies), other insurance (Insurance), usage of forward contracts and other hedging techniques (Forwards), and belonging to the agricultural holding (Vertical Integration).

The size of the credit rating score of a farm enterprise or agricultural holding is attributed in percent. The quantity of land in thousand hectares owned and rented from small owners available to the agricultural enterprises is proxy the scale of farm business. The state support for crop insurance, non-subsidized insurance, market instruments and vertical integration structure of risk protection are categorical variables.

The general features of the data are described in the Table 2.

Table 2. Data description

Variable (Abbreviation)	Unit	Mean	Std. Dev.	Min	Max
Credit Score (CSC)	%	57.64553	24.14541	37	93
Size of Land Bank (LNB)	th. ha	21.66274	83.85611	1	165
Participation in Government Subsidies Program (IPS)	dummy	.5375658	.4994862	0	1
Insurance Usage Without State Support (INS)	dummy	.4209512	.5870504	0	1
Forward Contracts and Hedging Usage (FRW)	dummy	.4857756	.6049499	0	1
Vertical Integration Usage (VIN)	dummy	.2122995	.3058007	0	1

4. Econometric Analysis

Indicators and some other criteria for assessing the creditworthiness may be used for the analysing the effectiveness of risk management measures for the economic results of agricultural producers. The data from scoring method makes it possible to estimate the impact of state support on other risk protection instruments in agriculture and investigate the level of influence on each other. For the purpose of analysis, a correlation matrix was generated from sets of observations for each pair of variables.

Results of risk management methods correlation analysis are presented in Table 3.

Table 3. Results of risk management methods correlation analysis

	IPS	INS	FRW	VIN
IPS	1.0000			
INS	-0.2225	1.0000		
FRW	0.5296	0.4548	1.0000	
VIN	0.6762	0.1501	0.4313	1.0000

The resulting matrix of pair wise correlation coefficients suggests the complementary nature of majority risk management tools and substitution between the other. The introduction of governmental program for subsidizing insurance premiums for agricultural producers enforces the vertical integration and usage of forward contract and other hedging techniques which is indicates by a close relationship between them. But the negative correlation exists between the independent crops insurances and those with the state support. These results sustain the hypothesis that some agricultural risk management tools are complementary while some can be called substitutive.

For the purpose of determining the impact of some risk management instruments on the agricultural producers creditworthy it is possible to use econometric analysis. The choice of criteria in the construction of the model was due to the main factors based on prior analysis and the availability of data.

The factors that determine the construction of the model are chosen on the supposition that each subsequent indicator considerable strengthens the given correlations. The parsimonious approach was taken in the formulation of regression equation, which means including a smaller number of independent variables but only the most important ones.

The dependent variable of the regression is the credit score while the risk management instruments and size of land bank are used as independent variables. The regression allows testing the implication and establishing the link between risk management and economic and financial performance of agricultural sector enterprises.

The model includes the variables as presented in Table 4:

Table 4. Specification of the model

#	Parameter	Variable	Type
1		CSC	Dependent
2	β_1	LNB	Independent
3	β_2	IPS	Independent
4	β_3	INS	Independent
5	β_4	FRW	Independent
6	β_5	VIN	Independent
7	β_0		Intercept

Since models of empirical econometric equation do not require a particular functional form of linear specifications were used. Investigation of relationship between above described indicators and credit score is done with the resultant regression equation:

$$CSC = \beta_0 + \beta_1 LNB + \beta_2 IPS + \beta_3 INS + \beta_4 FRW + \beta_5 VIN \quad (1)$$

The coefficients of the dependent variables show the amount of influence of particular agricultural risk management instrument on the credit score resulting figure controlling the size

of an enterprise. Within the framework of the study the parameters obtained in the analysis should be of use as coefficients assessing the value of different indicators to meet certain criteria for selecting borrowers.

The model is designed in such a way that it can be used both for the whole data set (Main Set) and for the subsets in compliance with the criteria characterizing the certain feature of agricultural producer. The first data subset includes only the agricultural enterprises participating in the government program on subsidising insurance premiums (Subset 1). The second data subset includes only the agricultural enterprises with land bank of at least 5 thousand hectares (Subset 2).

The results of regression are presented in the Table 5.

Table 5. Regression results and related statistics

	Main Set		Subset 1		Subset 2	
	Coef.	t	Coef.	t	Coef.	t
LNB	1.847287	3.20	2.389049	3.23	3.295563	2.11
IPS	.704792	9.52	.8998093	11.39	.0700837	4.10
INS	.0041256	2.96	.0110107	4.02	.0039128	3.05
FRW	.3623478	6.59	.5256274	7.47	14.32405	9.19
VIN	.1649641	7.14	.6725819	6.81	.1685451	2.57
CONS	27.98823	3.86	35.69668	4.43	35.60096	3.41
Number of obs.	1610		1097		638	
F	(5, 1604)	61.39	(5, 1091)	76.09	(5, 631)	79.89
Prob. > F	0.0000		0.0000		0.0000	
R-squared	0.3775		0.4311		0.4114	
Adj. R-squared	0.3698		0.4242		0.3762	

The evaluation of the regression equations as a whole indicates its significance by Fisher criterion which exceeds the table value. The free term and the coefficients of the regression equation obtained are statistically significant as the actual values of the Student's t-test for each of them exceed the required level of significance. Thus, the obtained equations for all considered criteria are statistically significant.

For of all three subsets for the model of agricultural borrowers the evaluation results provide similar conclusions: the estimated parameters are of the expected signs and significant which confirms the choice of criteria for the main indicators needed to calculate the level of credit rating score and support the supposition about the impact of risk measures on the scores for the rating evaluation. A similar conclusion can be drawn about the role of size, while the coefficient of the independent variable corresponding to size of land bank is significant at the 10% level in the one of the models.

Analysis of paired correlation coefficients of dependent variables indicates the possibility of multicollinearity that can lead to wider confidence intervals and less reliable probability values for the independent variables. However, as long as the underlying specification is correct, multicollinearity does not actually bias results and until it is not used for out of sample data for prediction it can be used for making conclusions.

According to the regression output the participation of agricultural enterprises in the state support for insurance programs brings noticeable positive gains in credibility confirming the hypothesis that such programs improve economic efficiency of agricultural sector. The important finding is that there are weak discernible effects with respect to size of the land bank

in the equations on the subset of the agricultural borrowers with the larger land banks, i.e. of larger size.

The results of regression estimation on the basis of empirical data justify the use of econometric modelling to study the effectiveness of agricultural risk management tools and may a reasonable alternative to the existing methods. But the practical application of this method depends on data availability when a sufficient number of registered transactions would allow constructing and evaluating a more detailed model.

Overall, assessment of the influence of the risk measure can be applied for estimation of the effectiveness of agricultural insurance subsidies allocated from budgets as well as for calculating the optimal number of insured farmers. Similarly, the results of regression analysis can be used for explaining the creditworthiness of agricultural enterprises.

5. Conclusions

The risks inherent to agriculture can be dealt with a number of methods belonging to the management practice of individual farmers and enterprises or applied by wider circle of market participants or by government. The strategies for reducing risks of agricultural enterprise and strategies for transferring and sharing risks with other economic entities constitute the two main groups of risks management practice in agribusiness. The strategies aimed at reducing risks include but not limited to diversification, maintaining inventories and reserves, marketing, hedging or insurance.

The governments participate in agricultural market due to number of reasons including the need to maintain the effectiveness of agribusiness and to prevent the outflow of resources from agricultural production. One of the widely used tool is subsidizing the insurance premium protects from risks in agricultural production by increasing farmers' incomes. However, the government support policies often stifle private agricultural insurance market while in the some instances financial intervention by the government can be incentive to increase the level of insured harvest or to use the others forms of agricultural risk management methods such as forward contracts and hedging.

The arbitrary application of risk instruments and their application by different decision making bodies without taking into consideration the actions of other market participants create contradictions and generate inefficiency. The risk management are usually complementary when taken by the same agents while usually contradict when taken by different stakeholders. The contradictions in the actions of main institutions lead to the emergence of inflexibility and ambiguity and create further insecurity. The existence of contradictions of economic interests of agricultural producers, governments, banks, insurance companies is objective process not denying the sustainable development of agricultural sector.

The risk management strategies substitution due to the absence of administrative, strategic control over selection of the alternatives has often negative connotation. The tools of risk management activity by agribusiness have its own advantages and limitations and improving the efficiency of protection usually requires different ways of risk management. The risk management strategies are considerably interrelated and assessing risk management tools in requires holistic approach. The qualitatively different and mutually complementary financial and credit relations in agricultural sector suggests that risk reduction methods in one instance complement while in the other substitute one another.

The data on scoring method for borrower by banks and indicators for assessing the creditworthiness of agricultural producers used in correlations supports the hypothesis that major risk management strategies are complementary in the development of more effective risk management system. However, as a particular case the governmental subsidies for insurance risk premiums and other than those insurance schemes are indeed substitutive.

The estimation results of regression where the dependent variable is the credit score and the independent variables are the risk management instruments and size of land bank confirms the hypothesis that the state support for insurance programs improves economic efficiency of agricultural enterprises and brings noticeable positive gains in credibility. The econometric modelling is a reasonable alternative to the existing methods of studying the effectiveness of agricultural risk management tools, estimation of the agricultural insurance subsidies usefulness and explaining the creditworthiness of agricultural enterprises.

This piece of research should be considered only as the initial stage in investigating the whole mechanism of interaction of different risk management practices in agriculture and their substitutive nature. The more rigorous econometric analysis on other geographical locations and time periods is required to propose the method of choice of agriculture risk protection instrument.

REFERENCES

- Alizadeh, A., & Nomikos, N. (2005). Agricultural reforms and the use of market mechanisms for risk management. *Report prepared for the Futures and Options Association, London.*
- Antón, J. (2009). Risk management in agriculture: A holistic conceptual framework. Part of the Trade and Agriculture Directorate project on Risk Management in Agriculture. Available at: (https://www.oecd-ilibrary.org/agriculture-and-food/managing-risk-in-agriculture/an-overview-of-risk-related-policy-measures_9789264075313-4-en)
- Coble, K. H., & Barnett, B. J. (2008). An assessment of risk exposure in agriculture: A literature review. *Organisation for Economic Co-Operation and Development (OECD), Paris.* Part of the Trade and Agriculture Directorate project on Risk Management in Agriculture.
- Diaz-Caneja, M. B., Conte, C. G., Pinilla, F. G., Stroblmair, J., Catenaro, R., & Dittmann, C. (2009). *Risk management and agricultural insurance schemes in Europe.* EUR-OP.
- Goodwin, B. K. (2001). Problems with market insurance in agriculture. *American Journal of Agricultural Economics*, 83(3), 643-649.
- Goodwin, B. K., Vandever, M. L., & Deal, J. L. (2004). An empirical analysis of acreage effects of participation in the federal crop insurance program. *American Journal of Agricultural Economics*, 86(4), 1058-1077.
- Kang, M. G., & Mahajan, N. (2006). An introduction to market-based instruments for agricultural price risk management. *Agricultural management, marketing and finance working document.* (FAO: Rome, Italy) Available at <https://agriskmanagementforum.org/sites/agriskmanagementforum.org/files/Documents> [Verified 1 April 2015].
- Hennessy, D. A. (1998). The production effects of agricultural income support policies under uncertainty. *American Journal of Agricultural Economics*, 80(1), 46-57.
- Keogh, M. (2012). Including risk in enterprise decisions in Australia's riskiest businesses. In *2012 Conference (56th), February 7-10, 2012, Freemantle, Australia* (No. 124202). Australian Agricultural and Resource Economics Society.
- Kimura, S., & Antón, J. (2011). Risk management in agriculture in Australia.
- Koundouri, P., Laukkanen, M., Myyrä, S., & Nauges, C. (2009). The effects of EU agricultural policy changes on farmers' risk attitudes. *European Review of Agricultural Economics*, 36(1), 53-77.
- Loch, A., Hatt, M., Mamun, E., Xu, J., Bruce, S., Heyhoe, E., ... & Ritman, K. (2012). Farm risk management in a changing climate. In *Paper presented at the 42nd ABARES Outlook conference* (Vol. 6, p. 7).
- Mahul, O., & Stutley, C. J. (2010). *Government support to agricultural insurance: challenges and options for developing countries.* World Bank Publications.

Miranda, M. J., & Glauber, J. W. (1997). Systemic risk, reinsurance, and the failure of crop insurance markets. *American Journal of Agricultural Economics*, 79(1), 206-215.

O'Donoghue, E. (2014) The Effects of Premium Subsidies on Demand for Crop Insurance. Economic Research Report, Number 169, 33 p. Available at: (http://ageconsearch.umn.edu/record/178405/files/ERR169%20_2_.pdf)

Paggi, M. S. (2016). The Use of Crop Insurance in Specialty Crop Agriculture. *Choices*, 31(3), 1-6.

Székely, C., & Pálincás, P. (2009). Agricultural Risk Management in the European Union and in the USA. *Studies in Agricultural Economics*, 109, 55-72.

Skees, J. R. (1999). Agricultural risk management or income enhancement. *Regulation*, 22, 35.

World Bank (2012) Conceptual Framework for Agri-Insurance Development in Ukraine. White Paper, IFC Agri-Insurance Development Project.

The evolution of European Management as a Support in the Development of the Moldovan Governing System

Simion Moraru, Assoc. Prof., PhD

Trade Co-operative University of Moldova, Chisinau, Moldova
moraru42@mail.ru

Elena Gaur, Assoc. Prof., PhD

Trade Co-operative University of Moldova, Chisinau, Moldova
elenagraur73@mail.ru

Irina Cosnicean, PhD

Trade Co-operative University of Moldova, Chisinau, Moldova
i.cosnicean@mail.ru

Tatiana Baran, Lecturer

Trade Co-operative University of Moldova, Chisinau, Moldova
taty.ady@mail.ru

Abstract: European specialty literature mentions the multitude of European cultures in business and different styles and management models based on customs, habits, skills and traditions proper to every nation or common to each people apart. The pluralism of cultures in European states was determined by scientists G. Hofstede and F. Trompenaars according to certain parameters that allowed the classification of country management and the determination of different models that eventually have risen to features and common characteristics in the leadership philosophy of European enterprises. The concept of euromanagement appeared in the early 1990s as a reflection of the rising European integration process. But the trends of forming euro-management do not mean the convergence of cultures in European businesses in the conditions of economic integration of states. By the management practice, euro-management tends to accumulate the most fertile experiences in developed countries, operating under the conditions of a market economy with fierce competition for many years. In such circumstances, a new European identity is shaped by the promotion of common cultural values for the European nations in accordance with the cultural varieties of each nation. The purpose of this article is to generalize from the European managerial experience accumulated to promote the development of business management in the Republic of Moldova that is in the transition period.

Key words: *euro-management, multitude of business cultures, styles and management methods, leadership philosophy, inertial management.*

1. Introduction

The Republic of Moldova in the last decade of the twentieth century has begun a new historical process, moving towards the construction of market production relations that are diametrically opposed to those based on state property and managed by the law of planning in the process of production, distribution, exchange and consumption.

This widespread defiance characterized by private property with laws, mechanisms and instruments immanent to new production relationships with a well-developed market governed by competitiveness and competition that creates an open access and equal conditions for all participants in the buying-selling processes, a system of economic relations that generates high labor productivity, a significant efficacy, quality, technological progress, modernization and a fairer relationship between people.

Conceiving radical transformations what's happening in the creation of the new economic system, trains the whole substance of the national economic science as well as modern theoretical concepts in developed countries, in the elaboration of new coherent fundamental solutions that are specific to the the nature of this economic system.

One of the basic pillars in creating a new economic architecture with vital and universal character, which can ensure the opening to what is called market economic relations is management.

During the '60s of the 20th century in the Republic of Moldova began the first developmental attempts of leadership conceptions especially at macroeconomic level. In the following years there was an opening by the scientists from Western countries.

As a result, in Moldova have appeared translations in Russian of hundreds of books, monographs, articles, communications regarding to theories and concepts in the given field. But education, scientific research, and practice were under socialist conditions by absolute domination of state property which required a tangle of managerial concepts in developed countries with super-centralized administrative elements accompanied by party decisions other malformations marked by communist doctrines, which had nothing in common with the market economy and which reduced the functionality and efficiency of leadership.

Beginning with 1991, management in Moldova has been reconsidered: decisions at the enterprises level as well as macroeconomic level have been adopted to the conditions of the transition country to market economy. Economic entities of all types and sizes gradually began to discard of restrictions and voluntarist approaches of socialism time.

But the mentality of specialists formed under socialism has been put to the hard attempt. The adaptation to market requirements was much more difficult and asked for a longer period of time.

The new generation of schooling managers who have begun their service during the transition period have not yet formed personalities in modern reform and management. The situation has become complicated with the start of economic reforms. Conceived as a combination of the radical model "Shock therapy" with the gradual pattern with partial reforms and longer periods. In the practice of the national economy inconsistent, incoherent, unsystematic reforms have been made.

Governors still maintained the inefficiency of large enterprises, totally uncompetitive who did not cease to insist to subsidies and centralized supply of raw materials; implemented economic policies such as "A step forward, two - back", creating a situation of uncertainty and an intransparent and corruptible business environment.

In the process of reforms, has been resorted to the liberalization of prices and markets, not taking into account macro stabilization, the fighting against inflation, and without an adequate reform of the state property, the privatization of which could create new jobs. Layoffs, hyperinflation at the beginning of 4 figures, then of 3 figures in the first 3 years. In one of the report of the 1995 year, the World Bank notes that reforms in Moldova has been impoverished the population.

According to the bank's estimates, over 70% of the population became poor, of which 60% suffered from acute poverty.

The social costs of the transition were so huge, the population was no longer willing to be as devoted to reforms as they were at first and did not voluntarily want to accept the further sacrifice of its material situation for the sake of reforms.

In order to get out of the situation of unbearable poverty the population began mass emigration, and the transition period (thought by the governors to be finalized in the mid 1990s) is still continuing.

At the present stage, Moldova is trying to adapt to current, regional and continental trends, focusing its political and economic efforts with the EU. That is why it is objectively necessary for the national economy to harmonize with the European one by studying, generalizing and broadly implementing the EU experience.

2. The Multitude of Cultures in European Affairs

In European literature, the terms "European management model", "European management style", "euromanagement" are used. These terms express European practice, which is different from American or Japanese, and on the other hand it embodies features and common characteristics in European management. It is generally recognized that different models of management exist in Europe and researchers identify in these models common properties and characteristics in the practical philosophy of leadership. From these practices the "best" are selected to which the European management tends, and which finally becomes more homogeneous. But until the present most specialists talk about the existence of several management models each of them form a part of their multitude. Simultaneous, currently it has become the creation of the European identity, promoting common cultural values, which is not contrary to the national specifics of each country. On the other hand, the diversity of cultures in Europe is a reality and a convergence of European cultures, it is difficult to achieve in the near future, in spite of economic integration. In Geert Hofstede's analysis, the diversity of cultures in Europe is expressed as it is known in the substantial dispersion from country to country of values at such a size as:

1. Individualism / collectivism with a scale of 100 points.
2. Distance dimension of power which correlates with differences in possession of wealth and the power received by inheritance which reduces the significance of personal qualities. The physique and the intellectual no longer have decisive importance in accomplishing a person, once received by inheritance and already possesses wealth and power. From here it goes without saying that that getting a performance by a person is not a compulsory necessity. The states that tend to institutionalize the differences of wealth and power among its citizens, according to Geert Hofstede's assessment, form a culture with a great distance of power while states that lead a socially oriented policy and tend to diminish inequalities in power and wealth, the author determines that a culture with a reduced distance of power;
3. The dimension of avoiding the uncertainty of the unknown future;
4. Male/female relationships that assess the division of roles between masculinity and femininity for different countries.

The dispersing of cultural values in European affairs is more significant if we include more countries. This grouping can be presented in the following way (see Table 1)

The diversity of cultures of European states that Geert Hofstede demonstrated in Table 1 is manifested in so many different styles of leadership and the variety of cultural values expressed in indices are scattered differently from one country to another.

The distance of power and wealth of an example is widespread from country to country as follows: from 11 in Austria to 68 in France and 65 in Belgium, the correlation of individualism / collectivism from 50 in the Russian Federation and the Republic of Moldova to 89 in the

United Kingdom and 80 in the Netherlands, and the masculinity / femininity relationship - from 5 to Sweden , 8 in Norway and 14 in the Netherlands to 79 in Austria, 70 in Switzerland and 66 in Germany, avoiding uncertainty - from 23 in Denmark to 94 in Belgium and 70 in Austria.

Table 1. Classification of management in some European countries according to the parameters of Geert Hofstede:

Country name	Individualism/collectivism	The distance of power and wealth	Avoiding uncertainty	Relations masculinity / femininity
Austria	55	11	70	79
Germany	67	35	65	66
Switzerland	68	34	58	70
Belgium	75	65	94	54
Denmark	74	18	23	16
Finland	63	33	59	26
Norway	69	31	50	8
Sweden	71	31	29	5
France	71	68	86	43
Italy	76	50	75	70
Spain	51	57	86	42
Netherlands	80	38	53	14
Great Britain	89	35	35	66
Republic of Moldova	50	95	90	40
The Russian Federation	50	95	90	40

Source: Hofstede, G. (1991). *Cultures and Organizations*. – London: McGraw Hill.

The diversity of cultures of European states that Geert Hofstede demonstrated in Table 1 is manifested in so many different styles of leadership and the variety of cultural values expressed in indices are scattered differently from one country to another.

The distance of power and wealth of an example is widespread from country to country as follows: from 11 in Austria to 68 in France and 65 in Belgium, the correlation of individualism / collectivism from 50 in the Russian Federation and the Republic of Moldova to 89 in the United Kingdom and 80 in the Netherlands, and the masculinity / femininity relationship - from 5 to Sweden, 8 in Norway and 14 in the Netherlands to 79 in Austria, 70 in Switzerland and 66 in Germany, avoiding uncertainty - from 23 in Denmark to 94 in Belgium and 70 in Austria.

It can be concluded that the diversity of cultures means different types of leadership. For example, the high level of the index to size levels avoiding the uncertainty and distance of power and wealth that dominates in several European countries, makes these countries form an organizational culture in accordance with traditional "mechanistic" and "bureaucracy" principles and countries with a low level of uncertainty and distance of power are less formalised and have a higher degree of decentralization.

In the first case the group of countries dominates the model of organizational culture that was named by G. Hofstede "a greasy machine".

These countries form the German cluster.

The companies in this group act as a regulated machine with a high level of specialization, rather formalised, but decentralized to such an extent that competent technicians and managers can make independent decisions, being free in their activity, equipped with knowledge of the branch and its own enterprise and managerial capacities, with a commanding style intended to ensure the effectiveness through innovation and competitiveness of produced (manufactured) goods.

Enterprises being specialized in a technological chain, Geert Hofstede, determines that they are formalized, coordinated with routine procedures and rules, but with a well-determined purpose - efficiency through renewal.

The second case is typical for enterprises in Scandinavian countries and somewhat more pronounced for the Anglo-Saxon ones.

Characteristic for Scandinavian enterprises is the organizational structure which is, as a rule, compliant to production technology, they are less related to different procedures and rules. Most large enterprises use different strategies in their competitive confrontation, depending on the concrete conditions and the market conjuncture where they tend to merchandise the goods, taking into account the central strategic tasks.

Large enterprises tend to help globally the world's largest markets, elaborating, according to M. Porter, differentiated strategies.

But there are groups of companies that focus their strategic efforts only in certain regions that can assure a strategic leadership position by setting up branch networks, maintaining fruitful relations with major local suppliers of raw materials, semi-finished products, buying as appropriate and shares from important partners to establish a stable co-operation alliance. Thus, the combined strategies used by transnationals in different countries enable them to achieve a synergistic effect in their activities.

The economy of the Scandinavian countries, Benelux and Finland is centered on socialdemocratic values. Partnership between business and society is evaluated as an economy of prosperity, for the whole society, redistribution of revenue being carried out in favor of the less insured.

In these countries dominate a social policy, the common rights of the whole society are defended and in this regard the state is a guardianship of the national economy, not limiting market mechanisms and at the same time supporting the principles of the open economy. All these have put their fingerprint on the management of these countries. Characteristic for Anglo-Saxon enterprises is elasticity - the basic vector in their activity.

The market dictates organizational and managerial rules. These economic entities make decisions to meet the market's specific requirements in which these enterprises realize their own economic interests.

Their co-ordination it is not rarely impersonal and informal. This decentralized Anglo Scandinavian model, in which competencies are directly linked to entities involved in economic relations, was named by G. Hofstede as "the village market".

The development of the market economy in France (unlike Germany, the Scandinavian countries and the UK) is guardianship by the state, tends to state affairs which is reflected in the high level of social guarantees granted to officials and the needy and supplemented by more limited support for private business.

This trend is conditioned by the fact that in the country continues to dominate traditional forces aspiring to "freedom, equality, brotherhood".

The organizational pattern for France is determined by Geert Hofstede as a pyramid of people and the organizational culture is the reduced distance of power and a high degree of avoidance of uncertainty.

Organization of enterprises is according to preset functions. Enterprise groups which are part of the holdings, have a high degree of socialization, are formalized and centralized what in practice means, that the decisions and coordination of the activity are being taken by upper echelons of management.

The role of leadership is very important. Enterprises' specialists and managers as a rule are well-equipped, competent, they know the situation not only from the enterprises and holdings but also from the branch, they have a dedicated attitude.

Top business leadership of enterprises takes key decisions for which they are needed analytical and conceptual capacities. F. Trompenaars, as well as G. Hofstede, has studied essentially the types of culture and leadership styles of the groups of linear managers of the middle caliber.

At the base of classifications of the various models of managerial culture, F. Trompenaars highlighted such organizational features as the centralization degree of power and the distance of centralized leading power or decentralized, hierarchical (system of subordination of positions, functions, authorities of the lower ones to the higher ones) or egalitarianism - a social concept that promotes equality, directing the goals of the activity - when the activity vectors are centered on achieving the expected results, or the focus is on people; formalizing functions or accepting an informal style in leadership, when managerial activity of enterprises is unfolding or in accordance with the legal provisions transmitted by the holding's superior bodies for achieving determined tasks, or the activity is unfolding in the absence of directives determined by higher institutional staff.

Analyzing organizational culture patterns, F. Trompenaars concluded the following forms of corporate culture: (Hofstede G., & Hofstede G. J. & Minkov M., 2012)

- "Family" - culture oriented towards the personality;
- "Incubator" - culture oriented towards the result; - "Eiffel Tower" - culture oriented towards the role; - "Self-guided missile" culture oriented on the project.

The principles of the incubator model are spread among UK and Danish small and medium-sized enterprises, as well as in the major scientific and industrial centers. The "Eiffel Tower" model is widely used in Germany, Austria and the "family" model in Spain, Italy, Greece. All these organizational cultures do not dominate in one country or another, they overlap and correspond to the traditions that have formed in these countries, the cultural principles.

Globalization and regionalization is a complex binom and contradictory.

Globalization contributes to deepening the integration of economic activity between enterprises, SMEs, companies, firms, holdings, national economies, corporate multinational societies in such a way that we can say that globalization deepens the processes of internationalization and the increasing of economic interdependencies.

From here we can conclude:

1. The necessity and timeliness of knowledge of business cultures at all levels, including combining and harmonizing between cultures at national, regional, corporate level;
2. Diversity of business cultures and organizational cultures initiates and contributes to the formation of various leadership models based on traditions, customs, beliefs, motivational systems, which explains the dominant role of national business cultures in interacting with organizational cultures at the enterprises.

A generalization of cultures in the countries that currently form the European Union shows us profound differences in history, customs, language, customs, while some specialists conclude, that the European Union is not a "multicultural" space.

On the other hand, more and more researchers support the idea that the culture and civilization of the EU Member States resembles more than they differ.

All these people have a common cultural fund and it is predominant. This common cultural ensemble prefigures the future European homogeneous culture and reflects the traits of the various cultures of the economically integrated states.

In literature it is highlighted a diversity of common European elements from which we have selected the following:

1. Most of the Europeans are Christian, the impact on traditions, customs, habits, culture as a whole is significant. Religion served as a basis for national culture formation;

2. The work of every individual becomes not only the way of existence but a component of life, social and moral obligation, it has become a cult, a religion, a specific ritual;

3. Professional realization is a self-motivating factor ut a career promotion becomes a value in life. Without interruptions, is implemented at the enterprises new machinery and technologies, which requires that the employees should obtain university studies after which they are continuously studying throughout their lifetime;

4. The Western European nations have material, moral, intellectual assets that form a common heritage, a developed market economy, and on this basis an expansion of influence and an economic domination, technical-scientific and industrial revolution, democratic values, human rights to decent life, work, health.

5. The mutual exercising of managers from EU countries, the cross-cultures of these countries have mutually conditioned each other and have determined a symbiosis of organizational methods, styles and ways of acting and behaving with employees.

6. It has become common for all EU countries that for each hired employee to create equal opportunities: job security, decent wages, opportunities for professional growth, trust in the future.

3. Concept and Common Values of Euromanagement

In spite of the obvious economic successes achieved by the EU member states for a long time euromanagement was not in the spotlight of European economic science. In the opinion of some European scientists, the leading methods used at enterprises were appreciated as being adopted and similar to the methods and styles of enterprises of the four major European countries: Germany, France, Great Britain, and Italy. At the beginning of the 1990s, European style became more evident through common values and characteristics as discipline in work, diligence, the professionalism of the employees, the work of everybody has become a collective action where each employee can demonstrate to his team, his/ her professional skills. Everyone at his workplace is making considerable efforts that the finished product to be competitive on the continental and international market. Such fructified attitudes in the workplace exceed its own material gain. Work becomes a specific myth that primarily is a high culture, expressed in business knowledge of the enterprise as well as development prospects. Owners and employees, managers and subordinates are pragmatic in their activity, contradictions that may arise find their solutions on the amicable way. Under such conditions in the economic literature, the first conceptions also emerged regarding to the European management. Keith Thurley and Hans Wirdenius with the work *Towards European Management* have placed the first cornerstone of euromanagement research. In this study the authors determined the following values that form the basis of the European management:

1. The need to make decisions only after a scientific argumentation combined with rational justification. The decisions are totally devoid of any ideology. Managers need to develop specific and pragmatic strategies appropriate to concrete situations without using universal theories;

2. The contributors will have a serious performance and behavior regarding to the future possibilities of the given organization and from here the need arises of an emotional participation to the results of the work at its own initiative;

3. It is necessary to use the managerial and technical experience to evaluate the results of the activity. Social capital includes stereotypes of conduct, skill, and knowledge;

4. It is necessary to admit to enterprises opinions, different ideas, pluralistic ideas, claiming to be necessary, to the achievement of the organization's purpose and democratization of the decision-making process;

5. The need for a creative spirit together and with the support of colleagues in schooling: self-training as a component part of the organization of working life. Such education needs to be transformed into a continuous educational process for collaborators of all ages and managers at all levels. (Thurley K., 1989)

The authors emphasize the necessity of intervening changes in daily activity, changes that contribute to increasing the quality and competitiveness of finished products, to the formation of an efficient management leader, as well as the need to feel the European leadership identity, which does not counterposes the national identity and at the same time having been based on a diversity of values which are characteristic to Europe. The aim of the euromanagement concept according to the authors consists in accepting pluralism, the integration of different leadership systems, the combination of science and rationality in making pragmatic decisions. Europeanization of management trains the entire French school of management of combining science with the rational, of the British one regarding to the pragmatic decisions of the German one, of rational bureaucracy, which combines the hierarchy with the most competent manager and the assent of collective decisions what explains the short distance of power and lack of respect. Decentralization and segmentation are the structural characteristics of the German society, developed by Max Veber. The values of the Euromanagement were further developed by Roland Calori and Philippe de Woot and other scientists, whose studies were elaborated based on the responses of 51 top managers (presidents, vice-presidents, main executive directors) of 40 transnational companies with basic functions in Europe. This material was discussed within the working group the European Round Table of Industrialists and the Business School from Lion - France. As a result of the studies of the materials 4 common values of European management have been synthesized:

- A stronger orientation towards people;
- Greater significance of internal negotiations;
- A higher level of integration of international diversity; - Balanced leadership between the extremities.

1. European firms compared to the American and Japanese have a stronger orientation towards people, a particular social responsibility. Profit is the dominant of the activity of American firms. In Europe profit is not yet all. Caring for employees is determined by the social market economy. Alfred Muller Armack (the school of Freiburg) was the first to propose this term. The state, in its opinion, uses its capabilities to develop the economy but in turn directs its forces to achieve the general social interest. The social market economy prevails in Europe hence the economic and social factors are important and condition each other. There can be no social responsibility without profit and vice versa. The US labor force is only a production resource, while in the European firms a particular attention is paid to individuality and Europeans are characterized as an individualistic and free society. Care for employers occurs and during the period when some firms are forced to lay off from their employees. (Calori R., 1994)

2. In order to make the necessary decisions, European management carries out internal negotiations that are of greater significance compared to American firms and are different of

the Japanese ones. In the USA, decisions are of the leadership. In Japan, decisions are made on the basis of consensus. In Europe top managers have the power to make decisions, but they have to negotiate and convince different levels of managers and employees teams, collaborators to get their support. As a rule, the solutions proposed by the top level of managers are discussed and are rarely criticized only after the collaborators are engaged in the collective activity.

3. European management disposes of a higher level of integration of international diversity, caused by the need to adapt to foreign outlet markets. Euromanagement in its international affairs finds out, identifies and adopts to cultural diversity and management styles using later the practices of these new markets. European business for centuries has cultivated tolerance and patience for businessmen towards the diversity of cultures that are reflected in the differences between consumers, or a population that speaks in several languages with specific traditions. That's why euro managers are adapting more easily to the new conditions from multiple markets, being flexible, accepting intercultural management. European firms in relations with other countries accept local managers who speak in a number of languages, in the leading of subsidiaries by giving them decentralization respectively for an accelerated adaptation to the conditions of local markets. Facing different cultures, management styles, effective practices and methods of work, euromanagers enrich their own arsenal of work;

4. Leadership between the extremities is one of the major features of euromanagement being equidistant towards the American and Japanese management model, the practice of which is rarely examined and assessed as being an extreme according to certain criteria. This equilibrium of extremes presented by euromanagers is determined by:

- a) the relations between the individual and the enterprise;
- b) the short or long horizon targeted;
- c) the balance between individualism / collectivism

The first position that determines the relationship between the individual and the enterprise is well described by Anthony Pilkington. "The Americans are considerably less loyal, considerably less faithful to their firm, their vision regarding to their career is more individualistic. Top managers without problems can go into a competitive campaign. They are self-assessing as an asset which has market-price. In Japan - it is a completely different situation. And Europe is somewhere in the middle and that is why it is more pragmatic. "The individual's loyalty towards the firm where they work in Europe is higher, that is why the fluctuations of the employees are lower. According to some assessments a manager works at a company in the USA on average 3 years, in Germany - 8 years. The short or long horizon targeted has its sense , because as a rule USA firms are opening their businesses in other countries as a rule in the short term for profit while Japan - in the long term that allows with time to elaborate development strategies and to invest in establishing long-term relationships with raw material suppliers. In Europe, a strategic development decisions with third countries varies from one country to another. The balance between individualism and collectivism is specific to euromanagement. In American firms, individualism prevails, while in the Japanese ones - collectivism. These four values mentioned above cannot and do not form a management model, but they are the first steps in its formation. Euromanagement concepts have also received a number of criticisms in the specialized literature. But reality proves the opposite. In interstate relations in the EU as well as outside the continent, there are European managers who speak 2-3 languages, they truly know the multitude of cultures, traditions, they have the capabilities to involve people, motivating them to communicate and convince, international experience, broad visions on concrete situations, deep knowledge in the micro and macroeconomic field.

4. The Particularities of the German Management Model

The German economy is one of the most developed and solid in the world based on the manufacturing industry and foreign trade.

GDP volume in 2016 has constituted 3,467 trillion USD. Germany has the largest economy in Europe and is the fourth in the world after nominal GDP. In 2016, the population of Germany accounted for 82.67 million people. These only a few economic benchmarks denote the effectiveness of the social market economy and German management. About half the German ethnicity practices Protestantism, the second half - Catholicism - these two major lines of Christianity had a significant impact regarding to the economic development model of Germany. The combination of the spirit of entrepreneurship with the ethics of Protestantism and with the social teaching of Catholicism as if they inevitably led to market economy with a social character. Theoretical beginning of German management was founded by the famous scientist Max Weber, by releasing the treaty "The theory of rationalization" which continues and today to be supported by many followers, and for some countries - continues to remain current. Among the particularities of the German management model, we select only a few aspects, having in mind limited possibilities of this material.

1. The high degree of professional training of managers of all levels is determined by the forms of schooling, starts with vocational - technical schools in which each disciple acquires knowledge and professional skills which he develops during the production internship. An important aspect in hiring at the enterprise, the individual must be a graduate of such a school, to dispose of a professional level, respectively abilities received and developed in the vocational-technical school. When advancing into service an important role plays the internship work directly in the production process. Technical training in vocational schools is one of the most advanced and effective in Europe, according to some assessments. In these schools, is cultivating engineering knowledge, technical training in different trades. Study programs are confirmed by the government, employers' association and branch unions. Students study one day a week theory and four days do practice. Over 70% of the employed workers are graduates of such schools. Future Master Managers then study in higher technical schools as well as Business School. Many of the top managers study in doctoral studies, support theses, become doctors in science in the technical, economics, and law fields. Such training in another technique and managerial of specialists, masters, managers at all levels make management to be in contact with the production process. For linear managers, technical competence is imperatively necessary in order to carry out his / her duties in an acquaintance of cause. Businesses simulate the professional growth of employees, which ensures easier adoption to the new technologies which are being implemented at the enterprise.

2. Competence and professionalism play a role in the German managerial culture of production. These qualities are confirmed by self-discipline and self-control. Managers authority at German companies relies heavily on deep knowledge of technological processes, professional skills combined with abilities and not by the post he has on the hierarchical scale. Managers tend to be as close as possible to the production processes in the sections, which creates an organizational structure acceptable to all, direct and effective communication, there are still necessary lucrative functional relationships between engineers, technicians, administrative staff and hired workers.

3. A greater volume of responsibilities and attributions is based on the fact that linear managers, engineers, high-skilled masters possess wide knowledge on the technological profile in which they are trained. That's why they do not need help from administrative staff and managerial staff. Employees receive tasks from the heads of departments or masters, and also when they are in need, become experts in solving technical problems.

4. Production quality and innovations, as well as the delivery of finished products to consumers and the ensuring of technical serving in the post-realization period is one of the competitive superiorities of German companies. In order to maintain a superior quality that is accepted by consumers, German companies constantly improve technology, introduce innovations that are developed not only by their own team but also by merger of enterprises.

5. Work relationships are ensured between owners, administration and hired workers in an efficient way, which ensures a stability of the teams. A special role is played by relations between managers, trade unions and labor councils.

6. Formal German management in the production process is the result of the detailed descriptions of the functions and procedures for each job. The high degree of formalization is determined by different instructions, sets of rules, attributes, functions, etc. The place of improvisation is less, in the day-to-day activity the employees empty the instructions, and the prescribed rules.

5. Conclusions:

- Years of independence have given a rise to a major structural crisis which captured all economic branches, the financial-banking sector and social life. In 2000, when the GDP of the country which started to fall, in 1991 reached the limit of the fall, the country's economy began to pass a period of stabilization, Fitch Rating assessed Moldova as the poorest in Europe. That year GDP calculated per capita in the country made up a few percent compared to GDP per capita in the EU. Proportion of labor force occupied in agriculture, the average in Moldova is several times higher than the EU average- 15 in that period. After 28 years of independence, we find out that the amount of remittances sent to the country by Moldovan emigrants is higher by several billion US dollars than the total wage fund of the country from this period.
- Changing the development paradigm from the consumption pattern to the model based on investments, modern technologies, innovations that would allow structural transformations, reforming the entire complex of the national economy which would ensure an intensive development, a multiple increase in productivity and efficiency.
- At present, Moldova is trying to adapt to the current regional and continental trends, focusing its political, economic and trade efforts on the EU. Hence, imperative is necessary to harmonize the national economy with the European one.
- Undoubtedly, the EU has made school in the field of inter-state economic integration, the development of the economies of member countries by applying different economic models, of various management models which are based on the European leadership identity which is not being opposed to national identities. Hearing and implementing these models becomes the main task of the generation which today manages the national economy.

REFERENCES

- Bloom H. & Calory R. & De Wood P. (1994) *Euromanagement: A new style for the global market* – London: Kogan Page.
- Calori R. & De Wood P. (1994) *A European management model: beyond diversity*. London: Prentice Hall.
- Calori R. & Dufour B. (1995) *Management European style* // Academy of management executive, August, vol.9, Issue 3, p.61-71
- Geppert M. & Matten D. & Williams K. (2002) *Challenges for European management in a global context: Experience from Britain and Germany*. – Palgrave Macmillan. Hofstede, G.

- (1991) *Cultures and Organizations*. London: McGraw-Hill., p.140-142. Hofstede G., & Hofstede G. J. & Minkov M. (2012) *Cultures and Organizations: Software of the Mind Intercultural Cooperation and its Importance for Survival*, Humanitas Publishing House.
- Laurent A. (1983) *The cultural diversity of western conception of management* // International Studies of Management and Organization, vol. 13, Nr.1-2. - p.77
- Lessem R. & Neubauer F. (1993) *European management systems: Towards unity out of cultural diversity*. – London: McGraw-Hill, p.40, p.214-215.
- Mats Alvesson (2013) *Understanding Organizational Culture*, 2nd edition, London: Sage Publications Ltd.
- Thurley, K., & Wirdenius H. Towards. (1989) *European management*. London: Pitman.

The Role of Commercial Diplomacy in Promoting and Facilitating International Business

Agnieszka Hajdukiewicz
Cracow University of Economics, Cracow, Poland
hajdukia@uek.krakow.pl

Abstract. In the era of globalization and intense competition, commercial diplomacy is a growing concern of governments and an important factor of international business development. It provides a government support to internationally expanding companies which helps them to identify and pursue international trade and investment opportunities. The main purpose of this paper is to examine the role and challenges of contemporary commercial diplomacy in business promotion and facilitation of trade and investment between countries. In order to meet this research goals, various methods are used, such as the critical review of existing literature, analysis of relevant legal and official documents and the case study of the Polish model of commercial diplomacy. The research showed, that with transformation of the world's economy and trading system, the scope and focus of commercial diplomacy tends to change. The activity of commercial diplomats increasingly focuses on promoting national brand and strengthening the image of national companies, expanding tourism and attracting FDIs. Moreover, one of the main priorities of commercial diplomacy is to support small and medium companies (SMEs) in the first steps to be made in foreign market. SMEs have a growing capacity to drive the economic development of a nation, but at the same time, in their internationalization process they have a higher exposure to trade and marketing barriers, as compared to large companies. With the technological revolution the function of supplying information has also evolved towards discovering more tailored and "hidden" information and public relations. Global challenges raise many questions of how to organize commercial diplomacy effectively and efficiently and each country applies its own model of CD services, with specific goals, structures and resources. The Polish organization model of commercial diplomacy is currently undergoing major reform in the course towards improving the government-business relationship and increasing the efficiency of trade and investment promotion activities through eliminating of tasks duplication. The research on commercial diplomacy provides a deeper understanding of its rationale and the complex determinants, and it allows to formulate some indications for governments and businesses on how to better use diplomatic tools in achieving internationalization goals.

Key words: *commercial diplomacy, international business, business promotion, trade and investment facilitation, Polish diplomacy.*

1. Introduction

In the age of enhanced globalization and competition, both governments, transnational corporations and NGOs need highly specialized knowledge in the field of diplomacy to face the complexity and uncertainty of the modern world and to build a proper image, competitive position and to promote their interests in the international arena. There are different types of diplomacy; in this article the focus is in on commercial diplomacy (CD).

Commercial diplomacy, as a government service to the business community, provides a mean to support domestic companies that want to enter new markets and to explore new export opportunities. Public sector involvement in the form of commercial diplomacy is a crucial condition especially for small and medium companies that are newcomers to foreign markets, where the economic, regulatory and socio-cultural context for doing business differs from the

one that they are accustomed to. Commercial diplomacy plays also an important role in attracting foreign direct investment (FDI) to the home country.

Governments undertake business promotion and facilitation activities to encourage competitiveness of their economies in order to respond to opportunities and threats of global markets and thus to secure both domestic economic interests and global competitive position. Trade and investment promotion, has become one of the most important functions of overall diplomacy.

The main purpose of this paper is to examine the role and challenges for contemporary commercial diplomacy as a business promotion and facilitation activity. In particular, this paper analyzes the concept and functions of modern commercial diplomacy, taking into account its global and national context. The case study of the Poland's organization model of diplomacy, presented in this paper, highlights the need to use and adapt the tools and structures of commercial diplomacy to meet the new challenges of a global marketplace.

2. The Concept of Commercial Diplomacy

In the academic literature a number of definitions of the term “commercial diplomacy” can be found and there is no agreement about its extend. In particular, the concept of “commercial diplomacy” in relation to “economic diplomacy” is often elaborated and interpreted in many different ways. Proposed definitions also vary according to the types of actors (public and private) that are involved in diplomatic activities as well as the scope of the issues that provide its content.

Some authors argue that commercial diplomacy is a part of economic diplomacy. Economic diplomacy is defined as diplomacy where diplomatic means are used to achieve economic, foreign policy goals (Reuvers & Ruël, 2012). Okano-Heijmans (2010) defines economic diplomacy as “the political means as leverage in international negotiations with the aim of enhancing national economic prosperity, and the use of economic leverage to increase the political stability of the nation”. In his research, commercial diplomacy is a strand of economic diplomacy, alongside with trade diplomacy, financial diplomacy, inducements, and negative sanctions and is described as “an activity conducted by state representatives abroad (with diplomatic status) in view of business promotion between a home and a host country”. According to Potter (2004), economic diplomacy and commercial diplomacy are irrevocably intertwined since CD aims at exploiting the opportunities that are more or less created via the other strands of economic diplomacy. Reuvers and Ruël (2012) use “commercial diplomacy” as an umbrella term for both - economic and commercial diplomacy, since according to them in practice there is not much of a differentiation between the two. They define commercial diplomacy as follows: “Commercial diplomacy is the use of diplomatic means to support commercial activities, such as export and foreign direct investment (FDI) promotion. It is pursued with resources available to the home country, aiming at outputs such as economic stability, home country welfare, and a national competitive advantage. ... Commercial diplomacy functions is an umbrella term, including nation branding and participation in multilateral meetings, such as those of the WTO, and rewarding and sanctioning other countries in order to achieve foreign policy objectives.” For Feketekuty (2012) commercial diplomacy is designed to influence government policy and regulatory decisions that affect global trade and investment. It involves the application of advocacy tools to government policies that affect international commerce.

Mercier (2007) notes that the concept of commercial diplomacy is usually interpreted in two ways. On a more general level, „as being a part of economic diplomacy”, that is related to economic policy issues. This broad definition seems to be more concerned with negotiations of trade agreements and their implementation. If narrowed on a micro level, the definition of

commercial diplomacy focuses on „supporting trade and inward as well as outward investment”. According to Visser and Ruël (2012) commercial diplomacy features two types of activities: policy making and business support.

A number of authors more clearly distinguish economic diplomacy from commercial diplomacy and emphasize that commercial diplomacy, as opposed to economic diplomacy, focuses on business support and promotion and that is a more entailing concept than trade and export promotion. Kostecki and Naray (2007) use the term commercial diplomacy to cover business-support activities performed by the members of diplomatic missions, their staff and the related agencies. In their interpretation, commerce refers not only to trade but also to those activities related to investment, tourism or intellectual property. They define commercial diplomacy as „a government service to the business community, which aims at the development of socially beneficial international business ventures”. Yakop and van Bergeik (2009) define commercial diplomacy as activities carried out by public officials from diplomatic missions, Foreign Affairs Ministry and other government departments, aimed to support the promotion of foreign direct investment and international trade by supplying information and advice about trade and investment opportunities and by organizing and helping to act as hosts to trade missions from the home country. Berridge and James’ definition of commercial diplomacy refers to „the work of diplomatic missions in support of the home country’s business and finance sectors” and includes „the promotion of inward and outward investment as well as trade” (Berridge & James, 2003). Naray (2008) defines it as: “an activity conducted by public actors with diplomatic status in view of business promotion between a home and a host country. It aims at encouraging business development through a series of business promotion and facilitation activities”. According to Saner and Yiu (2003) economic diplomacy which is concerned with economic policy issues, e.g. works of delegations at standard setting organizations such as the World Trade Organization (WTO), should be distinguished from commercial diplomacy which covers the work of diplomatic missions in support of the home country’s business and finance sectors in their pursuit of economic success and the country’s general objective of national development.

In most of definitions (Saner & Yiu, 2003; Naray, 2008; Yakop & van Bergeik, 2009), commercial diplomacy covers activities conducted by public actors, but not necessary with the diplomatic status (Kostecki & Naray, 2007). Diplomatic activities conducted by private actors, Saner and Yiu (2003) don’t consider as commercial diplomacy, they count them to corporate or business diplomacy. However, Lee (2004) suggest that both public and private actors provide commercial diplomacy services; he defines commercial diplomacy as “the work of a network of public and private actors who manage commercial relations using diplomatic channels and processes”.

The activities identified by Saner and Yiu (2003) in the area of commercial diplomacy include the promotion of inward and outward investment as well as trade. Important aspects of commercial diplomat’s work is reporting to the home country about export and investment opportunities and organizing and acting as hosts to trade missions from their home countries. They can also promote economic ties through advising and support both domestic and foreign direct investors. For its part, Naray (2011) identifies five areas in which commercial diplomats operate and six types of activities they perform. Five areas include: promotion of trade in goods and services, protection of intellectual property rights, cooperation in science and technology, promotion of made-in and corporate image, and promotion of FDI. The activities in these areas cover: intelligence, communication, referral, advocacy, co-ordination, and logistics. According to the Busshers and Ruël (2012) the concept of CD can best be described by its observable business promotion services.

In this paper commercial diplomacy is considered from an international management perspective, as activity based on the export and business promotion and facilitation services.

3. Benefits of Commercial Diplomacy

Since commercial diplomacy is publicly funded, the justification for using it needs to be based on an assessment of the shortcomings and benefits associated with the CD services. Reuvers and Ruël (2012) state that both business enterprises as well as the governments and society can be beneficiaries of commercial diplomacy. In their input-throughput-output model of CD they identify political and economic benefits of commercial diplomacy, stressing that commercial diplomacy should be a value added activity. Political benefits include job creation, increased tax revenues and stimulation of economic growth, while economic ones comprise such outcomes of commercial diplomacy as trade increase, nation branding and welfare increase. Naray (2008) posed six rationale for commercial diplomacy: (1) the need for access to reliable and neutral business information; (2) support for the newcomer's weak credibility and image in foreign markets, (3) partner search: encouragement of national firms (mainly SMEs) to internationalize, (4) conflict handling, (5) support of home country delegations to the host country, and (6) strategic concerns, such as government endeavour to engage in strategic trade policies, support for R&D activities or access to supplies for energy resources and other materials. He also stated that the main direct beneficiaries of CD are private business firms, but governments can also benefit from the CD services. Successful companies may improve the country's and the government's image. Also, if international business is developed successfully through CDC, the home country's and very likely also the host country's economy will benefit from enhanced economic exchange and integration.

In his newer research, Naray (2012) focuses on advantages of using CD mainly from a business perspective. He states that there are both practical and symbolic reasons why business people trust the institutions of commercial diplomacy and often use its services. The advantages of commercial diplomacy are connected to considering it as: (1) central platform for international business to government relations; (2) activities being characterized by neutrality and credibility; (3) support in the first steps to be made in foreign markets (good price/quality ratio). In his view, commercial diplomats offer a centralized platform with the location in the "target market" from a business perspectives, offering general and specific knowledge about it. Thanks to the centralization of governmental support and the resulting economy of scale, commercial diplomats can conduct business facilitation and promotion activities with lower costs (Villanueva Lop, 2017). Furthermore, commercial diplomats have better access to decision-makers, such as executives of large corporations, policy-makers, elites in the host country, having possibility of linking business with politics. Neutrality as a attribute of CD means that firms are not discriminated against their competitors. By credibility it is meant that diplomats in general enjoy good reputation, and are considered to be well informed about political and economic affairs. Moreover, commercial diplomacy as a form of governmental support services is to a large extent focused on small and medium enterprises (SMEs) (Busschers & Ruël, 2012). On the one hand, the SMEs have a growing capacity to drive the economic development of a nation and their role in the economy is increasing. On the other hand, in their internationalization process they have a higher exposure to trade barriers, while compared to the larger companies. According to the OECD, the main internationalization barriers of SMEs are: the shortage of working capital to finance exports; limited information to locate/analyze markets, the inability to contact potential overseas customers; and, a lack of managerial time, skills, and knowledge. The market-entry function of CD is particularly critical for SMEs that are newcomers to a certain region (Naray, 2012).

Private companies rarely invest in acquiring knowledge by themselves, as it is a risky investment for them, so it is important to use the governmental intelligence service. However, information is more accessible for companies today thanks to Internet based information systems and to the improved transparency in business brought about by different organizations such as the WTO. Thus, the traditional intelligence function of a commercial diplomat is decreasing at the expense of more specific, “hidden” information and new forms of promotion events such as trade fairs or trade missions (Villanueva Lop, 2017).

At the same time, government intervention through economic and commercial diplomacy is criticized by some economists and accused of transferring resources to an export industry that potentially distorts the efficient outcome. Some neoclassical economists hold the ideal of no governmental interference. For them firms should be able to enter foreign markets on their own account and if they have to be supported by governments, then, this is perhaps because of their products or services are not competitive. These critics argue that commercial diplomacy implies a transfer of resources from the public sector to commercial activities while it is not clear if the private benefits exceed the cost of providing the public service (Yakop & van Bergeijk, 2009). They believe that taxpayer’s money can often be wasted. However, most of economists provide justification for that governmental intervention (considered as “necessary evil”) based on the theory of asymmetric information and market failure. The competitive advantage of one company can limit ability of other firms to collect the knowledge needed in the process of internationalization. The task of CD is to address information asymmetry, imperfect networks and informal trade barriers, such as cultural or language barriers.

From a business perspective, there are some concerns related to the quality of information received from commercial diplomats and alternative actions. The leading concerns include their lack of practice and a “too general” overview, not very quick service and sometimes lack of updating. But the research conducted by Naray (2012) showed that companies often don’t know what commercial diplomacy can bring, what the company can expect from diplomats and how to contact them. This is not a lack of willingness to cooperate, but rather a misunderstanding of the services offered by commercial diplomacy.

4. Factors Influencing Commercial Diplomacy

In the literature on commercial diplomacy, there are many factors shaping its activities and influencing its effectiveness. The external phenomena such as globalization and internationalization that encourage more political and economic interdependencies between countries, as well as technological advances and increasing influence of private actors are often discussed as the elements of commercial diplomacy context (Ruevers & Ruël, 2012). In addition to that a number of authors stresses the importance of both home and host country characteristics as determinants of CD. Concerning the home country’s features Ruevers and Ruël (2012) identify ministry structure and subsidiary level as key factors of the CD’s context, influencing its outcome. The home country influence was also elaborated in the study of Stadman and Ruël (2012). According to them country factors that specifically influence commercial diplomacy can be grouped into ones concerning the government of a country and its foreign posts. On the government level, the factors are: the ministry responsible for commercial diplomacy, its structure, the level of centralization/decentralization, the degree of independence of trade promotion organization (TPO) etc. On the foreign post level the commercial diplomacy practices are influenced by the structural form of the agencies responsible for commercial diplomacy and depend on the level of government (central, regional and local) where the services of these agencies are provided. The structural forms of these agencies can be divided into private, public or a mix of public and private. Based on foreign economic policy goals the foreign posts can use different programmes and practices for the promotion of export and inward investment. According to Mercier (2007) the export

promotion programmes can be divided into market development programmes and export service programmes. Market development programmes are concerned with the generating of sales leads, the participation in trade shows, the preparation of market analyses etc. Export service programmes comprise holding seminars for exporters, providing them with export guidelines and helping them with the financing of export. The factors influencing commercial diplomacy services at the foreign post level include also a number of diplomats and employees working there and their characteristics and types. Commercial diplomats often have different styles based on their approach to commercial issues and their leading concerns. Kostecki and Naray (2007) distinguish three basic types of commercial diplomats: business promoter (the business-oriented diplomat, closely cooperating and actively supporting business), civil servant (the economic policy-oriented diplomat, who does the work that is requested by the ministry, in a mostly reactive way) and generalist commercial diplomat (the foreign policy-oriented diplomat, occasionally supporting business). In the classification by Galtung and Ruge three extreme types of diplomats were identified: the “elite-oriented”, that means a diplomat with a lot of connections, who usually comes from the upper class; the “treaty-oriented” diplomats, that should have a law background and be able to negotiate and draft agreements; and the “structure -oriented” diplomat, with a degree in social sciences, able to provide insight into the political, economic and social structure of the host country (Stadman & Ruël, 2012).

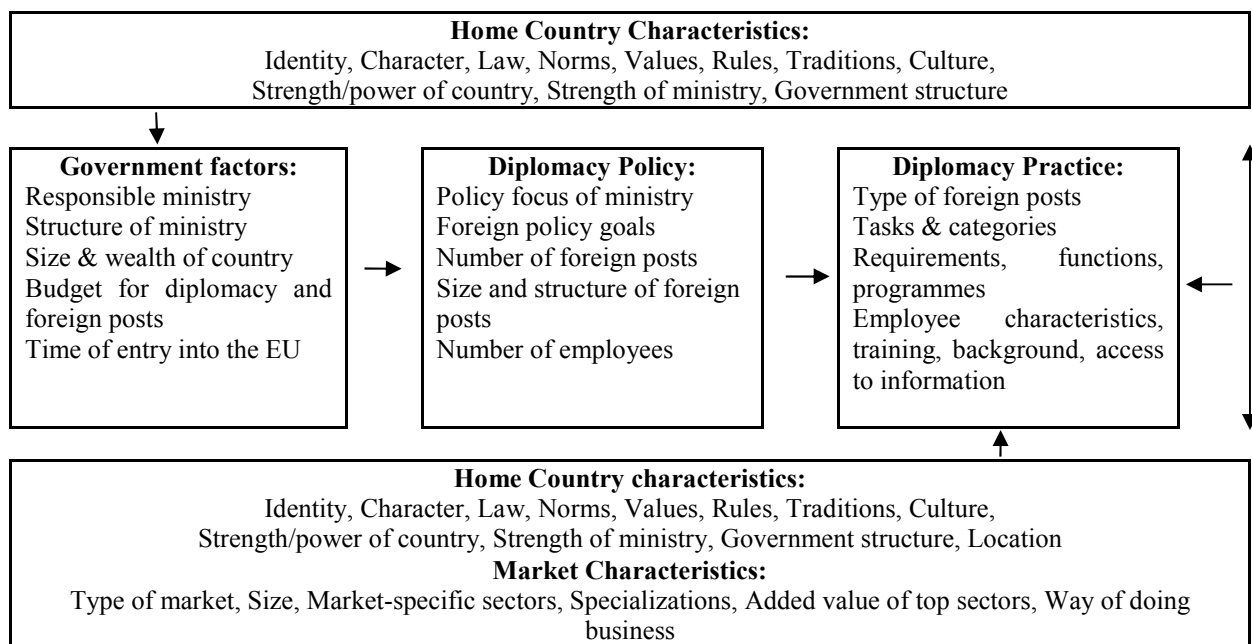


Figure 1 Factors shaping commercial diplomacy

Among host country characteristics influencing the commercial diplomacy policies and practices Kostecki and Naray (2007) considers the host country’s market size and potential as the most significant determinants for investment in commercial diplomatic relations. Another factor of influence according to them may be “gravity center” or top sectors, implying that some countries are very important markets for certain products. Many authors add such factors as cultural, legal and political situation in the host country and historic background between home and host country, such as for instance colonial ties (Reuvers, Ruël, 2012).

Since commercial diplomacy should add value for clients firms, by offering activities or services that are relevant and of a good quality, Kostecki and Naray (2007) focus on determinants of value-added commercial diplomacy. They pose several propositions that might impact the activity profile, the business orientation and the performance of CD services.

The propositions are grouped into five categories: client characteristics, home country features, host country features, the global environment, and the commercial diplomacy arrangements. In this approach, apart from the external context of CD services, which was already mentioned above, the focus is to a large extent on a client firm characteristics. The preparedness of the firm which makes use of commercial diplomacy can be an important determinant of CD effectiveness. Clients have to acquire some knowledge and skills to participate effectively in the service creation and delivery process. It is often the case that client firms do not positively participate in the service process, and they tend to be unprepared and their requests tend to be unspecific or unrealistic (Zuidema & Ruël, 2012). Therefore, the preparedness of a firm to go abroad, defined as a state of readiness for internationalization, has been a subject of numerous research. A distinction is often made between the firm's internal resources and capabilities used to deploy these resources. Resources are tradeable and non-specific, while capabilities are firm specific and used to engage resources within a company. Determinants of the commercial diplomacy linked to a firm's resources and capabilities include the size of a firm, the available business network in which a company can participate, the level of international experience of a firm and the degree to which they rely on foreign public customers and partners.

5. Evolution and the Main Characteristics of the Poland's Model of Commercial Diplomacy

The political and economic breakthrough in Poland in 1989, related to the fall of communism and the return to the market economy, did not imply an immediate change in economic diplomacy. The first Polish Minister of Foreign Affairs in the transformation period was in fact criticized for abandoning the construction of economic relations, not giving priority to economic diplomacy, and for the lack of strategies and structures, and deprecating the importance of diplomacy in the sphere of economy (Molendowski & Polan, 2007). The first bigger reform of the Polish economic diplomacy took place in July 1999 with the transformation of Commercial Counsellor's Offices (originating in communist times) into the Commercial and Economic Sections (Wydziały Ekonomiczno-Handlowe - WEH). These new units, functioning within diplomatic missions and consular offices, took over tasks in the field of economic relations as well as protection and promotion of Poland's economic interests abroad, thus constituting the institutional basis of Polish economic and commercial diplomacy. They were subject to the Ministry of Economy in respect of financial resources, staff and tasks to be performed. However, since their employees belonged to the Polish diplomatic corps, in their activities always the political and protocol primacy of the Embassy was emphasized. This model of economic diplomacy was the result of a compromise between ministries of economy and foreign affairs, that reconciled different concepts of commercial diplomacy in Poland, but for the most part it was criticized due to the lack of one centre with competences and resources in the area of economic (export) promotion and coordinating all initiatives and projects in this field. Pursuant to the 2006 reform of the organizational model of Poland's economic diplomacy, WEHs were being replaced by: Economic Departments (Wydziały Ekonomiczne - WE) subject to the Ministry of Foreign Affairs, and Trade and Investment Promotion Departments (Wydziały Promocji Handlu i Inwestycji - WPHI) subordinate to the Ministry of Economy. The aim of this reorganization was to distinguish different functions of diplomatic missions: analytical - performed for the government administration, from the purely commercial ones, dedicated to the business community. Thus, competencies of WEs included the analysis of macroeconomic situation in inward countries and the application of bilateral economic policy of the Polish government, while WPHIs were responsible for the promotion of the Polish economy and business, supporting SMEs in their export activities, attraction of inward investment etc.

5.1 Current challenges for the Poland's commercial diplomacy

The 2006 reorganization of the Polish economic diplomacy didn't end the discussion on the model of Poland's commercial diplomacy. In recent years according to a number of experts, there has been still a need for further reforms, which could define more precisely the division of competences between the Ministry of Economy and the Ministry of Foreign Affairs. These reforms could improve the coordination of activities and cooperation between ministries in the field of business support on foreign markets. In particular, many claimed that the reform of 2006 was incomplete, because one of its main goals was to create a government agency responsible for supporting internationalization of Polish enterprises and attracting foreign investments to Poland, which, however, was not set up. Lack of such an agency resulted in poor synchronization of activities and has deepened an "atomization" of the promotion and support system, leading to some inefficiency of the existing solutions.

At the same time, Polish business is more and more interested in expansion into new foreign markets. Taking into account the overdependence of Polish exports on one market - the European Union's - which has recently been stagnating, the main goal of promoting the Polish economy should be to facilitate the expansion of companies in more distant non-EU countries. In markets located in South Asia, North America, South America, Africa, the Middle East, Polish products and services could exploit their competitive advantage thanks to their quality and competitive prices. However, distant markets although promising and increasingly attractive, but at the same time might be very difficult for new companies to enter due to the different economic, political, social and technological business environment and numerous entry barriers. The changing geography of Poland's global business presence will require the state's political support and trade promotion, which is often a necessary condition for undertaking commercial activities on a new foreign market. Since in the past the Trade and Investment Promotion Sections were located mainly in Europe, nowadays it would also require building a new network of Polish diplomatic and consular post and trade missions, in order to expand into new countries and cities.

Besides, Polish entrepreneurs believe that a poor recognition of "POLAND" brand in the world is a significant obstacle in their expansion on foreign markets. Especially in the service sector Poland has relatively weak image and credibility. Therefore, the government should intensify activities aimed at promoting the country brand in order to increase the visibility and attractiveness of products and services from Poland in global markets.

According to the Polish Foreign Policy Strategy for the years 2017-2021, important tasks in the area of economic expansion and brand building include (The Ministry of Foreign Affairs of the Republic of Poland, 2017):

- assisting Polish businesses in expanding onto new international markets, in particular by developing cooperation with Asian, African, Middle Eastern, and Latin American countries;
- seeking cooperation opportunities with non-European partners, especially the People's Republic of China, in the implementation of regional infrastructure projects;
- identifying and eliminating barriers to non-EU markets that are particularly cumbersome for Polish exporters;
- attracting more foreign tourists by promoting innovative tourism products;
- protecting and projecting Poland's reputation as part of our political and economic promotion.

To meet the above mentioned ambitious goals, Poland has recently taken steps to build a new model of commercial diplomacy.

5.2 Main directions of the current changes of the Polish commercial diplomacy

The main element of the new reform of the Polish model of commercial diplomacy, was the establishment of The Polish Investment and Trade Agency as the central institution responsible for the economic promotion abroad and facilitation of foreign investment. Starting February 3, 2017, the Polish Investment and Trade Agency (PAIH), which is the joint-stock company with State Treasury as the only stockholder, replaced the Polish Information and Foreign Investment Agency (PAIiZ). This reorganization was much more than rebranding as it was connected with the expansion of the scope of the agency's activities. The Polish Investment and Trade Agency acts as the central point on the map of national economic agencies, engaged with foreign expansion of Polish entities, coordinating all operational instruments, such as diplomatic missions, commercial fairs and programmes dedicated to specific markets and sectors. It is in charge of the export promotion of Polish companies, especially small and medium enterprises, as well as for the promotion of the whole Polish sectors. Agency's mission is to create a positive image of Poland across the world and promoting Polish goods and services. The Agency is engaged with facilitating foreign investments in Poland, Polish investments abroad and also Polish investments in Poland, which implies a much broader scope of investment-oriented activities as compared with the previous model, in which the PAIiZ's core operations entailed servicing foreign investors in Poland. It is also responsible for providing information on legal and economic environment and organizing information and promotion venues in Poland and abroad.

Another important element of the current reform is the departure from the Investment and Trade Promotion Departments (WPHIs), operating as it was mentioned above by embassies and consulates, subordinate to both the Ministry of Foreign Affairs and the Ministry of Economy. WPHIs are being successively closed and replaced (but not necessary in the same locations in which they used to operate) by commercial offices abroad, which are subordinate to the new Agency. Until April 1st, 2018, 29 Foreign Trade Offices have been established, including ones in such distant locations as Astana (Kazakhstan), Dubai (United Arab Emirates), Jakarta (Indonesia), Ho Chi Minh City (Vietnam) or Tehran (Iran). Ultimately, there will be 70 locations of Foreign Trade Offices in the world. The services of Foreign Trade Offices include: helping to reduce business risk in foreign expansion by managing business information; selecting reliable business partners (they act as a "professional matchmaker" for Polish companies and foreign clients); arranging B2B talks; arranging trade missions and the presence of a client at trade shows; offering investment site advisory; getting the access to full range of business support tools offered by the Polish Development Found (PAIH, 2018).

The replacement of the old WPHIs with the network of foreign trade offices subordinate to the Polish Investment and Trade Agency (PAIH) is a qualitative rather than a quantitative change in the Polish commercial diplomacy model. These offices operate outside the structure of embassies, and their employees do not have diplomatic status. It lowers the operating costs of these branches, although at the same time it may somewhat weaken their credibility. It also implies direct subordination of the issues of commercial diplomacy to the ministry responsible for economy and development. The ministry intends to focus the Agency's activity on potentially attractive for Polish exporters non-European market, which are most often more difficult to reach than those geographically and culturally closer, especially those located in the European Union.

The resources within these support go first of all to those projects that have the best chance of success. Intensely promoted will be especially 12 industries, which were indicated in the "Strategy for Responsible Development" as the most innovative and prospective, and at the same time which can create the strong Polish brand, which in the future will be strongly

associated with Poland. These include among others yachts, furniture, cosmetics and medical equipment (The Ministry of Infrastructure and Development of the Republic of Poland, 2017). Under this program, entrepreneurs from twelve industries will receive assistance in creating and financing promotion programs, which will include not only participation in fairs, but also business to business meetings, bringing business partners to Poland, trips to meetings with a foreign contractor, consulting, training and many other activities that are needed to enter the remote market. These programs are financed mainly from European Union funds, but through the Agency as an administrator and with its active involvement.

The new system also assumes that foreign commercial offices in most cases operate in accordance with the commercial law. They can therefore conduct normal commercial and service activities. In addition, private companies will be able to participate in the promotion system of the Polish economy and will bear the costs of functioning of foreign trade offices. This means, that there has been a transition from the public to the public-private commercial diplomacy model. This is also favoured by the human resources policy, which presupposes the preference for young people to work in foreign trade offices who are knowledgeable in foreign languages and are not only risk-tolerant but also have good connections with business and are able to create good relations with the local business environment. Some promotion activities are undertaken together with the Polish diaspora. It is expected that these changes will lead to closer cooperation between the administration and business, and will ensure the better adjustment of CD services to the needs of companies as well as increase the efficiency of the funds spent on the international business promotion.

6. Conclusions

With globalization of the world's economy and trading system, the importance of commercial diplomacy has been increasing, since companies that operate more and more internationally face many constraints and challenges due to complex business environment and global competition and they show a growing need for a government support in their efforts to exploit their competitive advantage in international markets. Governments respond to these needs and invest considerable amounts of public resources by being engaged in the activities which are nowadays fundamental for commercial diplomacy, namely facilitation of international business and export/business promotion. It is expected that this should, in turn, result in increased international economic integration, growth, and employment along with generating good bilateral business relations between countries.

While the main functions of commercial diplomacy remain unchanged, the scope and focus of CD activities has evolved during the years; nowadays the main tasks include strengthening a country's image, building country brands and enhancing the companies' credibility abroad, attracting more tourists by promoting innovative tourists products as well as facilitating FDIs. In the area of export promotion the commercial diplomacy is tasked primarily with supporting SME's, which on the one hand, have a growing capacity to drive the economic development of a nation, on the other hand, in their internationalization process they have a higher exposure to trade barriers, when compared to large companies. The function of supplying information, which is one of the main responsibilities of commercial diplomats, has evolved towards discovering more tailored and "hidden" information and public relations.

There are many external and internal factors that can determine the relevance and effectiveness of commercial diplomat's work. They can be grouped into such main categories as: the home and host country characteristics, government factors, diplomacy policy of a country and diplomacy practices. In a complex environment, each country applies its own model of commercial diplomacy, with specific goals and task and structures and resources of CD services. The Polish model of commercial diplomacy is currently undergoing major

reform in the course towards improving the government-business relationship and increasing the efficiency of trade and investment promotion activities through eliminating of tasks duplication. The main element of this reform is the creation of The Polish Investment and Trade Agency as the central institution responsible for the economic promotion abroad and facilitation of foreign investment. It is set to play an important role in a modern mechanism of economic promotion abroad that effectively facilitates the internationalisation of Polish business and implements the Strategy for Responsible Development.

REFERENCES

- Berridge, G.R., & James, A. (2003). *A dictionary of diplomacy*. London, UK : Palgrave Macmillan.
- Busschers, S., & Ruël, H. (2012). The Value of Commercial Diplomacy from an International Entrepreneurs Perspective. In H. Ruël (Ed.), *Commercial Diplomacy and International Business: A Conceptual and Empirical Exploration* (pp.71 – 103). Bingley, UK: Emerald Group Publishing Limited.
- Feketekuty, G. (2013). (Ed.). *Policy Development and Negotiations in International Trade: A Practical Guide to Effective Commercial Diplomacy*. US: CreateSpace Independent Publishing Platform.
- Kostecki, M., & Naray, O. (2007). Commercial diplomacy and international business. *Clingendael Discussion Papers in Diplomacy*, 107, 1-41. Retrieved February 12, 2018, from https://www.clingendael.org/sites/default/files/pdfs/20070400_cdsp_diplomacy_kostecki_naray.pdf
- Lee, D. (2004). The growing influence of business in U.K. diplomacy. *International Studies Perspective*, 5(1), 50-54.
- Mercier, A. (2007). Commercial Diplomacy in Advanced Industrial States: Canada, the UK and the US. *Clingendael Discussion Papers in Diplomacy*, 108. Retrieved March 11, 2018, from https://www.clingendael.org/sites/default/files/pdfs/20070900_cdsp_diplomacy_mercier.pdf
- Molendowski, E., & Polan, W. (2007). *Dyplomacja gospodarcza. Rola i znaczenie w polityce zagranicznej państwa*. Kraków, Poland: Oficyna Ekonomiczna Grupa Wolters Kluwer.
- Naray, O. (2008). *Commercial Diplomacy: A Conceptual Overview*. Paper presented at the 7th World Conference of TPOs, The Hague, The Netherlands. Retrieved March 11, 2018, from http://www.intracen.org/uploadedFiles/intracenorg/Content/Trade_Support_Institutions/TPO_Network/Content/Conferences/2008/NarayConferencepaper.pdf
- Naray, O. (2012). The Commercial Diplomat in Interaction with International Business: Results of an Empirical Study. In H. Ruël (Ed.), *Commercial Diplomacy and International Business: A Conceptual and Empirical Exploration* (pp.151 – 181). Bingley, UK: Emerald Group Publishing Limited.
- Okano-Heijmans, M. (2010). Hantering van het begrip economische diplomatie. *Internationale Spectator*, 62, 73-76.
- PAIH (2018). Retrieved March 20, 2018, from: <https://www.paih.gov.pl/en>
- Potter, E.H. (2004). Branding Canada: The renaissance of Canada's commercial diplomacy. *International Studies Perspectives*, 5, 55-60.
- Reuvers, S., & Ruël, H. (2012). Research on Commercial Diplomacy: A Review and Implications. In H. Ruël (Ed.), *Commercial Diplomacy and International Business: A Conceptual and Empirical Exploration* (pp.1 – 27). Bingley, UK: Emerald Group Publishing Limited.
- Saner, R., & Yiu, L. (2003). International Economic Diplomacy. Mutations in Post-modern Times. *Clingendael Discussion Papers in Diplomacy*, 84. Retrieved November 15, 2017, from <https://www.clingendael.org/publication/international-economic-diplomacy-mutations-post-modern-times>
- Stadman, A., & Ruël, H. (2012). Competitors or Collaborators: A Comparison of Commercial Diplomacy Policies and Practices of EU Member States. In H. Ruël (Ed.), *Commercial Diplomacy and*

International Business: A Conceptual and Empirical Exploration (pp.183 – 225). Bingley, UK: Emerald Group Publishing Limited.

The Ministry of Foreign Affairs of the Republic of Poland (2017). *Polish Foreign Policy Strategy 2017-2021*. Retrieved March 11, 2018, from <http://www.msz.gov.pl/resource/0c98c3b2-9c5d-4c42-8761-f7827134ee76:JCR>

The Ministry of Infrastructure and Development of the Republic of Poland (2017). *Strategy for Responsible Development*. Retrieved March 11, 2018, from <https://rio.jrc.ec.europa.eu/en/library/strategy-responsible-development>

Villanueva Lop, G. (2017). Commercial Diplomacy In A Globalized World. *Przegląd Strategiczny*, 10, 367-382. DOI : 10.14746/ps.2017.1.20.

Visser, R., & Ruël, H. (2012). Commercial Diplomats as Corporate Entrepreneurs: An Institutional Perspective. In H. Ruël (Ed.), *Commercial Diplomacy and International Business: A Conceptual and Empirical Exploration* (pp. 29 – 70). Bingley, UK: Emerald Group Publishing Limited.

Woolcock, S., & Bayne, N. (Ed.). (2011). *The New Economic Diplomacy: Decision-Making and Negotiation in International Economic Relations*. UK: Ashgate.

Yakop, M., & Van Bergeik, P.A.G. (2009). The weight of economic and commercial diplomacy. *International Institute of Social Studies (ISS) Working Paper*, 478, 5-31.

Zuidema, L., & Ruël, H. (2012). The Effectiveness of Commercial Diplomacy: A Survey Among Embassies and Consulates. In H. Ruël (Ed.), *Commercial Diplomacy and International Business: A Conceptual and Empirical Exploration* (pp.105 – 140). Bingley, UK: Emerald Group Publishing Limited.

Prerequisites for Adequate Tourism Valorisation of Cultural Resources

Jelena Stupalo

Tourist Board Solin, Croatia

tzg-solin@st.t-com.hr

Goran Ćorluka, PhD

University of Split, University department of professional studies, Split, Croatia

gcorluka@oss.unist.hr

Abstract. Management of cultural resources for the purpose of their valorisation is a highly complex process and requires joint work, synergy and cooperation of cultural and tourism sector. On a national level, most archaeological sites and museums are managed by cultural institutions while tourist boards and local governments are side actors in that process. Many discrepancies in attitudes toward valorisation of cultural resources are found in the process which prevents it from occurring. The goal of this research is to define the main prerequisites for adequate tourism valorisation of cultural resources by including professionals and their practical experiences in a high quality focus group interview. The most important finding relates to the importance of education of participants in cultural and tourism sector in order to avoid discrepancies in the way they perceive the means of tourism valorisation of cultural resources. Specifically, tourism sector aims to exploit the resources economically in a short period of time without paying attention to carrying capacity of the historical resources. On the other hand, cultural sector especially those that manage archaeological sites, have lack of management and marketing skills to be able to valorise the heritage that leads to the need for ongoing education in those fields. Therefore, those key actors should find the mutual path to avoid the uncontrolled exploitations of cultural resources and to achieve its adequate valorisation.

Keywords: *cultural tourism, valorisation, cultural and tourist sector*

1. Introduction

UNWTO (1985) defined cultural tourism as a trip motivated by culture, which includes festivals and similar events, visits to historical sites and monuments, as well as study nature, folklore or art. Cultural motivation of travel differentiates cultural tourism from other tourism types (Ćorluka, Matošević Radić, Geić, 2013). Statistical data on Europe show that more than 50% of tourism in Europe is driven by cultural services, where the consumption of cultural services might appear as primary motivation or consumption while traveling (Cuccia and Rizzo, 2011). Therefore, the need arises for more effective use of this product through valorisation of heritage and cultural resources in general, which emphasizes the need for developing models in which culture and tourism may achieve the synergy. Elements of cultural and historical heritage gain the attraction of global tourism demand. Areas with rich history generate significant demand on the basis of their background. Numerous explanations have been offered as to why cultural tourism has grown. Some relate its popularity to supply factors and some to demand. On the demand side, some analysts argue that tourists have become bored with conventional forms of tourism, especially those that rely on heavily packed products (Douglas, Douglas, Derrett, 2001, pp. 119). Tourists feel a deep need to explore and discover what lies beyond their horizons of knowledge. Mayo and Jarvis (1981)

consider that the journey provides a tour of intellectual knowledge and at the same time is his / her need for exploring and learning the new one. According to research by Nicola and Mas (2006) tourists seeking to discover new cultures and knowledge are willing to travel long distances to meet their needs, while traveling time is not a limiting factor. Regarding Richards (2011) most of the tourists in this category are individuals, which are searching for the information about cultural resources on Internet, traveling during the whole year and spending more than average tourist. The supply side recognized the market opportunity. Through the identification of cultural motivation of tourist demand, cultural tourist offer was developed and valorised. Tourist motivated by this product emphasize as important the attractiveness of destination, complexity of tourism offer, means of presentation and product innovation, as well as the information availability and quality of all products in destination. Cultural tourists have a higher propensity to spend and in general have higher average income, they often do not spend on homogeneous mass products, being more interested in local quality goods (restaurants, wine, shopping) and in cultural events (shows, concerts, exhibitions) with higher value added, and which benefits are more likely to be evenly spread within the local economy (Figini and Vici, 2012). According to Institute of Tourism, Croatia (2015) exploring cultural heritage is the eighth motive of tourist arrivals in Croatia, mostly expressed by youth (under 29 years) older (50 and up) and those arriving to Croatia for the first time. When it comes to the cultural offer in destinations, tourists prefer following activities: visiting local events, sightseeing, visiting concerts, museums, exhibitions. In terms of the satisfaction, tourists are expressing high level of satisfaction with cultural heritage and complexity of offer while they are moderately satisfied with the diversity of cultural events. The cultural heritage is having a great impact in choice of destination by the senior citizens group (50 and up) and in the families coming for the first time in destination. Creative tourism i.e. creative experiences, according to international trends, are becoming a main focus of tourist nowadays leading to the interactive activities such as workshops. Cultural tourism is rapidly growing, with continuous development of sub forms. Cultural tourism is also identified as a successful strategy in resisting tourism seasonality and expanding tourist season (Ćorluka, Matošević Radić, Geić, 2013). The advantage of development of cultural tourism derives from the fact that cultural tourism is considered one such endogenous approach to development (Raj, Griffin, Morpeth, 2013, pp. 27). The importance of creativity in developing cultural tourism product, through experiences and interaction is in the focus, while trends, ethical manners, environmental impact and local quality of life are to be respected and taken into consideration.

Due to the need for following current trends, management of cultural resources, streaming toward valorisation of cultural resources should be at main focus.

It is important to stress out that the management of cultural resources for the purpose of their valorisation is a highly complex process which requires joint work, synergy and cooperation of cultural and tourism sector. On a national level, most archaeological sites and museums are managed by cultural institutions, while tourist boards and local governance are side actors in that process. Many discrepancies in attitudes toward valorisation of cultural resources are found in the process which prevents it from occurring.

According to the research provided by the Institute of tourism, Croatia (2015), a disagreement in attitudes towards cultural resources valorisation between many stakeholders was identified. Namely, representatives of the counties and municipalities are grading the existing cooperation with cultural institutions and tourism sector as relatively good, although one quarter of research participants consider this cooperation not to be on a satisfactory level. Most of the participants stress the importance of cultural resources in branding and running projects aiming at cultural tourism development. However, most of the municipalities and

counties do not have a tourism development strategy while development of cultural is included in general development plans. Although most of the research participants consider the cooperation with tourism and cultural sector a satisfactory one, still this cooperation is marked as the most important limiting factor in further development of cultural tourism offer. Apart from cooperation, promotion and limitations in existing cultural resources management models are three most important barriers in development of cultural tourism. Most of the the public sector representatives prefer investing in cultural tourism products that require small investments like festivals, events and other history projects. It is important to notice that investments in visitor centres or new museums are not considered as important and worth investing. Tourist boards and cultural institutions are currently running cultural tourism projects, but they do not express satisfaction with the level of culture and tourism synergy. On the other hand, representatives of cultural sector are not satisfied with the level of synergy, which leads to the question why cultural resources/programmes are not included in development of cultural tourism or cultural sector considers some resources more valuable in terms of the their use in tourism, than they really are. Differences between cultural and tourism sector are visible when it comes to the quality of cooperation. Most of the tourist boards consider this cooperation good or very good while cultural sector is not satisfied with the level of cooperation. They both consider that key problems in development of cultural tourism are – lack of awareness on tourism potential of cultural resources, inadequate cooperation promotion and management model. In the same time, the cultural sector points out more limitations in development of cultural tourism relating to the level of awareness on tourism potential of cultural resources, cooperation and promotion. The importance of visitor centres, festivals, reviving history projects, theme routes is stressed out by tourist boards. The cultural sector, on the other hand, gives general support to above mentioned activities, but are more ready to support investment in contemporary cultural production and creative workshops. Both sectors agree that more investments are needed in promotion, revitalization and private entrepreneurship in culture.

When we take into consideration the importance of cultural tourism, market trends and attitudes of all sectors included in the management of cultural resources, the need for adequate tourism valorisation of cultural resources becomes a high priority. The goal of this research therefore is to define the main prerequisites for adequate tourism valorisation of cultural resources by including professionals and their practical experiences in a high quality panel discussion.

2. Research Methodology

A pilot study with focus group interviews with professionals from tourism and cultural sector was conducted. Focus group members were tourist board representatives, University representatives, city government representatives and archaeological institutions representatives.

3. Research Results

Management of cultural resources for the purpose of their valorisation is a highly complex process and requires joint work, synergy and cooperation of cultural and tourism sector. Research finding indicate following process necessitating's for the tourism valorisation of cultural recourses:

- **Educated and proactive municipality** – Culture and all the process related to culture are not at the focus of the local leaders who don't have enough knowledge on management and valorisation of cultural resources and don't recognize its importance for the city development. The lack of financing when it comes to culture, perceiving

cultural investment as not necessary or being at the bottom of priority list and in general ignorance and lack of knowledge of local and national leaders, are main restraints in developing cultural products and valorisation cultural heritage. Dialogue with main stakeholders, as citizens, tourism sector and cultural sector, is desirable.

- **Educated and cooperative cultural and tourism sector** – Effective valorisation of cultural resources relies on the education and cooperation of cultural and tourism sector. Cultural sector should invest in the lifelong education with goal of obtaining appropriate skills and knowledge such as: education of tourist guides, education of employees in museums, archaeological sites and other cultural institutions in management, marketing and tourism segment, education of agencies in sector of archaeological tourism. The educational sector (universities) especially those in archaeology should be the initiators and carriers of valorisation and involvement of all key stakeholders in process of research presentation and interpretation of archaeological and cultural heritage and its tourism valorisation. The most important finding relates to the importance of education of participants in cultural and tourist sector in order to avoid discrepancies in the way they perceive the means of tourism valorisation of cultural resources. Specifically, tourism sector aims to exploit the resources economically in a short period of time without paying attention to carrying capacity of the historical resources. It also occurs that tourism sector due to the lack of knowledge are not interpreting the history in a proper manner thus leading to lack of authenticity which is one of the primary requisites for adequate valorisation of cultural resources. Therefore, the cooperation with cultural sector should be intensive and tourism sector should receive all the necessary data prior to organization of cultural events. On the other hand, cultural sector especially those that manage archaeological sites, have lack of management and marketing skills to be able to valorise the heritage that leads to the need for ongoing education in those fields. It seems that cultural sector, as defined by their profession, is mainly focused on the preservation and conservation of cultural heritage without investing in marketing and tourism valorisation of their resources. The perception of the cultural sector and tourism sector are much different when it comes to the exploitation of the resources. Cultural sector is not a fan of fast exploitation of the resources. They consider the exploitation of resources in terms of tourism valorisation as an „attack“ on the heritage. The valorisation of cultural resources, from their point of view, should be a long term process and when it comes to investments they prefer investment in conservation of the monuments rather than its interpretation and presentation. The lack of management skills and thus marketing and other skills in presenting the sites, is issue in almost any cultural institution. Therefore, the need for lifelong education and development of those skills should be set as a strategic goal on a national level. Tourism depends on cultural resources and therefore it should make additional efforts to maximize its potential. Therefore, those key actors should find the mutual path to to achieve its adequate valorisation.
- **Local community that respects and protects is heritage** – The importance of educating the local community is emphasized, from youngest to older generations, in order to emphasize the need for responsible and sustainable use of cultural resources in development of tourism. More education and more interaction with locals should be set as priority. The campaign with the aim of raising awareness of importance of cultural heritage protection should be developed.
- **Sustainable use of cultural resources – carrying capacity** – Efficient and transparent national laws with clearly defined local strategies for the use of cultural

resources – solid grounds for efficient processes in the development of cultural tourism and for valorisation of cultural resources are required. The cooperation between experts in cultural and tourism sector in defining the carry capacity of cultural resources is stressed as obligatory. Although the carrying capacity should be defined by laws and regulations both on national and local level the sustainable use of cultural resources should be set in the minds of local citizens and sectors using the cultural resources as a priority. Based on the efficient laws and regulations, the strategic documents should be developed with the aim of achieving the carrying capacity of the historic cities and sites. The lack of efficient laws and regulations has led to the uncontrolled exploitation of cultural resources.

4. Discussion

As noted earlier the management of cultural resources for the purpose of their valorisation is a highly complex process and requires joint work, synergy and cooperation of cultural and tourism sector. According to the findings driven from the organized focus group interviews, tourism and cultural sector should work more closely in order to achieve adequate valorisation of cultural resources. Since one of the prerequisites defined is an educated and proactive municipality, where the problems occur mostly in perception of culture thus also in financing of culture, the joint efforts of both sectors should raise awareness of local municipality to perceive culture as a driving force in development of cultural tourism. Projects prepared in a high quality manner and constant initiative and enthusiasm of the cultural and tourism sector should lead to more finances allocated for valorisation of cultural resources. This may be achieved through public-private partnership or through the applications for various grants allocated for presentation and protection of cultural resources. The other finding related to education of cultural and tourism sector emphasizes importance of cooperation between these two sectors and better education in those fields. In tourism sector, problem occurs in exploitation of resources which may be resolved through transparent and well defined laws and regulations on local and national level. Problems with unauthentic interpretation of cultural resources are easily reduced by closer cooperation with the cultural sector. Involving the representatives from the cultural sector at least as advisors in the process of organizing event is inevitable. On the other hand, cultural sector appears to have a problem with a lack of management and marketing skills and their perception on the valorisation of cultural resources. This leads to the lifelong education in those fields but points out the problems with financing this education. Since cultural tourism is a key driving force in development of tourism, cultural and tourism sector should work closely on organizing educational workshops and seminars for cultural sector, especially for the museum personnel or personnel working and managing the archaeological sites. The education is very welcomed in any sphere of EU funding therefore the finances could be allocated through EU funds. Another prerequisite for adequate valorisation of cultural resources implies the importance of local community respecting and protecting their heritage. In order to achieve this goal, the the campaign with aim of rising awareness of importance of cultural heritage protection should be developed. The education of local community, from youngest to older generations is a key to success. Therefore, the cultural and tourism sector should perform activities and campaigns of teaching the local community on heritage in their cities and the ways how to protect it and save it for the new generations. This may be done through various educational events. Further, the sustainable use of cultural resources should be a “must have” both for local community and for the cultural and tourism sector and the local municipality should invest effort in defining strategies and activities that would lead to the effective use of resources or i.e. achieving carrying capacity of the specific monument or site.

5. Conclusion

The management of cultural resources is a long term and flexible process that requires the involvement of the municipality, that needs to be a generator of team work among the main actors in planning and decision making processes within the historical cities. The most important finding relates to the importance of education of participants in the cultural and tourist sector in order to avoid discrepancies in the way they perceive the means of tourism valorisation of cultural resources. Specifically, tourism sector aims to exploit the resources economically in a short period of time without paying attention to carrying capacity of the historical resources, and sometimes due to the inadequate prior knowledge of historical data may create events that don't interpret the cultural resources in a proper manner. On the other hand, cultural sector especially those that manage archaeological sites, have lack of management and marketing skills to be able to valorise the heritage and produce the economic effects that leads to the need for ongoing education in those fields. Other prerequisites for adequate valorisation of cultural resources used for tourism include laws and regulations as well as the attitude of the local citizens in order to achieve sustainable development of historical cities and localities. Key actors in the process of valorisation and protection of the cultural resources should therefore find the mutual path to avoid the uncontrolled exploitations of cultural resources and to achieve its adequate valorisation.

REFERENCES

- Ćorluka G., Matošević Radić, M., Geić, S. (2013), Selective forms of tourism, the way of extending the summer season, *Economy Transdisciplinary Cognition Journal*, Vol. 16, Issue 2/2013, pg. 88-96.
- Cuccia, T., Rizzo, I. (2011), Tourism seasonality in cultural destinations: Empirical evidence from Sicily, *Tourism Management*, Vol. 32, pp. 589-595.
- Douglas, N, Douglas, N, Derrett, R. (2001), *Special interest tourism*, Wiley & Sons Australia, Ltd
- Figini, P., Vici, L. (2012), Off-season tourists and the cultural offer of a mass-tourism destination: The case of Rimini, *Tourism Management*, Vol. 33, pp. 825-839.
- Geić, S. (2011), *Menadžment selektivnih oblika turizma*, Sveučilište u Splitu, Split
- Institut za turizam (2006), *Hrvatski turizam, plavo bijelo zeleno*, Znanstvena edicija Instituta za turizam, Institut za turizam, Zagreb
- Institut za turizam (2015), *Akcijski plan razvoja kulturnog turizma*, Zagreb
- Marušić, M., Prebežac, D. (2004), *Istraživanje turističkih tržišta*, Adeco, Zagreb
- Marušić, Z., Tomljenović, R. (2010), *TOMAS Kulturni turizam 2008.*, Institut za turizam, Zagreb
- Mayo, E. J. i Jarvis, L. P. (1981), *Psychology of Leisure Travel*, CBI Publishing Co.
- Pančić Kombol, T. (2006), Kulturno nasljeđe i turizam, *Radovi Zavoda za znanstveni rad HAZU Varaždin*, No. 16-17, pp. 211-226.
- Pančić-Kombol, T. (2000), *Selektivni turizam*, TMCP Sagena, Matulji
- Rabotić, B. (2013), *Selektivni oblici turizma*, Visoka turistička škola strukovnih studija, Beograd
- Raj, R., Griffin, K., Morpeth, N. (2013), *Cultural tourism*, CABI, Oxfordshire, UK
- Richards, G. (2011). Tourism trends: The convergence of culture and tourism, *Academy for Leisure, NHTV University of Applied Sciences*

Brand Loyalty of Younger Adults in Beer Retail Shopping - Case of Croatia

Blazenka Knezevic, PhD

University of Zagreb, Faculty of Economics and Business, Zagreb, Croatia
bknezevic@efzg.hr

Petra Skrobot, PhD Candidate

University of Zagreb, Faculty of Economics and Business, Zagreb, Croatia
pskrobot1@efzg.hr

Mia Delic, PhD

University of Zagreb, Faculty of Economics and Business, Zagreb, Croatia
mdelic@efzg.hr

Abstract. This paper focuses on beer industry and beer retail in a particular market and examines the attitudes of young adults as retail consumers towards beer retailing and branding issues. In the introductory part the purpose was to explain the situation of a beer industry in Croatia and to assess the importance of brewing industry in national economy. Second chapter gives definitions on brands and branding based on secondary sources. Also, this part emphasizes the importance of consumers' attitudes in branding process. In last two chapters, the data from primary research conducted in Croatia on the sample of young adults are scrutinized. The primary research addressed following questions: value and frequency of beer purchase, occurrence and motives of impulsive beer purchasing, the very existence of favorite beer brand within the population, motivators of brand switching and potentials for specialization in beer retail in Croatia.

Key words: *beer brands, consumer behavior, brand loyalty, retail, Croatia*

1. Introduction

Food and beverage industry in Croatia is one of the most important industries of the national economy. According to the Institute of Economy (2016) it generates 4% of the gross domestic product (GDP) in Croatia (out of that 3,1% is food industry and 0,9% is industry of beverages). It should be noted that the production of food and beverages compared to other manufacturing sectors in Croatia makes the largest contribution to GDP and total employment. The share of food and beverages in 2013 amounted to 28,8% total value generated in manufacturing industry (in which food share is 21,8% and beverages is 6,4%). Food and beverage industry 2016 contributed to employment in manufacturing industry with 19,2% (Institute of Economy, 2016).

The strength and contribution of brewing industry to Croatian national economy can be illustrated by the fact that out of ten leading companies in the sector of drinks production (see Table 1), four are beer producers (breweries) and one is directly connected with brewing industry.

Table 1 Ten leading companies in the sector of drinks production in Croatia (2014)

	Dominant production	Total income (in million kunas)	Gross margin (% of income)
Jamnica	Water and non-alcoholic beverages	1.505,30	15,2
Zagrebačka pivovara	Beer	914,1	23,1
Coca-Cola HBC Hrvatska	Non-alcoholic beverages	818,5	6,5
Heineken Hrvatska	Beer	695,2	20,3
Badel 1862	Other alcoholic drinks	295,7	-14,9
Carlsberg Croatia	Beer	294,7	-5,9
Maraska	Other alcoholic drinks and Non-alcoholic beverages	149,8	-17,6
Slavonija slad	Hops	147,6	-4,5
Agrolaguna	Wines	102,7	0,6
Imota	Wines	77,9	76,6

Source: adapted from Institute of Economy, 2016

Note: 1 EUR = 7,55 kunas

Annual inflow to the state budget of the brewing sector amounts to more than 2 billion kunas (note 1 EUR = 7,55 kunas), which is three times higher than the national allocation for culture or nearly half of the total annual allocation for agriculture (Croatian Chamber of Economy 2016). In addition, brewing sector in Croatia has also a very important impact on employment. Continuous and steady trend of employment in this sector is confirmed by the fact that all branches of beer industry employ more than 27.000 people, what is 2 percent of total employment in the Republic of Croatia (Croatian Chamber of Economy, 2016).

In Table 2 data on beer industry in selected Central and Southern European Countries is shown. As it can be observed, total beer production in Croatia in 2015 was 3.379.000 hectoliters and total beer consumption was 3.322.000 hectoliters. Production was higher than consumption what can lead to conclusion that beer producers in Croatia have a potential for beer exports. According to Brewers of Europe (2016), beer import for 2015 in Croatia was 700.000 hectoliters and export was 768.000 hectoliters meaning that foreign exchange balance is positive in this particular industry. Croatian beer consumption per capita is 77 liters. According to analysis made by Brewers of Europe for 31 European countries (EU-28 plus Norway, Switzerland and Turkey), Croatia is on high 10th place considering the beer consumption per capita.

Table 2 Production and consumption of beer in selected Central and Southern European Countries (data for 2015)

Country	Total production (in hectoliters)	Total consumption (in hectoliters)	Consumption of beer per capita (in liters)	Consumption as a proportion of production
Croatia	3.379.000	3.322.000	77	98,31%
Slovenia	2.029.000	1.583.000	77	78,02%
Austria	9.023.000	8.975.000	105	99,47%
Czech Republic	19.053.000	15.703.000	143	82,42%
Hungary	5.965.000	6.541.000	59	109,66%

Slovakia	2.434.000	3.959.000	73	162,65%
Germany	95.623.000	86.018.000	106	89,96%
Poland	40.089.000	37.706.000	98	94,06%

Source: own compilation according to Brewers of Europe, 2016 (data on beer production and consumption) and Eurostat news release, 2016 (official data on number of inhabitants for each country)

A half of total beer quantity in Croatia is sold via retail channels (Ernst & Young, 2009). When it comes to loyalty of shoppers to a certain retail chain, Kaufland recorded the highest growth of loyalty in beer category, followed by Plodine and Interspar (InStore Magazine, 2015). Five leading brands in beer category in retail in Croatia hold 61% of total retail market share and those are: Ožujsko, Karlovačko, Pan, Löwenbräu and Osječko (according to GfK research presented in InStore Magazine, 2015). Consumer loyalty to leading brands grew, reaching 45% of consumers claiming that they are loyal to some leading brand where Ožujsko represents the brand with the highest expressed loyalty (InStore Magazine, 2015).

Therefore, this paper will focus on this important segment of national economy and will put especial attention on beer retailing trying to assess and present valuable data on attitudes of young adults on beer brands and their beer brand loyalty.

Firstly, upon secondary sources, paper will outline some basic definition on brands and brand loyalty. Secondly, the methodology of the primary research conducted on the sample of young adults in Croatia will be explained. Thirdly, paper will discuss the results of the primary research and draw conclusions on beer and beer brand loyalty in retail industry in Croatia.

2. Brand, Brand Management and Brand Loyalty - Basic Definitions

Brand is a unique design, symbol, word or combination of the above, which is used to create the impression or perception that identifies the product and distinguishes it from its competitors. Over time, the image among consumers is becoming associated with the level of credibility, quality and satisfaction what we call brand positioning, which helps consumers to identify the products which have certain advantages and value in a variety of products on the market. Legal name of the brand is "trademark" or "legally protected name" when it identifies or represents a company (adapted from Economic lexicon, pp. 476).

The word "brand" comes from the Ancient Greek and Roman times meaning stamped by fire and literally it was used when talking about the marking of animals or wine amphorae in order to highlight their owners.

Figuratively, nowadays, the word represents the characteristics of products which have a long-lasting impression on consumers. By definition, brands perform several important functions for the company (Kotler and Keller, 2008, pp. 274-275):

1. simplify the process of handling and routing products,
2. provide legal protection of the unique aspects of the product,
3. show a certain level of quality, enabling the customer faster and easier buying decision,
4. ensure customer loyalty,
5. allow the company to charge higher prices (up to 25% more than the products that have not a clearly developed or strong brand).

In addition, in modern economy, brands are important forms of intellectual property that directly affect the consumers' behaviour. Also, they may be the subject of buying and selling as brands "per se" having a certain market value.

Brand is the promise of satisfaction because in practice it represents an unwritten contract between producers and consumers, sellers and buyers (according to Healey, 2008, pp. 6).

Almost all entities at the market can have the brand: the company or organization, product or product group, sales forms, service or group of services, and even the individuals.

Brand equity has psychological and financial component. The psychological component of brand equity arises from the way in which customers feel, think and make decisions related to the brand, while the financial component is expressed in the brand price, its market share and the share in the overall profitability of the company.

It is hard to say in what form brand comes. Barwise (2003) emphasizes that brand may be:

- the name of the product, service or a company (we'll just mention few names from the beer industry: Carlsberg, Heineken, Paulaner, Stella Artois, Budweiser, etc.),
- trademark in pictorial form (we all know beer trademarks in the form of atypical letter B in the name Budweiser, a small key on the Becks beer, a friar of Paulaner, a star of Heineken, and a crown and HB capital letters on Hofbräu beer),
- phrase or slogan used to build customer loyalty (for instance: Stella Artois' advertising slogan in the United Kingdom was "Reassuringly Expensive", "Probably the best beer in the world" as the slogan for Carlsberg; "The King of Beers" as a slogan for Budweiser and „Gut, besser, Paulaner“ used for Paulaner beer in Germany).

Name, logo and slogan are called brand elements (see Kotler and Keller, 2008, pp. 282-283). However, brand primarily resides in the minds of consumers, and it is often a synonym for reputation. We can say that brand is a symbol to which the context is added, i.e. associated meaning. Brand is what the customer thinks that is, and the brand managers' job is to ensure that customers are thinking in the right way.

Healey (2008, pp. 6) claims that the brand management is a process of continuous battle between producers and consumers in order to define the meaning because people make their own decisions about what will be done and how to live and what to buy, but under conditions that are shaped by advertising, marketing and publicity brands.

Brand management (or branding) is the process of maintaining, improving and supporting the brand in a way to associate it with positive results. Brand management includes a number of important aspects, such as price, customer satisfaction, presentation at the store and attitude towards competition. Brand management is built on the principles of marketing, but focuses directly on the brand and answers the question of how brand can remain desirable for customers. Proper management of one brand may result in sales increase of other products bearing the same brand (adapted from Business Dictionary Online, 2013). For example, if the customer was satisfied with the experience of drinking beer, he would probably be inclined to buy the same brand the next time or even try out other types of beer that are promoted under the same brand name (in different packaging, with more or less alcohol content, additional flavours, etc.).

It should be noted that the process of brand management is actually an iterative (repetitive) and cyclic (circular) because the manufacturers (vendors) are constantly searching for ways to bolster the brand. In addition, it is important to mention that over time also the customer is going through a cycle where he first discovers a brand, then adopts it, interprets its importance and significance, and experiments with other products of the same brand, to ultimately share the information on the brand and the experience with the brand with family members, friends, acquaintances and colleagues. As the cycle of building the customer's awareness of the brand is always much longer than the process of the marketing approach related to the brand, it is extremely important for the company to know how long it takes to prevent the investment in improving the brand for which customers have not yet built the attitude (i.e. gone through the full cycle of building awareness of the brand).

Practical experience shows that the best principle in the development of the brand is the evolution principle. In doing so, it is recommended (Healey, 2008, pp. 18-20) that changes in the very brand essence remain constant, and to only change its display. Thus, brand factors important for customer loyalty for a long period, such as the meaning, promise, value and satisfaction that brand gives should be permanent, while other brand factors should change in response to changing customer expectations, but also in accordance with the development of competing brands. These factors include the design of packaging, production of beer with different proportions of alcohol and additives to improve taste, advertising methods, presentation in the media and on the web etc.

In accordance with the positive tendency towards a preferred brand, customers indirectly determine the success of retailers and manufacturers in a certain market. However, manufacturers are dominantly interested in maximizing profits of their own brands, while retailers focus on maximizing product category profits, including profits realized based on the producer and under its private labels (Agić and Alić, 2013, Pauwels and Srinivasan, 2004). Even though, the introduction of private labels into retailing chain can cause the decline of value of producer brands (Meza and Sudhir, 2008); some manufacturers actively support private retailers' labels due to the possibilities of creating entirely new conditions and strategic directions development (Tarzijan, 2004).

Finally, as LaTour and LaTour (2009) claim, the attitude of consumers towards the brand is largely determined by what the consumer feels about the brand (e.g. his/hers affection or reflectivity), as well as the overall evaluation of the brand (e.g. is brand generally perceived as good or bad). Therefore, regardless of the complexity of the brand management process, consumers and their attitudes will determine the outcome and duration of the process of building the brand, and thus affect the business performance of producers and retailers in the beer supply chains. Therefore, it is essential for all beer supply chain participants to learn the ways and stages of consumer decision making process when purchasing beer, and the factors that influence consumer preference for a particular brand of beer.

To achieve better understanding, this paper will focus on beer retailing and attitudes towards beer brands in one particular consumer group at a particular retail market.

3. Research Methodology

Numerous studies of consumer behavior address young population as a specific consumer group (Xu, 2008; Brown et al., 2000; Spero and Stone, 2004; Kaur and Singh, 2007). There are also studies for particular product categories (for instance Bruwer et al., 2011) dealing with wine and, scrutinizing collected results from the gender perspective. Therefore, based on acceptability of such approach in analysis of consumer behavior, this paper will explain findings from the gender perspective as well.

As the main objective of this study is to analyze preferences and attitudes of younger adults towards beer brands in retail shopping in one particular market, i.e. Croatia, the sample included students from various universities at given market. The basis for analysis were 232 valid questionnaires (N=232). In that number there were 155 females and 77 males i.e. 66,81% females and 33,19% males. In the sample there is a significantly higher proportion of females because the respectively high proportion of answers came from humanistic and social science Croatian universities where the gender structure is 70:30 in favor of females. All respondents were older than 18. The structure of valid questionnaires according to gender and ages is shown in Table 3.

Table 3 Structure of valid responses according to age and gender

Age	Absolute frequencies		Relative frequencies	
	Females	Males	Females	Males
younger than 21	26	14	16,77%	18,18%
21-24	94	36	60,65%	46,75%
25-30	27	20	17,42%	25,97%
older than 30	8	7	5,16%	9,09%
TOTAL	155	77	100,00%	100,00%

Source: Own research

As a research instrument, the questionnaire was used. The questionnaire consisted of 23 questions, of which 21 questions were closed and 2 were open-ended. There were 18 one-choice and 2 multiple-choice questions. One question was given in the form of Likert scale, suitable for assessing the key factors of beer category management, and it included 14 variables important for beer as a product category in retail. The results collected via this questionnaire were already discussed in several published studies from the aspect of attitudes and characteristics of the beer as a retail product category in general and from the gender perspective (see Knežević et al., 2014; Knežević et al., 2016). However, this paper will go further and explain preferences and attitudes of younger adults towards beer brands in retail shopping trying to assess their beer brand loyalty in a particular market. Therefore, the paper will focus only on 10 out mentioned 23 questions, i.e. this study will particularly address the issue of beer brands and consumers' loyalty to brands.

Ten questions to be analyzed in this study are: (1) what is the weekly value spent for beer in retail shopping, (2) what is the frequency of beer consumption, (3) how often unplanned beer purchase occurs, (3) what are the motivators for unplanned beer shopping, (5) how much time is spent in front of the shelves with displayed beers, (6) do consumer have preferred beer brand, (7) what are the drivers of beer brand change, (8) is there a necessity to change something in beer as a product category in preferred supermarket, (9) is there a necessity of specialization in beer retail, and (10) what could be the key motivators for shopping in a specialized beer store.

4. Discussion of Results

This chapter will discuss the research results in several aspects. Firstly, the value and frequency of beer purchase within younger adults as retail consumer group in Croatia will be presented. Secondly, the occurrence of unplanned beer purchasing and motivators of impulsive purchasing will be assessed. Thirdly, the chapter will analyze do younger adults have favorite beer brand and what are the key motivators of brand switching within this particular retail category. And, finally, the possibilities of further specialization in beer retail will be discussed.

4.1 Value and frequency of beer purchase

In younger adult population in Croatia the majority of respondents (66% of females and 47% of males) spend less than 20 kunas, i.e. less than 2,5 EUR on weekly basis (see Figure 1). That corresponds to quantity of 2,5 standard bottles (0,5 litres) of beer per week. Only 6,5% of males claim that they spend larger amounts (more than 100 kunas per week). To this variable we applied chi-square test which showed that difference between males and females in money value of weekly beer purchasing is statistically significant at $p < 0,05$ (the chi-square statistic is 14,2094. The p-value is 0,002634). Therefore we can conclude that males spend more money per week for retail beer purchase than females.

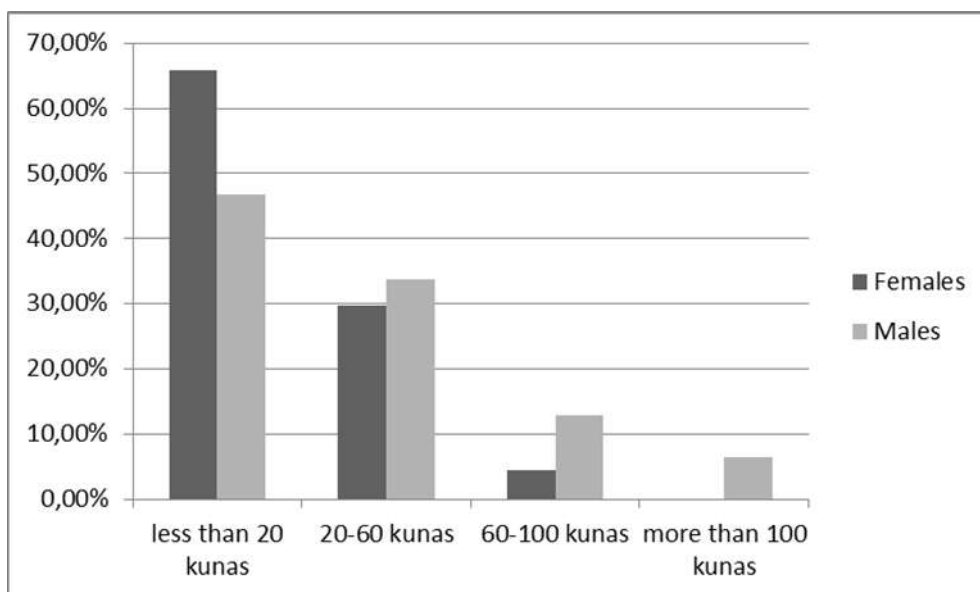


Figure 1 Value spend in beer retailing on weekly basis
Source: Own research

Note: 1 EUR = 7.55 kunas; 1 standard 0,5 litres bottle of beer in retailing in Croatia costs approx. 1 EUR

The frequency of beer consumption is shown in Figure 2. Majority of respondents claim that they consume beer on a monthly basis (49% females and 41% males). In males' population weekly basis is the second option, while the second option in female population is "several times a year". Therefore, we also performed the chi-square test which showed that the difference between genders is statistically significant at $p < 0,05$ (The chi-square statistic is 1,5122. The p-value is 0,021372). We can conclude that males consume beer on more frequent basis than females.

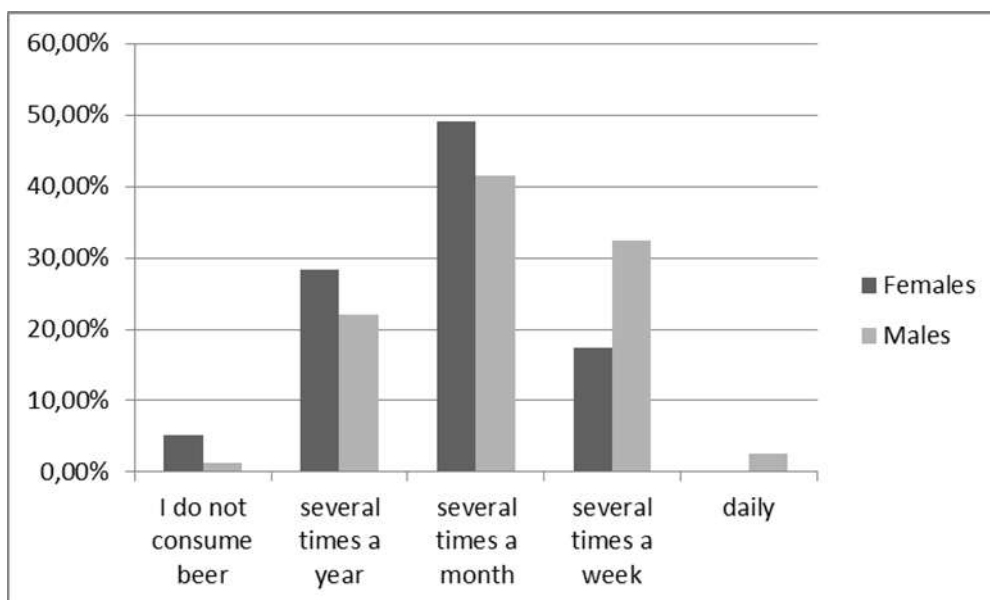


Figure 2 Frequency of beer consumption
Source: Own research

4.2. Unplanned – impulsive beer purchasing

In advance, we questioned the occurrence of unplanned beer purchase (see Table 4). 63,36% of respondents (69,03% of females and 51,95% of males) claim that they sometimes buy beer

although initially it wasn't planned. Moreover, we can observe that summarized options always and often are for females 9,03% and for males 18,18%. Thus, we performed chi-square test and calculated that chi-square statistic was 7,3361 with the 0,061921 p-value. This means that difference between gender is not significant at $p < 0,05$ but is significant at $p < 0,1$. Therefore, at the level of significance of 0,1 we can accept the claim that males more often buy beer unplanned than females.

Table 4 The occurrence of unplanned beer purchasing

Option	RELATIVE FREQUENCIES		
	Females	Males	Total
never	21,94%	29,87%	24,57%
sometimes	69,03%	51,95%	63,36%
often	7,10%	15,58%	9,91%
always	1,94%	2,60%	2,16%
Total	100,00%	100,00%	100,00%

Source: Own research

The most important reasons or key motivators of unplanned beer purchasing are shown in Figure 3. The majority is driven by action prices (43,23% males and 29,87% females). The second motivator for females is promotional packaging (17,42%), and then something else i.e. other (11,61%). For males the situation is opposite; the second motivator is something else i.e. other (22,08%) and then comes promotional packaging (15,58%).

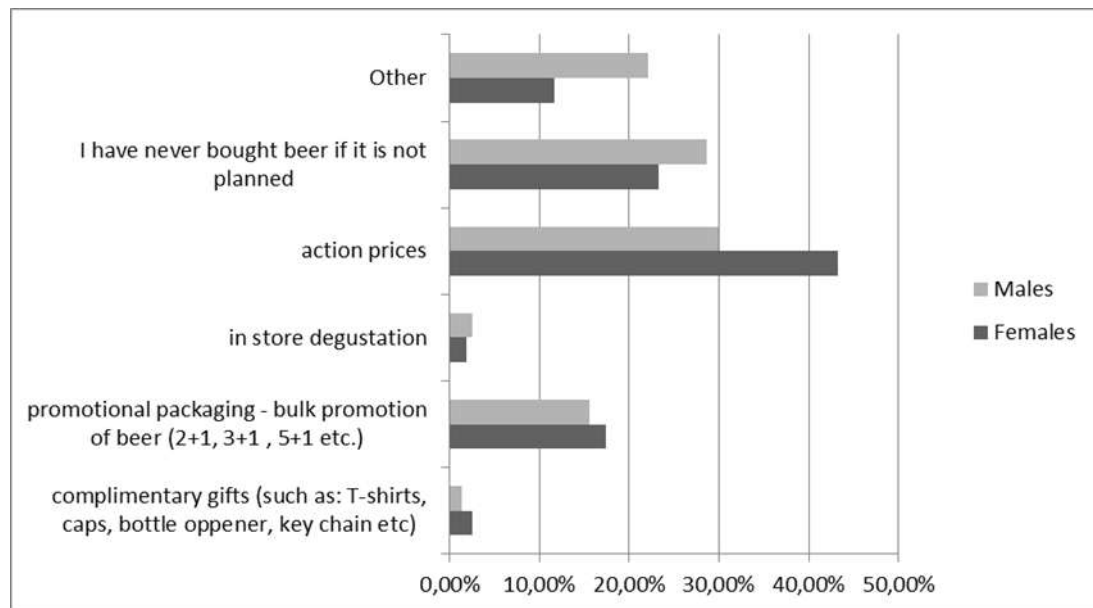


Figure 3 The most important reasons of unplanned beer purchasing

Note: respondents could select only one offered option; the option "other" was open ended. Source: Own research

In store degustation and promotional complimentary gifts are not perceived as important drivers of unplanned beer purchasing by this particular population. As option "other" was left as an open-ended response option, we observed some frequent answers given by the respondents: "I see beer - I buy beer!"; "the very glance to the beer was enough"; "As soon as I see the beer, I'm immediately thirsty"; "there was a new beer on the shelf"; "my current thirst"; "my friend called me and he said he will visit me". However, note that there is 23,23% females and 28,57% males claiming that they do not buy beer unplanned.

4.3. Beer brands in focus

According to data displayed in Table 5, the quantity of time spent in front of the shelves with the displayed beer in supermarket is estimated to extremely shorty amount (more than 70% of respondents claim that they spend less than 2 minutes). This can lead us to the conclusion that at the very entrance to the supermarket, young adults have a pretty clear idea of wanted or preferred beer brand. We have to point out that chi-square test showed that there is no statistically significant difference between genders for this variable.

Table 5 The quantity of time spent in front of the shelves with the displayed beer in supermarket

Option	RELATIVE FREQUENCIES		
	Females	Males	Total
I do not buy beer	3,23%	1,30%	2,59%
up to 2 minutes	70,32%	72,73%	71,12%
from 3 to 5 minutes	21,94%	23,38%	22,41%
from 5 to 10 minutes	4,52%	2,60%	3,88%
more than 10 minutes	0,00%	0,00%	0,00%
Total	100,00%	100,00%	100,00%

Source: Own research

Table 6 Existence of favorite beer brand

Option	RELATIVE FREQUENCIES		
	Females	Males	Total
I do not drink beer	4,52%	2,60%	3,88%
I do not have favorite beer brand	35,48%	28,57%	33,19%
It is a beer of domestic producer	37,42%	41,56%	38,79%
It is a beer of foreign producer	22,58%	27,27%	24,14%
Total	100,00%	100,00%	100,00%

Source: Own research

Respondents are as asked to state do they have favorite beer brand and results are shown in Table 6. Around one third claim that they do not have favorite beer brand. Out of those who have favorite beer brand, we can observe that they prefer beer of domestic producer. Upon this, we can drive a conclusion that younger adults in Croatia express accentuated consumer ethnocentrism in the purchase of beer in retail. Moreover, chi-square test showed that there is no statistically significant difference between genders when testing this variable.

Top three drivers that could provoke a change of a favorite beer brand are: (1) change of beer quality, (2) friend's suggestion and (3) price rise above 10% compared to other brands. Relative frequencies are shown in Table 7. Surprisingly, within this consumer group quality and friend's suggestions are significantly more important than price change, which means that younger adults, to some extent, would tolerate the price change of their favorite brand if quality would remain the same. But this claim should be further researched in future and by in-store experiments.

Table 7 Drivers of change of the favorite beer brand

Option	Females (N _f =155)	Males (N _m =77)	Total (N=232)
if it the quality of my favorite brand of beer changes	58,71%	66,23%	61,21%
if a friend suggested me to try some other brand of beer	40,00%	42,86%	40,95%

if the price rises more than 10% compared to other brands	24,52%	28,57%	25,86%
if some kind of beer that seems interesting appears at the market	21,94%	19,48%	21,12%
If I can get a complimentary gift in the store	5,81%	9,09%	6,90%

Note: multiple choice questions. Source: Own research

4.4. Need for change and further specialization in beer retail

Moreover, we have asked examinees to specify what should be changed or improved in traditional supermarkets regarding beer as a specific retail category. In Figure 4 results show that both males and females want to increase richness of assortment by adding new brands from abroad, and secondly, they would prefer lower beer prices. Only 20% of respondents claim that there is no need to change anything in beer category in their preferred supermarket. Therefore, we can draw a conclusion that majority of young adults in Croatia agree that there is a place to significantly improve this retail category in existing retail stores.

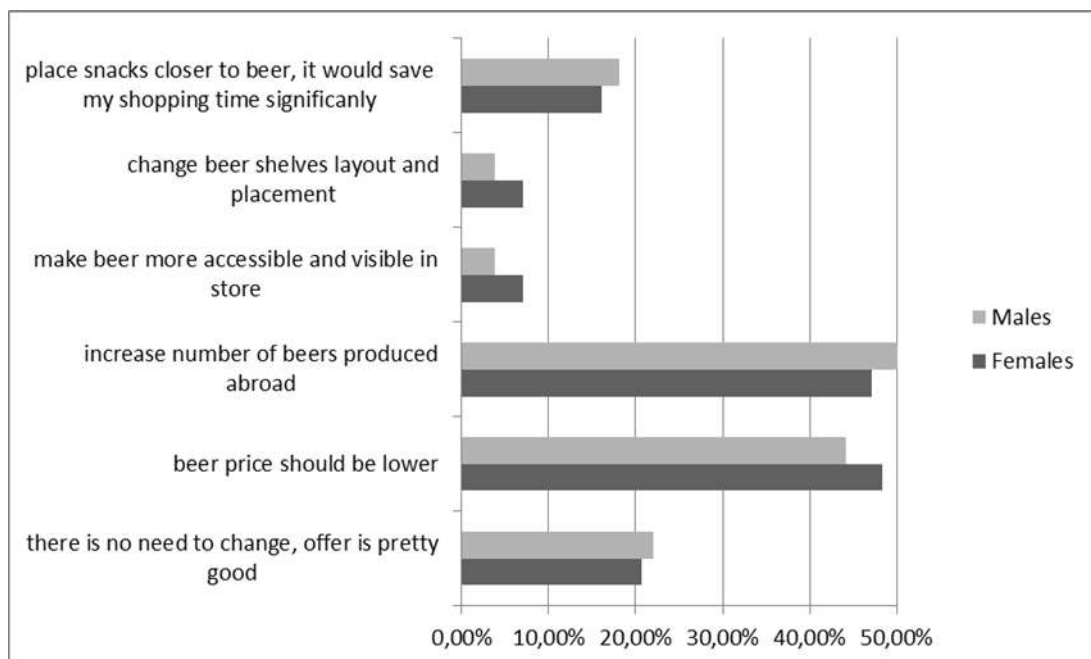


Figure 4 Desired changes in beer retail category in preferred supermarket
Note: multiple choice question. Source: Own research

Furthermore, with the growth of beer brands in EU and increased offer of craft beer in Croatian market, the question on potential of specialized beer store arises. Therefore, we asked how often would respondents visit some specialized beer store that offers exclusive and less known beer brands and what would motivate them to visit such store. Performed chi-square tests showed that there is no statistically significant difference between young males and young females regarding this two questions.

In Figure 5 the estimated frequency of visits to a specialized beer store is shown. Most frequent option, both for females and males, was visiting “at least once a month” (in both cases more than 45%), the second is “at least once a year”. Less than 10% of respondents claimend “never”. Thus, we conclude that even in younger adult population, there is a potential of opening and running of specialized beer store in Croatia.

Key motivators for purchasing in such store are shown in Figure 6. The interesting thing is that only 2 female respondents (i.e. 1,29% of females) clearly stated that they would never buy beer in a specialized store. The rich beer assortment is the top motivator for both, females

and males. Therefore, the previous claim on a potential of opening a specialized beer store is supported and in such store the key managerial issue would be assortment management and then organization of free degustation and specialized events.

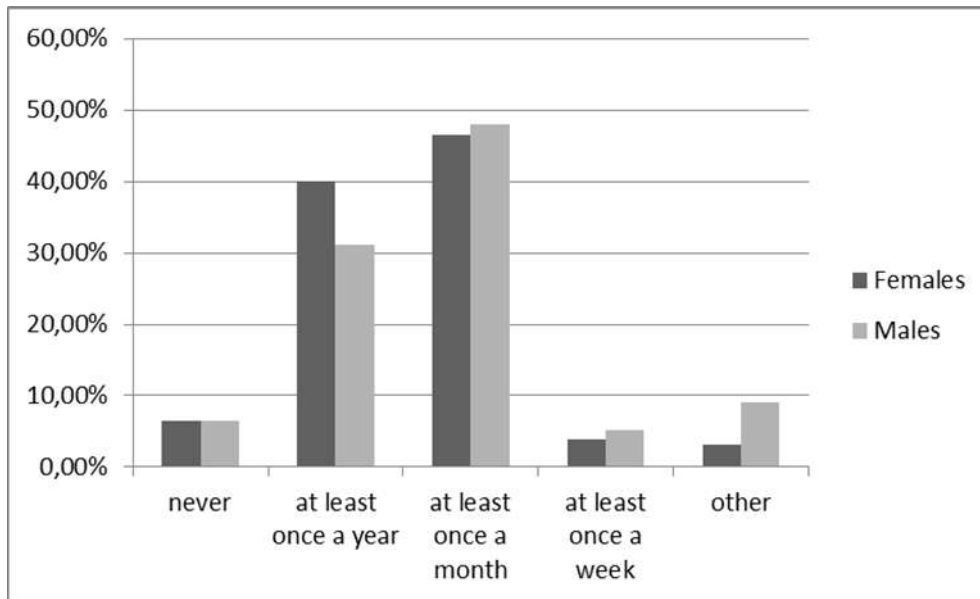


Figure 5 Estimated frequency of visits to a specialized beer store which would offer exclusive and less known beer brands.

Source: Own research

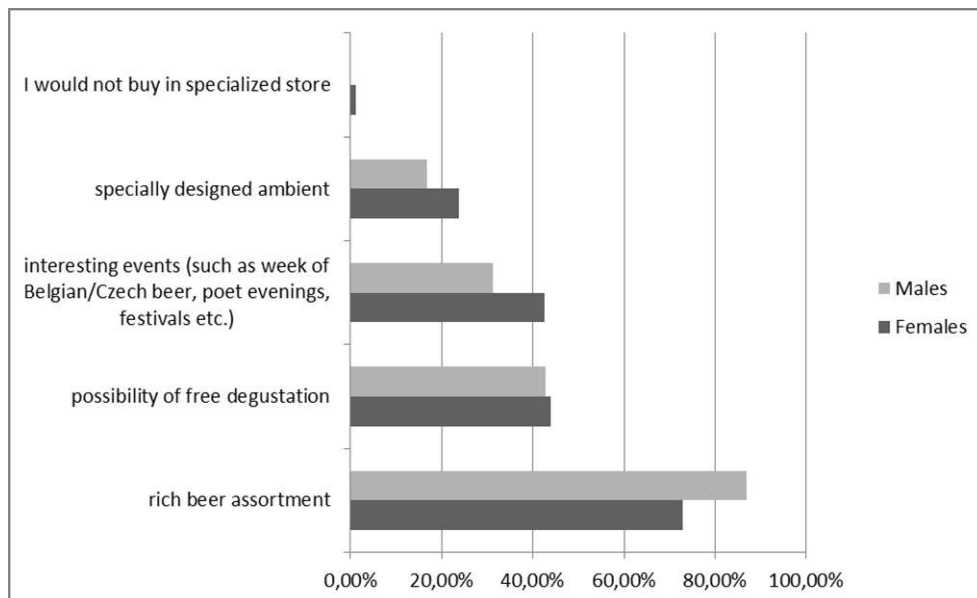


Figure 6 Key motivators of purchasing in a specialized beer store

Note: multiple choice question Source: Own research

5. Conclusions

Brewing industry in Croatia is the important part of the national economy, contributing with 2% to total employment in Croatia. In revenue generation, beer retailing is a vital part because a half of total beer quantity is sold via retail network. Also, there are a couple of leading brands competing in the beer retail market and five of them are holding more than 60% of the market share.

Regardless of position and relationships between producers and retailers, consumers are the ones that determine the outcome of the branding process on the market. In accordance with the positive tendency towards a preferred brand, customers indirectly determine the success of retailers and manufacturers and, therefore, it is necessary to analyze branding issues for particular products and particular consumer groups.

Upon primary results, we can draw out several conclusions on beer retail purchasing, beer as a brand and beer brand loyalty of younger adults in Croatia. Only in three examined variables there is statistically significant difference between males and females: (1) males spend more money on weekly basis for retail beer purchase than females (significant at $p < 0,05$), (2) males consume beer on more frequent basis than females (significant at $p < 0,05$) and (3) males more often buy beer unplanned than females (significant at $p < 0,10$).

Top three ranked key motivators of unplanned beer purchasing within this consumer group are: (1) action prices, (2) packaging and (3) other. Within the option, "other" the very sight of the beer on the shelf was isolated as the most frequent answer suggested by respondents.

Majority of young adult respondents at the very entrance to the store, have a clear idea on preferred beer brand (this is further supported in some other questions). They prefer beer of domestic producers. As the key drivers of eventual beer brand change, quality and friend's suggestions are isolated as significantly more important than the price change.

Majority of respondents agree that beer as a retail product category can be significantly improved. Moreover, the richness of assortment was pointed out as the most preferred change (approximately 50% of respondents stated that they would introduce more internationally produced beer brands). The second suggested improve is the decrease of the beer price which is very questionable as a suggestion because the standard bottle of beer in Croatian retail stores (0,5 liters) is priced around 1 EUR.

In this particular population there is a clear place for opening a specialized beer store, which would offer exclusive and less known beer brands and the key issue would be assortment richness, as claimed by our respondents.

There are several serious limitations of this research that have to be pointed to. First limitation is the sample per se, which involved mainly students. Therefore, the results are relevant for younger adult consumers while results for other consumer groups could be significantly different. Second limitation is related to the narrow geographical orientation on only one country, i.e. only Croatian market. Therefore, for future studies of this topic it would be advisable to conduct surveys in other markets and to conduct comparative analysis of behaviour and attitudes at various geographic markets among different consumer groups based on their socio-economic status.

REFERENCES

1. Agić, E., Alić, A. (2013), Comparative Analysis of Customers' Loyalty to Manufacturer and Retail Brands, in Knego, N., Renko, S. and Knezevic, B. (Eds.), Trade Perspectives 2013 - Supply Chain Relationships, University of Zagreb, pp. 241-263
2. Barwise, P. (2003), Preface in Clifton, R. (ed.) (2003), Brands and Branding, The Economist and Profile Books, pp. xiii-xvii
3. Brewers of Europe, (2016), Beer statistics 2016 edition, Brussels, available at: http://www.brewersofeurope.org/site/mediacentre/index.php?doc_id=840&class_id=31&detail=true (accessed on 27th December 2016)
4. Brown, K., McIlveen, H., Strugnell, C. (2000), Nutritional awareness and food preferences of young consumers, Nutrition & Food Science, 30 (5), pp. 230 – 235

5. Bruwer, J., Saliba, A., Miller, B. (2011), Consumer behaviour and sensory preference differences: implications for wine product marketing, *Journal of Consumer Marketing*, 28 (1), pp. 5 - 18
6. Business Dictionary Online (2013), available at: <http://www.businessdictionary.com/> (accessed 09th January 2017)
7. Croatian Chamber of Economy (2016), Image and reputation of beer industry (in Croatian: Imidž i reputacija industrije piva), available at: <http://www.hgk.hr/documents/grupacija2016tisak57722f3c62499.PDF> (accessed on 17th December 2016)
8. Economic lexicon, in Croatian: Ekonomski leksikon (2011), Leksikografski zavod Miroslav Krleža and Masmedia, Zagreb
9. Ernst & Young (2009), The contribution made by beer to the European economy, available at: www.thebrewersofeurope.org, (accessed on 23rd June 2016)
10. Eurostat news release (2016), Data on number of inhabitants, available at: <http://ec.europa.eu/eurostat/documents/2995521/6903510/3-10072015-AP-EN.pdf/d2bfb01f-6ac5-4775-8a7e-7b104c1146d0> (accessed on 05th January 2017)
11. Healey, M. (2008), What is branding?, RotoVision, Switzerland
12. Insitute of Economy (2016), Sectoral analysis – food and beverages (in Croatian: Sektorska analiza – hrana i piće), available at: <http://www.eizg.hr/hr-HR/Sektorske-analize-993.aspx> (accessed on 15th December 2016)
13. InStore Magazine (2015), Beers and Radrers (in Croatian: Pivo i radleri), 4(25), available at: <http://instore.hr/onlinemagazine/2015/36D/> (accessed on 22nd December 2016)
14. Kaur, P., Singh, R. (2007), Uncovering retail shopping motives of Indian youth, *Young Consumers*, 8 (2), pp. 128 - 138
15. Knežević, B., Škrobot, P., Delić, M. (2014), Adjusting Category Management towards Younger Consumers – The Key Factors of a Beer as a Retail Product Category in Croatia, in: EBES 2014 Anthology, Istanbul, pp. 15-27
16. Knežević, B., Škrobot, P., Delić, M. (2016), Attitudes of Younger Consumers towards Beer as a Retail Product Category from the Gender Perspective, in: Tome, E. (Ed.), Proceedings of the International Conference Theory and Applications in the Knowledge Economy - TAKE 2016, Lisabon, pp. 258-274
17. Kotler, P., Keller, K. L. (2008), Upravljanje marketingom (edition in Croatian), Mate, Zagreb
18. LaTour, K.A., LaTour, M.S. (2009), Positive mood and susceptibility to false advertising, *Journal of Advertising*, 38 (3), pp. 127-42
19. Meza, S., Sudhir, K. (2008), Do Private Labels Increase Retailer Bargaining Power?, *Quantitative Marketing and Economics*, 8 (3), pp. 333-363
20. Pauwels, K., Srinivasan, S. (2004), Who benefits from store brand entry?, *Marketing Science*, 23,(3), pp 364-390
21. Spero, I., Stone, M. (2004), Agents of change: how young consumers are changing the world of marketing, *Qualitative Market Research: An International Journal*, 7 (2), pp. 153 - 159
22. Tarzijan, J. (2004), Strategic effects of private labels and horizontal integration, *International Review of Retail, Distribution and Consumer Research*, 14 (3), pp. 321-335
23. Xu, Y. (2008), The influence of public self-consciousness and materialism on young consumers' compulsive buying, *Young Consumers*, 9 (1), pp. 37 – 48

Evaluation Model of Internal Control Activities in Industrial Enterprises

Lyudmila Mihaylova

University of Ruse “Angel Kanchev”, Ruse, Bulgaria
lmihaylova777@gmail.com

Emil Papazov

University of National and World Economy, Sofia, Bulgaria
epapazov@gmail.com

Ismail Bilgi

Certificated Independent Auditor, Edirne, Turkey
info@ismailbilgi.com

Abstract. The paper will build on the contemporary understanding of the role of internal control in managing enterprises. Practically applicable generalizations will be offered to show the main components and their specific characteristics of a well-structured internal control system. But the very purpose of the study will be to present an integrated model for evaluation of internal control activities. The proposed model will result from country-specific development parameters, typical for the economic and management reality of Turkey. Based on a theoretical and methodological analysis, the conclusion will be made that existing models proved in other countries can be of help. This raises the research interest of how the good foreign experience can be transformed to other countries and implemented successfully at company level. Such a model could be a starting point for adapting and offering ideas for realization of new trends in the management of the internal control in industrial enterprises. The effects of implementing of an evaluation model can be sought in terms of cost, time and quality. Such parameters indicate quantitative and qualitative characteristics of business activities in enterprises.

Key words: *internal control, management, industrial enterprises*

1. Introduction

The need for expanding the research activities in the field of control and the development of new models for their application are associated with the financial and economic crisis that took place towards the end of the first decade of the 21st century. As known, the 2008-2009 critical events started mainly due to weaknesses in financial reporting, but in the course of the escalation of the crisis problems of control emerged. The search for the deep reasons for such malignant phenomena, as well as the ways to deal with their consequences (for example, based on comprehensive internal control) predetermines the importance of the researching interest.

An adequate internal control allows managers of an organisation to delegate responsibilities with reasonable assurance that what they expect to happen, will actually do. Managers must develop internal controls for each activity, for which they are responsible. In addition, the internal control should be seen as a process integrated with all other processes and established, maintained, and monitored by people at all levels of an enterprise. On the one hand, internal control should increase the possibility of an enterprise to achieve its strategic goals and objectives. On the other hand, lower managers should focus on controlling, because they also make instructions to people working for the enterprise (Chand, 2015).

Principally, all forms of control must be cost effective, i.e. the cost of implementation should not exceed the benefits derived from having controls in place. The integrated model for evaluation of internal control activities is an illustration of new understandings and needs of enterprises.

2. An Integrated Model for Evaluation of Internal Control Activities in Enterprises

Having in mind the internal control analyses, a specific integrated model for evaluation of internal control activities in Turkish enterprises will be recommended. The model is based on the study of different elements and presents the connection between them:

- *Targets of the manufacturing industry in Turkey:* increasing R&D, developing of new special products, enhancing investments to improve environmental technologies, improving the infrastructure for local suppliers.
- *Control environment elements:* integrity and ethical values, management philosophy and operating style, organizational structure, assignment of authority and responsibility, human resource policies and practices, competence of the personnel.
- *Internal control mix:* internal variables (company objectives and strategies, risk appetite, management attitudes, company size and structure) and external variables (laws and regulations, governance codes, business culture, industry characteristics, uncertainty and risk, practical frameworks, professional standards).
- *Main processes of an enterprise:* supply, production, marketing, finance, accounting and human resources.
- *Control procedures concerning main processes* – specific for each enterprise. Investigations concerning the European part of the Turkish economy show that Turkish enterprises anticipate the role of “Control environment” and “Risk management” when implementing strategic internal control procedures (Bilgi, Mihaylova & Papazov, 2017). However, operatively they do not dispose of suitable instruments and models. The aim of the suggested model is to show the connections between five elements, described above. The elements of the suggested model and the links between them are presented in following scheme (Figure 1).

The information about the practical implication of the internal control in organizations is significantly limited, despite many theoretical publications. That’s why, the suggested model will be approbated. This model will be also applicable in other organizations, although their organizational structure and processes could differ.

The practical application of the model as technology is simple. The model is based on the information from self-assessment of control activities made by department managers. The assessment of the control procedures and activities is supported by answers such as “Yes – there is”, “No – there is not” and “Partially exists”. Findings of the approbation of model are related to the share (%) of keeping of procedures; partly keeping of procedures; not keeping of procedures.

On the base of the main findings, some problems can be formulated. Each of the problems has cause and effect connection with all elements of the evaluation model.

As known, manufacturing enterprises usually perform three basic functions – marketing, production, and finance (Nedyalkov, 2010; Ascioğlu, 2012; Nikolova, 2017).

Marketing defines supply and demand of a product. Production (operations) deals with the transformation process of resources into a product. Finance explores the efficiency of the previous activities. The approbation of the suggested model for evaluation of internal control activities in enterprises is in line with this postulate.

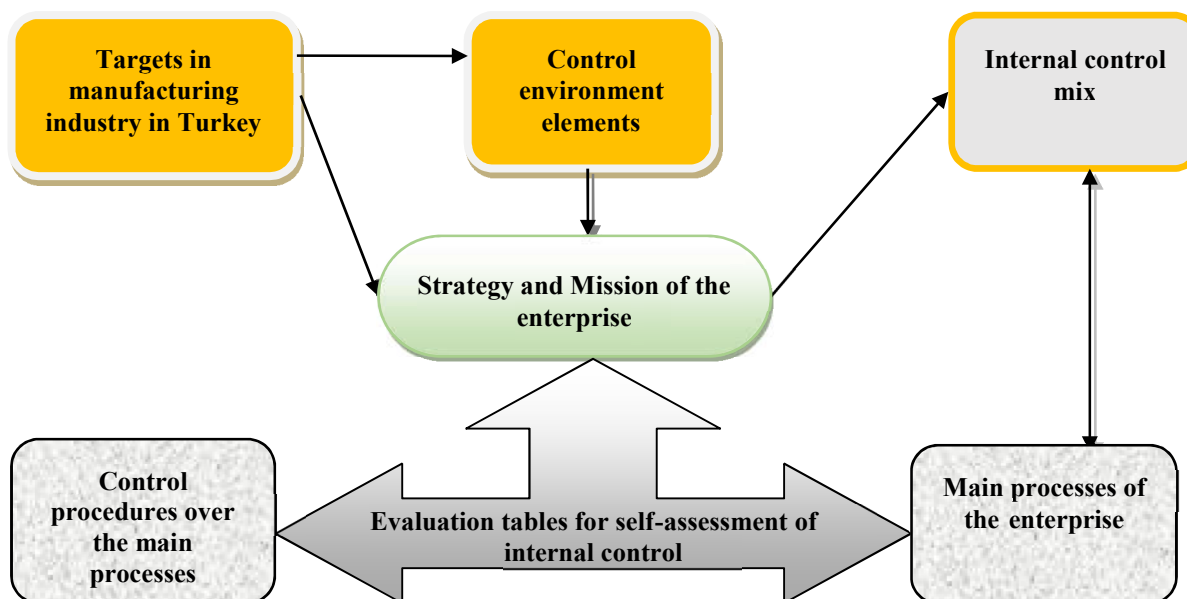


Figure 1 Integrated model for evaluation of internal control activities in enterprises

The internal controllers perform a number of important functions such as determining the adequacy of the internal control system, adherence to business policy, notifying the management of necessary changes and adjustments to this policy, safeguarding assets, establishing the reliability and accuracy of the accounting system and the information flows (Lambovska, 2016; Özdamar, 2002; Sychrova & Simberova, 2012). Traditional control approaches are applicable, but modern approaches such as “risk-focused internal control”, “control of self-assessment” can also be of help (Bilgi, Mihaylova & Papazov, 2017). The suggested evaluation model has been developed in line with the main findings about the enterprises of the European part of Turkey:

- too much trust – for example approval of documents without review; lack of verification of transactions after they have been entered in the system; lack of reconciliation, etc.;
- missing of a follow-up when things look “questionable” or “not reasonable” for the management;
- lack of control over cash;
- lack of control over purchasing of materials or supplies;
- lack of knowledge about the policies and procedures.

The approbation of the model has been done for a manufacturing enterprise. The results have been systematized in a case study used here as a research instrument (Papazov, 2012).

3. Approbation of the Integrated Model in an Industrial Enterprise

The approbation of the suggested evaluation model was undertaken at “Met Medikal” company, Edirne, Turkey. Five main groups of processes and activities were analysed – supply, production, marketing, accounting, finance and human resource management. The main purpose is the evaluation of the internal control activities and the applied instruments.

3.1 General information about the enterprise

The enterprise was established on 31 December 2002 in the European part of Turkey, as a family business. Its main activities are manufacturing and distributing of surgeon, medical and orthopaedic instruments, and equipment, for the domestic and foreign markets. The assets of the enterprise in 2016 were € 3.998.603. Net sales revenues added up to € 2.583.948, including € 1.409.272 export. Net sales revenues in 2017 were € 3.605.957, including € 3.275.103 export.

The main purpose of the enterprise is to maximize profit based on export and to ensure internal market supply.

Despite the fact that all managers are family members, major and minor decisions are coordinated with the general manager, including investments or marketing budgets. The operational decisions are taken by departmental managers, but should be approved or permitted by the general manager. The transfer of power is limited, therefore it is not possible to plan, organize or control processes effectively.

3.2 Information about company's internal control organization

The department for internal control at "Met Medikal" company was set up in 2010, when two experts (internal controllers) were nominated. The internal controllers were chosen to have university degrees in economics or management and enough experience in auditing companies. They did not possess certificates like CIA (Certified Internal Auditor), CCSA (Certified Control Self-Assessment), and CFE (Certified Fraud Examiner). No internal control regulations were in place that set out principles and procedures of internal control.

The analysis of some internal control processes is presented below. Once the management orders internal control over a particular department, the internal controllers determine the program, the task list, and the start and end dates. In some departments a preliminary study is done. Repeated scrutiny takes into account previous findings and reports, drawing attention to the violations found in them. Using different techniques, the internal control collects evidence and information recorded in worksheets (documents). These documents are stored and registered in an established manner.

To provide the necessary information, a preliminary report should be prepared before generalizing the final one or organizing a meeting with the relevant department heads and the management of the enterprise. The purpose of this meeting is to discuss the measures and methods for improving or correcting the violations discovered during the control. The information received at the final meeting is evaluated and a final report is prepared, and the conclusions and suggestions therein are sent first to the heads of departments, in which the check is made and then to all other stakeholders.

The internal control report has a standard form and is prepared by the internal controllers. It contains the name of the company, the company's correspondence number, and date of the report, names and positions of the shareholders, the topic of internal control, names and signatures of the controllers.

The first part of the report contains information related to the topic of control (date of control, scope, restrictions, etc.), the second part summarizes the data in the main sections and, finally, the third part presents the results and the recommendations.

The enterprise has a small number of control procedures related to activities, departments or processes. Written rules related to them are limited. The results and suggestions related to the control procedures of the main processes in the enterprise concern: supply; production; marketing; accounting and finance; and human resources management.

3.3 An example for evaluating control procedures concerning a main process (supply)

The obligation of the supply department in an enterprise is to provide all the necessary products and services at the right time and with the necessary specifics. Supply is considered a process starting with the order of the needed products and ending with their entering into the warehouse. Through quality assurance, the supply function strives to achieve efficiency, taking into account the short- and the long-term business goals.

The supplying activities are dealt with in three groups:

- purchase of common technical materials of negligible volume necessary for production;

- acquiring large quantities of technical raw materials from the domestic market;
- buying from foreign markets (import).

Following procedures are considered: control procedures of supply and stages related to the supplying process.

3.3.1 Assessment of the main control procedures of supply

Out of the 6 main supplying control procedures, only 2 (33%) were fully implemented by the enterprise and 4 (67%) were partially implemented (Table 1). Improvements are needed in this direction.

Table 1 Main control procedures of supply

Procedure	Control procedures	Yes	No	Partially exist
1	All supplying activities are done by Department "Supply". Other departments have not rights to do these activities.			X
2	There is an instruction manual.	X		
3	All activities in the enterprise are performed according to the instruction manual.			X
4	The supplying budget is prepared by the Department "Supplying" and approved by the Department "Finance".			X
5	Department "Supplying" uses software „Module for enterprise resource planning“.	X		
6	The philosophy "Just in time" is applicable.			X
Total		2	0	4
%		33%	0%	67%

Some decisions, which are normally a prerogative of the "Supply" department, are taken by the general manager. In this case, the proposal and the evaluation of all purchases, especially machines, apparatus or expensive raw materials required for production, must be made by the department "Supply", confirmed by the managers of the departments concerned, and approved by the general manager. The latter should not have the rights to decide individually for the enterprise's purchases.

Although the "Quality control" Department prepared a Supply Manual, it did not cover public procurement and procurement processes. So, the procedure remains to some extent contradictory.

The supplying budget must be agreed with the department of "Finance" and after that approved by the general manager.

Only the supply of most important materials (very expensive ones, which are bought in euro or dollars, or are rare to find) is concerned with the philosophy "Just in time". Other materials are allowed to be kept in stock in accordance with the production process.

3.3.2 Evaluation of the main stages of supply

The main stages of "Supply" are:

- determination of the purchase request;
- placing an order;
- realizing the purchase;
- storage of the purchased materials and sources and accounting of the purchase;
- application of control and evaluation procedures.

The following table shows the recommended control procedures and findings.

Table 2 Determination of the purchase request

Procedure	Control procedures	Yes	No	Partially exist
1	On the basis of the production program, it is determined by which product how much to produce, the type, quantity and time of delivery of the materials needed to implement the production schedule.	X		
2	If the quantity of reserves is monitored automatically, the system itself must warn about the optimal level of reserves and the situation should be evaluated by the responsible employees.		X	
3	To make the order of materials on the request of Production Department, a duplicate form is prepared - one copy for Supply Department and the other copy for Accounting Department.			X
4	Once Supply Department has conducted the necessary market and price research, a purchase order (copies to accounting and other departments) will be issued.			X
5	An order is being made for the purchase of all kinds of materials, raw materials and others.			X
6	The purchase order must contain all the information relating to the quality, quantity and price.	X		
7	The purchase order, request, and application form must be signed by the authorized persons.			X
8	Purchase orders must have a serial number.			X
Total		2	1	5
%		25%	13%	62%

Out of the 8 control procedures presented above and related to the purchasing process, 2 (25%) were implemented by the enterprise, 1 (13%) was not applied and 5 (62%) were partially implemented (Table 2). It is found that no effective system for controlling the activities related to the determination of the purchase request has been established.

Even if an enterprise resource planning system is used, if an optimal raw material and resource reserve is not built, the supplying process cannot be controlled.

The analysis of the order forms shows that they are made only in two copies – one for the “Supply” department and another for the warehouse. However, there is no copy for the accounting department.

The main problems concerning the determining of the purchase request are:

- no order form is prepared for some purchases;
- no approval exists for some order forms;
- changing some order forms after they are approved;
- making purchases without permission and order.

All of these situations can lead to unauthorized or self-interested individuals making purchases at their own discretion and causing different negatives. It is obligatory for the enterprise to take measures in this direction. The activities under this process need to be reviewed and improved in line with the above suggestions.

Main findings for placing an order show that of the 6 control procedures related to placing an order in the process of purchasing, 1 (17%) was applied by the enterprise and 5 (83%) were partially applied (Table 3). This is insufficient and needs improvement.

Table 3 “Placing an order” procedures

Procedure	Control procedures	Yes	No	Partially exist
1	The suppliers are determined on the basis of a market research and, without doing so, no purchases are made.			X
2	When buying the same raw materials from different suppliers, in order to avoid inconsistencies and differences in the products produced, the same quality and delivery conditions are required.	X		
3	Contracts concluded with suppliers include detailed information on quantity and type of delivery, quality, delivery time, payment terms, price and / or discounts.			X
4	The supply efficiency indicators (price, quality, easy access to suppliers, quantities, packaging and measurement of quality, etc.) are defined, measured and evaluated.			X
5	Contacts with suppliers are improved and developed by setting new conditions, developing plans, and more.			X
6	Contracts with non-eligible suppliers are terminated.			X
Total		1	0	5
%		17%	0%	83%

Suppliers are not determined after a preliminary price survey. No marketing research is conducted among sufficient number of companies. Instead of purchasing at the lowest price, the materials are purchased from the company that offers the highest price. It has been found that price surveys have not been made for some urgent purchases, and they were made at a higher price. A 10-year contract with a supplier company was concluded on the grounds that the price of their products did not change but before that there was no price survey.

The steps of increasing the efficiency and effectiveness of the “placing an order” should be reviewed. The creation of a unified control system that checks at a specific time and prevents supplies without pre-pricing is an obligatory condition. Checks should keep track of whether the company is doing business with one and the same supplier, although he offers high-priced products, or whether performance is measured under certain conditions.

Main findings about realizing the purchase shows that of the 15 control procedures related to “Realizing a purchase” 6 (40%) were applied at the enterprise, 5 (33%) were not applied and 4 (27%) were partially applied (Table 4). The drawbacks of this process and the recommendations for its improving are given below.

Table 4 Realizing the purchase

Procedure	Control procedures	Yes	No	Partially exist
1	The supplier activities and the purchase pricing must be controlled by an authorized officer.		X	
2	Authorization to purchase must be done by authorized officers.		X	
3	The purchase has to be realized according to the offer.			X
4	It is necessary Financial Department to decide whether the purchase will be paid in advance or later.	X		
5	Payments are approved and made only on the base of payment documents by authorized officer.	X		
6	Payments must be realized by check or bank transfer.	X		
7	Checks have to be signed by two authorized officers.		X	
8	The authorized officers have to be familiar with the all documents before signing the checks.	X		

9	To avoid duplicate payments, the payment and accompanying documents must be stamped "Paid".		X	
10	No blank check sheets should be signed.	X		
11	Access to accounting registers, cash and bank confirmations of the officers authorized to sign these documents is strictly forbidden.			X
12	The persons, authorized to sign the checks are forbidden to sign the so-called "Check payable to the bearer".		X	
13	All checks must be performed to avoid payment of the rejected checks.	X		
14	It is necessary to calculate correctly the difference in the terms of credits receiving.			X
15	Supplier discounts need to be properly calculated and controlled.			X
Total		6	5	4
%		40%	33%	27%

Some activities are not undertaken by the approved firm at negotiated prices because the approvals and pricing are not controlled by an appropriate person. At the same time, there are some cases, in which the purchase approval specifies quantities and prices, but the actual ones are different. The payment and other documents must be stamped and stored as "Paid" to avoid double payments. The possibility of using unstamped documents from employees to make a re-payment is highly probable, and there should be a stricter internal controls.

Sometimes, only one approving signature is enough, but the possibility of mutual control is reduced. In the case of goods on trust selling, there are differences between the payments and the maturity, calculated by Financial and Supply department. The last one calculates the maturity for non-weighted averages, whereas Finance department calculates maturity according to a weighted average, thus taking into account the quantities of purchased goods. The two departments have to decide which of these methods should apply.

Evaluation and findings about storage of the purchased materials and other resources – of 17 storage control procedures, 10 (59%) were implemented, 3 (18%) were not applied and 4 (23%) were partially applied (Table 5).

Table 5 Storage of the purchased materials and sources

Procedure	Control procedures	Yes	No	Partially exist
1	Acceptance and receipt of materials are performed only by the authorized departments – "Supply" and "Warehouse".	X		
2	Warehouse is an independent of "Supply" Department.	X		
3	The control of the incoming materials is done by the warehouse.		X	
4	Warehouse fixes the equality of the ordered and received commodity – number, quantity and quality.		X	
5	The purchase request, the quantity put in the invoice and the quantity of the materials received are controlled.			X
6	Upon delivery, at least 4 copies of the document for incoming materials have to be prepared – for warehouse, accounting-, purchasing- and supply department.	X		
7	Documents for incoming materials contain a serial number.			X
8	The received materials are classified as raw materials and auxiliary materials and stored at different stores.	X		
9	The raw materials and materials used in the production are stored safely in the warehouse and are ready to be submitted to production in the fastest way.	X		

10	The use of available raw materials and auxiliary materials is controlled in a secure manner by a computer system.	X		
11	The control of the materials, sent to the production is doing by special department.	X		
12	There is a document issued with a serial number certifying the sending of materials in the production.			X
13	A periodical inventory is made at the enterprise.	X		
14	The inventory takes place not only at the end of the period but also on a daily basis.	X		
15	There is an inventory plan indicating what and how inventory will be made at the enterprise.		X	
16	There are no removed company stocks of the previous year and included in for the following year.	X		
17	Checking the stocks at the end of the year.			X
Total		10	3	4
%		59%	18%	23%

The control over purchased materials is performed only by the “Quality control” department in accordance with the specifications. There is a need for coordination with warehouse management. It has been found that sometimes there is a discrepancy in the quantity of the order made and the actual quantity received. A better information system is required.

There are no documents available at the enterprise related to buying materials and other resources in batches. There are no registers concerning warehousing. It is necessary to prepare documents by serial numbers for each incoming batch and to register these documents in the relevant departments. Otherwise, abuses by workers concerning sales of the materials and resources for production needs can happen.

Evaluations and findings about accounting of the purchases – of 17 procedures, 7 (41%) were implemented, 1 (6%) were not applied, and 9 (53%) are partially applied (Table 6).

Table 6 Accounting of the purchase

Procedure	Control procedures	Yes	No	Partially exist
1	Accounting department is responsible for the preparation of accounting documentation for supply of materials.	X		
2	Supply Department approves the invoice, the delivery document, the bill of lading and the order document.	X		
3	The accounting department prepares a purchase dossier, incl. copies of a purchase request, order, bill of lading, and invoice, payment documents.			X
4	On the basis of the verified documents, the accounting department put the purchase at the accounting register.			X
5	The accounting department prepares accounting records by comparing the purchase approval and the delivery report issued within the enterprise, with the invoice.			X
6	At the end of the period, inventories are valued.	X		
7	Import raw materials and fuels are calculated on the basis of the delivery price plus all import charges.			X
8	The price of the acquired inventories includes customs duties, customs expenses, etc.	X		
9	Foreign exchange differences on transactions are required to be put at the financial statements.	X		

10	An annual revaluation is made for inventories and a reserve is allocated.	X		
11	The information about the materials sent to production process or returned back comes from warehouse to accounting department.			X
12	Partial deliveries of materials (in batches) are recorded by the accounting department.			X
13	A comparison between Purchase Registry and Payments Register is made.		X	
14	Monthly accounts information is sent to customers.	X		
15	Purchases made by affiliates are controlled separately from purchases made by other entities.			X
16	Protocols for incoming materials for which an invoice has not arrived are controlled at specified intervals.			X
17	The internal control system is designed to ensure that the inventories are recorded at the correct accounts, by the exact amounts for the period in which they are held.			X
Total		7	1	9
%		41%	6%	53%

The analysis of accounting documentation (purchase request form, application form, incoming material document, invoice, and copies of payment documents) shows that there are missing documents in the dossier or no records available for some purchases. This is the reason why incomplete accounting documentation is prepared or not prepared at all.

At the same time, a comparative analysis of the accounting records reveals that they are prepared based on uncertified or non-approved primary documents. This type of accounting dossier, relating to the purchase of materials, must contain all the documentation, without any deficiencies, and be prepared and stored under certain rules. The accounting department should establish and develop a mechanism to control the integrity of the dossier – without incomplete, unverified (unauthorized and unsigned) or missing accounting documents. Some of the documents relating to materials needed for production must be prepared by the warehouse and registered at the accounting department because they are primary and important for accountability. The partial deliveries are also subject of bookkeeping.

Accounting controls require double tracking of the supplying process – on the one hand, through debit and credit of inventory accounts, and on the other by debit and credit to the corresponding accounts. This should not be done by one and the same person.

4. Conclusion

The approbated integrated evaluation model at “Met Medikal” company shows some internal control specifics. A weak point found in the example is that no internal control plan is prepared. Internal controllers carry out control activities only on management instructions. After assessing the riskiest areas, annual plans for internal control activities should be prepared. These plans should cover the areas, subject of the verification, and the names of the persons, who will carry out the internal verification. It is necessary to have the plan validated and signed by the management and bound by an annual schedule of the enterprise. In addition, the plan must be flexible in view of adjustments and changes, if necessary.

“Met Medikal” enterprise has to build an internal control system in view of the activities, geographic features, organizational structure, corporate culture, and vision, and mission, style of management, strategies and policies. One of the main responsibilities of management is to avoid risks for the enterprise. In this respect the studied company show weak results.

According to the degree of application of the internal control procedures at the “Met Medikal” company, a more effective internal control of the marketing process was established compared to other processes, especially to the process of supply. For a business, whose primary purpose is to produce quality products and maintain a high market share compared to competitors, a similar emphasis on internal control is understandable.

The effective implementation of internal control procedures is connected with following the marketing process, then accounting and finance – with 65% implementation rate, human resources management – 63%, production – 62% and supply – 40%. Evaluation of the last one was described in details.

REFERENCES

- Ascioglu, Ö. (2012). Internal Auditing in Turkey. *Journal Internal-Auditing.com*. Article available online at: <http://www.internal-auditing.com/art.asp?n=283>.
- Bilgi, I., Mihaylova, L., & Papazov, E. (2017). Internal control activities in small Turkish companies. *Management: journal of contemporary management issues*, 22 (Special Issue), 69-83.
- Chand, S. (2015). Managerial Functions: Basic Functions That Should Be Performed By a Manger. Available on: <http://www.yourarticlelibrary.com/management/managerial-functions-basic-functionsthat-should-be-performed-by-a-manger/8614/>.
- Lambovska, M. (2016). Methodological features of risk management in internal control systems. *Economics* 21, 1(1), 77-78.
- Nedyalkov, A. (2010). Aspects of Operations Management of Services. *Annals of "Eftimie Murgu" University of Resita, Fascicle II – Economic Studies*, 17 (1), 270-279, Available at SSRN: <https://ssrn.com/abstract=2922854>.
- Nikolova, B. (2017). Nature and Characteristics of the Control Impact in the Area of Financial Control (Theoretical Concepts and Practical Aspects). *Izvestia, Journal of the Union of Scientists – Varna, Economic Sciences Series*, (2), 260-266.
- Özdamar, K. (2002). *Paket Programlarla İstatistiksel Veri Analizi*. 1.4. Baskı. Eskişehir: Kaan Kitabevi.
- Papazov, E. (2012). *Business games*. Ruse, Avangard Print Publisher.
- Sychrova, L., & Simberova, I. (2012). Key performance indicators as a basic element for a marketing efficiency measurement. *The 7th International Scientific Conference on Business and Management*. (pp. 488-493). Vilnius, Lithuania.

Reception Operations in Ports of Nautical Tourism

Vedrana Musinov

University of Split, University department of professional studies, Split, Croatia, student
vedranamusinov@gmail.com

Goran Ćorluka, PhD

University of Split, University department of professional studies, Split, Croatia
gcorluka@oss.unist.hr

Abstract. Nautical tourism as the dominant selective form of tourism is gaining on share in international tourism. Despite the importance of nautical tourism in tourism development and lengthening the tourist season, a theoretical gap in tourism literature was identified, especially in business operation. The purpose of this paper is to foster theoretical knowledge of reception operations in ports of nautical tourism. Research goals were achieved by conducting a personal interview survey. Specifics of reception operation in ports of nautical tourism were identified in the field of accommodation facilities, reservation procedure, arrival, stay and departure procedure. This paper provides understanding of reception operations in ports of nautical tourism and fills an identified gap in the nautical tourism literature. Research findings are an important contribution to nautical tourism theory and practice.

Key words: *reception operations, port of nautical tourism, nautical tourism*

1. Introduction

Nautical tourism, also known as “yachting” or “marine” tourism is a syntagm used to define a selective form of tourism that covers a variety of activities related to different types of waters: seas, rivers, lakes or canals. It can be defined as a set of activities, features and relations, whose common goal is to satisfy boaters need for sports, pleasure and relaxation. In addition, all other services provided at sea or in ports of nautical tourism, which are related to the boater or his (rented) vessel, can also be considered a part of nautical tourism. Nautical tourism is a sum of poly-functional activities and relations that are caused by the tourists boaters' stay within or out of the ports of nautical tourism, and by the use of vessels or other objects related to the nautical and tourist activities, for the purpose of recreation, sports, entertainment or other needs (Luković, T. i Gržetić, Z., 2007). As a branch of tourism, nautical tourism is a compound touristic and maritime activity whose definition is complex because of its intensive connections with maritime and navigational activities (Luković, 2007). The main characteristics of nautical tourism are: the boaters' mobility in destination, a wide spectrum of activities they engage in and services they use. Nautical tourism covers the entire spectrum of activities given that boaters are not stationary, but guests are characterized precisely by their mobility (Gračan et al., 2016). Nautical tourism is developing rapidly on regional and local level and is considered as one of the most propulsive kinds of recreational tourism. Its growth has developed some sub types, shaped in special selective types, and as such, they have been developing on their own, those are nautical tourism ports, charter and cruising (Luković, 2008). This form of maritime tourism is gaining momentum and is becoming one of the leading forms of tourism with significant economic implications

(Ćorluka, Matošević Radić, Geić, 2013.). Nautical tourism contributes to economy development by fostering their growth and development through both their current activities and those related with them horizontally (excursion tourism, diving tourism, photo safari, servicing) or vertically (handicrafts, shipbuilding), implying contribution to the growth in employment of domicile inhabitants, which is particularly important for insular economy (Jugović et al., 2011).

Besides the given factors, such as nature and landscape beauty, clean environment and climate conditions, any nautical destination needs to develop a wide set of infrastructure to accommodate boaters needs. The base of this infrastructure is the ports of nautical tourism with all the services they provide for boats and for boaters. Croatian legislation recognizes four types of ports of nautical tourism: Anchorage, Dry storage, Dry marina, and Marina (Pravilnik o razvrstavanju i kategorizaciji luka nautičkog turizma, 2008), where anchorages and dry storages offer only basic services for vessels, while dry marinas and marinas offer a variety of services for vessels as well as for boaters. Marinas are rated with anchors (two to five) where higher ratings denote higher quality of services, more facilities, greater focus on environment and clients' needs. The need for excellent staff to provide these services grows proportionally to the growth of nautical tourism share. Nautical tourism port is essentially a tourist facility, which from a business, spatial, construction and functional aspect, provides a venue and service in its entirety for satisfying the requirements of nautical tourism and nautical tourists, namely boaters (Kasum, et al., 2010). The quality, equipment and infrastructure itself of Croatian harbor and marina, still greatly lags behind other countries that nautical constant investment each year boosts its ports and marinas to raise to a higher level. (Gračan, et al., 2016). Also, the Action plan of nautical tourism development, published by Croatian Institute for Tourism, states that the level of skills and competencies in yachting tourism, as well as the general public knowledge of the importance of yachting tourism for economy and social development, is insufficient. It proposes introducing multiple improvements in educational system, in order to override these problems. The problem identification is the first step in implementing proposed improvements. The aim of this paper is to identify the specifics of reception operations in ports of nautical tourism and create a guideline for writing educational materials. By fostering theoretical knowledge of reception operations in ports of nautical tourism the identified theoretical gap will be covered. At the same time the paper is an important contribution in satisfying requirements made by practical sector. As the main workflow and hospitality settings are quite similar to the hotel procedures, corresponding hotel literature was used as a guideline for creating this paper.

2. Research Methodology

Qualitative research method in the form of in-depth interview with four reception staff members including the reception manager as industry professionals was used. Desk research about hotel and marina offers and currently available educations for receptionists and reception managers in ports of nautical tourism was also conducted with purpose of ascertaining current educational opportunities. The same methodology was used in creating introduction that is based on nautical tourism theory. In presenting the findings, the authors have used descriptive and comparison methods.

3. Research Results and Discussion

Specifics of reception operation in ports of nautical tourism were identified in the field of accommodation facilities, reservation procedure, arrival, stay and departure procedure.

3.1 General

All reception office spaces in ports of nautical tourism must meet certain standards as stated in Rules on classification and categorization of ports of nautical tourism published in National gazette number 72/2008. Higher marina ratings (higher number of Anchors) denote higher quality and larger scale of offered services. However all the ports of nautical tourism base their reception operations on similar, if not the same, principles. Specifics of reception operation in ports of nautical tourism were identified in the field of accommodation capacities, reservations, customer reception, stay and departure activities.

3.2 Accommodation facilities

Accommodation facilities in marinas are called berths (on the water) or dry storage (on land). We can define berth as a space on the quay equipped with maritime bollards, anchor blocks and mooring lines. Dry storage can be defined as an area on land equipped with cradles, posts or racks. All must be equipped with water and electricity supply. Use of berth can be agreed upon for different periods of time – annual, half-year, month, day or even half a day. The type of accommodation primarily depends on the type of the watercraft and after that the clients wishes are taken into consideration. To allocate a berth to the specific vessel following factors must be taken into consideration:

- Vessel dimensions (length over all (LOA), width, draft)
- Vessel weight
- Period of use of the berth
- Weather conditions, sea currents, tides and lows in the period of use
- Skippers sailing abilities, skills and experience
- Special needs/demands from crew members, passengers or the vessel itself (ie. Presence of disabled persons, pregnant women, small children, non-standard hull construction etc.)

3.3 Reservation procedure

3.3.1 Reservations classification

Reservations can be classified according to different criteria. Based on business activity and depending on their offer, marinas can make reservations for berthing services, dry storage, crane or travel lift (lifting/lowering) services, restaurant services and other services such as laundrette services, transportation, accommodation, sports or wellness facilities etc. Depending on length of stay, reservations can be classified as long-term and short-term ones. Long-term reservations usually need to be made several months in advance and require term contracts with full vessel data. Short-term reservations are made several days or even just hours before the vessels arrival to marina. These usually refer to transit berthing options. Number of users' classification implies three options: (i) individual reservation for one vessel, for both short and long-term stay and one or more boaters; (ii) flotilla reservations made for several vessels, more boaters and short-term periods of use and (iii) charter fleet formation. The latter implies negotiations regarding use of facilities, prices and conditions; in most cases involvement of higher management is required. Based on distribution channels, reservations are direct – directly at the marina reception and indirect trough online reservation systems, booking agencies and similar intermediators.

3.3.2 System complexity

The reservation process in marinas is complex due to the accommodation of both vessels and guests. The most significant difference comes from the fact that hotels can sell one room to one client at any given point in time, while marinas can sell the same berth several times over.

Most long-term contracts include the clause that marina is entitled to use the berth while the users vessel is out from marina. Basically this means that if a berth is sold on annual basis, and becomes available during longer period of time, it can be resold on monthly basis and then again on daily basis. This process is quite dynamic and requires excellent organizational skills from the person conducting the reservation. Besides the information on vessels coming in and out of the marina, information on the weather in the following 72 hours also need to be taken into consideration. The receptionist needs to be a quick-thinking person who is able to simultaneously communicate in several languages and through different communication channels, which knows the marina facilities to detail and is able to predict short-term demand and consumer behaviour. Reception staff is often the coordinator and organizer of activities and processes in marina, so investing in their training and knowledge is the key to success. Preferred communication channels in marinas are: e-mail for long-term periods and phones or VHF for transit berth use.

3.3.3 Information sources, proofs and data processing

To book a transit berth marinas will need information on vessels owner/skipper, period of stay, name and length of the vessel, contact details and special demands. For long-term contracts additional information are needed: owners passport for natural person or Trade Court Statement if the vessel is company owned, certificate of registry, proof of payment for permit for sailing in Croatian waters, proof that the tourist tax has been paid, insurance details (third parties insurance), proof that the vessels customs status is clear, proof that the vessel is seaworthy, the authorization to use the vessel if owner is not present or the vessel is company owned etc. Skipper needs to provide his skippers licence that is issued by competent authority. If the vessel has a nonstandard hull, construction plans are required in order to avoid hull damages. All the information are stored in marina PMS (Property Management System), while document copies are stored in accordance with marina policies and General Data Protection Regulation. Every marina has their own terms and conditions, house rules, business policies and procedures, but all are based on similar presumptions. Waiting lists in marinas are quite specific as not all berths are suitable for all vessels. “First come – first served” rule is applicable, but only after taking vessel dimensions and special construction details into consideration. On daily basis receptionists will provide other departments on occupancy rate and details on new arrivals. Preregistration process is the process of entering available details on vessels and its crew in the marinas data base. It is used to shorten the amount of time that a client needs to spend at the front office. Daily monitoring of the fleet in the marina is conducted several times every day and it is used to control if all the vessels in the marina are registered in the system, as well as if all those who left have actually registered their (temporary) departure. These logs used to be manual, but nowadays modern solutions such as RFID, QR codes, ultrasonic sensors, mobile apps etc., which reduce staff engagement, are available. Accurate information on vessel movements is subject to controls from different Government institutions (Customs department, Harbour master etc.)

3.4 Arrival, stay and departure procedure

3.4.1 Arrival procedure

Marinas are not obliged to take in any unannounced arrival, but will try to avoid declining berthing options, especially in cases of bad weather. On daily basis during the sailing season, a limited amount of berths is available for transit use depending on marina location, day of the week, fleet structure, weather conditions and other factors. Process of admission to marina differentiates depending on the period of stay, services used and the type of client. In comparison to a hotel, marinas have the advantage of not needing extra time to prepare the

berth for the next client, except in cases of exceptional damage to the mooring lines or supply points.

Marina provides different types of services to clients. In most of the marinas they can be split into 5 main categories:

- Berthing/ dry berthing services
- Hoisting / crane services
- Vessel service and maintenance (engine service, sails service, rigging, hull maintenance, cleaning etc.)
- Bar and restaurant services
- Other (waste collection, chandlery, broker, grocery shop, wellness, fitness and training, accommodation facilities etc.)

3.4.2 Stay procedure

All the services provided by the marina must be recorded in the PMS in a timely manner. Depending on the marina procedures and the type of PMS every department can enter their own services into the system or can report it to the reception staff that will enter the data. The former way is considered more effective as employees have a greater sense of responsibility and awareness of the results. The accuracy of the entered data (both on vessels and guests) is of utmost importance not only for charging the client, but also in respect to many regulatory institutions who control this branch of tourism such as Customs and Tax department, Police department, Harbour master etc. Boaters and their vessels tend to create large amount of (hazardous) waste. While staying in the marina boaters have to be provided with adequate facilities for waste disposal and tracking.

3.4.3 Check-out procedure

Check-out procedures in marinas depend on type of contract (long-term or short-term). Keys to successful check out procedure are confirming all the services entered into PMS actually belong to certain user and that there are no complaints regarding the quality of provided services. Some of the possibilities during the check-out are (i) both vessel and client are leaving the marina after unspecified period of time. In this case full payment of all the provided services is required prior to leaving the marina, (ii) vessel stays in the marina while the client is leaving in which case the marina will need to check that both vessel documents and keys are deposited at the marina reception and water and electricity plug-ins are disconnected for safety reasons. Client can instruct the reception on the required services that are to be done while he is away from the marina. In this case client can pay for prior services but the full payment is not mandatory as the marina has a safety deposit in form of the vessel. This means that marinas retain the right to keep the vessel until the due debt is settled, and in some extreme cases they have the right to sell the vessel in order to cover their fees.

The “value for money” is one of the most important aspects of studying customer satisfaction and accordingly, creating a good name for the marina among boaters. Prior to concluding their stay in the marina, every boater should be interviewed in regard to his stay. Receptionists should be instructed and trained on obtaining satisfaction feedbacks from customers in order to identify and correct eventual problems or discrepancies in quality of service. Many ports of nautical tourism are therefore introducing quality standards such as ISO, Golden Anchor scheme and similar.

4. Conclusion

Croatian coast is one of the most attractive sailing areas in the Mediterranean. During the last two decades it has become one of major nautical tourism forces in the world with significant charter and private boats fleet. Nautical tourism is making a significant share of all tourist

arrivals and overnight stays, as well as in Croatia's national income. As much as it is contributing to the local economy, increased numbers of tourists and their vessels is creating a deep ecological impact on the environment of the Adriatic coast. Therefore the creators of National development strategy see the future of nautical tourism in development based on sustainable development principles. When compared to Mediterranean competitors, one of the biggest disadvantages for Croatia is the "value for money" aspect. The main goal after identifying our weaknesses is to rectify them through proper education and creation of quality product. To complete this task, all parties involved must take steps to improve the system and all the links that make a chain of nautical tourism. We firmly believe that the answer to these challenges lays in quality educational programs and training possibilities for all levels of employees, especially those who are most often in contact with clients. Reception staff, as a parts of the nautical port puzzle, need to be adequately educated, knowledgeable and well trained to meet all the customer demands and answer their questions and problems in a timely and accurate manner. To achieve these goals, schooling system and training centres need to, on one side, create such programs that will provide their students with unique set of knowledge and skills, but also, on the other side, engage theory and field experts to create adequate learning materials.

In this paper we have listed the basic differences that prove that reception operations in nautical tourism are specific and need to be studied apart from similar operations in other selective forms of tourism. Specifics of reception operation in ports of nautical tourism in the field of accommodation facilities, reservation procedure, arrival, stay and departure procedure were identified. Therefore, a wider study that would include theory and field experts should be conducted as a base for creating study materials for reception staff. Also, schools and higher educational institutions should create courses for receptionists that will include selective forms of tourism, nautical tourism in particular.

The paper files the identified theoretical gap in nautical tourism literature is and is a contribution to nautical tourism practice. Further activities to boarder the knowledge and gain the awareness of theoretical knowledge are needed, as this selective form of tourism is rapidly growing.

REFERENCES

- Croatian Bureau of Statistics (2012), Nautical tourism, Capacity and Turnover of Ports, Number 4.3.5., Zagreb
- Ćorluka G., Matošević Radić, M., Geić, S. (2013), Selective forms of tourism, the way of extending the summer season, *Economy Transdisciplinarity Cognition Journal*, Vol. 16, Issue 2, 88-96.
- Gračan, D., Gregorić, M., Martinić, T.,(2016), Nautical tourism in Croatia: current situation and outlook, *Tourism & Hospitality Industry*, Congress Proceedings, 66-79.
- Jugović, A., Kovačić, M., Hadžić, A. (2011), Sustainable development model for nautical tourism ports, *Tourism and Hospitality Management*, Vol. 17., No. 2, 175-186.
- Kasum, J., Bozic-Fredotovic, K., Vidan, P. (2010), *Management of natural resources, sustainable development and ecological hazards II*, edited by: Brebbia, C.A., Jovanovic, N., Tiezzi, E., WIT Press, Southampton
- Luković, T. (2007), Nautički turizam – definicije i dileme, *Naše more*, 54 (1-2), 22-31.
- Luković, T. (2008), Selective tourism, fast fading fad or a scientific-research necessity, *Acta Turistica Nova*, Vol. 2, No. 1, 51-74.
- Luković, T., Gržetić, Z. (2007), Nautičko turističko tržište u teoriji i praksi Hrvatske i europskog dijela Mediterana, Hrvatski Hidrografski Institut, Split
- Web site:

Pravilnik o razvrstavanju i kategorizaciji luka nautičkog turizma (NN 72/08), Retrieved 26.03.2018 from https://narodne-novine.nn.hr/clanci/sluzbeni/2008_06_72_2402.html

Institut za turizam,(2015) *Akcijski plan razvoja nautičkog turizma*, Retrieved 03.04.2018. from: http://www.mint.hr/UserDocsImages/arhiva/151022_AP-%20nauticki-www.pdf (03.04.2018)

Traditional Versus Low-Cost Airlines' Passengers. A study on Iasi Airport

Laura Diaconu Maxim

Faculty of Economics and Business Administration,
"Alexandru Ioan Cuza" University of Iasi, Romania
lauradiaconu_07@yahoo.com

Andrei Maxim

Faculty of Economics and Business Administration,
"Alexandru Ioan Cuza" University of Iasi, Romania
andrei.maxim@feaa.uaic.ro

Abstract. Due to the liberalization of the aviation market in the European Union, the low-cost carrier (LCC) model has gradually developed in the member states and this type of airlines became a popular alternative to the traditional ones. The aim of this paper is to analyse the major features of the Romanian air travel market and to identify the characteristics of the passengers of both LCCs and traditional airlines, from Iasi Airport. In order to reach this purpose, the research methods consisted in an investigation of the specialized literature, in a statistical analysis of the secondary data and in a comprehensive survey that targeted passengers from Iasi Airport, which travelled on routes served by LCCs, as well as by traditional carriers. In Romania, after the implementation of the "open skies" agreement, in 2007, the number of the routes operated from/to this state and the number of the airlines' passengers has considerably increased. Among all the Romanian airports, in 2017, Iasi Airport registered the highest increase in the number of transported passengers, being also placed in a top 5 at European level. The findings of our survey reveal that the great majority of the traditional airline's passengers travel for business reasons, frequently or occasionally, and less than one third for leisure purposes (to visit friends or relatives, for tourism and other non-business reasons). Meanwhile, the LCCs' passengers could be classified in three groups: business travellers, leisure passengers with a budget constraint (the largest segment) and leisure travellers without a budget constraint.

Key words: *traditional airlines, low-cost carriers, airlines' passengers, Iasi Airport*

1. Introduction

In the end of the 1980's, the European air transport network was fragmented, the airlines being considered public entities designed to serve mainly national interests (Button, 2001). To a large extent, the intra-EU routes were served by the EU flag carriers, which operated under bilateral air services agreements between the member states. In this context, the three 'Packages' of EU legislation represented a considerable progress in liberalizing the European aviation market. Due to these regulatory changes, starting from April 1997, the EU carriers could choose their schedules, capacity and routes anywhere in the Union (ELFAA, 2004). Moreover, as a consequence of the decisions made by the EU Court of Justice in 2002 in the 'Open Skies' cases, the EU air carrier clause was introduced in the bilateral air services agreements signed between the EU States and third States, in order to ensure the complete freedom in this sector (Burghouwt et al., 2015). Therefore, during the last fifteen years, the number of new airlines and, consequently, the routes have significantly increased and fares have fallen.

In this liberalized aviation market, the low-cost carrier (LCC) model has gradually developed, this type of airlines becoming a popular alternative to the traditional ones. In addition to market

deregulation, the expansion of the low-cost carriers was also favoured by some economic and political determinants, by the technological development and by the increasing transparency of fares through the online retailing (Schnell, 2003; Taneja, 2004). The low-cost model focuses on those strategies meant to reduce the costs through maximum utilization of the aircrafts and work force, developing point-to-point routes, using secondary airports, a single aircraft type in order to diminish the maintenance, repair and overhaul costs, offering a single class with no frills on the flight and charging for services like seat reservation and checked-in baggage (Wensveen and Leick, 2009; Pels et al., 2009; Dobruszkes, 2006; Francis et al., 2007; EUROCONTROL, 2017). Further cost reductions result from the negotiation of lower airport fees and taxes, arguing that the airports will compensate through the increase in the number of passengers (Francis, Fidato and Humphreys, 2003).

During the last 10 years, in EU, the LCCs proved to be the fastest growing market segment, to the detriment of traditional airlines. From 2007 to 2016, while low-cost flights grew by 61%, the traditional ones diminished with 10% (EUROCONTROL, 2017). These changes made the EU become the largest low-cost market in the world, with 32% of the global LCCs' traffic (Gerasimova and Krasteva, 2017). The increasing presence of the low-cost carriers in emerging economies had an important contribution to this positive evolution of the LCCs' segment in the EU. In 2009, after the fifth EU enlargement (in 2007), the new West–East air connections represented almost 60% from the total number of the new routes opened up between Western Europe, on one side, and Central and Eastern Europe, on the other side (Dobruszkes, 2009). This trend might suggest the emergence of new forms of mobility: post-migration flows of the Eastern Europeans who have gone to work in Western Europe, including visits to relatives abroad, new tourist practices and destinations and new types of business. Among the Central and Eastern European states, Bulgaria and Romania were the fastest LCCs growing markets in terms of departing seats' capacity, in 2016. In Bulgaria, the annual growth rate was 25.4%, while in Romania it was 21.6% (OAG, 2017). Looking at these statistics and considering the fact that the LCCs' target segment is represented by the price-sensitive consumers, we may argue that these low-cost airlines represent a successful business model that meets the needs of people rather than making them adapt to it. The LCCs have created opportunities for consumers, influencing their attitudes and enhancing their motivations towards air travel (Teichert, Shehu, and von Wartburg, 2008). Meanwhile, the low-cost model also represented a challenge for the airlines' market, redefining the airline business operations (Bieger and Wittmer, 2006). Actually, the emergence of the LCCs involved adaptations in both directions. While the low-cost airlines have started operating from major airports to attract customers from the traditional airlines, the last ones have increasingly changed their offers, charging for different services, such as food, seat choice, checked baggage, like the LCCs.

Although the literature regarding the evolution, characteristics and differences between LCCs and traditional airlines is quite consistent, the studies regarding the differences between the passengers' characteristics using the LCCs and the traditional airlines are quite limited. An investigation of this difference was conducted on the case of the Belgrad airport's passengers (Kuljanin and Kalic, 2015) and on the case of Taiwanese travellers (Lu, 2017). Most of the researches have focused only on the features of the low-cost airlines' passengers, such as Saha (2009), in the case of Thailand, or Martinez-Garcia and Royo-Vela (2010), in the case of Spain. The lack of research regarding the differences between the passengers' characteristics using the LCCs and the traditional airlines is more pronounced in the case of Romania. Until now, no other study focused on this topic has been conducted. Therefore, the results of the present paper underline novel important ideas that bring significant added value to the literature.

The aim of this paper is to analyse the major features of the Romanian air travel market, in general, and to identify the characteristics of the LCCs and the traditional airlines' passengers from Iasi Airport. In order to reach this purpose, the research methods we used consisted not

only in an investigation of the specialized literature and in a statistical analysis of secondary data, but also in a comprehensive survey carried out at Iasi Airport, among passengers on the routes that are served by both LCCs and traditional carriers. Therefore, after a brief presentation of the Romanian air travel market, the data and the methodology will be described. These parts will be followed by the results and discussions of the study conducted on the LCCs and traditional airlines' passengers.

2. Trends and Features of the Romanian Air Transport Market

After the EU adhesion, Romania has implemented the "open skies" agreement, which considerably liberalized the airlines' market. According to this agreement, any European airline could operate flights not only from Romania to its country of origin, as it happened until January 2007, but also to any other destination in the EU. Moreover, any EU company could create its air bases in a Romanian town and operate domestic flights. These major changes had a significant impact on the number of routes operated from/to Romania by both traditional airlines and LCCs, and, consequently, on the number of transported passengers. According to the data offered by Eurostat (2009), compared to 2006, in 2007, Romania registered an increase of 41% in the total number of passengers, from all the airports. Moreover, between 2007 and 2017, this number augmented more than 34%, from almost 7 million to over 20 million passengers (see Figure 1).

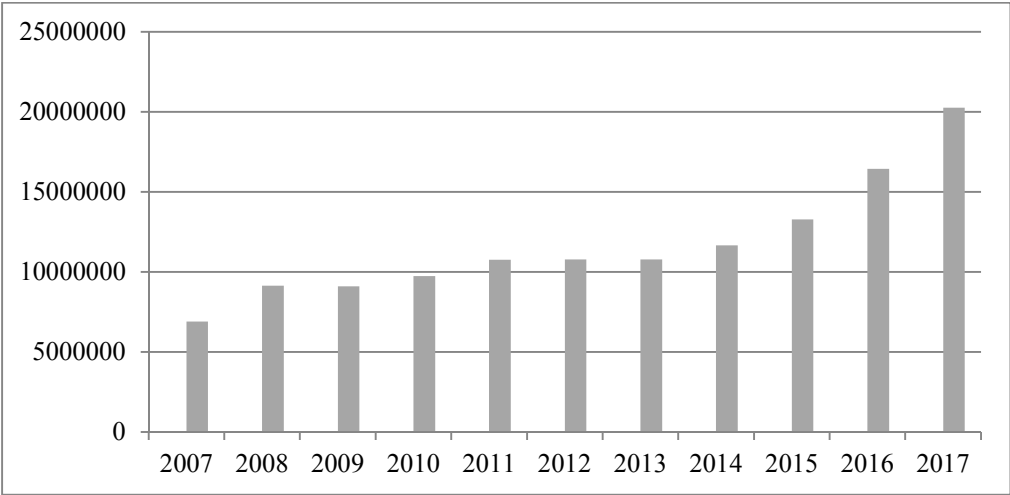


Figure 1 Total number of passengers from all Romanian airports, between 2007 and 2017

Source: compiled by authors from various annual reports

As shown in Figure 1, the total number of passengers at all the Romanian airports registered a significant increase especially after 2013, in 2017, the number being almost double compared to 2013. This evolution could be partially explained through the fact that, between 2009 and 2013, the Romanian passengers were negatively influenced by the global economic crisis, which led to a reduction of the income's level and of the well-being of the population. This proves that the air transport is a cyclical sector, the demand being connected with the economic cycles (Hatty and Hollmeir, 2003). Other explanations could be related to the emergence of the new LCCs on the Romanian market and, also, to the increase in the number of the routes operated by the existent low-cost airlines, after 2013. This explanation is supported by the statistical data, which show a positive evolution of the market share of the LCCs in Romania, especially between two periods: 2007 – 2009, from 8% to 34% (Diaconu, 2011), and 2013 – 2017, from 42% to more than 54% (OAG, 2017). The positive trend of the LCCs on the

Romanian market might suggest that the price of the air transport represents a constraint factor for a growing portion of the population (Flouris, 2007).

In 2017, the largest market shares of the LCCs were achieved by Wizz Air (54.76%), Blue Air (26.31%) and Ryanair (16.37%), the routes with the highest seat capacity being to Italy, Great Britain, Spain and Germany (Wizz Air, 2017). Actually, in a 2017 top of all the airlines (low-cost and traditional) operating in Romania, Wizz Air was on the first position, with a market share of over 40% (Romania Insider, 2018). In 2017, this LCC maintained its leading position for the fourth consecutive year; meanwhile, the Romanian flag carrier TAROM has been dramatically losing market share during the last three years. Due to the reduction in the number of routes and in the fleet size, TAROM obtained only 15% of the market share in 2017 (Romania Insider, 2018). Meanwhile, Blue Air, the Romanian LCC, has constantly gained ground on the airlines’ market: the number of transported passengers in 2017 increased by 70% compared to the previous year, when it was more than double compared to 2015 (NewsAir, 2018). In 2017, Blue Air had 18.3% of the seats of the Romanian airlines’ market, being placed on the second position after Wizz Air, with 35% of the seats (OAG, 2017). The third and fourth places were occupied by TAROM (13%) and Ryanair (11%).

The increase of the share of LCCs on the Romanian market was registered both in terms of international and domestic destinations. However, the growth is impressive especially on the domestic market, where in 2016, only two years after the launch of the low-cost flights within Romania, the LCCs held a third of the overall seat capacity (OAG, 2017).

Iasi Airport is among the fastest growing airports in Romania, considering the number of transported passengers. In 2017, it has been placed even in a European top 5 airports. As shown in Figure 2, the highest increase in the number of transported passengers was registered between 2015 and 2017.

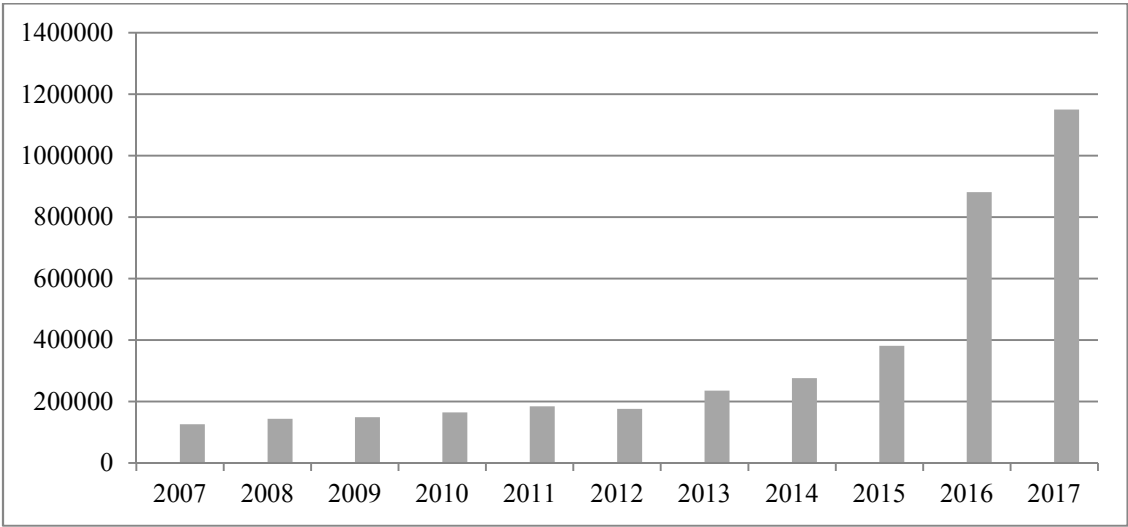


Figure 2 Total number of passengers at Iasi airports, between 2007 and 2017

Source: compiled by authors from various Iasi Airport’s Press Releases

According to a Press Release of Iasi Airport (2018), in 2017, the passengers’ traffic increased by 30%, compared to 2016, and by 200% compared to 2015. This positive evolution was determined by several main factors. In the end of 2014, a second runway of the airport was inaugurated, with a length of 2400 meters, being the most modern in the country. Moreover, in October 2015, a new terminal (T3) became operational. These investments had soon positive

results, the number of internal and international routes and frequency of flights from Iasi Airport constantly increasing between 2015 and 2017.

From the point of view of the internal flights, in 2015, the Romanian LCC Blue Air has launched its first internal route from Iasi to Bucharest, which, until then, was monopolized by TAROM. In 2017, Blue Air has launched other three new internal routes from Iasi, to Cluj, Timisoara and to Constanta (this last one being operated only during the summer). From the point of view of the international routes, in 2017, 8 countries and 19 destinations have been reached directly from Iasi Airport, with the help of 4 carriers: Blue Air, TAROM, Wizz Air and Austrian Airlines (Iasi Airport News, 2018). All these achievements were significant if we consider the fact that, until 2013, there were only two direct flights from Iasi Airport: one to Bucharest (operated by TAROM) and one to Vienna (operated by Austrian Airlines).

In 2017, year in which the number of passengers at Iasi Airport surpassed 1 million, the highest traffic was registered in August – 125605 persons, with 30% superior to the same month of 2016 and almost the same number of passengers recorded during all the months of 2007. The explanation of this record is related to the fact that, during summer, new flights were launched (to Glasgow, Valencia, Florence and Constanta), the frequency of certain routes (Munich, Milan and Turin) has increased and the charter flights (to Antalya, Rhodes, Zakyntos and Heraklion) were introduced.

The positive trend of passengers' traffic on Iasi Airport is expected to continue in 2018, when Wizz Air will extend its operations, by adding the second Airbus A320 aircraft to Iasi, by introducing 6 new direct routes (to Dortmund, Malmo, Thessaloniki, Eindhoven, Paris and Billund) and by increasing the frequency of 3 of the existing ones, from Iasi to Milano, to Tel Aviv and to Roma (NewsAir, 2017). All these changes will lead to an increase of Wizz Air's operations at Iasi Airport by 70%, covering 14 routes to 10 countries.

In 2017, according to the information offered by Iasi Airport through various press Releases, there were 5 national routes from Iasi – to Bucharest (operated by TAROM and Blue Air), Cluj (Blue Air), Oradea (Blue Air), Timisoara (Blue Air) and Constanta (Blue Air) – and 19 international ones – to Madrid (TAROM), London (TAROM, Wizz Air and Blue Air), Turin (TAROM and Blue Air), Tel Aviv (TAROM and Wizz Air), Paris (Blue Air), Rome (Blue Air and Wizz Air), Barcelona (Blue Air), Brussels (Blue Air), Koln (Blue Air), Munich (TAROM and Blue Air), Glasgow (Blue Air), Valencia (Blue Air), Florence (Blue Air), Milan (Blue Air and Wizz Air), Larnaca (Wizz Air), Bologna (Wizz Air), Catania (Wizz Air) and Wien (Austrian Airlines). To all these regular flights, 4 charter flights added during summer (to Antalya, Rhodes, Zakyntos and Heraklion). Analyzing the frequency of all these routes and their seats' capacity, we may argue that, in 2017, most of the passengers from Iasi Airport were transported by a LCC, Blue Air and Wizz Air having the major contribution to the traffic increase on this airport.

3. Data and Research Methodology

In order to achieve the established purpose, we have conducted a survey at Iasi Airport, between November and December 2017, on a sample of 237 passengers. This sample included only the passengers who travelled on one of the five routes on which two or more airlines compete and at least one of them was an LCC (see Table 1). The passengers were randomly chosen and the questionnaires were fulfilled in the check-in area of Iasi Airport.

Table 1 Information about the routes considered in the study

Flight from Iasi to:	Airline	Flight frequency per week	Days	Departure time	Destination airport
Turin (Italy)	TAROM	3	Wednesday	16:45	Caselle Torinese
			Friday	14:30	
			Sunday	14:15	
	Blue Air	2	Tuesday	10:55	Caselle Torinese
			Saturday	06:45	
Munich (Germany)	TAROM	2	Monday	16:50	München Franz Josef Strauss
			Thursday	13:50	
	Blue Air	3	Tuesday	15:00	München Franz Josef Strauss
			Thursday	15:00	
			Sunday	17:40	
London (UK)	TAROM	2	Tuesday	14:30	Luton
			Sunday	20:50	
	Blue Air	3	Wednesday	08:30	Luton
			Friday	08:30	
			Sunday	08:30	
	Wizz Air	7	Monday	06:00	Luton
			Tuesday	21:15	
			Wednesday	06:00	
			Thursday	06:00	
			Friday	06:00	
Saturday			21:15		
Sunday			06:00		
Tel Aviv (Israel)	TAROM	3	Tuesday	07:00	Ben Gurion
			Friday	07:00	
			Sunday	07:00	
	Wizz Air	2	Tuesday	06:00	Ben Gurion
			Saturday	06:00	
Bucharest (Romania)	TAROM	25	All days	5:50 – exc. Tuesday	Otopeni
				09:30 – exc. Saturday & Sunday	
				11:50 – only Saturday, Sunday	
				13:50 – exc. Saturday & Sunday	
				19:00	
	Blue Air	15	All days	07:00 – exc. Sunday	Otopeni

				12:30– exc. Saturday & Sunday	
				20:40 – only Friday	
				21:35 – only Wednesday & Thursday	
				23:25 – only Sunday	

Table 1 offers information about the routes taken into account into the present study, including airlines, flight frequency per week, days in which the flight is operated, departure times and destination airports. As it results from Table 1, both the traditional airline TAROM and the 2 LCCs (Blue Air and Wizz Air) use the same destination airports for all the routes included into the study. From all the airports, only in London the LCCs and the Romanian flag carrier TAROM use a secondary airport (Luton). Therefore, it cannot be argued that, compared to TAROM, the two analysed LCCs benefit from the cost advantages offered by the secondary airports.

The 237 surveyed passengers had to answer 14 questions, which were grouped in three variable sets. The first one referred to information related to travel, such as type of airline, purpose of the trip, frequency of flying, persons they were travelling with and moment of buying the ticket. The second set included aspects related to the preferences for different attributes of the airlines' services which may influence the type of the airline chosen (traditional or LCC). In the end, the respondents were asked several questions which underlined their socio-economic characteristics, such as gender, age, monthly income, residence and occupation.

The data was processed with the help of the SPSS program. We have performed Pearson bivariate correlation analyses to identify the relationships between the variables related to the trip, some particular features of the airlines' services that might have influenced the decision regarding the type of the airline and the socio-demographic characteristics of the passengers of the low-cost and traditional carriers. Moreover, we have conducted a two-step cluster analysis, in order to identify the groups within those travellers who use the two types of airlines on competing routes. We have chosen this analysis because it offers the possibility of using a mixture of continuous and categorical variables on large datasets (Everitt et al., 2011).

4. Results and Discussions

The results obtained after processing the questionnaire's responses show some significant features of the low-cost and traditional airline's passengers. We notice that there is no difference in terms of gender between the two groups of passengers, men prevailing in both cases: 54% for the traditional airline TAROM and 57.4% for LCCs. Moreover, most of the people travelling with both types of airlines are employed: 56.4% for TAROM and 48.4% for LCCs. However, we notice that in the case of TAROM's passengers, more than 60% are travelling for business purposes, while over half of the LCC's clients have leisure purposes (tourism, visiting relatives or friends and other non-business purposes).

The correlation analysis between the trip's purpose of all the passengers (TAROM and LCCs') and the number of the persons they are accompanied by shows that 78.8% of those who are travelling for business purposes are alone, while 89.6% those who are on a leisure trip are accompanied by at least one more person. Another distinctive feature between the business and the leisure passengers is that the large majority of first ones buy the ticket at most one month before the flight (82.2% of TAROM's business travellers and 76.6% of LCCs' business passengers). Meanwhile, more than half of the leisure travellers of both types of airlines buy the ticket at least one month before the flight.

Our analysis do not show a relationship between the age of the respondents and the type of the airlines they have chosen, over 50% of both TAROM and LCCs' travellers being between 30 and 49 years old.

A significant relationship is found between the income of the respondents and the type of the airline they have chosen. While most of the of the LCCs' travellers (54.2%) have a low (under 1500 RON / approx. 320 EUR) or medium to low monthly income (between 1501 and 2500 RON / approx. 320-536 EUR), 72.4% of TAROM's passengers receive medium to high (between 2500 and 4500 RON / approx. 536-965 EUR), high (between 4500 and 9000 RON / approx. 965-1930 EUR) or very high (over 9000 RON / over 1930 EUR) monthly income. Considering these results, it is not surprising that most of the passengers (76.5%) of the LCCs have chosen this type of airline mainly because of the reduced price of the tickets (see Table 2). In the case of TAROM, the main reason for choosing this company by 57.4% of the respondents is the time-table of the flights. However, the large majority of TAROM's passengers (89.8%) consider that the price-quality ratio of the received services is poor and very poor. Meanwhile, 64.8% of the LCC's travellers argue that the price-quality ratio of the services they have received is good and very good.

Table 2 The major reason for choosing LCCs / TAROM

Main reason	Percentage of passengers from total LCCs' travellers	Percentage of passengers from TAROM's travellers
Price	76.5%	1.2%
Additional services	1.3%	19.5%
Time-table of the flight	4.6%	57.4%
Punctuality	13.2%	5.5%
Other reason	4.4%	16.4%

By using the two-step cluster analysis, the passengers of LCCs and traditional airlines are segmented in several categories which underline the main features of each of the two groups of travellers. The variables used in the segmentation process are the purpose of the trip, the frequency of flying, the monthly income, the residence and the occupation (see Table 3). The results of the two-step cluster analysis are presented in the next two subsections.

Table 3 The variables used in passengers' segmentation

Categories of variables	Variables	Values	Scale
Trip related variables	Purpose of the trip	Business, Leisure (tourism, visit friends/relatives, other reason)	Binary
	Frequency of flying	Very low, Low, Medium, High, Very high	Ordinal
Socio-demographic variables	Monthly income	Low, Medium to low, Medium to high, High, Very high	Ordinal
	Residence	Romania, Other EU state, Non-EU state	Nominal
	Occupation	Employed, Unemployed, Student, Retired, Other situation	Nominal

4.1 Major Characteristics of the LCCs' Passengers

The passengers of the LCCs were grouped into three segments with distinctive characteristics (see Table 4). The silhouette measure of cluster cohesion and separation is 0.8, indicating a good quality cluster model.

Table 4 Segments for LCCs' passengers

Cluster	Segment 1 – Business travellers	Segment 2 – Leisure travellers with budget constraint	Segment 2 – Leisure travellers without budget constraint
Size	37.6%	38.3%	24.1%
Purpose of the trip	Business (83.4%)	Leisure (74.6%)	Leisure (89.6%)
Monthly income	Medium to high (42.3%)	Medium to low (67.9%)	Medium to high (37.4%)
Frequency of flying	High (42.6%)	Low (52.8%)	Medium (48.8%)

The first segment includes the business travellers (37.6%), while the other 2, which represent 62.4% of the total sample, refer to the leisure passengers. A large part of the people included in the first segment – “Business travellers” – has a medium to high monthly income (42.3%), obtaining between 2500 and 4500 RON (which is equivalent to approximately 536-965 EUR), and travels with a high frequency of flying (42.6%), once or twice per month.

Segment 2 includes “Leisure passengers with budget constraint”, meaning those people who mainly travel for tourism, to visit friends or relatives or for other non-business purposes, but who have a reduced income (67.9% of them receiving a medium to low monthly income, which is between 1501 and 2500 RON / approx. 320-536 EUR). Meanwhile, most of them (52.8%) have a low frequency of flying, traveling 2 to 4 times per year.

The third segment refers to the “Leisure passengers without a budget constraint”. This segment is driven by people who travel for leisure purposes (89.6%), a large part of them (37.4%) having medium to high income level. Almost half of them (48.8%) have a medium frequency of flying, between 6 and 10 times per year.

4.2 Main Features of Traditional Airline's Passengers

The passengers of the traditional airline TAROM were grouped in three segments, which have approximately similar sizes (see Table 5). As in the case of the LCCs' travellers, the main segmentation variable was the purpose of the trip. The silhouette measure of cluster cohesion and separation is 0.6, indicating a good quality cluster model.

Table 5 Segments for TAROM's passengers

Cluster	Segment 1 – Frequent business travellers	Segment 2 – Occasional business travellers	Segment 3 – Leisure travellers
Size	39.1%	31.1%	29.8%
Purpose of the trip	Business (89.4%)	Business (81.6%)	Leisure (83.5%)
Frequency of flying	Very High (42.9%)	Medium (36.2%)	Medium (35.7%)
Occupation	Employed (94.2%)	Employed (73.0%)	Employed (52.4%)
Residence	Romania (89.6%)	Romania (61.3%)	Other EU state (47.2%)

The common characteristic of the three segments is the fact that most of the people are employed. However, the share of the employed passengers is higher in the first segment (94.2%), compared to the segment 2 (73%) and the segment 3 (52.4%).

The first two segments refer to the business passengers. A large part of the people (42.9%) included in Segment 1 – “Frequent business passengers” tends to fly one time per week or more. Meanwhile, over one third of the people from Segment 2 – “Occasional business passengers” – have a medium frequency of flying. The majority of the people included in these two segments live in Romania.

Segment 3 mainly comprises the leisure travellers (83.5%), a large part of them flying between 6 to 10 times per year. Compared to the other two segments, almost half of the people included

in this segment do not live in Romania but in another EU state, being either Romanians or having another nationality. This result indicates that the traditional carrier TAROM also attracts the Romanian people who live abroad and come back into the country to visit their relatives or friends. Meanwhile, this result is also due to the foreign students who come in Romania to study and to their relatives who visit them.

5. Conclusions

The results of the present paper underline novel important ideas that bring significant contribution to the literature, considering the fact that the differences between the Romanian passengers' characteristics using the LCCs and the traditional airlines have not been previously investigated.

After the EU adhesion and the implementation of the "open skies" agreement, Romania registered an increase in the total number of airlines' passengers. In this context, the LCCs have gained ground, offering more options to the Romanian travellers, at lower costs than the traditional carriers.

Iasi Airport is among the fastest growing airports in Romania, from the point of view of the transported passengers. In 2017, one traditional airline – TAROM, the national flag carrier – and two LCCs – Blue Air and Wizz Air – have operated on this airport, serving 5 national and 19 international routes, with regular flights.

The results of our study conducted on the passengers of Iasi Airport show that more than 60% of TAROM's clients are travelling for business purposes, while over half of the LCCs' travellers have leisure purposes (tourism, visiting relatives or friends and other non-business purposes). This aspect was confirmed by the two-step cluster analysis, which helped us identify the distinctive segments of travellers for the two types of airlines.

The passengers of the LCCs were grouped into three segments. The first segment includes the business passengers, a large part of them having a medium to high monthly income and a high frequency of flying. The second segment refers to the "leisure travellers with budget constraint", most of the people included in this group having a medium to low monthly income and a low frequency of flying. Compared to this segment, the third one includes those passengers that do not have a budget constraint and travel with a medium frequency (between 6 and 10 times per year).

For the traditional airline TAROM, three segments of passengers were identified. The first two segments refer to the business passengers, the difference between them being related to the frequency of travelling: the first segment includes the frequent business travellers, while the second one the occasional business passengers. An important aspect is revealed by the third segment – leisure travellers, half of the people included in this group living not in Romania but in another EU state. This result has been influenced by the Romanian people who live abroad and come back to visit their friends and relatives, as well as by the foreign students who come in Romania for the university studies.

The correlation analysis conducted on all the passengers (TAROM and LCCs') offers us a more detailed perspective about the characteristics of the persons who are travelling for business and leisure purposes. Therefore, we found out that most of the business passengers, from both types of the airlines, travel alone, while the great majority of those who are on a leisure trip are accompanied by at least one more person. Another distinctive feature between the business and the leisure passengers of both types of airlines is that, while the large majority of the first ones buy the ticket at most one month before the flight, more than half of the leisure travellers purchase the ticket at least one month before the flight.

Another important finding of the study refers to the income of the passengers travelling with TAROM and LCCs. While most of the of the LCCs' travellers have a low or medium to low monthly income, over two-thirds of TAROM's passengers receive medium to high, high or

very high monthly income. Considering these results, it is not surprising that most of the passengers of the LCCs have chosen this type of airline mainly because of the reduced price of the tickets.

Based on the results obtained in the present paper, a future research direction may be to conduct this study on other Romanian airports, in order to see if there are major differences between them in terms of types of passengers attracted by the traditional airlines versus the LCCs.

REFERENCES

- Bieger, T., & Wittmer, A. (2006). Air transport and tourism - perspectives and challenges for destinations, airlines and governments. *Journal of Air Transport Management*, 12 (1), 40-46.
- Burghouwt, G., De Leon, P.M., & De Wit, J. (2015) *EU Air Transport Liberalisation Process, Impacts and Future Considerations*, OECD – International Transport Forum. Discussion Paper No. 2015-04. Retrieved February 12, 2018, from <https://www.itf-oecd.org/sites/default/files/docs/dp201504.pdf>
- Button, K. (2001). Deregulation and Liberalization of European Air Transport Markets. *Innovation: The European Journal of Social Science Research*, 14(3), 255-275.
- Diaconu (Maxim), L. (2011). The Low-Cost Carrier Model – the Case of Romania. In *Proceedings of the 7th International Conference on Management of Technological Challenges: vol. 1* (pp. 369-372). Democritus University of Thrace, Alexandroupolis.
- Dobruszkes, F. (2006). An analysis of European low-cost airlines and their networks. *Journal of Transport Geography*, 14(4), 249–264.
- Dobruszkes, F. (2009). New Europe, new low-cost air services. *Journal of Transport Geography*, 17(6), 423-432.
- EUROCONTROL. (2017). The rapid rise of low-cost carriers. *EUROCONTROL Report*. Retrieved February 22, 2018, from <http://www.eurocontrol.int/news/rapid-rise-low-cost-carriers>
- European Low Fares Airlines Association (ELFAA). (2004). *Liberalization of European Air Transport: the Benefits of Low Fares Airlines to Consumers, Airports, Region and the Environment*. Retrieved February 22, 2018, from <http://www.elfaa.com/documents/ELFAABenefitsofLFAs2004.pdf>
- Eurostat. (2009). Air passenger transport in Europe in 2007. *Eurostat – Statistics in Focus*. Retrieved February 16, 2018, from http://www.ontit.it/opencms/export/sites/default/ont/it/documenti/files/ONT_2008-12-10_02097.pdf
- Everitt, S.B., Landau, S., Leese, M., & Stahl, D. (2011). *Cluster Analysis*, 5th ed. Chichester: Wiley.
- Flouris, T. (2007). Financial comparisons across different business models in Canadian airline industry. *Journal of Air Transportation*, 12, 25-52.
- Francis, G., Dennis, N., Ison, S., & Humphreys, I. (2007). The transferability of the low-cost model to long-haul airline operations. *Tourism Management*. 28 (2), 391-398.
- Francis, G., Fidato, A., & Humphreys, I. (2003). Airport–airline interaction: the impact of low-cost carriers on two European airports. *Journal of Air Transport Management*, 9(4), 267-273. [https://doi.org/10.1016/S0969-6997\(03\)00004-8](https://doi.org/10.1016/S0969-6997(03)00004-8)
- Gerasimova, V., & Krasteva, N. (Eds.). (2017). *Budget airlines in South-East Europe*. Business Intelligence for South-East Europe. Retrieved March 05, 2018, from http://investsofia.com/wp-content/uploads/2017/06/BUDGET-AIRLINES-IN-SOUTHEAST-EUROPE-2017_IO5NsOe.pdf
- Hatty, H., & Hollmeir, S. (2003). Airline strategy in the 2001/2002 crisis—the Lufthansa example. *Journal of Air Transport Management*, 9, 51–55.
- Iasi Airport News. (2018). *Record in passengers' traffic on Iasi Airport*. Press Release. Retrieved March 05, 2018, from <http://www.aeroport-iasi.ro/noutati>
- Kuljanin, J., & Kalic, M. (2015). Exploring characteristics of passengers using traditional and low-cost airlines: A case study of Belgrade Airport. *Journal of Air Transport Management*, 46, 12-18.
- Lu, J.L. (2017). Segmentation of passengers using full-service and low-cost carriers – Evidence from Taiwan. *Journal of Air Transport Management*, 62, 204-216.

- Martinez-Garcia, E., & Royo-Vela, M. (2010). Segmentation of low-cost flights users at secondary airports. *Journal of Air Transport Management*, 16, 234-237.
- NewsAir. (2018). *Blue Air carrier over 5 million passengers in 2017*. NewsAir Traffic. Retrieved March 05, 2018, from <http://www.newsair.ro/tag/traffic>
- NewsAir. (2017). *Wizz Air will bring a new airplane at Iasi and will launch flights to 6 new destinations*. Wizz Air Press Release. Retrieved March 05, 2018, from <http://www.newsair.ro/wizz-air-mai-duce-o-aeronava-la-iasi-si-lanseaza-zboruri-spre-sase-destinatii-noi.html>
- OAG. (2017). *Understand air passenger traffic flows in any and every market*. OAG Traffic Analyser. Retrieved March 07, 2018, from <https://www.oag.com/analytics/traffic-analyser>
- Pels, E., Njegovan, N., & Behrens, C. (2009). Low-cost airlines and airport competition. *Transportation Research Part E: Logistics and Transportation Review*, 45(2), 335-344.
- Romania Insider. (2018). *Disappearance of state-owned Romanian airline, a matter of time*. Retrieved March 08, 2018, from <https://www.romania-insider.com/wizz-air-tarom-disappears/>
- Saha, G.C. (2009). Service quality, satisfaction, and behavioural intentions: A study of low-cost airline carriers in Thailand. *Managing Service Quality*, 19(3), 350–372.
- Schnell, M. C. A. (2004). Does the effectiveness of airline strategies change? A survey of European full service airlines. *International Journal of Transport Management*. 1 (4), 217-224.
- Taneja, N. K., (2004). *Simpli-flying: optimizing the airlines business model*. Aldershot: Ashgate.
- Teichert, T., Shehu, E., & von Wartburg, I. (2008). Customer segmentation revisited: the case of the airline industry. *Transportation Research Part A*. 42, 227-242.
- Wensveen, J.G., & Leick, R. (2009). The long-haul low-cost carrier: A unique business model. *Journal of Air Transport Management*, 15(3), 127-133.
- Wizz Air. (2017). *Wizz Air Annual Report and Accounts*. Retrieved February 26, 2018, from, https://cdn.static.wizzair.com/static/downloads/ipo/Wizz_Air_Holdings_Plc_Annual_report_and_accounts_2017.pdf

Public Policies and Entrepreneurship Development in Romania

Andreea - Oana Iacobuță

Alexandru Ioan Cuza University of Iași, Romania, Faculty of Economics and Business Administration
andreea.iacobuta@uaic.ro

Abstract. Considering the recent events in Romania, related to all sorts of instability, this paper aims at analysing and discussing the way this context influences entrepreneurship, as a key element for economic development. Based on the existing literature, we first provide an overview of the factors that influence entrepreneurship. From the perspective of our paper, we focus mostly on the contextual determinants of this phenomenon. Then, using a set of variables from Global Entrepreneurship Monitor (GEM) and the White Charter of Romanian SMEs, we analyse the entrepreneurial profile of the Romanian economy over time, in relation with its determinants. The last part of the paper discusses the policies implemented by the different Romanian governments to support entrepreneurship. It highlights the main macro policies such as, taxation, the rule of law etc. of the recent period and it shows that the mix of incoherent policy measures has created instability, confusion and chaos rather than encouraging entrepreneurial activities.

Key words: *entrepreneurship, context, instability, policies, Romania.*

1. Introduction

Over the time, entrepreneurship has been incorporated in economic growth theories and entrepreneurial activity has been associated with greater economic prosperity (Holcombe, 1998; Baumol, 2002; Van Praag & Versloot, 2007). A wide range of studies underline that entrepreneurship plays a major role in the economic development and analyse the correlation between entrepreneurial activity and economic growth (Wennekers, van Stel, Thurik & Reynolds, 2005; Wong, Ho, & Autio, 2005; Acs, Desai & Hessels, 2008; Nitu-Antonie, Feder & Munteanu, 2017; Rusu & Roman, 2017 etc.).

Simply synthesised, “the entrepreneur’s activity benefits the buyer, the seller, and more generally, the entire economy” (Holcombe, 2003, 25). Supporting entrepreneurship has become a priority in any policy agenda, be it national, European or international.

What makes someone want to become an entrepreneur? Which factors contribute to the success of an entrepreneur? Why in some countries entrepreneurship is more developed or more appreciated? This list of questions is much longer in reality and the answers are quite complex due to the complexity and the multifaceted dimensions of this phenomenon.

The existing literature points out to two main categories of determinants of entrepreneurship: individual ones (such as socio-demographic and perceptual factors) and context determinants (institutions, culture, access to financing etc.). Referring to the first category, Arenius & Minniti (2005, 234) pointed out that entrepreneurs rather rely on subjective perceptions than on objective expectations. Aiming at determining what makes individuals to actively get involved in entrepreneurship in the initial phase in Portugal, Figueiredo & Brochado (2015) show that early-stage entrepreneurship is associated with educated young males, with a medium to higher level of income, with low level of perceived risk and a positive personal attitude towards innovation and who perceive themselves as having the necessary business skills. Their results are in accordance with other studies in the field. If considering the level of education, researchers have proven a positive relationship between

having a diploma and entrepreneurial activities (Arenius & Minniti, 2005; Zhao & Seibert, 2006). Also, men are twice as likely to consider an entrepreneurial career as women (van der Zwan, Verheul & Thurik, 2012). The positive perception about own skills and experience increases the likelihood to get involved in entrepreneurial activities (Arenius & Minniti, 2005).

Figure 1 below presents a synthesis of both individual and context determinants of entrepreneurship.

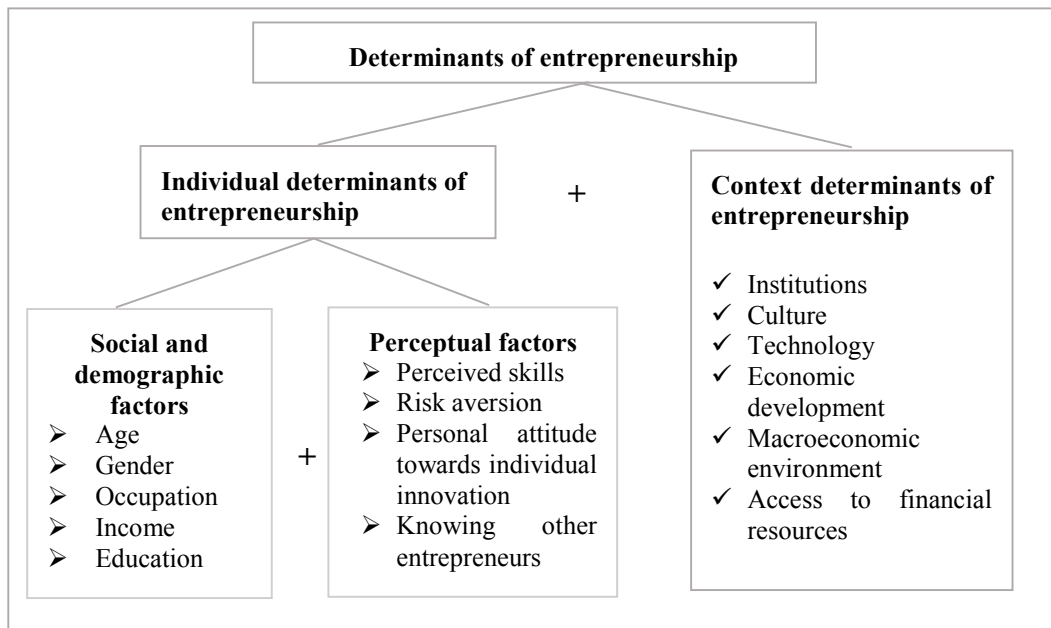


Figure 1. Determinants of entrepreneurship

Source: Author's presentation based on Figueiredo & Brochado (2015, 184)

Even though “entrepreneurship is about people” (Arenius&Minniti, 2005, 233), as Boettke and Coyne pointed out “differences in economic outcomes across societies are not due purely to differences in entrepreneurial spirit, but instead are due to differences in institutions. The institutional environment in which entrepreneurs act, shapes and constrains the opportunities available at any point in time” (Boettke & Coyne, 2009, 138). The context provided by the existing institutional framework explains the variations in entrepreneurship development and behaviour across countries. Even if entrepreneurs are everywhere, no matter a country's level of development, entrepreneurship will flourish and be mostly productive in those societies where formal and informal institutions provide incentives for entrepreneurial activities.

This paper focuses on the context determinants of entrepreneurship. Considering the recent events in Romania, related to all sorts of instability, different political attacks to the rule of law, frequent and unclear changes in legislation, massive street protests etc., this paper aims at analysing and discussing the way this context influences entrepreneurship, as a key element for the country's economic development.

The outline of the paper is as follows. In Section 2 we provide the theoretical background for our analysis by presenting several studies existing in the field, on the issue of entrepreneurship and its context determinants. In Section 3, based on data from Global Entrepreneurship Monitor (GEM) and the White Charter of Romanian SMEs, we sketch and briefly analyse the entrepreneurial profile of the Romanian economy over 2007-2015. Section 4 discusses the policies implemented by the different Romanian governments to support

entrepreneurship. The last part of the paper concludes and shows possible policy implications that may be extracted.

2. Context Determinants of Entrepreneurship

The literature related on the contextual determinants of entrepreneurship is also very rich and complex. Numerous empirical studies have tried to identify and correlate factors related to macroeconomic environment, institutional framework, fiscal policy, access to financing etc. with the motivation and the level of entrepreneurial activity.

The level of economic development, the quality of the legal and regulatory environment, ease of access to finance and the importance of the informal sector were proven to be significantly related to entrepreneurship (Klapper, Laeven, L. & Rajan, 2006). A more recent study developed by Arin et al. (2015) shows that GDP per capita, unemployment, inflation and taxation are linked to entrepreneurship. In an empirical study using panel data for 18 EU countries for the period 2002-2015, Rusu & Roman (2017) prove that inflation rate, foreign direct investments, access to finance and total tax rate are the macroeconomic determinants of entrepreneurship.

When analysing the impact of financial capital and access to finance on entrepreneurship, the existing studies show that the availability of financial capital and ease of access to finance are likely to lead to an increase in the number of entrepreneurs and to entrepreneurship development (Aghion, Fally & Scarpetta, 2007; Klapper, Amit & Guillén, 2010; Werner, 2011; Musso & Schiavo, 2017). Van Stel, Storey & Thurik (2007) found that minimum capital requirement required to start a business and labour market regulations lower entrepreneurship rate. All the procedures related to starting up a new business were also found to be statistically significant related to entrepreneurial activity (Rusu & Roman, 2017).

A large part of the literature deals with the influence of institutional conditions on the entrepreneurial activity (Simón-Moya, Revuelto-Taboada & Guerrero, 2014). Campbell & Rogers (2007) showed that there is a positive strong relationship between economic freedom and new business formation.

In a panel study for 43 countries, Aparicio, Urbano & Audretsch (2016) found that control of corruption has a positive impact on opportunity entrepreneurship. The quality of economic and political institutions is negatively correlated with entry into informal entrepreneurship and is positively associated with entry into formal entrepreneurship (Autio & Fu, 2015). Using a qualitative approach, the study of Touzani, Jlassi, Maalaoui & Hassine (2015) on entrepreneurship in Tunisia, shows that a context of poverty, mafia, corruption, bureaucracy may significantly affect the decision to start up. Also related to the quality of institutional framework, greater political stability leads to an increased rate of entrepreneurship and wealth creation (Dutta et al., 2013).

3. Entrepreneurial Profile of Romanian Economy Over 2007-2015

According to the GEM Report in 2015/16, Romania, besides Croatia, Estonia, Hungary, Latvia and Poland (from the European Union member states), belongs to the efficiency-driven category of economies. When compared these countries display several common features in terms of entrepreneurship evolution but also significant differences.

Table 1 presents the evolution of Total Early-Stage Entrepreneurial Activity (TEA) and Established Business Ownership (EB) in Romania between 2007 and 2015.

TEA shows the percentage of individuals aged 18-64 in an economy who are in the process of starting a business (a nascent entrepreneur) or owner-manager of a new business which is less than 42 months old (Global Entrepreneurship Monitor, 2017, 16). Its evolution shows an

upward trend from 2010 to 2014. After small levels between 2008 and 2010, the rate increased 2.3 times in 2011 compared to the previous year, an evolution which can be partially explained by the effects of the financial crisis. In Romania the economic crisis peak was reached in 2009 and 2010.

In 2015 in Romania TEA was 10.83%, slightly smaller than in 2014, higher than the rate registered in Croatia (7.69%), Hungary (7.92%) and Poland (9.21%) but smaller than TEA in Estonia (13.14%) and Latvia (14.11%).

EB reflects the percentage of the adult population between the ages of 18 and 64 years who are currently an owner-manager of an established business, i.e. owning and managing a running business that has paid salaries, wages, or any other payments to the owners for more than 42 months) (Global Entrepreneurship Monitor, 2017, 16).

As can be noticed, EB is significantly smaller than TEA, showing that the new businesses are not necessarily sustainable over time. According to the GEM Report 2015/16, “relative to TEA, there are comparatively fewer established businesses in the factor- and efficiency-driven economies (...) while fewer people start businesses in the developed economies, there are proportionately more that have made it to the mature business phase” (Global Entrepreneurship Monitor, 2016, 19).

The smallest value of EB in Romania, after the beginning of the crisis, was registered in 2010, the rate showing an ascending trend afterwards. In 2015 EB was 7.47%. When compared to the rates registered in the other European economies in the same category, this rate was higher than in Croatia (2.81%), Hungary (6.49%) and Poland (5.92%) but smaller than in Estonia (7.74%) and Latvia (9.59%).

Table 1 Entrepreneurial activity in Romania, 2007-2015

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total Early-Stage Entrepreneurial Activity (TEA)	4.02	3.98	5.02	4.29	9.89	9.22	10.13	11.35	10.83
Established Business Ownership (EB)	2.51	2.07	3.38	2.09	4.57	3.91	5.35	7.60	7.47

Source: Global Entrepreneurship Monitor, from <http://www.gemconsortium.org/data/key-aps>

A more detailed profile of the Romanian entrepreneurship can be provided if considering the individuals’ entrepreneurial behaviour and attitudes (Table 2).

The share of those who see good opportunities to start a firm in the area where they live (*Perceived Opportunities* variable in the table below) decreased during the crisis, the lowest level being reached in 2009 (13.8%) and then increasing, once the economy has started to recover.

“Perceived capabilities” reflects “the percentage of individuals who believe they have the required skills, knowledge and experience to start a new business” (Global Entrepreneurship Monitor, 2017, 16). The level of this indicator registered small fluctuations over the years.

The percentage of individuals who believe that failure would prevent them from starting a new business (so-called “fear of failure”) was the highest in 2009 (52.84%), then slightly decreasing to 40.49% in 2015.

The share of those who are latent entrepreneurs and who intend to start a business within the next three years decreased from 11.68% in 2007 to 6.25% in 2009 and then increased 4.3 times, reaching 27.02% in 2012. Regarding this aspect, Romania has always been among the European countries, both efficiency and innovation driven, with individuals declaring high entrepreneurial intentions. For example, in 2015, the share was of 29.01% in Romania, the

highest among the European countries in the sample, compared with 17.21% in Croatia, 16.68% in Estonia and 19.97% in Poland.

The Motivational Index shows the ratio of improvement-driven opportunity TEA to necessity TEA. This index registers relatively low values in Romania, showing that the early-stage entrepreneurs are rather necessity than opportunity motivated, if compared with the Dutch (with an index of 4.17), the Estonians (4.17), the Finish (4.19) or the German ones (3.75).

Table 2 Entrepreneurial Behaviour and Attitudes in Romania, 2007-2015

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Perceived Opportunities	26.23	25.75	13.80	17.52	36.06	36.73	28.86	32.41	33.31
Perceived Capabilities	29.35	23.77	27.33	38.18	41.63	38.34	45.87	48.44	46.33
Fear Of Failure Rate	33.47	48.81	52.84	41.12	36.12	40.87	37.26	41.25	40.49
Entrepreneurial Intentions	11.68	8.55	6.25	8.59	24.66	27.02	23.65	31.70	29.01
Motivational Index	n/a	n/a	n/a	1.59	0.83	1.56	1.00	1.72	1.21
High Status to Successful Entrepreneurs	62.50	68.53	67.19	65.50	69.42	73.58	72.57	75.22	75.07
Entrepreneurship as a Good Career Choice	61.02	n/a	57.55	66.45	67.85	71.15	73.61	73.64	72.42

Source: Global Entrepreneurship Monitor, from <http://www.gemconsortium.org/data/key-aps>

When it comes to societal values and perceptions, captured by GEM with the variables “high status to successful entrepreneurs” and “entrepreneurship as a good career choice”, both indicators exhibit high values over the analysed period, Romania consistently being among the European Union members with the highest levels on all attitude measures.

Figure 2 below synthesises the environmental conditions of the Romanian entrepreneurship in 2015. The scores Romania registered for each of the 12 dimensions are as follows: entrepreneurial finance (1.97), government policies: support and relevance (2.09), government policies: taxes and bureaucracy (2.06), government entrepreneurship programs (2.18), entrepreneurial education at school stage (2.35), entrepreneurial education at post-school stage (2.73), R&D transfer (2.16), commercial and legal infrastructure (3.64), internal market dynamics (2.5), internal market burdens or entry regulations (2.38), physical infrastructure (2.9) and cultural and social norms (2.41).

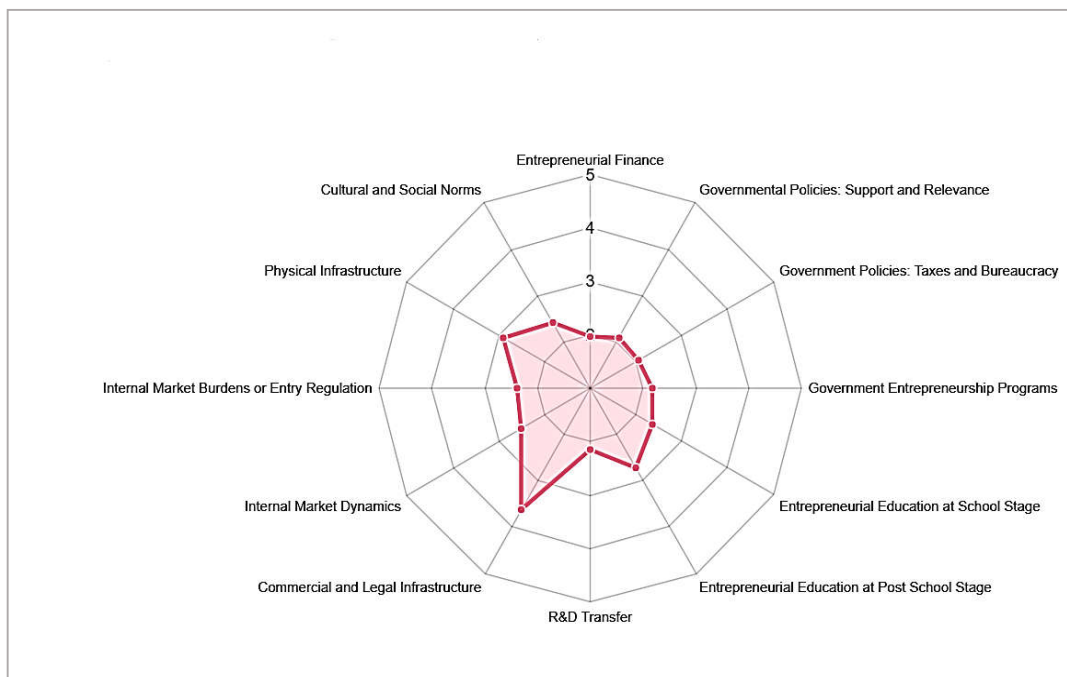


Figure 2 Entrepreneurial Framework Conditions in Romania in 2015

Note: 1 means “highly insufficient”, 5 means “highly sufficient”
 Source: Global Entrepreneurship Monitor, Economy profile Romania, from
<http://www.gemconsortium.org/country-profile/103>

The figure and the scores above (most of which decreased from 2014 to 2015, possible because of some political instability and changes in government) show that there are a lot of aspects to be improved in order to make entrepreneurship a relevant economic issue in Romania: from financing to government programs and support and to enhancing entrepreneurial education and culture.

4. Policies to Support Entrepreneurship in Romania

Numerous more recent surveys point out the perception of the Romanian entrepreneurs regarding the economic environment and the issues they are confronted with in their activities.

Figure 3 below shows entrepreneurs’ perception of the Romanian economic environment. Although the trend is optimistic since the decrease in the share of those considering the economic environment as “business hostile” is significant from 78.07% reported in 2010 to 33.29% in 2017, the level is still high. The reason for optimism is supported by the decrease in the percentage of those considering the environment as “neutral” and the increase in the percentage for “business friendly”.

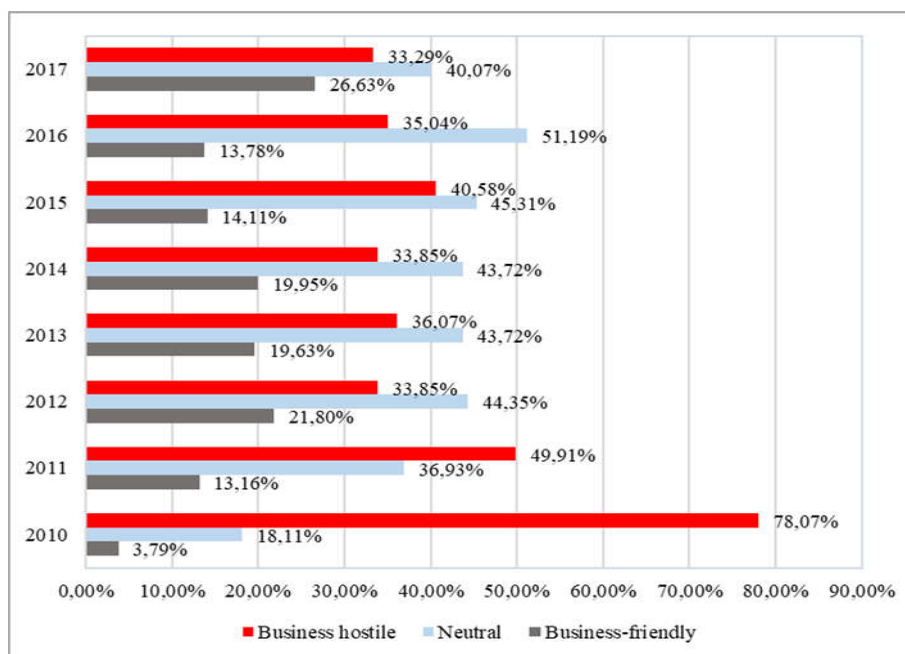


Figure 3 Entrepreneurs' perception of the Romanian economic environment

Source: Author's translation and presentation based on Nicolescu O. (coord), The White Charter of Romanian SMEs 2017, the XVth edition, Presentation of Research Report XV, from <http://cniplmmr.ro/wp-content/uploads/2017/07/PPT-CA-2017v3.pdf>

If referring to the main issues the Romanian entrepreneurs declare to be confronted with, they mostly relate to the institutional environment and the consequences of its weaknesses. According to the 2016 Barometer of the Romanian Entrepreneurship, the main obstacles for the development of entrepreneurial initiatives in Romania are the fiscal and legal framework, its bureaucracy and its instability, tough access to financing and poor education (EY Romania&Raiffeisen Bank, 2016).

Another survey points out to a similar image (Figure 4).

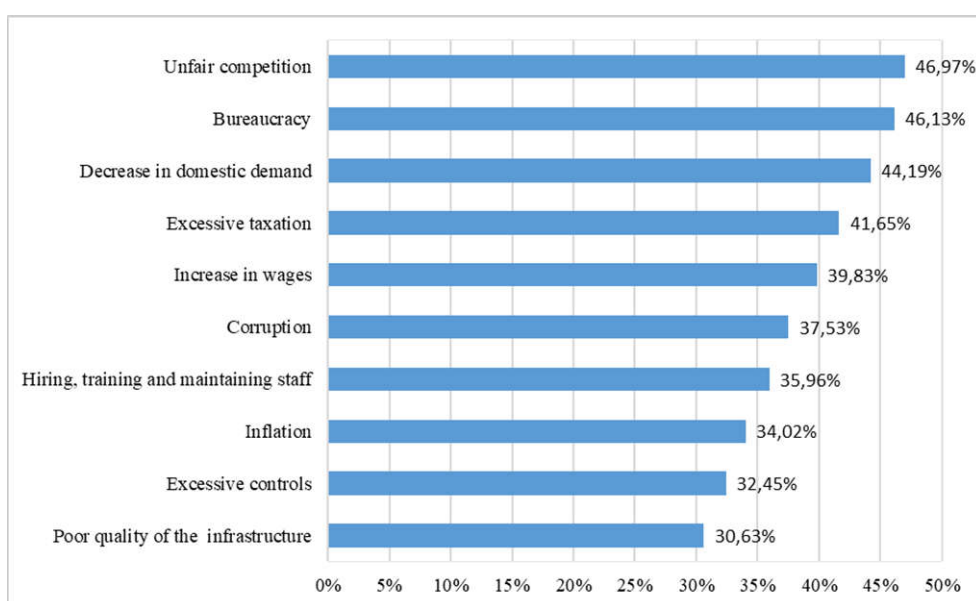


Figure 4 Top 10 of the difficulties encountered by the SMEs in Romania in 2017

Source: Author's translation and presentation based on Nicolescu O. (coord). The White Charter of Romanian SMEs 2017, the XVth edition, Presentation of Research Report XV, from <http://cniipmmr.ro/wp-content/uploads/2017/07/PPT-CA-2017v3.pdf>

Although fiscal and legal framework are the main issue for the Romanian entrepreneurs, several measures adopted in the last years have led to a certain improvement: for example, the fiscal relaxation measures, including a reduction in the standard VAT rate from 24% to 20% in January 2016 and to 19% in January 2017.

Since January 2017, in Romania, several different events, related to political life, and numerous policy measures sometimes unclear even for those who proposed them and then changed their mind and gave up or made on the spot adjustments, have created difficulties, chaos and confusion in the socio-economic and business environment.

Numerous and controversial changes in the judiciary, government ordinances that triggered street protests and international outcry, several changes of governments etc. created political instability, weakened the rule of law, the judicial independence etc.

Different economic policy measures adopted in order to fulfil some prior election promises and in the name of an always revised governing program are not credited with too many chances to solve the difficulties signalled by the entrepreneurs and the business environment. Some of these measures such as, the increase in the gross minimum wage in from 1250 Romanian lei (in 2016) to 1450 lei starting with February 1st 2017 and then again to 1900 lei at the beginning of January 2018 (because of shifting the social contributions from employers to employees), have turned into a burden for some entrepreneurs since they went bankrupt or fired a part of the personnel. Another adopted measure consists in the huge increases in the public sector wages, some of them with no correspondence in the level of productivity. The need for money to pay the wages has, as main consequence, almost zero public investment, which seriously affected the industry and the constructions. In order to raise money, the government took the profits of the national companies, profits which should have been reinvested. Another way of raising money was to interfere in the private pension fund, by redirecting some of the funds from the "second pillar" of private pension to state pension fund (for the beginning, the government reduced the contribution from 5.1% of the gross wage to 2.5% and the intention is transform the private pension system from mandatory to optional).

Another example is the Start-Up Nation Program whose purpose is to help those who want to start a business. Over 8000 firms were declared as winners in 2017 but in January 2018 less than 200 beneficiaries had actually received the promised financing. Some of the young entrepreneurs got tired with bureaucracy and changing legislation and decided to sell their business on different websites.

At the same, through the proposed governing program 2018-2020, the government declare its support to SMEs and entrepreneurship. The main proposed measures are: Development of Investment and Export Promotion Regional Agencies, Continuation of the Program Romania Start-up Nation, Strategic Invest Romania - State Aid Program to Support the Strategic Investments of Local Entrepreneurs, Creation of the National Program for Entrepreneurship Development, Support Program for Internationalization, Establishment of Entrepreneurship High Schools, Professional Romania Program (vocational education and training), Adoption of the Law of the Lobby (the aim is to create a Lobby Register similar to the European Transparency Register) and Restoration of the Business Environment (that is, creating a predictable framework for the future) (Romanian Government, 2018).

5. Conclusions

Entrepreneurship is undoubtedly a complex phenomenon, influenced by numerous factors which should be taken into consideration when designing and implementing policies.

This paper aimed at analysing and discussing the way the existing context influences entrepreneurship in Romania. The evolution of the Romanian entrepreneurship between 2007 and 2017 points out ups and downs caused by the financial crisis, the political instability and different policy measures, some of them with positive impact, some of them with a negative one. Different economic policy measures adopted lately by the Romanian government are not credited with too many chances to solve the difficulties signalled by the entrepreneurs and the business environment.

The existing data from several surveys show that the Romanian entrepreneurs are no different from the rest of entrepreneurs. They are seeking and want to exploit opportunities like any other business person from any other countries. What they need is “an institutional environment that encourages markets and rewards productive activity” (Holcombe, 1998, 60)

A lot of aspects need to be improved in order to make entrepreneurship a relevant economic issue in Romania: from financing to fiscal relaxation, to government programs and support, and to enhancing entrepreneurial education and culture but mostly the Romanian entrepreneurs need a clear, simple, less bureaucratic, predictable and stable legal framework to properly value their potential.

REFERENCES

- Acs, Z.J., Desai, S. & Hessels, J. (2008). Entrepreneurship, economic development and institutions. *Small Business Economics*, 31, 219–234.
- Aghion, P., Fally, T. & Scarpetta, S. (2007). Credit constraints as a barrier to the entry and post-entry growth of firms. *Economic Policy*, 22(52), 731–779.
- Aparicio, S., Urbano, D. & Audretsch, D. (2016). Institutional factors, opportunity entrepreneurship and economic growth: Panel data evidence. *Technological Forecasting and Social Change*, 102, 45–61.
- Arenius, P. & Minniti, M. (2005). Perceptual Variables and Nascent Entrepreneurship. *Small Business Economics*, 24, 233-247, from <https://link.springer.com/article/10.1007/s11187-005-1984-x>
- Arin, K.P., Huang, V.Z., Minniti, M., Nandialath, A.M. & Reich, O.F. (2015). Revisiting the determinants of entrepreneurship: A Bayesian approach. *Journal of Management*, 41, 607–631
- Autio, E. & Fu, K. (2015). Economic and political institutions and entry into formal and informal entrepreneurship. *Asia Pacific Journal of Management*, 32 (1), 67–94.
- Baumol, W. J. (2002). *The free-market innovation machine: Analysing the growth miracle of capitalism*. Princeton, NJ: Princeton University Press.
- Boettke, P.J. & Coyne, C.J. (2009). Context Matters: Institutions and Entrepreneurship. *Foundations and Trends in Entrepreneurship*, 5(3), 135–209.
- Campbell, N., & Rodgers, T. (2007). Economic freedom and net business formation. *Cato Journal*, 27 (1), 23-36.
- Dutta, N., Sobel, R.S. & Roy, S. (2013). Entrepreneurship and political risk. *Journal of Entrepreneurship and Public Policy*, 2(2), 130-143.
- EY Romania & Raiffeisen Bank (2016). Barometrul antreprenoriatului românesc – sinteză (*Barometer of the Romanian Entrepreneurship – synthesis*), from http://cursdeguvernare.ro/wp-content/uploads/2016/05/EY_Barometrul-antreprenoriatului-romanesc_2016_sinteza.pdf
- Figueiredo, V. & Brochado, A.O. (2015). Assessing the main determinants of entrepreneurship in Portugal. *Tourism & Management Studies*, 11(1), 182-190, from https://repositorio.iscte-iul.pt/bitstream/10071/8883/1/publisher_version_774_2807_1_PB.pdf

- Global Entrepreneurship Monitor (2016). Global Entrepreneurship Monitor Global Report 2015/16, from <http://www.gemconsortium.org/report>
- Global Entrepreneurship Monitor (2017). Global Entrepreneurship Monitor Global Report 2016/17, from <http://www.gemconsortium.org/report>
- Holcombe, R. G. (1998). Entrepreneurship and Economic Growth. *Quarterly Journal of Austrian Economics*, 1(2), 45-62, from https://mises-media.s3.amazonaws.com/qjae1_2_3.pdf?file=1&type=document
- Holcombe, R. G. (2003). The Origins of Entrepreneurial Opportunities. *The Review of Austrian Economics*, 16:1, 25–43, from <https://link.springer.com/article/10.1023/A:1022953123111>
- Klapper, L., Amit, R. & Guillén, M.F. (2010). *Entrepreneurship and firm formation across countries*. In International Differences in Entrepreneurship; Lerner, J., Schoar, A., Eds.; University of Chicago Press: Chicago, IL, USA, 129–158.
- Klapper, L., Laeven, L. & Rajan, R. (2006). Entry regulation as a barrier to entrepreneurship. *Journal of Financial Economics*, 82, 591–629.
- Musso, P. & Schiavo, S. (2008). The impact of financial constraints on firm survival and growth. *Journal of Evolutionary Economics*, 18 (2), 135–149.
- Niculescu O. (coord) (2017). The White Charter of Romanian SMEs 2017, the XVth edition, Presentation of Research Report XV, from <http://cnipmmr.ro/wp-content/uploads/2017/07/PPT-CA-2017v3.pdf>
- Nitu-Antonie, R.D., Feder, E.S. & Munteanu, V.P. (2017). Macroeconomic Effects of Entrepreneurship from an International Perspective. *Sustainability*, 9, 1159.
- Romanian Government (2018). Programul de guvernare 2018-2020 (*Governing Program 2018-2020*), from http://gov.ro/fisiere/pagini_fisiere/PROGRAMUL_DE_GUVERNARE_2018-2020.pdf
- Rusu, V.D. & Roman, A. (2017). Entrepreneurial Activity in the EU: An Empirical Evaluation of Its Determinants. *Sustainability*, 9, 1679.
- Simón-Moya, V., Revuelto-Taboada, L. & Guerrero, R.F. (2014). Institutional and economic drivers of entrepreneurship: An international perspective. *Journal of Business Research*, 67 (5), 715–721.
- Touzani, M., Jlassi, F., Maalaoui, A. & Hassine, B.B.J. (2015). Contextual and cultural determinants of entrepreneurship in pre- and post-revolutionary Tunisia: Analysing the discourse of young potential and actual entrepreneurs. *Journal of Small Business and Enterprise Development*, 22(1), 160-179
- Van Praag, C.M. & Versloot, P.H. (2007). What Is the Value of Entrepreneurship? A Review of Recent Research. *Small Business Economics*, 29 (4), 351–382.
- Van der Zwan, P., Verheul, I. & Thurik, A.R. (2012). The entrepreneurial ladder, gender and regional development. *Small Business Economics*, 39 (3), 627-643, from <https://link.springer.com/article/10.1007/s11187-011-9334-7>
- Van Stel, A., Storey, D.J. & Thurik, A.R. (2007). The effect of business regulations on nascent and young business entrepreneurship. *Small Business Economics*, 28, 171–186.
- Wennekers, S., van Stel, A., Thurik, R. & Reynolds, P. (2005). Nascent Entrepreneurship and the Level of Economic Development. *Small Business Economics*, 24, 293–309.
- Werner, A. (2011). Do credit constraints matter more for college dropout entrepreneurs? *International Journal of Entrepreneurship and Innovation Management*, 14 (2-3), 190–205.
- Wong, P.K., Ho, Y.P. & Autio, E. (2005). Entrepreneurship, innovation and economic growth: Evidence from GEM data. *Small Business Economics*, 24, 335–350.
- Zhao, H. & Seibert, S. (2006). The big five personality dimensions and entrepreneurial status: a meta-analytical review. *Journal of Applied Psychology*, 91(2), 259-271, from <https://pdfs.semanticscholar.org/1046/9075c749654963e591011637df730921acfa.pdf>

A Particular Analysis of Consumer Behaviour of Products in Decline Phase

Oana Țugulea

Alexandru Ioan Cuza University of Iași, Faculty of Economics and Business Administration
Iași, Romania
ciobanu.oana@uaic.ro

Mădălina Ferchiu

Alexandru Ioan Cuza University of Iași, Faculty of Economics and Business Administration
Iași, Romania
madaferchiu12@yahoo.com

Claudia Stoian (Bobâlca)

Alexandru Ioan Cuza University of Iași, Faculty of Economics and Business Administration
Iași, Romania
iuliana.bobalca@uaic.ro

Abstract. This paper investigates the dimensions of consumer behaviour in a particular context: products in decline phase. This analysis is conducted based on traditional factors influencing consumer behaviour. The objectives of the research are to identify the factors or dimensions of consumer behaviour for the specific case of purchasing a product in the decline phase and to compute the impact of each dimension. The resulted dimensions are: (1) satisfaction, (2) safe use, (3) situational factors, (4) technical factors, (5) self-perception, (6) promotions and (7) used to buy. The highest positive impact is attached to dimension “satisfaction”, while the highest negative impact is attached to dimension “promotions”.

Keywords: *consumer behaviour; factors influencing consumer behaviour; exploratory factor analysis.*

1. Introduction

The concept of consumer behaviour is a very complex one. This concept is approached in various fields of analysis, such as psychology, sociology, general economics, management or marketing. The buying process, as a part of consumer behaviour, is divided in five well known stages: need recognition, information search, evaluation of alternatives, purchase decision and post-purchase behaviour. A subject of great interest in consumer behaviour research is identifying factors influencing the consumer to buy a specific product or service and also all his decisions involved in this process. Although it is useful to understand these factors, it is also important to understand that “consumer behavior is very difficult to predict” (Khaniwale, 2015, p. 284). The purpose of this research is to reveal dimensions of consumer behaviour from a different perspective, derived from the well-known factors that influence consumer behaviour: psychological, socio-cultural, personal and situational factors (Munteanu et al., 2008). The objectives of this research are:

- (1) identify the factors or dimensions of consumer behaviour for the specific case of purchasing a product in the decline phase;
- (2) compute the impact of each dimension on consumer behaviour decisions.

2. Literature Review

Khaniwale (2015) identified the theoretical factors that influence consumer behaviour and the associations that exist between these factors and consumer buying behaviour. The author's paper identifies the main factors – cultural, social, personal and psychological – and their sub-categories. The author suggests managers to consider these factors, especially when developing products

Díaz et al. (2017) studied the differences between online and offline consumer behaviour in the specific context of buying cinema tickets, as part of the leisure consumption. In this specific context, researchers found that the important factors that influence intentions and behaviours are lifestyles and values. The analysis of these factors was approached for both online and offline behaviour. Research results of Díaz et al. (2017) reveal that there are more significant effects of values for online shoppers.

Particularly for social media, Wang (2017) studied the effects of evaluative, affective and cognitive dimensions upon purchase behaviour and found that it is influenced only by evaluative and cognitive dimensions.

There is a vast literature upon factors affecting consumer behaviour of green products (Joshi and Rahman, 2015; Maichum, Parichatnon and Peng, 2017; Anvar and Venter, 2014; Tan et al., 2014; Sangroya and Nayak, 2017; Braga Junior et al., 2015).

Joshi and Rahman (2015) reviewed 53 researches published between 2000 and 2014, referring to factors affecting consumer behaviour in the green purchase intention. The conclusion of their study is that the major factors encouraging the purchase of green products are subjective norms and environmental knowledge and concerns; also, the major barriers are low consumer trust in this type of products, issues associated with availability of green products and high prices.

Maichum, Parichatnon and Peng (2017) study reveals the determinants of green products purchase intention. Their research investigated only 18 – 29 years old consumers from Thailand and concluded that environmental attitude, environmental knowledge and environmental consciousness have significant positive influences on the intention to purchase this type of products.

Concerning the same green market, Anvar and Venter (2014) studied consumers in Generation Y category from South Africa in order to identify the factors that influence their purchase behaviour and their attitude. According to their findings, the attitude of Generation Y consumers from South Africa is positively influenced by the studied factors: price, environmental awareness and social influence. Also, as expected, a positive attitude towards green products is an indicator of a high probability of purchasing these types of goods.

Tan et al. (2014) research conducted in Malaysia identified three independent variables related to behaviour of young consumers of green products: government and industry role, social influence and environmental concern.

Sangroya and Nayak (2017) studied the factors that influence the consumption of green energy and found that, among the financial aspect, consumers are also driven by social and emotional factors. Researchers propose a model with four value dimensions: functional, social, emotional and conditional value, with proposed scales.

Braga Junior et al. (2015) concluded that green products declared purchases are not affected by environmental concern; there is a strong association between environmental concern and intention of purchase.

Sustainable purchase behaviour has also been receiving a large attention in the specific literature (Joshi and Rahman, 2017; Lazzarini, Visschers and Siegrist, 2017). For example, Joshi and Rahman (2017) study focused on sustainable purchase behaviour of people living in

Delhi. Researchers identified elements that predict this type of purchase of educated young Delhi consumers: environmental concern, subjective norms, consumers' knowledge regarding sustainability related issues, consumer attitude towards sustainable purchasing, supportive behaviours for environmental organizations and perceived marketplace influence.

Evaluation of sustainability was also studied by Lazzarini, Visschers and Siegrist (2017). In the particular case of food products with different seasonality, labelling and country of production, investigating Swiss consumers, the study reveals that consumers evaluate food products social sustainability and the environmental impact based on sustainability labels and country of origin

A field that was studied for factors influencing consumer behaviour was the one of technology consumption. From this perspective, Roman et al. (2015) study reveals the factors influencing the behaviour of smartphone services in a specific context: multinational companies. Results indicate that effective use is directly influenced by organizational factors (management decision and award advantage) and socio-cultural factors (social norm) and indirectly influenced by organizational factors (daily tasks, business trips), innovation factors (experimentation) and support services (on-line consultancy).

The life cycle of a product is very similar to the life of a human being, as products are firstly launched in the market (are given "birth"), then they are developed by launching better versions of the initial one and then they are abandoned by consumers for new better products (they get "old"). Derived from this philosophy, the four phases of the life cycle of a product, as presented in the general marketing literature, are: introduction, growth, maturity and decline (Munteanu et al., 2008).

The last phase of the product life-cycle is the decline phase. After stages of introduction and success in the growth and maturity stages, decline is characterized by an important decrease of sales and profits. This is the stage where producers and promoters usually decide to withdraw products from the market.

Yet, sometimes producers and marketers are inventive enough to find solutions to reinvigorate the market or to adjust some features of the products in decline phase and manage to maintain the products much longer than the competitors.

Little research has been conducted on consumer behaviour of products in the decline phase. Cox et al. (2013) were a team of researchers investigating this aspect in UK. Researchers found that nowadays consumers expect updated versions of the products, in order to replace the older versions, as they associate the new versions with their identity and success. The desire to keep up with fashion is stronger than concerns on safe environment (Cox et al., 2013).

3. Research Purpose and Objectives

The purpose of this research is to reveal the factors of consumer behaviour from a different perspective, derived from the well-known factors that influence consumer behaviour: psychological, socio-cultural, personal and situational factors.

The objectives of this research are:

- (1) identify the factors or dimensions of consumer behaviour for the specific case of purchasing a product in the decline phase;*
- (2) compute the impact of each dimension on consumer behaviour decisions.*

This is an exploratory research. There are no research hypotheses for this research.

4. Research Methodology

Population and sample

This research is investigating the determinants of consumer behaviour of a product in decline phase. For this purpose, we selected a specific product in order to collect data. The selected product was the CD / DVD.

The CDs / DVDs market in Romania is represented by a variety of consumers, from the perspective of various demographic segmentation criteria, such as age, sex, culture, education, but also from the lifestyle point of view. This heterogeneous segment is derived from the varied purposes a CD or a DVD is meant to be used. These products have the main purpose to store any type of data: music, movies, games, photos or software.

The studied population in the present research is represented by people living in the city of Iași, Romania, with age over 18. The targeted population is characterized by an active lifestyle, having various hobbies and passions such as listening to music, watching movies or playing computer games in the spare time.

The sample was composed of 119 respondents that usually buy CDs or DVDs. The snowball sampling method was used, as it was difficult to find respondents that still buy these types of products. Data was collected in April 2017.

The instrument

A questionnaire was built in order to collect data from respondents. The questionnaire was built after a previous documentary (Datculescu, 2006) and qualitative research phase. Items were grouped in sections, as follows:

- an introductory section with 2 items:
 - one item to filter the respondents
 - one item to identify the category of products that respondents had bought in the previous purchase (CD or DVD);
- the second section that groups items into the four factors that influence the consumer buying behaviour:
 - 19 items describing the psychological factors dimension,
 - 7 items describing the marketing mix factors dimension,
 - 8 items describing the situational factors dimension,
 - 9 items describing the socio-cultural factors dimension;
- the final section with socio-demographic identification items (age, sex, income and rural/urban environment).

There were 145 fulfilled questionnaires, out of which 119 questionnaires were valid. Factor analysis was conducted on the 119 cases, Principal Components Method with Varimax rotation in order to identify the dimensions defining the factors that influence consumer behaviour in the specific case of purchasing products in the decline phase.

5. Research Results

Objective 1: identify the factors or dimensions of consumer behaviour for the specific case of purchasing a product in the decline phase.

Exploratory factor analysis, the Principal Components Method with Varimax rotation was conducted in SPSS. There were 43 items included in the analysis, composing the four factors that define the consumer behaviour (psychological, marketing mix, situational and socio-cultural factors). The 5 points Likert scale was used for all items included in the exploratory factor analysis.

KMO and Bartlett's Test value is > 0.6 and $\text{sig} < 0,05$. This indicates that variables can be grouped in dimensions.

Table 1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,610
Bartlett's Test of Sphericity	Approx. Chi-Square	578,295
	Df	153
	Sig.	,000

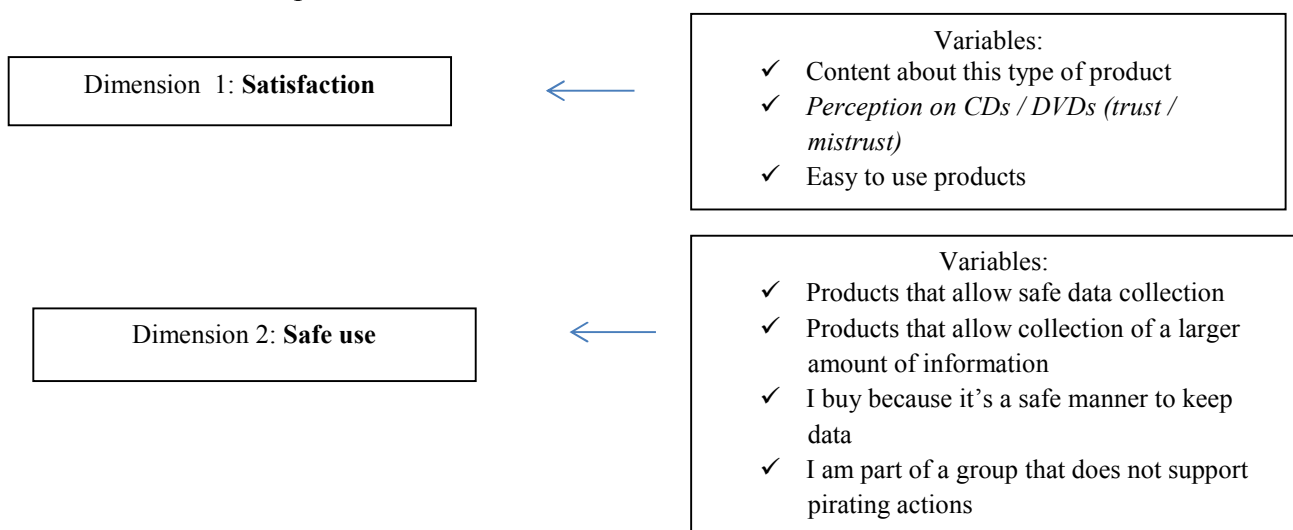
In the explained variance table, 7 factors are identified to have an eigen value > 1 . The total variance explained is approximate 70%.

Table 2: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,061	17,006	17,006	3,061	17,006	17,006	2,450	13,613	13,613
2	2,547	14,152	31,158	2,547	14,152	31,158	2,421	13,452	27,065
3	1,776	9,869	41,026	1,776	9,869	41,026	1,969	10,937	38,002
4	1,475	8,195	49,221	1,475	8,195	49,221	1,837	10,205	48,207
5	1,463	8,129	57,349	1,463	8,129	57,349	1,413	7,852	56,059
6	1,113	6,183	63,532	1,113	6,183	63,532	1,232	6,845	62,904
7	1,041	5,783	69,315	1,041	5,783	69,315	1,154	6,411	69,315
8	,952	5,291	74,606						
9	,805	4,473	79,080						
10	,651	3,618	82,698						
11	,571	3,171	85,869						
12	,507	2,819	88,688						
13	,482	2,678	91,365						
14	,424	2,354	93,719						
15	,416	2,314	96,033						
16	,289	1,606	97,639						
17	,234	1,299	98,938						
18	,191	1,062	100,000						

Extraction Method: Principal Component Analysis.

The items loading < 0.5 (Costello and Osborne, 2005) and items with cross-loadings were removed from the analysis. After successive analyses, the items were grouped as the Rotated component matrix indicated. The resulted dimensions were labeled and the grouped variables in dimensions are represented below:



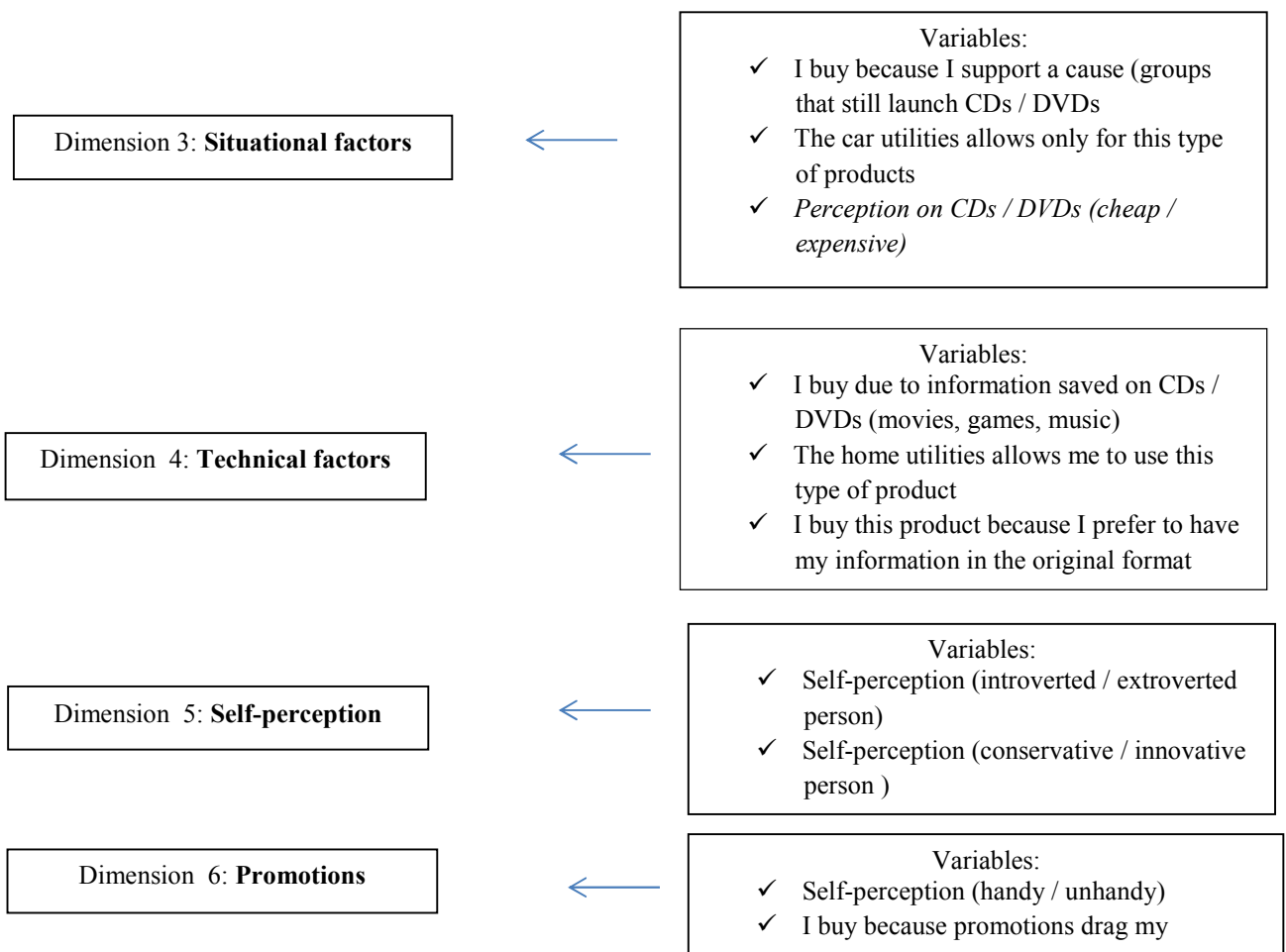


Figure 1: Grouping variables in dimensions using exploratory factor analysis

Dimension 7 is represented by one variable („I am used to buy this product”). This item will be analysed in a future qualitative research with the purpose to identify other items that could compose a future measurement scale.

The table below presents each dimension with explained variance for each factor.

The reliability of each scale, using Cronbach’s Alpha, was computed in SPSS.

Table 3: Explained variance for each factor

Dimension	Satisfaction	Safe use	Situational factors	Technical factors	Self-perception	Promotions	Used to buy
Percent of total variance explained (%)	17,006	14,152	1,776	1,475	1,463	1,113	1,041

The internal consistency of the scale *satisfaction*, measured with Cronbach-alpha, is -0.446. The scale has an unacceptable reliability.. If one item is removed, particularly “*Perception on*

CDs / DVDs (trust / mistrust)”, the internal consistency is 0.804. The new scale has a good reliability. The item “*Perception on CDs / DVDs (trust / mistrust)*” is deleted from the scale.

The internal consistency of the scale *safe use*, measured with Cronbach-alpha, is 0.716. The scale has an acceptable reliability.

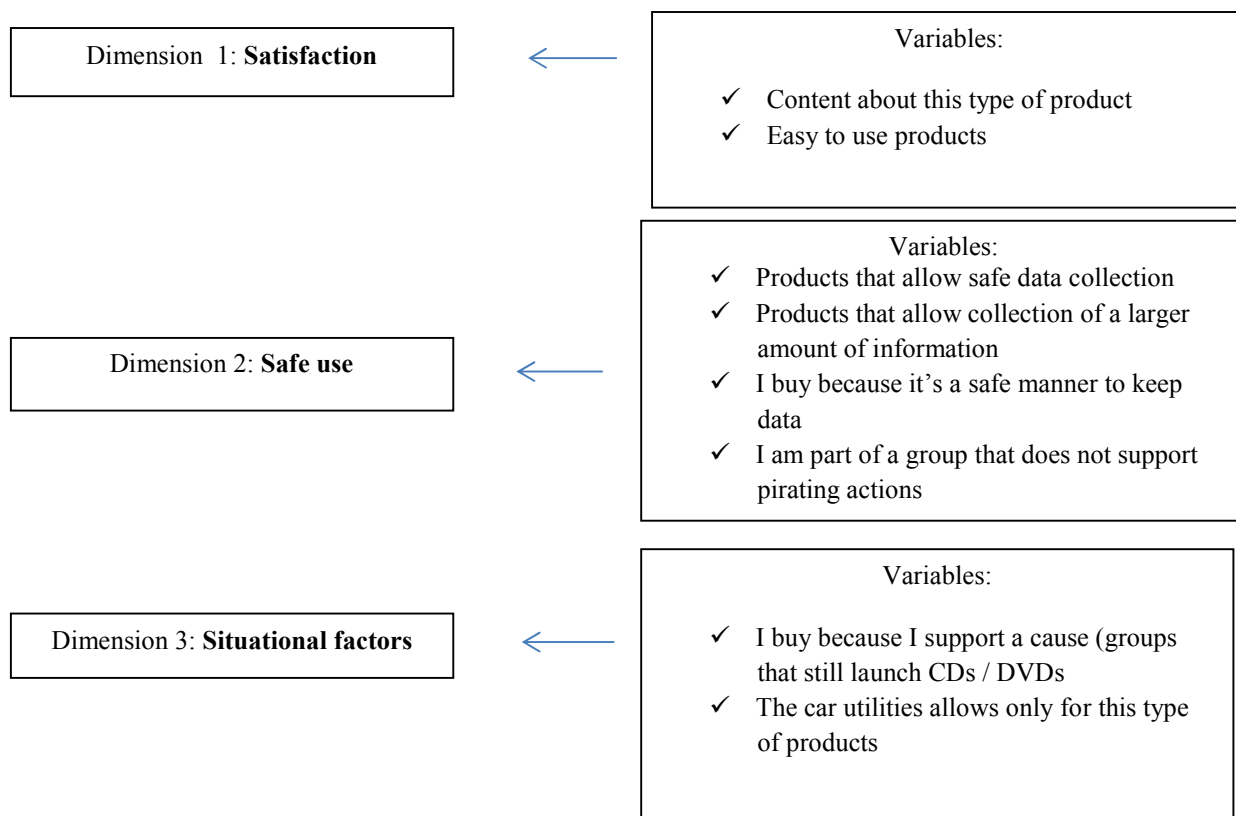
The internal consistency of the scale *situational factors*, measured with Cronbach-alpha, is 0.605. The scale has a low reliability. If one item is removed, particularly “*Perception on CDs / DVDs (cheap / expensive)*”, the internal consistency is 0.672, very close to 0.7. In this case, the scale has an acceptable reliability. Yet, the scale should be considered for further investigation in future research.

The internal consistency of the scale *technical factors*, measured with Cronbach-alpha, is 0.608. The scale has a low reliability. If any item is removed, the scale has a lower reliability. The scale should be considered for further investigation in future research.

The internal consistency of the scale *self-perception*, measured with Cronbach-alpha, is 0.453. The scale has an unacceptable reliability. No item can be removed, as the scale has only two items. This might be the reasons of the very small Cronbach’s Alpha coefficient. The more items are in the scale, the highest is the probability to have a good reliability. The scale should be considered for further investigation in future research.

The internal consistency of the scale *promotions*, measured with Cronbach-alpha, is 0.118. The scale has an unacceptable reliability. No item can be removed, as the scale has only two items. Just as in the previous scale, the fact that there are only two items in the scale might be one of the reasons of the very small Cronbach’s Alpha coefficient. The scale should be considered for further investigation in future research.

The new proposed scales are figured below:



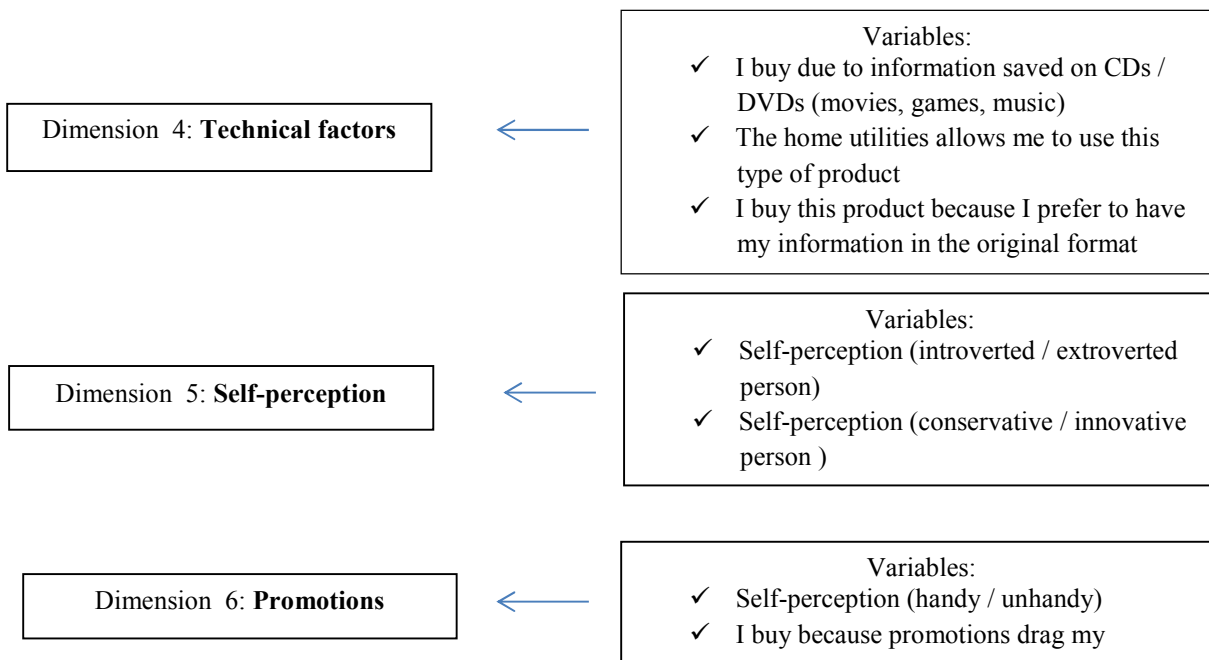


Figure 2: Final grouping variables in dimensions

Objective 2: compute the impact of each dimension.

For each scale, the mean of scores was computed. Each score was transformed from 1 to 5 scale to -2 to 2 scale. The mean for the last dimension was computed as item mean.

Table 4: Transforming dimensions scores

Dimension	Mean on 1 to 5 scale	Mean on -2 to 2 scale	Scores on -100 to 100 scale
Satisfaction	4.20	1.20	60
Safe use	3.22	0.22	11
Situational factors	2.57	-0.43	-21.5
Technical factors	3.58	0.58	29
Self-perception	3.50	0.50	25
Promotions	1.92	-1.08	-54
Used to buy	3.24	0.24	12

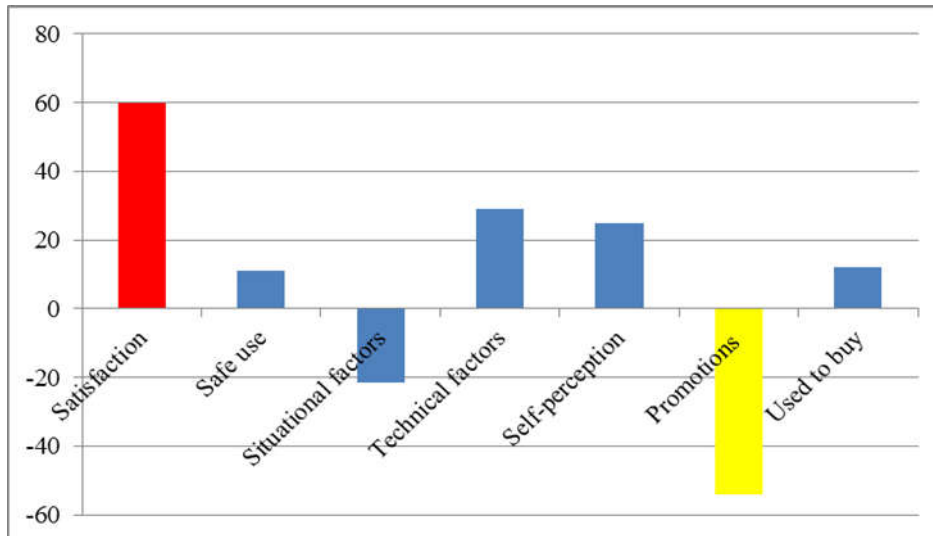


Figure 3: Computed impact of each factor

The dimension *satisfaction* has the highest positive impact while the dimension *promotions* has the highest negative impact, comparing to all the other dimensions.

6. Conclusions

The purpose of this research was to identify the dimensions derived from the factors that influence consumer behaviour related to products in decline phase of the product life-cycle. The product selected in order to collect data was the CD / DVD.

The main factors that influence consumer behaviour are: psychological, socio-cultural, situational and marketing mix factors (Munteanu et al., 2008). For each of this factor scales have been composed, based on previous documentary and qualitative analyses. An exploratory factor analysis was conducted on the collected items.

The resulted dimensions are: (1) *satisfaction*, (2) *safe use*, (3) *situational factors*, (4) *technical factors*, (5) *self-perception*, (6) *promotions* and (7) *used to buy*.

The dimension *satisfaction* has the highest positive impact in consumer behaviour decisions. The dimension *promotions* has the highest negative impact in consumer behaviour decisions.

Research implications

This research is original from two perspectives:

- (1) there is no previous research to group the items representing the factors that influence consumer behaviour in order to regroup the items into different dimensions, based on exploratory factor analysis;
- (2) the research only involves products in the decline phase of the product life-cycle.

Managerial implications

The results of this research are very useful for managers that still promote and sell products in the decline phase, especially CDs / DVDs. Managers should study the resulted dimensions in order to understand better the behaviour of consumers of these types of products. Strategies can be created in order to find new marketing segments and promote the products or to reinvigorate the promotional strategies according to the specificities on the consumer behaviour.

Results indicated at objective 2 reveal that the dimension *satisfaction* has the highest positive impact. This is very useful information for managers, in order to promote and sell CDs and DVDs that ensure highest possible satisfaction (see the items composing this scale). Also, the highest negative impact belongs to the dimension *promotions*. On one hand, this is an indication that, for this type of products in decline phase, promotional activities are not so important in the buying decision process. On the other hand, another aspect to consider is that all promotional activities should include very accurate information and should be very ethical.

Future research

This factor analysis reveals that dimensions can be created based on factors defined by variables from the literature, factors defining influence on consumer behaviour. These new factors / dimensions have different structures and meanings comparing to those heavily studied in the general marketing literature. These factors should be studied in more depth in a future qualitative and quantitative research, including a confirmatory factor analysis.

As a future research direction we also mention a qualitative research based on in-depth interviews or focus-groups in order to define a new scale for Dimension 7 (*used to buy*), which was identified in this paper with a single item. This new scale should be analysed testing the reliability of the scale and using exploratory and confirmatory factor analysis.

Also, dimensions *situational factors*, *technical factors* and *promotions* should be considered for further future research in order to reveal more reliable scales.

This study could also be conducted for products in the introduction, growth or maturity phase of the product life-cycle. Also, the study can focus on a specific category of products, as was the case of this study (CDs / DVDs).

Limitation of research

One important limitation of this research is the small number of respondents. The small number of respondents is explained by the difficulty to find users of a product that in the decline phase of the product life-cycle. This exploratory research is useful to create a general scale to identify the dimensions of consumer behaviour factors. This research needs to continue with a larger number of respondents, in order to obtain more reliable scales.

REFERENCES

- Anvar, M. & Venter, M., (2014). Attitudes and Purchase Behaviour of Green Products among Generation Y Consumers in South Africa. *Mediterranean Journal of Social Sciences*, Vol. 5, No. 21, 183-194.
- Braga Junior, S. S., da Silva, D., Gabriel, M. L. D. S. & de Oliveira Braga, W. R., (2015). The Effects of Environmental Concern on Purchase of Green Products in Retail. *Procedia - Social and Behavioral Sciences*, 170, 99 – 108.
- Costello, A. B. & Osborne J. W., (2005). Best Practices in Exploratory Factor Analysis: Four Recommendations for Getting the Most from Your Analysis. *Practical Assessment Research & Evaluation*, Vol. 10, No 7. <http://pareonline.net/getvn.asp?v=10&n=7> – April 2010.
- Cox, J., Griffith, S., Giorgi, S. & King, G., (2013). Consumer understanding of product lifetimes, Resources. *Conservation and Recycling*, 79, 21– 29.
- Datulescu, P., (2006). *Cercetare de marketing. Cum pătrunzi în mintea consumatorului, cum măsoară și cum analizezi informația*, Editura Brandbuilders Grup, București.
- Díaz, A., Gómez, M. & Molina, A., (2017). A comparison of online and offline consumer behaviour: An empirical study on a cinema shopping context. *Journal of Retailing and Consumer Services*, 38, 44 – 50.

- Joshi, Y. and Rahman, Z., (2015). Factors Affecting Green Purchase Behaviour and Future Research Directions. *International Strategic Management Review*, 3, 128–143.
- Joshi, Y. and Rahman, Z., (2017). Investigating the determinants of consumers' sustainable purchase behaviour. *Sustainable Production and Consumption*, 10, 110 – 120.
- Khaniwale, M., (2015). Consumer Buying Behavior. *International Journal of Innovation and Scientific Research*, Vol. 14, No. 2, pp. 278-286.
- Lazzarini, G. A., Visschers, V. H. M. & Siegrist, M., (2017). Our own country is best: Factors influencing consumers' sustainability perceptions of plant-based foods. *Food Quality and Preference*, 60, 165 – 177.
- Maichum, K., Parichatnon, S. & Peng, K., (2017). Factors Affecting on Purchase Intention towards Green Products: A Case Study of Young Consumers in Thailand. *International Journal of Social Science and Humanity*, Vol. 7, No. 5, 330-335.
- Munteanu, C., Maxim, E., Sasu, C., Prutianu, S., Zait, A., Manolica, A., Jijie, T., Monoranu, A., (2008). *Marketing. Principii, practici, orizonturi*, Ed. Sedcom Libris, Iasi.
- Roman, T, Vasilache, S., Maxim, E. & Manolica, A., (2015). Factors that influence the behaviour of consumers of smartphone services in multinational companies. *Current Science*, Vol. 109, No. 6, 1038 – 1046.
- Sangroya, D. and Nayak, J., K., (2017). Factors influencing buying behaviour of green energy consumer. *Journal of Cleaner Production*, 151, 393 – 405.
- Tan, S. H., Yeo, S. F., Ling, G. M. and Cheah, C. S., (2014). Factors that Influence Green Purchase Behaviour among Young Consumers. *Advanced Materials Research*, Vol. 1051, pp 1035-1039.
- Wang, T., (2017). Social identity dimensions and consumer behavior in social media. *Asia Pacific Management Review*, 22, 45 – 51.

The Fit Between Marketing High Education and Required Skills for Marketing Practice

Maria Antónia Rodrigues

Porto Accounting and Business School, Porto, Portugal
CEOS, Polytechnic of Porto.
mar@iscap.ipp.pt

Inês Veiga Pereira

Porto Accounting and Business School, Porto, Portugal
CEOS, Polytechnic of Porto.
inespereira.iscap@gmail.com

Abstract. Marketing has evolved deeply along the years. From a secondary and empirical activity, when compared to other organizational functions, marketing has become broader, more relevant, more rational and a differentiating factor in competitive markets. Marketing concept has evolved, new paradigms have aroused and its activities have become more relevant for organizations. Nowadays, companies are searching for marketing competencies which connect with complementary competencies and also with soft skills. Given the increase of marketing relevance both for companies and other organizations, this paper aims to access the fit between marketing training offered by High Education Institutions (HEI) and organizations' demanded skills for marketing practice. This work's methodological approach is of qualitative nature was developed in three steps and focuses on the case of academic education in Portugal. The first step of the methodology process refers to the gathering of all marketing degrees' curricular plans of the Portuguese University and Polytechnic Institutions. On the second phase, all the Curricular Units (CUs) from 32 degrees were classified. Finally, the classified CUs were grouped and compared with the required marketing competencies, marketers should have. Being an exploratory study results should be carefully analysed. Nevertheless, it was found that there is a lack of adjustment between academic marketing education and marketing professionals demand. HEI should adopt a more interactive perspective, such as the "new marketing DNA" model for marketing education to prepare students for the market needs. In order to increase the fit between both, some actions are required, as follows. Marketing degrees should develop integrated marketing communications by adding digital marketing and other tools in order to develop skills about online and offline marketing communication, which deliver a multichannel message in a consistent manner; include courses from different marketing areas such as services, industrial marketing, tourism marketing and social marketing as marketing practice in each context differs; further, include seminars, laboratory, simulation and internships will be important for soft skills development, highly valued by marketing practitioners. Nevertheless, the results are very important for different stakeholders. Firstly, HEI which are willing to update and adjust their degrees, may find here important suggestions, secondly, students who wish to understand the potential results of their training and the need for complementary education and finally, for the market which can have a deeper knowledge of the HEI training abilities and therefore the skills of future marketing professionals.

Key words: *marketing education, marketing skills, marketing practice, high education*

1. Introduction

Marketing practice involves the development of a set of activities either, centralized in a department, or dispersed along the organization. In spite of the different theoretical paradigms that justify the organizational approach of marketing, it is extremely relevant to the

achievement of organizational objectives. The investment in marketing activities has been increasing, through internal development or outsourcing, from services to industry, in small or large organizations, more strategic or operational, the need for human resources and marketing skills is indisputable.

If twenty years ago the offer of higher education in the field of marketing was small, today, the advanced training in marketing or related areas proliferates amongst business schools. High education institutions (HEI) offer degrees organized according to what has been the typical paradigm focusing on delivering marketing knowledge on a functional marketing perspective. As new skills have been demanded by the market, HEI feel the urge to adapt their curriculum to deliver those skills to graduates. In this context, the objective of this study is to verify if there is an adjustment between marketing higher education and skills required by the market, considering in one hand, the curricular offer of undergraduate degrees and, on the other hand, marketing activities developed in organizations.

This research is organized in 9 points, after this introduction, theoretical chapters (2 to 5) discuss the development and nature of marketing activities in organizations, old and new marketing DNA model and soft skills required by the market, chapter 6 presents and justifies the methodology used in the study and in chapter 7 the results are exposed. Following, results are discussed in chapter 8 and finally, the work ends with the conclusions, limitations and future research suggestions.

2. The Development of Marketing Activities in Organizations

From studies about development of marketing in organizations, several analysis perspectives are identified. The philosophical perspective, related to the organizational culture, tries to understand the marketing orientation of the organizations and highlights the relevance of the orientation to the market (Kohli e Jaworski, 1990; Deshpandé e Farley, 1998; Homburg e Pflesser, 2000; McDonald e Meldrum, 2013). The structural perspective gives relevance to the marketing department, in particular its position, power and influence (see for example Merlo, 2011). The results' perspective highlights the organization's performance and highlights the marketing contribution (Sheth and Sharma, 2001; Götz et al., 2009). The functional marketing perspective gives evidence to the management of marketing activities and the 'make or buy' decision.

All perspectives, individually or interrelated, are important for the theoretical and practical understanding of marketing in organizations. For example, some studies show that market orientation positively influences the organization performance (Cano et al., 2004, Kirca et al., 2005). Others support the claim that a strong and influential marketing department improves the organization's performance (Wirtz et al., 2014).

Marketing activities allow the contact between organization and its markets and significantly influence the overall success of the organization (Urbonavičius et al., 2007). The adoption of a research perspective based on marketing activities implies a conceptual approach and the existing empirical studies.

From the literature emerges a lack of consensus amongst authors regarding the boundaries of marketing activities in the organization. In general terms, there are two paradigms underlying the identification of marketing activities (Harris and Ogbonna, 2003): the paradigm based on marketing-mix management and the paradigm based on the 'new' marketing concept. Marketing activities based on marketing-mix include activities related to the product offer (goods and / or services), price management, advertising and promotion, market research and distribution (George and Barksdale, 1974). This conceptualization of marketing activities was considered inappropriate (Harris and Ogbonna, 2003), which led some authors to add new

variables (see for example Kotler, 1986; Vignali and Davies, 1994) or to radically contest this approach (O'Malley and Patterson, 1998). In addition to the theoretical contribution resulting from the conceptual debate about the delimitation of marketing activities in the organization, the critical authors did not provide much alternatives (Harris and Ogbonna, 2003), for example through new frameworks. According to Dibb et al. (2014: 397) "by better clarifying marketing practice and its scope further refinements to empirical measurement instruments are enabled". Nevertheless, it is possible to identify some studies and authors that explicitly or implicitly contributed to the understanding of marketing activities in the organization. We emphasized the studies that propose a new paradigm and concept of marketing and the studies that suggest how marketing should be developed in the organizations with a market orientation (Webster, 1994, Day, 1994, 1998, among others). The debate around this issue proves that the boundaries of marketing activities in organizations are not easy to delimit and extend beyond the marketing departments themselves (Dibb et al., 2014). As O'Malley and Patterson (1998) refer, many marketing activities as communication, price, distribution, product development, are controlled by other functional areas and not by the marketing department. As David Packard's popular expression emphasizes, marketing is: "something too important to be left to the marketing department".

3. The Nature of Marketing Activities

In the literature about marketing activities it is possible to identify an axis of investigation that characterizes the nature of marketing activities in different dimensions. However, the authors point out a clear insufficiency of studies in this area (Hooley and Cowell, 1995; Workman et al., 1998, Urbonavičius and Dikčius, 2009). Particularly in the Portuguese context, there is no study to analyze marketing practices or activities in the organizations so far, although the authors recognize that it is difficult to generalize the results of existing studies to a sector, that is so diversified in terms of activities and orientation, such as the service sector (Hooley and Cowell, 1995).

It is possible to identify a set of dimensions that serve as the basis for studies on the nature of marketing activities in the organization (see Table 1).

Table 1 Dimensions that characterize the nature of marketing activities

Authors	Geographical context and type of study carried out	TOPICS STUDIED						
		Type of organization (services or industry)	Organizational Economic context (prosperity or recession)	Relevance of marketing activities	Size of organization	Organizational strategy	Responsibility for the development of activities	Investment in marketing activities
George and Barksdale (1974)	USA Activities related to the marketing							
Hooley and Cowell, 1985, 1995	UK Questionnaire. Quantitative study.							
Urbonavičius et al., 2007	Lithuania Questionnaire to top managers. Activities associated with marketing mix, marketing planning and market research							
Urbonavičius and Dikčius, 2009	Questionnaire to top managers							
Webster et al., 2005	Interviews with CEOs and senior marketing executives.							
Harris and Ogbonna, 2003	Case study - qualitative study							
Wirtz, et al., 2013	Questionnaire, USA, Europe and Asia.							
American Marketing Association and Aquent, 2010	Questionnaire to members and visitors of AMA and Aquent							
Barwise and Styler, 2003	Telephone interview. USA, UK, France, Japan, Germany, China and Brazil							

Studies characterize the nature of the marketing activities in organizations according to different dimensions that are highlighted below:

- Size of the organization: There is no consistency over the years in the results of the different studies on the influence of the size of the organization in the development of marketing activities. Recent studies have shown that larger firms attribute greater relevance to marketing activities than small firms (Urbonavičius et al., 2007, Urbonavičius and Dikčius, 2009). Older studies report that the size of the organization, in terms of turnover or number of employees, has no influence on the marketing activities developed (George and Barksdale, 1974).
- Economic context: studies that analyze this dimension seek to understand if the nature of marketing activities change according to the economic context of prosperity or recession. Studies report that service firms are less affected by the crisis context, which is justified by the fact that they operate mainly in new and growing markets, while industrial firms are more affected because they operate mainly in mature markets (Hooley and Cowell, 1995). Urbonavičius and Dikčius (2009) studies's show that the importance of activities related to price and communication activities increases during recession periods.
- Type of organization: there are several authors who, at different times have sought to characterize the nature of marketing activities according to the type of organization (service organizations vs. industrial organizations). The approaches adopted by the authors are different. Some of them seek to capture the differences by considering the activities individually, others, consider the overall marketing activities, and draw more general conclusions. The greater coherence between the authors is based on the assumption that there is a clear difference between the marketing activities carried out by service organizations and industrial organizations (George and Barksdale, 1974, Hooley and Cowell 1995, Urbonavičius et al., 2007, Urbonavičius and Dikčius, 2009). Already in the 1970s, George and Barksdale (1974, p.65) assumed "a lack of marketing orientation and limited view of the marketing function in service firms". According to the authors, when comparing industrial and service organizations, the following conclusions are drawn:
 - Marketing activities are less likely to be developed in the marketing department.
 - They are more likely to engage in advertising activities internally than outside, using advertising agencies.
 - They are less likely to have an overall sales plan.
 - They are less likely to develop activities related to vendor training programs.
 - They are less likely to hire companies related to market research and marketing consultants.
 - They are less likely to invest more in marketing (as a percentage of sales volume).

The marketing function arises less structured in service organizations than in industrial organizations (George and Barksdale, 1974). In services, marketing activities related to marketing-mix appear more fragmented, which hinders control and reduces the efficiency of marketing efforts (George and Barksdale, 1974). When the activities related to the definition of objectives, policies, audits and general marketing plans, the authors did not find significant differences between the two types of organization (George and Barksdale, 1974). In relation to market research activities, the authors op. cit. point out that there is a similar effort between different types of organizations.

Subsequent studies corroborate, in general terms, the idea of a less developed marketing activity in service organizations because the markets in which they operate, are new and

growing and are not as demanding as the mature markets in which industrial organizations operate (Hooley and Cowell, 1995). That study presents the following conclusions:

- Service organizations have less market research activity than industrial organizations
- Service companies are less sophisticated in the development of marketing planning activities, and are less receptive to the use of strategic marketing planning tools. In particular service organizations tend to restrict their plans to a shorter time (one year).
- Service and industrial organizations support new business by leveraging different activities. The activities related to the sales force, service and customer support are the most valued by service organizations.

In both studies, the authors (George and Barksdale, 1974; Hooley and Cowell, 1995) make recommendations to service organizations, to make the development of their marketing activities more professional. Hooley and Cowell (1995) find this option mandatory, as markets in which service organizations operate, become more competitive and inevitably more mature. George and Barksdale (1974) propose service organizations to re-examine their marketing activities and to see if they cannot benefit from greater coordination and integration of their marketing efforts.

The results of recent studies note interesting changes. In general, marketing activities are considered less important for industrial organizations than for service organizations (Urbonavičius and Dikčius, 2009). Individually, communication, distribution and price management activities are considered more relevant in services organizations than in industrial organizations (Urbonavičius and Dikčius, 2009). In general terms, the results of the studies emphasize for both types of organizations the importance of marketing planning activities and price management (Urbonavičius et al., 2007) and the positive relationship between the evaluation of the importance of marketing activities and sales growth (Urbonavičius and Dikčius, 2009).

- Activities development responsibility - responsibility for the development of marketing activities is a topic that raises a great deal of discussion among authors. It is not relevant for this study to take one perspective and enter into this discussion, but it is important to understand reality. The results of the studies show many organizations don't have a marketing department and that many activities are developed by other areas of management. As Harris and Ogbonna (2003) point out, the development of marketing activities follows the trend of decentralization and dispersal by the organization and are developed by 'part-time marketers' (page 504) who usually adopt an approach to marketing activities, based on marketing-mix management and more rarely, relationship-based (new marketing concept). This does not mean that marketing has lost value in the organization or that marketing departments are 'dead', as said Piercy (1998) and Webster et al. (2005). On the contrary, the dispersion of marketing activities reflects the increasing relevance of marketing throughout the organization (Harris and Ogbonna, 2003). Other studies emphasize the relevance of organizational structure and marketing department in the development of marketing activities. They reveal that organizations that have a more developed management structure give greater relevance to marketing activities (Urbonavičius et al., 2007). Companies with a marketing department attach greater importance to marketing planning, market research, communication and product management activities than those which don't (Urbonavičius et al., 2007).
- Organizational strategy: some studies seek to understand if the strategy developed by the organization influences its marketing activities. As one would expect, organizations that develop low-price strategies, value more price-related activities, and organizations that develop strategies based on product or service quality, value mainly

market research, marketing planning and communication (Urbonavičius and Dikčius, 2009).

- Investment in marketing activities: studies that relativize marketing activities in terms of investment or resource allocation have different perspectives, considering each of the activities individually or assuming a global perspective, in a static or evolutionary way.

Marketing activities considered individually or as a whole have different and variable financial resource allocations over the years. Traditionally the marketing budget of industrial organizations was larger than of service organizations (George and Barksdale, 1974). Almost half of service organizations devoted 4% or less of their sales to marketing activities, while in industry organizations the same parameter revealed a higher percentage (George and Barksdale, 1974). This trend justified the smaller purchase of services related to marketing activities and lower market orientation of service organizations (George and Barksdale, 1974). The results of the studies reveal that in a more or less significant way the investment by the organizations in marketing activities is over the years increasing, in spite of the economic recession registered in some of the years and of the decrease observed in some countries (Barwise and Styler, 2003 American Marketing Association and Aquent, 2010).

From the MET report (Barwise and Styler, 2003, see Table 2) covering a set of countries (USA, France, Japan, Germany, UK, China and Brazil), which account for 70% the following conclusions are reached:

- Different countries have different investments in marketing activities. To point out the strong growth in China (11.6% from 2003 to 2004), followed by the United Kingdom (6.3% from 2003 to 2004) and the US (4.6% from 2003 to 2004).
- Organizations in different industries are investing heavily in interactive marketing activities. This marketing activity, which includes online promotions, email campaigns, websites and online advertising, already accounts for 10% of total marketing investment in the business to business (B2B) market and 6% in the business to consumer (B2C).
- Organizations in the B2B market for B2C organizations invest less in advertising (30% vs. 50% of total marketing investment) and more in public relations / sponsorship (23% vs 10%) and interactive marketing activities (10% vs. 6%).
- Investment in marketing activities has varied over time.
- Advertising activities represent the largest marketing investment. However, in some of the years there has been a divestment in this activity.
- Sales promotions represent approximately 20% of total marketing investment and reflect an increase, though not significant, over the years.
- Public relations showed steady growth (accumulating 6.8% between 2001 and 2004 in the main five markets).
- In contrast, activities related to direct marketing registered minimum growth, except in 2002, which grew by 3.8%
- The marketing activity with the highest growth rates is related to interactive marketing (9.3% in 2003 and 11.6% in 2004). Growth is particularly high in the UK and the US. Significant growth has also been recorded in China, which shows that the trend is not confined to Western and developed markets. Japan and France fall behind in this global trend.
- The responses obtained in the qualitative study reveal that the organizations are in different stages of development of the interactive marketing activity but the growth of

the investment in this activity is guided by the perception of speed, adaptability and control capacity, and in many contexts the lower cost compared to other activities.

- The study sought to verify if there is any relationship between the size of the organization, turnover and investment in marketing activities. The results of the study suggest that medium-sized organizations intend to increase their marketing investment more than large ones.

Table 2 Investment in marketing activities by country and evolution in the period

		Marketing activities						Total (incl others)
		Adverstitising	Sales promotion	Brand PR/Sponsorship	Direct mail	Interactiv e Marketing	Other	
Total 2004	(n=891)	40,6	20,5	15,2	13,6	8,3	1,8	100%
USA	(n=251)	40,8	18,6	14,3	15,9	8,9	1,5	100%
Japan	(n=112)	44,8	22,2	15,2	8,3	7,5	1,9	100%
Germany	(n=118)	33,9	23,5	17,7	13,7	9	2,3	100%
United Kingdom	(n=121)	40,9	15,8	14	19,5	8,6	1,2	100%
France	(n=121)	36,1	25,8	16	12,4	6,4	3,3	100%
China	(n=86)	42,7	23,4	17,2	6,7	7	3	100%
Brazil	(n=85)	36	25,8	21,1	7,4	7,4	2,3	100%
2003 % of total		40,5	20,5	15,4	14	7,7		98,1
2002 vs 2001*		-2	0,8	1,8	3,8	6,6		0,6
2003 vs 2002		-0,2	0,4	3	0,4	9,3		1,1
2004 vs 2003		3,6	3,2	2,1	0,5	11,6		3,4
2004 vs 2002		3,4	3,6	5,1	0,9	22		4,5
2004 vs 2001*		0,7	3,5	6,8	4,6	29,8		4,5

* excludes China and Brazil

Source: adapted from the MET report (Barwise and Styler, 2003)

Overall, recent results from the study of America Marketing Association and Aquent (2010) corroborate the results of the previous study. According to America Marketing Association and Aquent (2010):

- Of the marketing professionals interviewed, 38% reported an increase in the marketing budget compared to the previous year (2009 vs 2010), a smaller percentage, approximately 30% reported a decrease for the same indicator.
- Smaller organizations are the least likely to increase marketing budgets, while larger companies are more likely to be allocated more resources for the development of marketing activities. Regarding marketing activities individually, the report shows the organizations' continued commitment to interactive marketing activities. If in 2009 social networks were used by half of the marketing managers, by 2010 it was expected more than 80%. Online and mobile-related activities represent eight of the ten areas where significant investment increases are expected for 2010. On the other hand, a smaller allocation of resources to traditional media activities was expected, for example 34% of marketing managers reported a decrease in newspaper advertising

and more than 25% reported lower investment in advertising in magazines and on radio ads.

Marketing activities of various natures, whether centralized in a function or department or as advocated by some authors (Webster et al., 2005), dispersed by the organization and outside it, represent a relevant contribution to the organization's competitiveness and resources allocation.

“Today, marketing in many large companies is less of a department and more a diaspora of skills and capabilities spread across and even outside the organization.” (Webster et al., 2005, p. 36).

In summary, from the literature review emerges a set of marketing activities that companies generally value, develop and require skills. Regardless of the philosophical discussion that dominates the theme, of the underlying paradigm and of the boundaries that define the marketing development in the organizations, of the various authors (for example, George and Barksdale 1974, O'Malley and Patterson 1998, Dibb et al., 2014) identify the main marketing activities developed in organizations, i.e: market research, sales management, customer management, communication, distribution channel management, price management, marketing planning, digital marketing, interactive and online, public relations, sales promotions and direct marketing.

The relevance of marketing to organizations and various activities is indisputably clear, it is extremely relevant to understand whether, on the side of higher education curriculum follow the requirements of this market. From here emerges the research question that guides this work: What is the adequacy of the curricular plans of marketing higher education degrees to market demands, in terms of required skills for developing marketing activities?

4. Old and New Marketing DNA Model for High Education

Harrigan and Hulbert (2011) have studied United Kingdom organizations and degrees' programs and suggested a “new Marketing DNA” so that British academics could use as guide to teach marketing graduates the skills they need to develop marketing activities. In fact, they have found that British degrees are structured according to the “old Marketing DNA”. According to these authors the “old marketing DNA” represents what is being delivered in the majority of marketing education in the 21st century and it includes: marketing in the context of the wider organization, segmentation, targeting and positioning, marketing planning, contexts of marketing, marketing environment, 4Ps of marketing, buyer behavior, marketing communications, marketing channels, marketing research and implementation and control.

The “new marketing DNA” reflects the relationship between the organization and the customer and includes: customer led marketing, value driven marketing strategy, online and offline integrated marketing communication, data driven marketing and channels. This model reflects the market point of view and could guide high education institutions to adapt their degrees curriculum to market requirements (Harrigan and Hulbert, 2011).

5. Soft Skills

According to Floyd and Gordon (1998) Soft skills refers to interpersonal abilities such as written and oral communication, critical thinking, creativity, teambuilding, and decision-making that are highly valued by organization leaders as being essential for effective functioning in the workplace. In the past, business schools were strongly criticized for placing too much emphasis on technical skills, whereas developing soft skills received little attention (Lamb, Shipp, and Moncrief, 1995). Insufficient commitment to applying these modern educational perspectives in the classroom has resulted in students who lack appropriate skills

demanded by businesses, such as oral and written communication, cross-functional integration, and teamwork (Wright, Bitner, and Zeithaml, 1994). Granitz and Higstad (2004) add that one of the problems with today's students is their deficiency in critical thinking skills and problem solving.

McWhorter (1988, p. 97) defined critical thinking as the "the careful and deliberate evaluation of ideas or information for the purpose of making a judgment about their worth or value." Incorporation of analysis and synthesis into the problem-solving process (Beyer, 1987) makes critical thinking a highly relevant practice in regard to marketing decision making (Klebba & Hamilton, 2007) and, hence, marketing education.

Despite the effort from HEI to integrate these skills amongst the curriculum, Treleven and Voola (2008) stated that practitioners still maintain the belief that marketing graduates lack adequate skills in this area, indicating that many higher education institutions may be lagging behind the objective.

Gaedeke, Tootelian and Schaffen (1983) have found 34 characteristics which might influence the potential hiring criteria. Amongst the most relevant were verbal and written communication skills. Further, Boatwright and Stamps (1988) have determined 33 characteristics which were used to identify seven dimensions of employer hiring criteria: leadership characteristics, academic characteristics, professional characteristics, willingness to relocate, communication skills, self-starter characteristics and social characteristics. These authors concluded that academic skills were less important than being a self-starter, leadership characteristics and communication skills (e.g. ability to write and verbal communication) for marketing related industries and consumer product.

Previous research has also found that employers place greater importance on initiative, interpersonal skills, willingness to relocate, grade point average and reputation of HEI (Kelley and Gaedeke, 1990). Therefore, teachers should stimulate students to develop certain personal characteristics, developing problem solving, communication and technical skills, and not only display knowledge of the content of the course. Those skills may be developed amongst other courses by using different methodologies, such as case analysis and computer simulation, which develops problem solving and technical skills HEI (Kelley and Gaedeke, 1990) or by creating specific courses to teach those soft skills.

Internships were also indicated as important because placing marketing students as interns in business world places, in legitimate positions and responsibility in one way to help students to develop initiative, self-confidence assertiveness, maturity and marketing related experience (Kelley and Gaedeke, 1990).

Although it is extremely important to delimit marketing activities to understand both marketing practice and the value it adds to the organization (Dibb et al., 2014), this is not an easy task. Marketing activities include a broad and diverse set of activities, related to the concept, marketing process, and market orientation. It includes activities of tactical and strategic nature, developed in the organization, in the marketing department and in other functional areas (Dibb et al., 2014). In practice, its delimitation, relevance and location will depend on the organization's activity and the understanding of marketing from the organization and managers. Further, the skills required to develop those activities, both hard and soft, also depend on the activities developed internally and which perspective old vs new marketing DNA better fits organizational structure.

6. Method

The development and implementation of marketing process on organizations requires the definition of several marketing activities. Therefore, high education marketing curriculum

must lead to those competencies development and universities should teach the skills that are required by stakeholders, in particular marketing practitioners.

Clarke, Gray, and Mearman (2006) point out two different approaches when marketing education is concerned: “instrumental” and “intrinsic”. The intrinsic approach is based on the assumption that education has value in itself. It is concerned with the “development of individual potentialities or the development of intellect and character” (Peters, 1970, p. 27), and it implies that education provides people with the capability to make their own choices in live. Conversely, the instrumental approach focuses on skills, implying that “business schools should teach students so they can hit the employment world fully trained” (Clarke et al., 2006, p. 191). Thus, education is not perceived as an end in itself but as the mean to an end (Helgesen et al., 2009). This article adopts the position that marketing education must respond to the needs of its stakeholders who, in the main, are marketing practitioners.

Some authors state that marketing teaching is not reflecting what is happening in marketing practice and thus not delivering marketing graduates with the skills to actually work in marketing (Walker et al., 2009). So, this paper aims to analyze if high education curriculum gives students the skills to develop marketing activities in organizations.

To achieve our goal we have analyzed all the marketing undergraduate degrees and related degrees (such as, marketing and communication; marketing and international business, marketing and advertising, marketing management and sales management). Although, we can find 42 different degrees registered at the education ministry, several of them are repeated because they are day or evening courses, with the same curriculum, but different ministry codes. Thus, the repeated courses were excluded and 32 were analyzed, totalizing 1055 curricular units (CU). A qualitative approached was used. Each CU was classified in different groups according to its name and syllabus. All the UCs were classified, despite being from marketing area or not, so that it could be understood the proportion of different areas in the degrees and 40 different classifications were obtained. Table 3 shows the first classification of all the CUs from all marketing degrees, and how many CUs from all the degrees are included in each classification.

Table 3 CUs classification from Portuguese Marketing Degrees

Name	Number of CUs included	Name	Number of CUs included
Accounting	33	Maths and statistics	57
Advertising	34	Methodology	8
Branding	21	Mkt fundamentals	36
IMC	70	Mkt simulation	35
Consumer behavior	34	Mkt planning	21
Data analysis	9	Operational mkt	7
Design	4	Optional	41
Digital marketing	35	Other	9
Channels	32	Public relations	14
Economics	49	Pricing	8
English/other languages	35	Product management	16
Ethics	10	Relationship mkt and CRM	17
Finance	27	Human resources	26
Industrial mkt	12	Sales and sales force management	25

Information technologies	36	Seminars	5
International mkt	23	Service marketing	19
Internship	22	Social sciences	9
Law	50	Soft skills	57
Management	44	Strategic management	12
Market research	41	Strategic mkt	12

Source: developed by the authors

First of all, the CUs not directly connected with marketing were all grouped in their scientific areas. Those scientific areas found were: accounting, Economics, English, Law, Management, Maths and Statistics, Human Resources and Social Sciences. The marketing related CUs were classified in smaller groups, so that we could make the distinction between them and analyze its weight in the several degrees. Some were easier to classify than others, and we have decided to separate the different variables of the communication mix, which were found. Therefore, integrated marketing communication (IMC), public relations (PR), sales, advertising, digital marketing were obtained, as literature emphasizes the importance of marketing investment in these areas, as noted in chapter 2. Marketing fundamentals includes all introduction marketing CUs, such as marketing I, marketing Introduction and marketing fundamentals. Several degrees have marketing project, simulation, laboratory or cases analysis CUs which, because they all have practical goals were classified as marketing (MKT) simulation. Further, several degrees had optional CUs which list was extremely long and several of them allowed students to choose UCs from different scientific areas, therefore they were all classified as Optional. Marketing auditing, marketing planning and marketing metrics are all part of MKT PLANNING. Due to the fact that they refer to specific marketing areas and they could rarely be found in the degrees curriculum (only 9 in total) we grouped social marketing, tourism marketing, finance marketing and sensorial marketing in OTHER. Finally, taking into consideration the importance stated by marketing practitioners (see chapter 1 in soft skills development, several UCs were found that could fit this classification, thus communication skills, writing skills, entrepreneurship, leadership, team management, innovation and personal relations are some of the examples included in SOFT SKILLS.

After this first analyzes, we grouped the classification in bigger groups as it is explained in the next chapter, as well as the results obtained.

7. Results

In order to understand if Portuguese high education institutions (HEI) marketing curriculum was more related to the proposed “old marketing DNA” or the “new marketing DNA” the different marketing CUs were grouped accordingly. On table 4 it can be seen the percentage of marketing CUs, from all the Portuguese marketing degrees, which develop the subjects proposed.

Table 4 CUs grouped according to Old DNA classification

OLD MARKETING DNA	% CUs
Marketing in the context of the wider organization	5%
Segmentation, targeting and positioning,	31%
Marketing planning	3%
Contexts of marketing	15%
Marketing environment	9%

4Ps of marketing	25%
Buyer behavior	8%
Marketing communications	27%
Marketing channels	5%
Marketing research	9%
Implementation and control	3%

Source: developed by the authors

It could be found that several of the Old DNA subjects were approached in different UCs, therefore, some of them repeated in different contexts. For example, segmentation, targeting and positioning could not be found in an specific CU, but they were studied in the majority of the CUs including marketing fundamental, strategic marketing, industrial marketing, international marketing, digital marketing and communication. Further, areas deeply studied in marketing HEI curriculum are segmentation, targeting and positioning, 4Ps of marketing and marketing communications followed by the contexts of marketing. Little attention appear to be given to marketing research, marketing planning and implementation and control, which reflect only 9%, 3% and 3% of the total CUs, by this order.

When the new DNA is concerned, some degrees include specific course for approaching themes more adequate to this perspective. Consumer behavior (63% of the degrees have this course) and marketing research (100%) address costumer led marketing element of the new DNA. Branding (63% of the degrees have this course) and strategic marketing (38%) address value driven strategic marketing; online and off-line integrate marketing communication are studied with Integrated marketing communication courses (in 100% of degrees) and Digital Marketing (in 78%). 78% of the degrees have Marketing Channels course and, therefore, the element channels is addressed (logistic courses were also included in this group). Finally, skills developed in courses such as the element data driven marketing may be addressed by relationship marketing and CRM (only 44% of degrees have this course), data analysis (only 25%) and math and statistics, which give the inputs for previous courses (in 100% of the degrees).

Literature has been pointing out the need to develop several different skills, such as written and oral communication, critical thinking, creativity, teambuilding, and decision-making. As explained before several of those were included in the 'soft skills' category. Thus, if we add up MKT Simulation and Seminars where skills such as problem solving and technical skills, communicative skills and critical thinking may be developed, these 3 course groups are only 9% of the total amount of courses. Concerning the degrees which have these courses in their curriculum, 63% of the degrees have Marketing simulation courses (including laboratory); 78% have at least one course which specifically address some soft skill and only 13% include seminars.

Internships are also an important way develop different skills, especially because students have the possibility to interact with real problems and take responsibility for their work. From the degrees analyzed in 56% internship is part of the curriculum and only two of them have more than one internship along the degree.

Concerning the different marketing contexts, Table 5 shows the percentage of degrees which include courses from each of the areas. It can be seen all the degrees include IMC courses, 78% include digital marketing courses and only 38% have industrial and strategic marketing courses. Only 22% of the degrees have courses about other areas of marketing, such as marketing for small and medium companies, finance marketing, sensorial marketing, Tourism

marketing, political marketing and 4 degrees have a course about social marketing and Nonprofit Organizations.

Table 5 Percentage of Marketing contexts courses included in the degrees

COURSES	% of Degrees with the course
IMC	100%
DIGITAL MARKETING	78%
INTERNACIONAL MKT	69%
SERVICE MARKETING	56%
INDUSTRIAL MKT	38%
STRATEGIC MKT	38%
OTHER	22%

Source: developed by the authors

Finally, marketing communication is one of the areas that more attention has been given in Portuguese marketing degrees. Adding to IMC courses it can be found public relations, sales and advertising, which represent 14% of all the courses, and if we had digital marketing as one variable of the communication mix it will add up to 17% of total.

The findings derived from this study have presented an general overview of marketing degrees in Portugal and the courses offered by these courses, considering different aspects, such as marketing areas and skills developed. The connection between those courses and the “old marketing DNA” and the “new marketing DNA” was assessed, as although marketing may be different in every organization its components are similar and connected. Rather than discussing the right model, this article will go on to discuss if the marketing curriculum at HEI degrees is adequate to develop the skills required from the stakeholders (marketing practitioners) point of to develop marketing jobs.

8. Discussion

This article presents an analyzes of all Portuguese marketing degrees and a classification of all the CUs included in those degrees in order to discuss if there is a fit between marketing degrees curriculum and the required skills to develop marketing activities.

Graduates will find jobs in different marketing areas so marketing roles and knowledge required may differ from each case. Taking this into consideration, degrees include courses on integrated marketing communication and digital marketing, which shows the importance give to communication and interactive marketing, the area where the investment has been having an higher growth in organizations. Some degrees included international marketing, service marketing, industrial marketing and strategic marketing, but a large percentage of degrees don't. In this area, a lot more can be done, as, for example, industrial and service marketing have specificities students should know of, so that they perform their jobs better if they work in each of these businesses. Adding up to this, there are several specific marketing areas that were given almost no attention to and which have been growing in Portuguese context: tourism marketing and social marketing, as only 1 and 4 (by this order) courses are lectured in marketing undergraduate degrees. Therefore, more attention can be given to these areas, as understanding the differences between each of them can be an advantage for graduates who want to enter the market.

Through data analyzes it could be seen that the majority of degrees fit the “old marketing DNA”. The organization focusing on the 4Ps perspective, including product management,

price management, marketing channels, marketing communication, advertising and public relations, marketing planning, and market research still plays an important role on marketing curriculum. Nevertheless, several concepts such as segmentation, targeting and positioning; marketing research and marketing environment are addressed in different courses, showing a better synergy between different areas. Paradigm change would lead to focus on customer lead marketing and value driven marketing strategies. Therefore, understanding consumer behavior, experiences, motivations and insights, Branding and relationship marketing are elements to focus on.

Concerning the “new DNA” concept, if we agree that this is adequate model for marketing education to prepare students for what the market requires, several conclusions can be taken. The organization response role side, which includes online and offline integrated marketing communications and channels is relatively well addressed and there is a high proportion of courses on these areas. Which could be improved is the relationship between all the elements within each part, for example, the multichannel nature of marketing communications and the importance of consistency between all communication may be lost if we discuss all the elements of the mix from that point of view. In fact, if digital marketing, PR and sales are seen as independent from IMC that online and offline integrated marketing communications perspective may be lost. Furthermore, despite the effort place by several degrees to include CRM in their curriculum, a lot more can be done concerning data driven marketing. Data mining, marketing analytics, predictive analysis and ROI are not given a lot of attention and those skills can be distinctive concerning marketing activities.

Other than marketing knowledge skills considered important by marketing practitioners are soft skills. By data analysis the majority of degrees have at least one course about some soft skills development, such as written an oral communication or creativity. It is natural that several soft skills are taught within other courses by the activities developed such has group work written tasks, projects presentations. Nevertheless, the fact the a teacher can focus on developing those skills in a particular CU warranties that those are addressed and students give it the right relevance. Being prepared for a job interview and being aware of aspects valued by the company is important to get good results. Although, the majority of degrees have marketing simulation courses it could be suggested that all degrees could have at least one laboratory or simulation course so that problem solving and technical skills could be developed. Additionally, only a small percentage of Portuguese degrees deliver Seminars to students. Listening to different perspectives and experiences are important ways to improve analytical and discussion skills. Seminars should, therefore, be included in more degrees.

Finally, skills developed by internships cannot be forgotten. From the market point of view, a company experience may lead to a real perspective about organizations, responsibility and the skills required, giving students a better understanding of the skills needed and valued by marketing practitioners. Therefore, as only about half of the degrees include internships in the curriculum, degrees that offer it may be the ones which offer students an important preparation on market valued skills.

To sum up, although HEI have been making an interesting effort to improve the fit between marketing degrees and market required skills, some skills still need to be address and or improved. Therefore, introducing different modules such as delivering the value proposition, data-driven analytical marketing, multivariate statistics for data mining or strategic marketing intelligence might help to fill this gap.

9. Conclusions, Limitations and Future Research

High Education institutions offer a large number of marketing degrees which should deliver graduates the skills required by stakeholders to perform marketing activities. This research,

analyzed 32 marketing degrees in Portugal and compared their courses with the marketing activities developed and skills valued by the market.

Including courses about specific areas such as services, tourism, industrial, social and international may lead to skills development and better adaptation to organization specific realities.

Address a more interactive marketing perspective by focusing on customer lead marketing and a value driven marketing strategy, through the development courses on customer behavior, marketing insight, branding, value proposition and customer equity. Work on online and offline integrated marketing communication by integrating all the elements of the communication mix, including digital marketing. Additionally, include new modules for more specific areas such as data-driven analytical marketing, multivariate statistics for data mining or strategic marketing intelligence.

Develop through the existing CUs or by creating specific ones soft skills. Some examples include oral and written communication, team management and also adding Seminars, Simulation and internship for practical, technical, analytical skills development.

This paper focused on Portuguese marketing high education degrees and therefore, cannot be generalized to other countries. In the future it could be interesting to compare it with other countries, especially the ones with older marketing degrees and with leading marketing companies. The skills were determined according to literature review and, therefore, they may not reflect the skills required by Portuguese organizations. It would be interesting to research marketing practitioners and ask them about the skills they require and also, as more than 90% of Portuguese companies are small or medium, to research if the skills required in these organizations are different and, therefore, if the degrees are delivering them to students.

REFERENCES

- American Marketing Association e Aquent (2010). *2010 Trends in Marketing: Salaries, Strategies and Beyond*, AMA.
- Barwise, P. and Styler, A. (2003). *The MET Report 2003: Marketing Expenditures Trends 2001-04*. London Business School.
- Beyer, B. K. (1987). *Practical strategies for the teaching of thinking*. Boston, MA: Allyn & Bacon.
- Boatwright, E.W. and Miriam B. S. (1988). Employers' importance ratings of student characteristics: a conjoint analysis approach. *Journal of Marketing Education*, 10 (SUMMER), 74-78.
- Cano, C., Carrillat, F. and Jaramillo, F. (2004). A meta-analysis of the relationship between market orientation and business performance: evidence from five continents. *International Journal of Research in Marketing*. 21 (2), 179-200.
- Clarke, P., Gray, D., and Mearman, A. (2006). The marketing curriculum and educational aims: Towards a professional education. *Marketing Intelligence & Planning*. 24, 89-201.
- Day, G. (1994). The capabilities of market-driven organization. *Journal of Marketing*. 58 (October), 37-52.
- Day, G. (1998). What does it take to be market-driven?. *Business Strategy Review*. 9(1), 1-14.
- Day, G. (1999). The market-driven organization. *Sloan Management Review*. 41(1), 11-12
- Deshpandé, R. and Farley, J. (1998). Measuring market orientation: generalization and synthesis. *Journal of Market-Focused Management*. 2(3), 213-232.
- Dibb, S., Simoes, C. and Wensley, R. (2014). Establishing the scope of marketing practice: insights from practitioners. *European Journal of Marketing*. 48(1/2), 380-404.
- Floyd, C. J., and Gordon, M. E. (1998). What skills are most important? A comparison of employer, student, and staff perceptions. *Journal of Marketing Education*. 20, 103-109.

- George, W. and Barksdale, H. (1974). Marketing Activities in the Service Industries. *The Journal of Marketing*. 38(4), 65-70.
- Götz, O., Hansen, A., Jo, A. and Krafft, M. (2009). The role of marketing and sales in organizations and its impact on performance. MSI Working Paper Series, Marketing Science Institute, Cambridge, MA, 29-48.
- Harris, L. and Ogbonna, E. (2003). The organization of Marketing: A Study of Decentralized, Devolved and Dispersed Marketing Activity. *Journal of Management Studies*. 40(2), 483-512.
- Harrigan, P. and Hulbert, B. (2011). How can marketing academics serve marketing practice? The new marketing DNA as a model for marketing education. *Journal of Marketing Education*. 33(3), 253-272.
- Homburg, C. and Pflesser, C. (2000). A multiple-layer model of market-oriented organizational culture: measurement items and performance outcomes. *Journal of Marketing Research*. 37(11), 449-462.
- Hooley, G. and Cowell, D. (1995). The Status of Marketing in the UK Service Industries. in Akehurst, G. e Alexander, N. (Ed.), *Retail Marketing*, eds, Routledge: UK.
- Gaedeke, R.M., Tootelian, D.H. and Schaffer B.F. (1983). Employers want motivated communication for entry-level marketing positions: survey. *Marketing News*. 17(August 5), 1.
- Granitz, N., and Hugstad, P. (2004). Creating and diffusing a technology champion course. *Journal of Marketing Education*. 26, 208-225.
- Helgesen, O., Nettet, E., and Voldsund, T. (2009). Marketing perceptions and business performance: Implications for marketing education. *Marketing Intelligence & Planning*. 27, 25-47.
- Kelley, C.A. and Gaedeke, R.M. (1990). Student and employer evaluation of hiring criteria for entry-level marketing positions. *Journal of Marketing Education*. 12, I. 3, pp 64-71.
- Kirca, A., Jayachandran, S. and Bearden, W. (2005). Market orientation: a meta-analytic review and assessment of its antecedents and impact on performance. *Journal of Marketing*. 69 (April), 24-41.
- Klebba, J. M., and Hamilton, J. g. (2007). Structured case analysis: Developing critical thinking skills in a marketing case course. *Journal of Marketing Education*. 29, 132-139.
- Kohli, A. and Jaworski, B. (1990). Market orientation: The construct, research propositions, and managerial implications. *Journal of Marketing*. 54 (1), 1-18.
- Kotler, P. (1986). Megamarketing. *Harvard Business Review*. 64(2), 117-124.
- Lamb, C. W., Shipp, S. H., and Moncrief, W. C. (1995). Integrating skills and content knowledge in the marketing curriculum. *Journal of Marketing Education*. 17(2), 10-19.
- McWhorter, K. (1988). *Study and thinking skills in college*. Boston: Scott, Foresman.
- McDonald, M. and Meldrum, M. (2013). *The Complete Marketer: 60 Essential Concepts for Marketing Excellence*, 1st Ed., Kogan Page: UK e USA, from http://www.amazon.co.uk/dp/0749466766/ref=rdr_ext_tmb#reader_0749466766
- O'Malley, L. and Patterson, M. (1998). Vanishing point: the mix management paradigm re-viewed. *Journal of Marketing Management*. 14(8, November), 829-851.
- Peters, R. S. (1970). *Ethics and education*. Oxford, England: Allen & Unwin.
- Piercy, N. (1998). *Market-Led Strategic Change*. Oxford: Butterworth Heinemann.
- Sheth, J. and Sharma, A. (2001). Efficacy of financial measures of marketing: It depends on markets and marketing strategies. *Journal of Targeting, Measurement and Analysis for Marketing*. 9(4), 341-356.
- Treleaven, L., and Voola, R. (2008). Integrating the development of graduate attributes through constructive alignment. *Journal of Marketing Education*. 30, 160-173.
- Urbonavičius, S., Dikčius, V. and Kasnaukienė, G. (2007). Importance of Marketing Functions in a Company. *Engineering Economics*. 53(3), 71-77.
- Urbonavičius, S. and Dikčius, V. (2009). Perceived role of marketing activities in the context of transitional economy. *Tržište*. 21 N. 2), 167-182.

- Vignali, C. and Davies, B. (1994). The marketing mix redefined and mapped: introducing the MIXMAPP model. *Management Decision*. 32(8), 11-16.
- Walker, I., Tsarenko, Y., Wagstaff, P., Powell, I., Steel, M., and BraceGovan, J. (2009). The development of competent marketing professionals. *Journal of Marketing Education*. 31, 253-263.
- Webster, F. (1994). *Market Driven Management*, Wiley: London.
- Webster, F., Malter, A. and Ganesan, S. (2005). The Decline and Dispersion of Marketing Competence. *MIT Sloan Management Review*. 46(4), 34-44.
- Wirtz, J. Tuzovic, S. and Kuppelwieser, V. (2014). The role of marketing in today's enterprises. *Journal of Service Management*. 25(2), 171 – 194.
- Wright, L., Bitner, M., and Zeithaml. (1994). Paradigm shifts in business education: Using active learning to deliver services marketing content. *Journal of Marketing Education*. 16(3), 5-19.
- Workman, J., Homburg, C. and Gruner, K. (1998). Marketing organization: an integrative framework of dimensions and determinants. *Journal of Marketing*. 62, July), 21-41.

Consumer Behavior and its Impact in the Intention to Return to the Wine Event

Alice Trindade

NIDISAG, ISAG- European Business School, FEP University

Ana Pinto Borges

nidisag@isag.pt

NIDISAG, ISAG- European Business School

Elvira Vieira

nidisag@isag.pt

ISAG – European Business School, Research Group of ISAG (NIDISAG), IPVC- Polytechnic Institute of Viana do Castelo and UNIAG - Applied Management Research Unit

nidisag@isag.pt

Abstract. This paper evaluates the consumer behavior, in the context of the “Essence of Wine” and its impact regarding the intention to return to the event. Data from a random sample of 1080 visitors were collected through face-to-face interviews, during the four days of the event. The data was subjected to clustering analysis. We performed the ANOVA test to describe each cluster taking into account the socio demographic characteristics in order to evaluate the impact in the intention to return and the global satisfaction with the event. After that, multiple regression analysis was used to identify the factors that influence frequency of participation on fairs and wine workshops. We found out that it is possible to segment the visitors of the Essence of Wine event, according to different consumer behavior variables. The different segments had significant differences with respect to the global level of satisfaction and intention to return. It was proved that both sociodemographic and consumer behavior characteristics had an impact on the frequency of acquisition of wine magazines and frequency of participation on wine fairs. The results allow the segmentation of the public and identify the target audience. The results obtained are a useful framework to the organizers of the event in the process of defining the communication strategies for the next edition of the event.

Keywords: *Wine Events, Consumer Behavior, Clustering*

1. Introduction

During the last years, we have been assisting to an exponential growth of events at a global level (Vinnicombe & Sou, 2017). In fact, events play a key role in the contemporary global identity of cities being also related with the economic, social and cultural processes (Barrera-Fernández & Hernández-Escampa, 2017).

Food and wine festivals are a major motivation for travel and leisure (Park et al., 2008) being a good opportunity to improve destination image and to generate new flows (González-Reverte & Miralbell-Izard, 2009). Wine events often provide the opportunity for visitors to sample all the wines from the different regions, attracting the attention of the media and well-known personalities within the wine and food community (Hoffman et al., 2001).

Besides that, these kind of events often provide some significant benefits to the city, not only in terms of increased money that comes into the region, but also in terms of the benefits brought by tourists entering the region and buying other products (Hoffman et al., 2001). Marketers

should, therefore, understand the factors that motivate consumers to attend wine and food festivals in order to successfully differentiate their products (Park et al., 2014). In this context, academic interest on the wine area has been growing (Vinnicombe & Sou, 2017). From the different topics covered the consumer behavior literature stands out (Bonn and Cho, 2018).

This study aims to contribute to this debate by evaluating the consumer behavior, in the context of a wine event, the “Essence of Wine”, that occurred in the city of Porto. The intention was, in a first stage, to group the respondents according to their interest and knowledge about wine, as well as the monthly average expense in wine and the monthly average number of wine bottles purchased. In a second stage, analyze the impact of such groups on the intention to return and global satisfaction with the event. Finally, the study examined whether socio-demographic characteristics and consumer behavior characteristics regarding wine, influence the frequency of acquisition of specialized magazines and the frequency of participation on wine fairs, the core businesses of the company under study. This choice is based on the idea that cultural festivals and events are becoming an increasingly important component of tourism destination portfolios (Bowdinet al., 2006).

In this article, we started by establishing the theoretical framework of the importance of such events to the tourism sector. We explored the recent studies, on this area, and we built our hypotheses for this study. On section 2, we detailed the methodology, explaining the data collection and selection as well as the methods used and the results obtained. Finally, we discuss the implications of the results, the limitations of this work and the future developments.

2. Literature Review: Wine Research

Winemaking industry is increasing. In a study performed by Iaia et al. (2017), a search on Google regarding the topic “wine” has presented approximately 21 million videos, 6.5 million images and 800 million pages. Besides that, the authors found more than 9 million videos on YouTube and more than 400,000 apps, still on this subject.

Just to have an idea of the increasing importance of the wine industry and its evolution, according to the authors, there are 58.5 million regular drinkers (people that drink wine at least once a month), who search for wine information online. 51% of these users express their opinions through the web and/or via word-of-mouth influencing other users (Iaia et al., 2017).

When looking to the academic world, it is also visible that wine, as a research topic, continues to capture the attention of the academia. The studies performed under this area address a plethora of diverse contexts. The majority of them attempt to extend information and knowledge to assist the wine industry to resolve relevant issues (Bonn & Cho, 2018).

During the 90s, research on this area has been focused on the wine history, education, governmental policies and business. However, with the new century, the focus turned up to be on wine marketing, tourism, viticulture, business, hospitality and education (Bonn & Cho, 2018). This is a result of the advance of globalisation that has projected many businesses into the international market and gave birth to new concerns (Agnoli et al., 2016).

Nowadays, consumers have to deal with a high variety of products and with increasingly complex decision-making processes, giving the huge amount of variables that have an impact on their decisions (Agnoli et al., 2016, Shanka & Taylor, 2004). These factors can be crucial when they decide whether they participate or not, on wine fairs and events.

The consumers’ value perception of wine and, consequently, their decisions, can vary from a region-of-origin and from the normative perspective (Bizjak et al., 2018; Lee et al., 2016). In this scenario, the concepts of consumer knowledge as well as consumer behaviour come into play (Agnoli et al., 2016). With this study, we aim to understand whether it is possible to segregate the visitants of the Essence of Wine event according to their knowledge, interest on

wine, the monthly average expense in wine and the monthly average number of wine bottles purchased. Then we hypothesized that:

H₁: The visitants of this wine event can be grouped according to their behavior in relation to the knowledge about wine, the interest in wine, the monthly average expense in wine and the monthly average number of wine bottles purchased.

Additionally, some authors have been defending the idea that the personal involvement and the consumer socio demographic characteristics, have an impact on the marketing strategies on the wine area, and consequently, on the way it is promoted (Taylor et al., 2018). Combining the degree of knowledge about the wine industry with the socio demographic characteristics of the visitants, of a real life wine event. This study aims to perceive whether it is possible to differentiate the clusters having into consideration their socio-demographic characteristics. By doing so, we hope to be capable of describing each one of the clusters, based on such criteria. Therefore, it is hypothesized that:

H₂: The clusters have different profiles depending on sociodemographic characteristics.

On top of that, according to the literature, customer loyalty is a behavior that is reflected in the visitor's consumption (Monteiro & Borges, 2015). In this paper, customer loyalty is measured through the intention to return to the Essence of wine.

With respect to this topic, several authors have already asserted that higher perceptions of service quality led to higher satisfaction, which then increases the intention to return. (Chang, 2000, Trindade et al., 2017, Worsfold et al., 2016). Besides that, socio-demographic characteristics seem to have an impact on the intention to return (Monteiro & Borges, 2015). Having this in mind, we proposed to test whether the different respondents from the different clusters had different levels of intention to return. Therefore, it is hypothesized that:

H₃: The clusters have different influences on the intention of returning to the next edition.

Nevertheless, perceptions of physical environments can affect satisfaction and intention to return differently. One reason could be that satisfaction and return intentions are qualitatively different constructs. (Worsfold et al., 2016). This explains why we decided to test such hypothesis separately.

Customer satisfaction can be defined as a measure of how products and services supplied by one company meet or surpass customer expectations (Mangesh, 2017). However, product performance is not only compared with the expectations, but also with other elements depending on the situation of purchase or consumption, consumer desires or ideal performance (CuadradoGarcía et al., 2017; Trindade et al., 2018). This study aims to test whether the different respondents, grouped into the different clusters, have different levels of satisfaction. Therefore, it is hypothesized that:

H₄: The clusters have different influences on the global satisfaction with the event.

The consumer behaviour literature, on the wine area, suggests that wine purchasing is too multifaceted to be only captured by looking to the product attributes. Therefore, studies regarding consumers' intrinsic and extrinsic motivational attributes with respect to the wine industry started to emerge.

On table 1, there is a resume of the studies performed on the consumer behaviour and motivational factors that affect the wine consumption as well as the results obtained.

Authors	Results
Charters and Pettigrew (2008)	The authors point out that enjoyment is the most important motivational driver of wine consumption.
Cox (2009)	The author highlights some wine consumption predictors, namely: wine's extrinsic attributes, such as previous consumption, product involvement, and other psychological intrinsic factors.
Hussain et al. (2007)	This author enhances the importance of wine knowledge as a predictor of wine consumption.
Jaeger et al. (2009)	This author points out the importance of the interest in knowledge as a predictor of wine purchase and consumption.
Mitchell (2006)	The author found out that social interaction and the desire to share wine with others is one of the determinants of the wine purchasing and consumption.
Santos et al. (2006)	The authors showed that consumers with high involvement in wine and high interest in appellation origin tended to view themselves as superior to others.
Taylor et al. (2018)	The authors show the influence of Intrinsic and extrinsic motivational factors and personal involvement with wine on the marketing strategies in the wine area.
Yoo et al. (2013)	The authors found that the perceived health benefits of red wine were higher in the Australian sample than the Korean sample. Sowing the impact of different cultures on the wine habits. The results also indicated that health-oriented wine is more attractive to Korean consumers than for Australian consumers.

Source: Authors

Given the above literature, it seems likely that both intrinsic and extrinsic motivation, influence wine consumption. In this context, we want to test, whether the different clusters have different consumer behaviour attitudes, with respect to wine. Therefore, it is hypothesized that:

H₅: The cluster presents different consumer behaviors.

Additionally, we want to test whether socio demographic characteristics, besides being a good predictor of wine purchase and consumption, are also indicators of the frequency of acquisition of specialized magazines and the frequency of participation on fairs and wine workshops.

Finally, we also intend to test whether consumer behaviour characteristics such as interest and knowledge about wine, are also indicators of the frequency of acquisition of specialized magazines and the frequency of participation on fairs and wine workshops. Thus, it is hypothesized that:

H₆: The frequency of acquisition of specialized magazines depends on the consumer's socio demographic and consumer's behavior characteristics.

H₇: The frequency of participation on fairs and wine workshops depend on the consumer's socio demographic and consumer's behavior characteristics.

Although previous research had already proposed that motivational factors interact to predict wine consumption, this interaction has not been tested empirically. With this study, we are attempting to close this gap, by testing such hypothesis in the context of a real world wine event. By doing so, we hope to provide an enhanced understanding of consumer behaviour to both

managers and organizers of the event in order to improve their knowledge regarding the target consumers.

As previously stated, the event under study is the Essence of Wine event, our case study. Giving the fact that, the Essence of Wine is the leading company in the organization, production of wine and food events, in Portugal, the single case study approach is suitable for this analysis, and it is representative of the reality under study (Yin, 2003). A brief description of this event is provided below (see section 2.1).

2.1. The Essence of Wine

In recent years, destination marketers have focused on event marketing. There has been increasing awareness of the potential financial benefits of events to local tourism marketing development (Li, Song & Collins, 2014).

The Essence of Wine started in 2004, and it has been the leading company in the production and dissemination of wine and gastronomy events, in Portugal. Additionally, this company also has a strong presence in Brazil (EV, 2018).

This company organizes wine fairs, where the visitors are invited to taste more than 3,000 free wines that come from 400 domestic and foreign producers.. This event counts already with fourteen editions, being recognized in both national and international levels (EV, 2018).

In addition to the organization of wine events, the organizers of the Essence of Wine publish a monthly Wine Magazine that compiles articles regarding wine, gastronomy and wine tourism, which is available in Portugal, Brazil, Angola and Mozambique (EV, 2018).

In 2017, the event took place in Palácio da Bolsa, in Oporto and it lasted 4 days – from 23 to 26 of February. The event received around 20,000 people, being one of the main wine events performed in this city (EV, 2018). The option for the city of Porto can be explained by its historic and patrimonial richness, and by the cultural growth that the city has been experimenting, being elected, for the third time, in 2017, as the “Best European Destination”.

3. Methodology

3.1. Questionnaire

A survey was conducted during the four days (from 23 to 26 of February) in the event the Essence of Wine, in the North of Portugal, in 2017. In collecting the data, we used sampling for convenience and the respondents’ anonymity was guaranteed.

In order to avoid biases related to questionnaire structure and wording, a pilot survey was performed to test the questionnaire before the conduction of the full survey. The purpose of the pilot test was, above all, to refine the questionnaire, in order to ensure that there will be no problems in collecting the data (Saunders et al, 2009). In addition to it, in order to encourage cooperative behaviour, respondents were informed that the research had scientific aims and the higher education institution was presented at the beginning of the survey.

A sample of visitors produced 1080 useable questionnaires - we only considered the questionnaires that were properly fulfilled. Given the population of 20000 visitors from the 14th edition of the “Essence of Wine”, the sample should be a minimum of 377 respondents, with a confidence level of 95% and a 5% confidence interval, so we can state that the collected sample is representative of the population study.

The survey had different parts; the first one had to do with the socio-demographic data. The second one showed a specific section for the foreign and national tourists (people out of the Metropolitan Area of Porto) – Tourists were asked about their accommodations and the activities they intended to do in the city.

Afterwards, it was presented a section regarding the expenses on the city, the loyalty and the intention to return, followed by the main reasons and sources of knowledge regarding the event. Then, there was the satisfaction section, ending with the interest and habits related with wine that the respondents might had.

In this study, we gave more focus on the socio-demographic data and consumer behaviour variables such as the interest and knowledge about wine, frequency of acquisition of wine specialized magazines and presence on wine activities.

Thus, the variables under study can be described as follows:

- Nominal Variables: Gender, Marital Status, Educational Degree, Work Conditions, Gross Monthly Income, Nationality, Residence, Intention to return;
- Ordinal Variables: Global satisfaction with the event, Interest and Knowledge about Wine; Wine activities frequency and Importance of Wine characteristics;
- Numerical Variables: Age, Monthly average number of bottles of wine purchased, Monthly Average expense in wine.

3.2 Description of the sample

The sample contained 41% females and 59% males and it has the follow age breakdown: 18-25 (16%), 26-35 (30%), 36-45 (28%) and more than 45 (25%). With respect to the marital status, 43% single, 45% married and 10% divorced. Regarding the educational degree, 6% had the Basic Level, 26% the Secondary Education, 68% had a higher level (Bachelor or more). The majority of the respondents were employed (83%), 8% were students, 3% were unemployed and 0.4% were domestic. More than half was residing in Portugal (93%) and had Portuguese Nationality (93%). Concerning the Gross Monthly Income, 10% received less than 600€, 20% between 600€ and 999€, 27% between 1000€ and 1499€, 18% between 1500€ and 1999€ and 25% more than 2000€.

3.3 Methodology followed

In a first stage, we performed a descriptive statistics of the variables accompanied by a cluster analysis, where the respondents were grouped according with their wine habits (average monthly expense/number of wine bottles purchased), interest and knowledge about wine (section 4.1.). In this subsection, we also used the parametric test ANOVA to analyse the significant differences between the visitants that were included in each one of the clusters and the socio demographic characteristics, the intention to return to the next edition and the global satisfaction level.

At a second stage, we applied a multiple regression analysis to explore whether the socio demographic and visitor segmentation characteristics had any kind of influence concerning the frequency of acquisition of specialized magazines and the frequency of participation on wine events (section 4.2.). It is worth mentioning that the quantitative analysis was performed through the SPSS (21) at a significant level of 5%. The results are showed in the next section.

4. Research findings

4.1. Cluster Analysis

Cluster analysis was applied to classify the respondents according to different criteria. The grouping of people was made by a hierarchical cluster analysis, using the ward method that has a dissimilarity' technique: the sum of the quadratic error.

As criteria for deciding the number of clusters we used the R-Squared, as suggested in Maroco (2007), having chosen the solution with the less number of clusters and with a considerable part of the variance – almost 74% (R_a^2 : 0.744) - of the total variance.

To identify the variables with more relevance, within the clusters, we followed the analysis of the F statistic of ANOVA, as described in Maroco (2007).

The respondents were grouped based on different criteria: knowledge about wine, the interest in wine, the monthly average expense in wine and the monthly average number of wine bottles purchased.

The dimensions that allow a better differentiation of the clusters were: the knowledge about wine

($F=5304.590$), the interest in wine ($F=176.457$), the average expense in wine, per month ($F=20.823$) and the monthly average number of wine bottles purchased ($F=17.056$), respectively.

These factors were statistically significant for a level of confidence of 0.05.

As a result of the application of such criteria, we were able to segregate our respondents in three clusters, that were labeled based on the strongest criterion, the knowledge about wine. The hypothesis 1 is verified. Below, it is presented a brief description of each cluster and we verified that all the different profiles are depending on sociodemographic characteristics (see Table 1). We observe that gender, age, marital status and gross monthly income are significant, the remain variables are not significant. In this sense, the hypothesis 2 is only partially verified.

Cluster 1 (Wine Experts): composed by 198 respondents, this cluster is characterized by respondents that are mostly female (68%), with an average age of 43 years, married (57%), with a Gross Monthly Income between 1500 and 2999 euros (48%) and with a high intention to return level (87%). This cluster is the one in which the respondents show a bigger interest (92%) and a greater knowledge about wine (100%).

Cluster 2 (Wine Socialite): composed by 360 respondents, with an average age of 35 years old that are essentially single (53%). The Wine Socialite cluster has a gross monthly income between 600 and 1499 euros (54%) and clearly shows the intention to return (86%). This cluster is characterized by respondents with limited interest or interest (75%) in wine and that consider themselves to have limited knowledge about wine (85%).

Cluster 3 (Wine Lovers): Composed by 441 respondents. This cluster is the most representative of the event and it is characterized by respondents that are mostly female (63%), that have an average age of 39 years, married (57%), with a gross monthly Income between 600 and 1499 euros (50%) and with a high intention to return (76%). This cluster has respondents that are very interested (58%) in wine and that consider themselves as having enough knowledge about wine (100%).

Table 1 Socio Demographic characteristics of the clusters

Variables	Cluster 1	Cluster 2	Cluster 3	ANOVA
N	198	360	441	
Gender (%)				0.000*
Female (%)	68%	50%	63%	
Male (%)	32%	50%	37%	
Age (Mean)	43	35	39	0.000*
Marital Status (%)				0.000*
Single (%)	26%	53%	43%	
Married (%)	57%	37%	47%	
Divorced (%)	14%	9%	9%	
Windowed (%)	3%	1%	2%	
Educational Degree (%)				0.140
Basic Level (%)	9%	4%	5%	

Secondary Education (%)	17%	30%	28%	
Bacharelot (%)	47%	49%	48%	
Master or PhD (%)	27%	17%	20%	
Work Conditions (%)				0.073
Paid Employed (%)	38%	58%	56%	
Self Employed (%)	51%	20%	30%	
Unemployed (%)	2%	5%	1%	
Retired (%)	5%	2%	4%	
Student (%)	4%	12%	6%	
Domestic (%)	0%	1%	0%	
Looking for the 1st job (%)	1%	3%	2%	
Gross Monthly Income (%)				0.000*
Less than 600€ (%)	8%	14%	8%	
From 600€ to 999€ (%)	15%	25%	18%	
From 1000€ to 1499€ (%)	14%	29%	32%	
From 1500€ to 1999€ (%)	23%	18%	16%	
From 2000€ to 2999€ (%)	25%	10%	17%	
More than 3000€ (%)	14%	5%	10%	
Nationality (%)				0.559
Portuguese (%)	93%	93%	94%	
Other (%)	7%	7%	6%	
Residence (%)				0.489
Portugal (%)	92%	93%	95%	
Other (%)	8%	7%	5%	

Source: Authors. Made in IBM SPSS. * Significant for a level of confidence of 5%.

Regarding table II, it was visible that the wine experts were the ones that had the highest rate of the intention to return (87%), being side by side with the Wine Lovers (86%). Thus, hypothesis 3 is verified, giving the contrast of these two groups with the Wine socialite group that has a percentage of 76%.

With respect to the global level of satisfaction, the wine experts were also the ones that were globally more satisfied with the event (mean of 4.52, in a five-point Likert scale). Having significant differences when compared with the wine lovers and wine socialite groups. Consequently, hypothesis 4 is verified.

Table 2 Intention to return and Global Level of satisfaction of the clusters

Variables	Cluster 1	Cluster 2	Cluster 3	ANOVA
Intention to return (%)				0.000*
No (%)	2%	2%	2%	
Yes (%)	87%	76%	86%	
Don't Know (%)	11%	22%	13%	
Global Level of satisfaction (Mean) ^a	4.52 ^a	4.32 ^a	4.41 ^a	0.003*

Source: Authors. Made in IBM SPSS. * Significant for a level of confidence of 5%. Scales used on the survey: (a) Scale that goes from 1- Very Unsatisfied to 5- Very satisfied.

Table 3 Consumer Behaviour characteristics of the clusters

Variables	Cluster 1	Cluster 2	Cluster 3	ANOVA
Interest in Wine (%)				0.000*

No Interest (%)	0%	2%	0%	
Limited Interest (%)	0%	24%	0%	
Interested (%)	8%	46%	42%	
Very interested (%)	92%	29%	58%	
Knowledge about wine (%)				0.000*
No Knowledge (%)	0%	11%	0%	
Limited Knowledge (%)	0%	85%	0%	
Knowledgeable (%)	0%	3%	100%	
Great Knowledge (%)	100%	0%	0%	
Wine activities frequency ^b (Mean)				
Frequency of acquisition of Wine Magazines (Mean) ^b	3.15 ^b	1.77 ^b	2.46 ^b	0.000*
Frequency of visits to Internet portals specialized in wines (Mean) ^b	3.32 ^b	1.98 ^b	2.83 ^b	0.000*
Frequency of visits to wine fairs (Mean) ^b	3.36 ^b	1.97 ^b	2.84 ^b	0.000*
Frequency of visits to cellars (Mean) ^b	3.36 ^b	2.22 ^b	3.02 ^b	0.000*
Frequency of participation in wine proves (Mean) ^b	3.42 ^b	2.06 ^b	2.97 ^b	0.000*
Wine Habits (Mean)				
Average number of bottles, bought per month (Mean)	20	9	13	0.000*
Monthly average expense in wine (Mean)	156	60	104	0.000*
Importance of wine characteristics (Mean)				
Importance of the Wine Origin (Mean) ^c	4.27 ^c	4.00 ^c	4.22 ^c	0.005*
Importance of the Wine Region (Mean) ^c	4.49 ^c	4.06 ^c	4.18 ^c	0.004*
Importance of the Certification (Mean) ^c	3.93 ^c	3.60 ^c	3.74 ^c	0.017*
Importance of the Brand (Mean) ^c	3.65 ^c	3.64 ^c	3.59 ^c	0.743
Importance of the Bottle (Mean) ^c	3.25 ^c	3.22 ^c	3.18 ^c	0.855
Importance of the Price (Mean) ^c	3.88 ^c	4.01 ^c	4.00 ^c	0.523
Importance of the Quality/Price relation (Mean) ^c	4.27 ^c	4.26 ^c	4.50 ^c	0.018*
Importance of the Recommendation (Mean) ^c	3.98 ^c	4.00 ^c	4.11 ^c	0.376

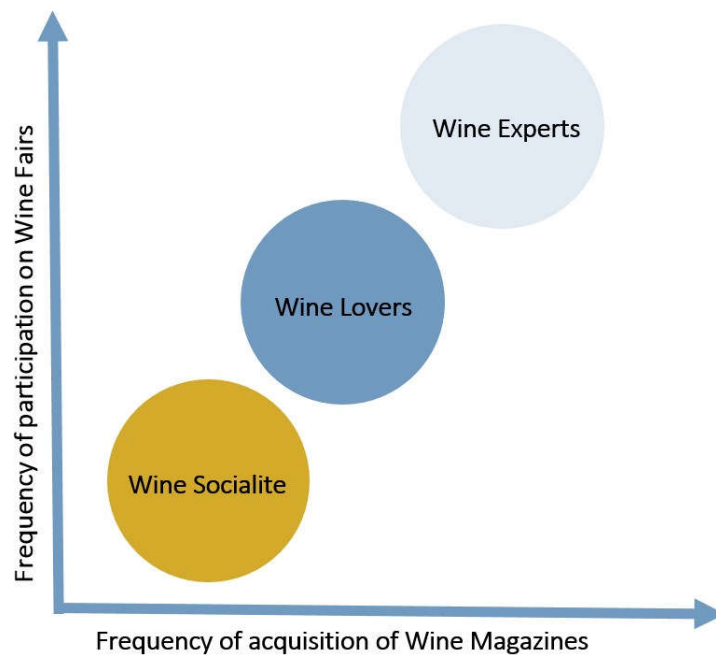
Source: Authors. Made in IBM SPSS. * Significant for a level of confidence of 5%. Scales used on the survey: (b) Scale that goes from 1- Never to 4- Regularly | (c) Scale that goes from 1- No importance to 5- Very Important.

Finally, looking to table III, we observe that each cluster has presented different consumer behaviour. The hypothesis 5 is verified. When we analyse the results with respect to the frequency of wine activities, the Wine Experts cluster was also the one that had the higher frequency (means between 3.15 and 3.42 in a four-point Likert scale), in opposition with the Wine Socialite that had frequencies between 1.77 to 2.22 (in a four-point Likert scale).

The Wine experts are also the ones that buy the highest number of wine bottles (20) and have the highest monthly expense on wine (156 euros). Finally, looking to the Importance of the wine characteristics, it was visible that the respondents that belong to the Wine expert cluster were the ones that attributed a higher importance to the Wine Origin, Wine region and Wine Certification. On the other hand, respondents that belong to the Wine Lovers cluster were the ones that gave more importance to the quality/price relation criteria.

Still on the consumer behaviour variables, if we focus on the frequency of participation on wine fairs and on the acquisition of wine magazines – the variables under study, it is possible to see that the Wine Experts were the ones with the highest frequency of participation on wine fairs and acquisition of wine magazines, in opposition with the Wine Socialite that had the lower frequency in both parameters (see scheme I).

Scheme 1 Consumer Behaviour: Wine Clusters



Source: Authors

4.2. Linear Regression Analysis: The Knowledge and Interest on wine effect

Regression analysis is one of the most widely used statistical techniques to model the relationship among variables in order to describe or predict phenomena (Erford, 2008). In this section, we will test the relation within the different existent qualitative and/or ordinal variables. Despite the fact that our variables are ordinal and not numerical, we still used the linear regression analysis due to the fact that our scales are equal or higher than four, which make them suitable for this analysis (Maroco, 2007). The results are exhibit on table IV.

Table 4 Predictors of the Frequency of acquisition of specialized wine magazines (Model I), Frequency of the participation in wine fairs (Model II).

Variables	Model I	Model II
Constant	0.089	0.265
Age	0.085***	-
Knowledge on wine	0.108***	0.118***
Interest in wine	-	-0.061***
Frequency of visits to specialized wine websites	0.417***	0.086***
Frequency of participation on wine proves	0.237***	0.373***
Frequency of acquisition of specialized wine magazines	-	0.174***
Frequency of visits to cellars	-	0.220***
Frequency of participation of wine fairs	-	-
Intention to Return	-	-
Level of Global Satisfaction	-	-
R2a	0.453	0.594
Durbin- Watson	1.906	1.904

* Significant at the $p < 0.05$ level; ** significant at the $p < 0.01$; *** significant at the $p < 0.001$ level, | Model I: Dependent variable: Frequency of acquisition of specialized wine magazines: $p < 0,000$ | Model II: Dependent variable: Frequency of the participation in wine fairs: $p < 0,000$ | Model III: Dependent Variable: Wine Clusters: $p < 0.000$.

The first step, in order to test the hypothesis 6, was to explore whether the socio demographic and consumer behaviour characteristics had any kind of influence in the frequency of acquisition of specialized magazines.

A linear regression established that the knowledge on wine, the age, the frequency of visits to specialized wine websites and the frequency of the participation on wine tastings could, in statistical terms, significantly predict the frequency of acquisition of specialized wine magazines – see model I, table IV. The model is overall significant ($p = 0.000$). The four independent variables contribute to explain 45.3 % of the variability of the frequency of acquisition of specialized wine magazines ($R^2_a=0.453$).

In fact, for a level of significance of 5%, all the equation variables had an impact on the Frequency of acquisition of specialized wine magazines - Knowledge on wine ($p=0.000$), Age ($p=0.001$), Frequency of visits to specialized wine websites ($p= 0.000$) and Frequency of participation on wine tastings ($p= 0.000$), with the exception of the constant ($p= 0.916$) which was not significant for this level of significance. Hypothesis 6 is verified.

The regression presents a Durbin-Watson statistic of 1,906 (value closed to 2), indicating the nonpresence of autocorrelation in the residuals. Besides that, all the independent variables present a Variance Inflation Factor (VIF) =1, which is inferior to ten, indicating that there is no multicollinearity problems within the data (Erford, 2008).

The second step, in order to test hypothesis 7, we explored whether the socio demographic and consumer behaviour characteristics had any kind of influence on the frequency of participation in wine fairs.

A linear regression established that the Interest and Knowledge on wine, the Frequency of visits to specialized wine websites, the Frequency of the participation on wine proves, the Frequency of visits to cellars as well as the Frequency of acquisition of wine specialized magazines could, in statistical terms, significantly predict the Frequency of the participation in wine fairs – see model II, table IV. The model is overall significant ($p = 0.000$). The six independent variables contribute to explain 59.4 % of the variability of the Frequency of the participation in wine fairs ($R^2_a=0.594$).

In fact, for a level of significance of 5%, all the equation variables had an impact on the Frequency of acquisition of specialized wine magazines - Knowledge on wine ($p=0.000$), Interest in wine ($p=0.013$), Frequency of acquisition of specialized wine magazines ($p=0.000$), frequency of visits to specialized wine websites($p=0.004$), frequency of participation on wine proves ($p=0.000$) and frequency of visits to cellars ($p=0.000$). The constant was not significant, for this level of significance ($p= 0.214$). Hypothesis 7 is verified.

The regression presents a Durbin-Watson statistic of 1.904 (value closed to 2), indicating the nonpresence of autocorrelation in the residuals. Besides that, all the independent variables present a Variance Inflation Factor (VIF) =1, which is inferior to ten, indicating that there is no multicollinearity problems within the data (Erford, 2008).

In both equations, a residuals analysis was performed. The outliers can be identified as those observations with standardized residual values above 3.3 (or less than -3.3). Once, the Studentized Deleted Residual were less or equal to 3.00, in absolute value, we confirm the nonexistence of outliers (Erford, 2008). Additionally, the maximum value for the Cook's distance (0.153) was less than 1.00, indicating that there are no influential data on the regression (Erford, 2008).

5. Discussion and Conclusion

This research reveals an important framework for event managers, being very important for the promotion of Essence of Wine and the city of Porto.

As stated, since the beginning, this paper intended to, first, group the respondents according to their interests and knowledge about wine, as well as, the monthly average expense in wine and the monthly average number of wine bottles purchased. Second, see the influence of such criteria concerning the intention to return and global satisfaction with the event. Third, examine whether socio-demographic characteristics and consumer 'behavior characteristics regarding wine, influence the frequency of acquisition of specialized magazines and the frequency of participation on wine fairs, the core businesses of the company under study.

In the first stage, by performing a cluster analysis, we were able to identify three types of visitants of the Essence of Wine, with respect, essentially, to their knowledge about wine: The Wine Experts, Wine Lovers and Wine Socialites.

In the second stage, by performing an ANOVA test, we could observe that the clusters had significant differences with respect to some socio-demographic characteristics such as gender, age, marital status and gross monthly income. Additionally, we also found significant differences with respect to the intention to return and level of satisfaction with respect to the Essence of Wine. In both cases, the Wine experts were the ones with the higher rates.

Still on the ANOVA test, we could find that the Wine Experts group, the one with the higher knowledge and interest on this topic, were the group that included the respondents that mostly frequent wine related activities. Therefore, this group represents the target people of this type of events.

In the third stage, by applying a multiple regression, we were able to verify that both sociodemographic characteristics and consumer behaviour characteristics had an influence on the frequency of acquisition of specialized magazines and on the participation frequency on wine fairs. It can be pointed out that both regressions had a percentage of prediction around 50%, which is representative when talking about social sciences, which is the case (Hair, 2009). In future researches, it would be interesting not only to see if the results hold but also to further explore the comparison between the results during the event and after the event.

Acknowledgement

The authors are deeply grateful to ISAG – European Business School for the availability of the database.

REFERENCES

- Agnoli, L., Capitello, R., & Begalli, D. (2016). Behind intention and behaviour: Factors influencing wine consumption in a novice market. *British Food Journal*, 118(3), 660-678.
- Barrera-Fernández, D., Hernández-Escampa, M. (2017). Events and placemaking: the case of the Festival Internacional Cervantino in Guanajuato, Mexico. *International Journal of Event and Festival Management*; Vol. 8, Ed. 1, 24-38.
- Bizjak, P. S., Hristov, H., Kosmerl, T., Kuhar, A. (2018). Influence of consumer regiocentrism on perceived value of wine. *British Food Journal*, 120(1), 33-43.
- Bonn, M. A., Cho, M., & Um, H. (2018). The evolution of wine research. *International Journal of Contemporary Hospitality Management*, 30(1), 286-312.
- Bowdin, G., Allen, J., O'Toole, W. (eds) (2006). *Events Management*, 2nd edition, London: Elsevier Butterworth-Heinemann;
- Chang, K. (2000). The impact of perceived physical environments on customers' satisfaction and return intentions. *Journal of Professional Services Marketing*, 21(2), 75-85.
- Charters, S., Pettigrew, S. (2008). Why do people drink wine? A consumer-focused exploration. *Journal of Food Products Marketing*, 14 (3), 13-32.

Cox, D. (2009). Predicting consumption, wine involvement and perceived quality of Australian red wine. *Journal of Wine Research*, 20 (3), 209-229.

Cuadrado-García, M.; Pérez-Cabañero, C. & Montoro-Pons, J.D. (2017). Managing satisfaction in cultural events. Exploring the role of core and peripheral product, *Journal of Contemporary Management Issues*, 22(1), 157-174

Erford, B. (2008). *Research and Evaluation in Counseling*, 2nd edition, USA: Cengage Learning, 425-427.

EV (2018). Essencia do Vinho website. Retrieved from: <http://www.essenciadovinhoporto.com/>. Accessed at: 02/05/2018~.

González-Reverté, F., Miralbell-Izard, O. (2009). Managing music festivals for tourism purposes in Catalonia (Spain). *International Association of Scientific Experts in Tourism*, 64(4), 53-65.

Hair J., Black W., Babin B. , Anderson R. (2009). *Multivariate Data Analysis*, 7th edition, London: Pearson.

Hoffman, D, Beverland, M, Rasmussen, M (2001). The evolution of wine events in Australia and New Zealand: A proposed model. *International Journal of Wine Marketing*, 3(1), 54-71.

Hussian, M., Cholette, S., Castaldi, R. (2007). Determinants of wine consumption of U. S. customers: An econometric analysis. *International Journal of Wine Business Research*, 19 (1), 49-62.

Iaia, L., Scorrano, P., Fait, M., Cavallo, F. (2017). Wine, family businesses and web: Marketing strategies to compete effectively. *British Food Journal*, 119(11), 2294-2308.

Jaeger, S. R, Danaher, P. J., Brodie, R. J. (2009). Wine purchasing decisions and consumption behaviours: Insights from a probability sample drawn in Auckland, New Zealand. *Food Quality and Preference*, 20 (4), 312-319.

Lee, W.J.T., Cheah, I., Phau, I., Teah, M. and Elenein, B.A. (2016). Conceptualising consumer regiocentrism: Examining consumers' willingness to buy products from their own region. *Journal of Retailing and Consumer Services*, 33 (2), 78-85.

Li, H., Song, W., Collins, R. (2014). Post-event visits as the sources of marketing strategy sustainability: a conceptual model approach. *Journal of Business Economics and Management*, Vilnius, 15 (1), 74-79.

Mangesh, K. (2017). How Satisfied is my Customer?: An Evaluation of Customer Satisfaction of Cellular Service Providers in the Region of Mumbai with Special Reference to Tata Docomo. *International Journal on Customer Relations*. New Delhi. 5(1): 31-36;

Maroco, J. (2007). *Análise Estatística com Utilização do SPSS* (3), Edições Sílabo; 10.

Mitchell, R. (2006). Influences on post-visit wine purchase (and non-purchase) by New Zealand winery visitors," in Carlsen, J. and Charters, S. (Eds.), *Global Wine Tourism Research, Management, & Marketing*, CABI, Cambridge, MA, 95-109.

Monteiro, A., Borges, A.P. (2015). Impact of socio-demographic characteristics and loyalty on the visitors' satisfaction. *European Journal of Applied Business and Management*, 1(1), 224239.

Park, K-S, Reisinger, Y., Kang, H-J (2008). Visitors' motivation for attending the south beach wine and food festival, Miami Beach, Florida. *Journal of Travel & Tourism Marketing*, 25(2), 161-181.

Santos, C. R., Blanco, M. C., and Fernandez, A. G. (2006). Segmenting wine consumers according to their involvement with appellations of origin. *The Journal of Brand Management*, 13(45), 300-312.

Saunders, M., Philips, L., Adrian, T. (2009). *Research methods for Business Students*, (5th edition), 124-161.

Shanka, T., Taylor, R. (2004). Discriminating factors of first-time and repeat visitors to wine festivals. *Current Issues in Tourism*, Vol. 7, No. 2, pp. 134-145.

- Taylor, J. J., Bing, M., Reynolds, D., Davison, K., Ruetzler, T. (2018). Motivation and personal involvement leading to wine consumption. *International Journal of Contemporary Hospitality Management*, 30(2), 702-719.
- Trindade, A., Borges, A. P., Vieira, E., Gomes, S. (2018). Satisfaction Scoring Index for a musical festival during and after the event: The NOS Primavera Sound Case Study. *European Journal of Applied Business and Management*, Special Issue - WTHM, 109-121.
- Trindade, A., Borges, A.P., Vieira, E. (2017). Level of Recommendation and Satisfaction after an event: the NOS Primavera Sound case study. *European Journal of Applied Business and Management*, 3(3), 52-65.
- Vinnicombe, T., Sou, J. (2017) Socialization or genre appreciation: the motives of music festival participants, *International Journal of Event and Festival Management; Bingley*, 8(3), 274291.
- Worsfold, K., Fisher, R., McPhail, R., Francis, M., & Thomas, A. (2016). Satisfaction, value and intention to return in hotels. *International Journal of Contemporary Hospitality Management*, 28(11), 2570-2588.
- Yin, R.K. (2003). *Case Study Research: Design and Methods*, Applied Social Research Methods Series, 4th ed., Vol. 5, Sage Publications, Thousand Oaks, CA.
- Yoo, Y.J., Saliba, A.J., MacDonald, J.B., Prenzler, P.D., Ryan, D. (2013). A cross-cultural study of wine consumers with respect to health benefits of wine. *Food Quality and Preference*, 28 (2), 531-538.

CIET | **Split**
2018 | **Track 3**

**Electrical Engineering,
Information Technology and
Mechanical Engineering**

Eight Key Fields Analysis (EKF) and the 3-Pole (Win-Win-Win) Challenges for Mobile Telecommunication

Leonidas A. Papakonstantinidis
Technological Educational Institute of Peloponnese, Greece
papakon@gmail.com

Igor Jurčić
HT ERONET and University of Mostar, B&H
ijurcic77@gmail.com

Abstract. Following time will bring huge changes in telecommunication or more precisely in more precisely in ICT (Information and Communication Technologies) world. The Fourth Industrial Revolution (Industry 4.0) is a term that on the best way describe following time. But it is important to understand and to see that ICT will be a base for Industry 4.0 period or better say, Vision 2020 in ICT will set the foundation for the Industry 4.0. In this new world, telecommunication operators will be one of the key players for Vision 2020 in ICT and for Industry 4.0. It can be said that this time will bring two new transformations – transformation of each industry sector according to products and services based on Industry 4.0 and mobile telecom operators transformation to new generation of telecom operators so called Telco 2.0. This article will explain two new models/analysis, *win-win-win papakonstantinidis model* and *Eight Key Field analysis*, which will help that these transformation become seamless transformations as much as possible.

Keywords: *win-win-win papakonstantinidis model, Eight Key Fields analysis, telecommunications, mobile operators, Industry 4.0.*

1. Introduction

The following period will bring huge changes in business and in people lives. This new age have been already recognized and named The Fourth Industrial Revolution or Industry 4.0. Mobile telecom operators will have enormous roles in this new period but it is up to them how much they will earn and how huge the roles will be. According to some approximations this new market will worth up to 3.000 billion US\$ by 2020 year and there will be several key industrial players in this new ecosystem.

Such numbers indicate that many new companies will try to find positions for themselves. New companies but also the famous and well established global ones such as Google, Facebook, Amazon and similar ones which have already found their positions for this new age and which will try to spread their roles in this new business ecosystem. In such environment, mobile telecom operators have to reorganize and reshape themselves and become ICT (mobile) operators. The two analysis which will be described in this article or better say so far obtained results of these analysis, will help to transform modern mobile telecom operators into ICT mobile operators. Two independent researchers from different universities and from different countries have been developed two independent analysis, approaches or models which should help to modern mobile

operators in their transformations. In this article will be described the main ideas of these two analysis, their main characteristics, specifics, diversities and similarities.

2. Current situation in ICT/telecommunication market

Modern mobile and fixed telecom operators have already started to prepare themselves for this new era in telecommunication segment or even better say in ICT segment. There are a lot of examples for confirmation of previous statement. Almost all major and the biggest international mobile telecom operators such as Vodafone, Telefonica, DT, Orange, AT&T, Verizon Wireless, SK, DoCoMo, Telstra, Hutchinson and many others from entire world, report to the public about their achievements and plans in their preparations in this segment for this new era every month or even every week.

In professional and business literature and on different websites could be found many examples of testing new systems such as 5G mobile networks, IoT systems, IIoT systems, OTT applications, cloud services, ... and many others. Mobile telecom operators which were previously mentioned and many others together with different vendors of ICT equipment such as Huawei, Ericsson, Nokia, ... and many others are continuously working on developing of these new systems. And every day it is visible that results and achievements are bigger and bigger.

Here will be very briefly mentioned only some of them and only several of such examples because it is impossible to show all of them (I. Jurčić, D. Jurčić, CIET 2016):

- Telekom operators: AT&T, Deutsche Telekom, DoCoMo, Orange, Telefonica, Telenor, Telstra, Verizon Wireless, Vodafone and many others,
- Vendors of telecommunication equipment: Alcatel-Lucent, Nokia, Ericsson, Qualcomm, Huawei, Intel, Samsung and many others,
- International organizations: 5G PPP, 5G MF, METIS i METIS II, IEEE, GSMA, WWRP and many others.

The following time is a great chance for the modern telecom operators to become even better. Their challengers (for example alternative telecom operators, companies with OTT services, even global ICT companies such as Google, Amazon, Facebook, ...), if properly make an approach for the changes those follows, will be able to become significantly stronger in the market and even takeover a significant part of the ICT market. It depends on how they all will be prepared for the following changes in the ICT market. (S. Gotovac, I. Jurčić, I. Radoš, SplitTech 2016)

Regarding research that was conducted in second half of 2016. Year (European communications, magazine, Q3, 2016), telecom operators battle for differentiation. This term “differentiation” is crucial one for the most number of operators. Regarding this report/research, question “what do you regard as the main drive for operators providing content”, the answers are as following: Creating differentiation from competitors (41%), Generating new revenue (33%), Reducing churn (10%), Attracting new customers (10%), Others (6%). Key managers from telecom operators understood that differentiation is the main driver for their growth in following years. And if you are differentiate from your competitors, you will have big revenue, less churn and you will attract new customers.

According to same report, question “what do you regard as the biggest challenge to the success of your digital content strategy”, first two answers was: Creating differentiation from competitors (24%) and Complexity of relationship with partners (16%).

So, 40% of answers were regarding differentiation from competitors but also regarding relationship with partners. And according to the same report, less than 20% of telecom operators

think that are very differentiated from their competitors. More than 80% of answers were “slightly differentiated” or “not differentiated”.

According to similar research/report from the same magazine but one year later (European communications, magazine, Q3, 2017), the key managers from telecom operators gave similar answers. Question “what do you regard as the main driver for operators providing content”, the answers were as following: Generating new revenues/profits (34,5%), Creating differentiations from competitors (29%), Attracting new customers (17%), Reducing churn (9,5%), Shoring up core services (8%) and Other (2%). And question “What do you regards as the biggest challenge to the success of operators’ digital content strategy”, were as following: Creating differentiation from competitors (23,5%), ..., Understanding what consumers want (15,5%), Complexity of relationship with partners (9,5%).

First, third and fourth answers were very interesting for this analysis and they worth almost 50% of all answers. Telecom operators will need many changes in their business strategies, creating products and services, recognizing what customers want and many other things that will be easily solved with new analysis. And another question from this report/research is also very interesting – “Which of the following do you consider to be the biggest competitor to operators in content space”. Key managers from telecom operators recognized main competitors from non-telecom world and answered as following: Netflix (37%), Google (18,5%), Amazon (14%), National broadcasters (11,5%), Facebook (9%), Other (7%), Apple (2%) and Snapchat (0,5%).

Telecom operators must have many changes in organizational issues, approaches to customers, creating of new types of products and services and many other issues. They need to create “shift in mindset” and these new analyses will help them for adjusting in following years to this new era often called “Industry 4.0”. The most important conclusion from these analysis is clear that (mobile) telecom operators will experience huge changes in its business models, access to users, and the creation of new products and services. These new analyses will help them to easily pass through following changes. And these analyses will grow and change themselves as the same way as mobile telecommunication markets will be changed. These both two analysis are in their development stages (different phases) and will be important for (mobile) telecom operators in following years. There are a lot of similar analysis, surveys, reports and news about telecom operators, vendors and international organizations those will involve in these changes and their achievements and results. Publicity is informed about their achievements and results every day and it is clear that telecommunication market changes dramatically and becomes more and more ICT market. And telecom operators (specially: mobile telecom operators) must understand that they have to change themselves as soon as possible. Otherwise, their future in the business environment will be very questionable.

3. Eight Key Fields (EKF) Analysis

Eight Key Filed Analysis (EKF Analysis) was originally provided as analysis for telecom operators as analysis which will be improved version of Technical-economical analysis (TEA). But through years and research those have been conducted, this analysis became much more than that. EKF Analysis have become analysis in which is analysed all important data of mobile telecom operators – organizational, technical, economical, regulative, environmental and all others important for telecommunication business. This analysis grown up through last years. If it would be analysed article published on SoftCOM 2016 (I. Jurčić, S. Gotovac, SoftCOM 2016), it could be found some details about this analysis from that period. For example, it was mentioned and briefly explained one of eight key fields – “Coverage and Availability” (C&A KF) key field. After the conducted

research and analysis during last period of one and a half year, in this article will be presented that the same field exist in this analysis but with some different parameters in the field which will better show quality of mobile telecom operator in this segment and will be better explained what will be following proposed steps for mobile telecom operators.

In previously mentioned article (I. Jurčić, S. Gotovac, SoftCOM 2016) it was shown and described “C&A” key field as filed with ten main factors which describe this field. It was also mentioned that key field “Coverage and Availability” will be defined with appx. 10 weight factors and that each factor can (but it doesn’t have to be) have the same amounts of weight factors. In this mentioned article was also described that weight factors in EKF analysis could be different for analysis of operators in different countries and that these values of weight factors must be the same if analysis will be made for one or all operators in the same country. It was noted that analysis for two or more operators from different countries would be quite difficult but enforceable.

The eight key fields will be distributed in specific format and in different levels. That format can be presented as “2 – 4 – 2 format” and names and distribution of key fields will be slightly different in comparison with proposal that was presented in 2016. year. It is clear that this analysis is still under construction but with completely clear configuration. The eight key fields will be named, defined and distributed on following way that is presented in following table.

Eight Key Field Analysis				
Technical level	Coverage and Availability		Technological and IT development	
Business Level	Products and services	Pre-sales and sales	After sales and customer care	Human Resources (HR)
Environmental level	Political, Financial, Regulatory and Law environment		Quality of brand and presence in public	

Table 1. Distribution of fields in EKF Analysis

In this article will be briefly and very basically described key field “Coverage and Availability” and it will be make comparison with details published in 2016. year. It will be also described logical approach to forward and backward links to this field. At the end of this chapter will be shown examples how will be calculated items in this field.

The field “Coverage and Availability” is technical field because it describes details regarding technical availability to users. These two terms mean that mobile telecom operators have access to users by the air but also by physical connections. Although physical connections don’t characterized mobile operators in new era they will be very important. After analysis of many professional and scientific articles and all other papers and reviews of telecommunication market, it could be concluded that these items will be almost crucial for telecommunication business especially in new era – Industry 4.0 era.

Each field should give two main types of results: the value (in points which will be comparable with competitors) of mobile telecom operators and the potential of mobile telecom operators for following period (in points too).

According to these assumptions, the field “Coverage and Availability” will give two main types of results: availability to customers in private and business segments and in urban areas, rural areas, on the roads, locations where masses of people are crowded (stadiums, halls, shopping malls, etc) and in other countries (roaming agreements) and potential of mobile telecom operators for new coverage and additional access to customers and for delivering new types of products and

services which will be involved in following years (appx. 5 years ie. half of time between two mobile network generations).

And following items will be components of this field:

- Coverage of GSM signal which is sufficient for establishing a high level of voice calls and send SMS messages – ie. minimum XY dBm,
- Coverage (in percentage of entire country or any other observed part of a particular country) of radio signal which offers data connections with minimum access rate of AB Mb/s (of course this minimum rate will be calculated according to new products, services and content that will be offered to customers and according to the world average mobile data access rate – this minimum Internet access rate should be defined for this analysis at the beginning of new year),
- Mobile data access rate in urban area (cities and towns),
- Mobile data access rate at the stadiums, shopping malls, ...
- Mobile data access rate in rural and suburban areas,
- Length of optical cables in kilometers among big towns and cities,
- Capacity in Gb/s or Tb/s for connections among big towns or cities,
- Percentage of connected flats and houses (number of connected flats and houses in comparison with entire number of flats and houses) by optical cables,
- Percentage of connected companies and offices ie. business customers (number of connected locations of companies and offices in comparison with entire number of locations of companies and offices) by optical cables,
- Number of countries in which mobile operator has at least one commercial roaming agreement – of course it will be pointed importance and significance of individual countries, number of countries but also number of all commercial agreements).

Each of these items will be explained in details and it will be given rules for calculations of each of these items in following analysis and research. The general idea is that obtained results will be possible to estimate the value of the mobile operator in the points, its comparison with the other operators and the potential for further development that this mobile operator possesses in this segment. In this short preview, it was given main idea of this analysis. Results will be very important and useful for evaluating mobile telecom operators but also for fixed telecom operators, ISPs or CATVs which will start offering mobile services in following period as Mobile Virtual Network Operator (MVNO) or Service Providers (SP).

As it was noted at the beginning, the Information and Communication Technology ICT will be a base for the Fourth Industrial Revolution (Industry 4.0). As it can be seen, the Eight Key Filed Analysis (EKF Analysis) was originally provided as analysis for telecom operators as analysis which will be new analysis. This new analysis will improve some or all possibilities that are offered by Technical-economical analysis (TEA), SWOT analysis, PESTLE analysis, Porter's Five Forces analysis, Ansoff matrix and BCG matrix and what is very important, all factors in this new analysis will be numerically valuated. This analysis will go further as an alternative, game/bargaining analysis' expression. As technology go on with faster "jumps" from the one point to the other, at the same time, human, economic, social, psycho...relations are changed faster and faster. Especially, the capital socio-economic system which dominated on the others during the industrialization, 18th century, (and recently on the communism, 20th century). In the field of socio-economic relations, was noted a double trend: Leaving the Classical Economic School with the "morality" in focus"(Adam Smith, David Ricardo, Carl Marx, John Stuart Mill it passed in the

New-Classical, [focusing on short-term equilibrium”] (Alfred Marshal, Leon Walras, John Hicks, and alle) Neoclassical economics is an approach to economics focusing on the determination of goods, outputs, and income distributions in markets through supply and demand Marginal Economics can be the result of this.

As the new-classical economic school was “ready” to be overcome, a new theory has been arisen as a “theory of everything” the **game theory and its bargaining problem**. On this bargaining problem **our approach** - tabled on **Visby University Gotland SW at the 2002-14-08** session -as an extension of "Nash Equilibrium" (NE) was treated, taking into account the COMMUNITY as the third part of a bargain/ any bargain between two-sides. As it will be presented bellow, the global “trend” today is rather the convergence toward new ethical values, i.e. participatory democracy, social cooperative enterprises, social economy, the third pole of the economy, green growth, local development, natural environment etc.

4. Win-Win-Win Papakonstantinidis model

4.1. The sharing problem

4.1.1. Three central assumptions

It was expressed by E. Roy Weintraub that neoclassical economics rests on three assumptions, although certain branches of neoclassical theory may have different approaches: people have rational preferences between outcomes that can be identified and associated with values; individuals maximize utility and firms maximize profits; people act independently on the basis of full and relevant information.

From these three assumptions, neoclassical economists have built a structure to understand the allocation of scarce resources among alternative ends—in fact understanding such allocation is often considered the definition of economics to neoclassical theorists. Here's how William Stanley Jevons presented "the problem of Economics".

Given, a certain population, with various needs and powers of production, in possession of certain lands and other sources of material: required, the mode of employing their labor which will maximize the utility of their produce.

The win-win-win papakonstantinidis model is a methodological tool for conflict resolution, especially in the case of decision-making, or in forming "instant reflection winning strategies" the

4.2. Bargain (which is the frame)

For the needs of the study, we adjust the conceptualization, in order to deal with the development of vertical cooperative promotion management decisions. It has to prove that building a strong competitive advantage in a market mainly depends on the trust links among the partnerships in the vertical marketing channels.

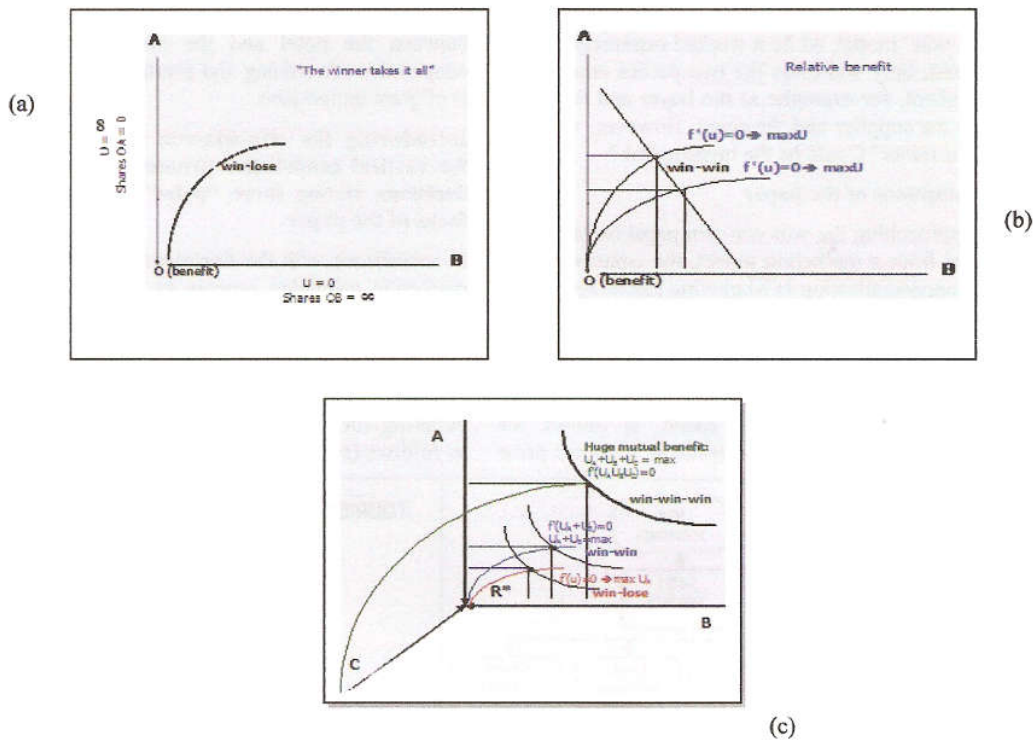


Fig. 1. Conceptual framework – the “win-win-win papakonstantinidis conceptualization” (c) compared to “win-lose” (a) and “win-win” (b) approaches

Cohesion in partnership in the supply chain may be measured by the diversification Rate (R^*) from strict rules: from this point of view, customers intervention should be useful, so as to diversify these “rules” at customized level adjusting them to their needs, wants, consuming identity, including communication codes, customs, ethics, culture. The win-win-win methodology, as a marketing channels’ development model, should facilitate customers to “readjust” bargaining rules in each market, through a sensitization process: Community of customers is defined as a discrete spatial/cultural entity at its sensitization process’ limit.

4.2.1. Definitions

Bargaining problem

Bargaining. It is defined as a form of energy between two distinguishable entities with different expectations and controversial interests, where each part intends to sovereign. Practically, the social relationship “imitates” the natural relation, which is by nature conflictive; in order, the distinguishable entity acquires independent presence and action. This action is directed by the motive of gaining an individual profit. (Nash, Nasar and Kuhn, 2001).

A two-person bargaining situation involves two individuals (Von Neuman and Morgenstern, 1947), who have the opportunity, either to be competitors to each – other (win-lose), or to make coalitions, or even to create pure individual strategies, based on bargainers’ instant reflection behavior (win-win) (Nash, 1950; Arrow and Debreu, 1954; Aumann, 1987; Crawford, 1997). Nash (1951) focused on payoff shares/utilities combination. Bargain may result in either agreement or disagreement (Nash, Nasar and Kuhn, 2001). Utility expresses the constraint or the “fear factor” of disagreement for the negotiator who desires negotiations to be led in agreement more than the other one. Who needs more, negotiation leading to an agreement expects more utility, but –

probably there is a loss in terms of “shares”, due to lack of risk. On the contrary, who is indifferent about “agreement” or expects less utility per unit, has- to win in “shares” under the dogma “the more risk, the more profit” (Crawford, 1997). So, bargaining problem is mainly based on “Utility Theory” – a mathematical theory of the Neoclassical School of Thought, able to explain (satisfactory) the individual expectations/anticipations, of a possible outcome. Usually, it is expressed in the form of a mathematical function: $f(u) = u^{1/2}$. Individual winning strategies are corresponding 1-1 to utilities $U(A)$ and $U(B)$ (Chun and Thomson, 1990). Utility theory of the individual is mainly based on the “concept of anticipation”. In the “two-person utility theory”, two (2) individuals in a bargain have the opportunity to collaborate for mutual benefit in more than one way. In its simple/initial version, no action, taken by one of the two individuals without the consent of the other can affect the well-being of the other one, but in real terms, there is only ONE decision, taken by the individual involved in a bargain.

Then, a number of terms must be analyzed:

- Win-win perception: It is based on when each side of a dispute feels they have won. Since both sides benefit from such a scenario, any resolutions to the conflict are likely to be accepted voluntarily. The process of integrative bargaining aims to achieve, through cooperation, win-win outcomes.
- It is necessary to analyze the Nash “non cooperative-instant reflection game”/or a “win-win perception” as follows: Non-co-operative game is a game between two (2) players/individuals who have opposite interests (Aumann, 1987). Each player makes his own choices, based on instant reflections’ rational movements and his physical cleverness. The game (bargain) is determined by the result (pay-off) and not by player’s expectations. It presupposes best choices by both players towards meeting individual interests (“winning strategies” – Harsanyi, 1973). Players (negotiators) do not regret, a posteriori, for their own decision taken, based on personal choices, during the bargain. Each of the players knows a priori that the other negotiator (or player) is as clever as he is. During the bargain, “mutual respect” between the two bargainers to each other’s best choices is necessary. It is recognized that the more DETERMINED the breakdown of the negotiation (=less utility), the more satisfied (=better shares) – the more risk, the more profit. (Spais, Papakonstantinidis and Papakonstantinidis, 2009),
- Social behavior is not recognized as an acceptable one in the bargain, thus deriving unfair results: That means, “who needs the agreement as the result of a bargain, has to loose in shares, by accepting any result”. Information may be the “link” between knowledge creation and the bargaining process. In particular, “Information” is a power factor in pure individuals winning strategies (Aumann, 1987). The more information, the better winning strategy, the more profit. Each of the players (negotiators), starting negotiations with the other, expects to gain the maximum profit. Interaction, based on instant reflection individual winning strategies, is the base of the Nash Non Cooperative Games Theory. (Spais, Papakonstantinidis and Papakonstantinidis, 2009),
- Win-win-win perception: It is based on the assumptions of information accessibility and diffusion that characterize the modern globalized societies as well as the complexity in the decision-making values that the “third win” (the “C” factor) could unlock a series of obstacles. Another assumption is that the individual (although his/her doubts) must believe that there is a “third” distinguishable part in the bargain (based on behaviorist analysis through the “neural networks”). Sensitization is introduced (regarding the integrated information) as a main variable of the bargain (the “third invisible part of the negotiation”/

the “C” factor). It is about an encephalic hard process in the bargain, which smoothes the angles of conflict or the shares/utilities (according to Nash). The “third win” functions as an umbrella, which conjoins different “dipolar relationships”. Especially, in the business context, it must be understood that the existence of a “distinguishable entity”, depends upon the degree of understanding and sensitization of knowing better the other polar (the partnerships in a supply chain), even through pecuniary values.

4.2.2. Tendencies

Tendency to conflict. Refers to the tendency to competition between the two parts of the bargain with different expectations and controversial interests, results from the combination of: a) the case of the distinguishable entity, b) mistrust of each distinguishable entity, and c) the tendency to improvement. Based on the above, the motive of individual benefit leads with mathematic precision to the conflict, the tendency to sovereignty and from there to a competition climate, which is the corner stone of our economic system.

Tendency to sovereignty. The reason for which it is repeated is stressing the importance of “the need” for sovereignty, which finally “shapes” the expectations. Therefore, we have the following paradox: the expectation determines the motive (individual benefit, sovereignty, competition etc.) and simultaneously “is determined” by the internal need of dominance-sovereignty, something that characterizes our natural world.

Tendency to improvement. Constitutes the core requirement of the above tendency to conflict. Mistrust of each distinguishable entity. Deals with the intentions of the other Two distinguishable entities have different expectations; otherwise, the expectation of each one would be identified with the expectation of the other. Therefore, there would not be a bargaining and, of course, no “conflict” and no “distinguishable entities”. If we had two “players” with precisely opposite interests and expectations, then the (A) would doubt the intentions of (B) and (B) would doubt the intentions of (A). We would have thus a “never-ending circle of expectations” (Varoufakis, 2001).

4.2.3. Assumptions

According to Papakonstantinidis (2002, 2004a, 2004b, 2007), the conditions describing the bargaining situations of the win-win-win papakonstantinidis model are as follows:

1. In a bargaining situation, there are two distinguishable entities with opposite expectations and opposite interests.
2. These distinguishable entities, with the precisely opposite expectations, should be motivated (for individual benefit), so that they are activated and they transform the opposite expectations in opposite interests and from there in opposite “strategies of victory, or sovereignty”.
3. Since we accept the existence of the “distinguishable entity” and the motive of individual profit, we must accept the following condition: the mistrust of each pole of the bargaining situation, regarding the intentions of other. Two distinguishable entities have different expectations; otherwise, the expectation of each one would be identified with the expectation of other.
4. The natural tendency of individuals to improve continuously their position, results as basic consequence of the above assumptions, but simultaneously recommends the reason for all above. This natural tendency is permanent. It does not have upper barrier, while on the contrary it has a lower one.
5. Tendency to conflict, which refers to the tendency to competition between the two parts of the bargain with different expectations and controversial interests, results from the combination of:

a) the case of the distinguishable entity, b) mistrust of each distinguishable entity and c) tendency to improvement.

6. Tendency to sovereignty, which refers to the reason for which it is repeated, is in order to stress the importance of “need” for sovereignty, which finally “shapes” the expectations.

7. The strategic choice, the decision and the strategic plan: If all the above aim to achieve the strategic goal of sovereignty, then the strategic plan is the means for accomplishing such a goal.

8. The respect of each one of the two poles, in the rationalism of the other, without moral or other extensions. This is essential and necessary condition for the establishment of the bargaining (in opposite case, there is no negotiation, but simply a “sovereignty” of the one pole to the other). Each one from the two opposite poles just simply respects the “bargaining power of the other”, or the “rationalism of the other”, which is about “a better organized strategic plan for the achievement of sovereignty”.

9. The two “opposite” poles are involved in a bargaining situation through the STRICT choices (that have resulted from rationalism and strategies for sovereignty that shape their final decisions), they never regret for their choices and for their final decisions.

One of the applications of the win-win-win papakonstantinidis model (since 2002/14/08) is on innovative bargaining solution analysis Bargaining seems to be critical for marketing channel coordination, e.g., for vertical cooperative promotion¹. According to Spais, Papakonstantinidis and Papakonstantinidis (2009), the importance of this theory is arisen from the transfer of the pure trust theory to a marketing context, which can be achieved in order to analyze marketing phenomena of bargaining especially in cooperative promotion programs characterized by conflict and mistrust. Marketing phenomena refer to understanding of the bargaining problem resolution and the types of negotiation in which the marketing channel member and the business dispute the price, which will be communicated and the exact nature of the transaction that will take place and eventually come to an agreement in terms of a promotion management strategy. The theory considers the information accessibility and diffusion that characterize the modern marketing environment, and the complexity in the decision-making of marketing channel members values that the “third win” (the “C” factor: the customer) could unlock a series of obstacles. The individual (although his/her doubts) must believe that there is a “third” distinguishable part in the bargain. The ‘win-win-win papakonstantinidis’ theory supports the significance of the tendency to sovereignty, the tendency of conflict, which results from the combination of: a) the case of the distinguishable entity, b) mistrust of each distinguishable entity, and c) tendency to improvement in a vertical marketing channel.

Based on the assumptions of the ‘win-win-win papakonstantinidis’ conceptualization, the limitation in contexts such as the cooperative promotion programs, as identified in a previous study (Spais, Papakonstantinidis and Papakonstantinidis, 2009) is that utility assessment and cost-utility analyses such as costs/quality-adjusted expected profits model from the partnership for A and B factors and the demand model for C factor are frequently presented to demonstrate the value of many utility options in the marketing literature. However, utility indicators require various methods that introduce significant methodological challenges, which directly influence the results and ensuing cooperative promotion management decisions in vertical marketing channels.

¹ Spais G and Papakonstantinidis LA (2011) Joint Presentation in the EUROMED/EMBRI Word Conference – Book of Proceedings

5. Conclusion

In this article was described and given two approaches in analysis for telecom operators with special accent on mobile telecom operators. In following years, years that many experts, scientists, university professors and many others have already recognized as Industry 4.0 era, mobile telecom operators will feel significant changes in their organizational charts, in approach to customers, in processes of creating of products and services, in their business strategies and many other issues. These two analysis which have been developed and will be developed and improved in following years will definitely help in preparing mobile telecom operators for Industry 4.0 era. Although these two analysis were completely different and give different types of results, in this article were explained and described their main ideas and targets and in following months and years they both will be developed and improved. And they both will be very important for analysis and for creating new business strategies of modern mobile telecom operators.

REFERENCES

Authored book:

Nasar, S. 1998. A Beautiful Mind. New York: Simon and Schuster.

Pareto Vilfredo (1906) Manual of Political Economy. 1906

Smith Adam (1776). An Inquiry into the Nature and the Causes of the Wealth of Nations "1 (1 ed.). London: W. Strahan. Retrieved 2012-12-07., volume 2 via Google Books

Smith Adam (1778). An Inquiry into the Nature and the Causes of the Wealth of Nations 2 (2 ed.) London: W. Strahan; T. Cadell. Retrieved 10 March 2015 via Google Books

Chapter in an edited book:

Sen Amartya K., 1970, Collective Choice and Social Welfare, ch. 3.4

Instance of publication in press:

Arrow Kenneth 1951, 2nd ed., 1963 Social Choice and Individual Values, Yale University Press

Kuhn W, Harold; Nasar, Sylvia (eds.). "The Essential John Nash" Princeton University Press. pp. Introduction, xi. Retrieved April 17, 2008.

Nash, J.F., Jr. 1995. Autobiography Les Prix Nobel The Nobel Prizes 1994, ed. T. Frangsmyr Stockholm: Nobel Foundation. Online

Neumann, J. von 1928. Zur theories der gesellschaftsspiele. Mathematische Annalen 100, 295–320. English translation by S. Bergmann in Contributions to the Theory of Nash, John Forbes (born 1928) Games IV, ed. R.D. Luce and A.W. Tucker. Princeton: Princeton University Press, 1959.

Neumann, J. von and Morgenstern, O. 1944. Theory of Games and Economic Behavior Princeton: Princeton University Press (2nd edn 1947).

Pareto Vilfredo (1896) Cours d' Économie Politique Professé a l' Université de Lausanne. Vol. I, 1896, Vol. II, 1897.

Pareto Vilfredo (1896) Cours d' Économie Politique Professé a l' Université de Lausanne. Vol. I, 1896, Vol. II, 1897.

Unpublished doctoral dissertation or master's theses:

Nash, J.F., Jr. 1950. Non-cooperative games. Doctoral dissertation, Princeton University Nash, J.F., Jr. 1950. The bargaining problem. Econometrica 18, 155–62

Published proceedings:

Jurčić, I., Jurčić, D. (2016):” The potential for the development of new products and services in the tourism industry based on new ICT technologies, ” CIET 2016, Split, Croatia

Jurčić, I., Gotovac, S.(2016):” New approach in mobile telecom operators analysis - Analysis of Eight Key Fields” SoftCOM 2016, Split, Croatia

Gotovac, S., Jurčić, I., Radoš, I.:” Services in tourism based on Vision 2020 – a chance for telecom operators”, Splitech 2016, Split, Croatia

Godel Kurt,(1931) “ ‘ ‘ Uber formal unentscheidbare S ‘ ‘ atze ‘ ‘ der Principia mathematica und verwandter

Systeme I’ (1931) Richard Zach First publication: *Monatshefte fur Mathematik und Physik* ‘ ‘ , 37, 173–198

Reprints: S. Feferman et al., eds., Kurt Godel. *Collected Works Volume I: Publications 1929–1936* New York: Oxford University Press, 1986, pp. 116–195.

Moreno-Ternero-, Juan, D. Roemer John E. (2005) *Impartiality and priority. Part 1: the veil of ignorance*” –Yale University (February 9, 2005)

Moreno-Ternero, Juan D. Roemer, John E (2011) “A common ground for resource and welfare egalitarianism,” *Working Papers 11.12, Universidad Pablo de Olavide, Department of Economics*

Myerson, R.B. 1999. ‘Nash equilibrium and the history of economic theory. *Journal of Economic Literature* 37, 1067–82.

Nash, J.F., Jr. 1950. Equilibrium points in *n*-person games. *Proceedings of the National Academy of Sciences, USA* 36, 48–9.

Nash, J.F., Jr. 1950. Non-cooperative games. Doctoral dissertation, Princeton University Nash, J.F., Jr. 1950. The bargaining problem. *Econometrica* 18, 155–62

Nash, J.F., Jr. 1951. Non-cooperative games *Annals of Mathematics* 54, 286–95

Nash, J.F., Jr. 1953. Two-person cooperative games *Econometrica* 21, 128–40.

Papakonstantinidis LA (2013) *The Intermediate Community: A Behavioral / Bargaining Approach For Conflict Resolution At The Local Level/ Bayesian Analysis EUROMED World Conference-Proceedings..... P. 1443*

Papakonstantinidis LA (2012) *The 'Win-Win-Win Papakonstantinidis Model' as a Bargaining Solution Analysis for Local Government Decision from Territory-Community to 'Behavioral' Community: The Case of Greece*

Papakonstantinidis LA (2016) *Volume II titled “The “win-win-win papakonstantinidis model” VOLUME II: COLLECTION social choice, social welfare: theoretical background 2016 RESEARCH GATE*

Papakonstantinidis LA (project2016-2020) *Social Welfare: Collection of bibliographic references and the win-win-win papakonstantinidis model- Project*

Papakonstantinidis LA “Involving communities in rural tourism: A "win-win-win papakonstantinidis model" methodological approach and the examination of two Women Rural Tourism Cooperatives' Case Studies *IJRCM* , VOL No 2, 2012/1,issue no 1

Papakonstantinidis LA (2017) *The win-win-win papakonstantinidis model: the Community's key-role in bargaining problem: Political Game as a function of “Bargaining” ”Principal-Agent” and “Ultimatum” game : The “rainbow concept” in the Political Bargain under publication*

Papakonstantinidis LA: the “S.H.I.E.L.D model” *Presentation Book of Proceedings “World Conference “Turismo Verde”, Rome, 1997*

Rawls John .(1958) “Justice as Fairness. *The Philosophical Review*”, Vol. 67, No. 2 (Apr., 1958), pp. 164- 194. Stable

Rawls John .(1958) “Justice as Fairness. *The Philosophical Review*”, Vol. 67, No. 2 (Apr., 1958), pp.

164- 194. Stable

Comparing Virtual and Augmented Reality: In Which One Would You Like to Live in?

Luka Tomasović, Mateo Čobanov

Department of Applied Sciences, University of Split, Split, Croatia
ltomasov@oss.unist.hr, mateo8421@gmail.com

Josip Musić

Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split, Split, Croatia
jmusic@fesb.hr

Barbara Džaja

Department of Applied Sciences, University of Split, Split, Croatia
bbarisic@oss.unist.hr

Abstract. Today there are two competing, but similar technologies that exist for improved user experience: Augmented Reality (AR) and Virtual Reality (VR). They are on the cutting edge of several research fields including computer vision, sensor fusion and human-computer interaction. In this paper two technologies are compared through ODG R7 AR glasses and HTC VIVE VR glasses in practical application scenario(s). The comparison is made on several levels: ease of installation and usage, technical characteristics, price and most importantly user experience. With that goal in mind a within-user study on 40 test subjects was performed. The age of test subjects ranged from 19 to 55. Each test subject performed predefined tasks with AR and VR systems after which she or he completed a short survey. Obtained results were statistically analysed, and based on them and other comparison criteria, conclusions about user experience and preferences were drawn.

Key words: *virtual reality; augmented reality; ODG R7; HTC Vive*

1. Introduction

The seeds for developing parallel worlds probably started back in 1965, when Ivan Sutherland (Sutherland, 1965) published his paper in which he introduced concepts like immersion in simulated world and complete sensory input and output. This is the basic terminology of today's virtual reality research. Virtual reality (VR) refers to synthetically generated reality that simulates the real world. It has the tendency to completely immerse the user into the imaginary world, by cutting the strains of the real world. The more the subject's senses are cut off from the real world and integrated into virtual one, the better performance of the virtual world is accomplished (Rubio-Tamayo, 2017). Sutherland managed to provoke the objectives in science like using the screen as a window to another world, and to make that world look real, sound real and feel real. A few decades later, a similar research began, when in 1990s Tom Caudell tried to solve the problem of how to facilitate workers guidance on the factory floor during production (Mekni, 2014). He used the term *augmented reality* to refer to technology and its representation of world which mixes computer-generated content (virtual reality type content) with live video feed or environment. Therefore, it can be stated that augmented reality (AR) is a technology that superimposes a computer-generated image on a user's view of the real world, thus providing a composite view. In AR users are not completely cut off from the real world, like in VR, on the contrary, their real world is

augmented *i.e.* enriched with additional information. Regardless of which reality it is about, user study on both of them is indispensable, since they are ubiquitously becoming a part of everyday life, in games, in navigation, medicine, construction, etc. (Li, 2018). It should be noted that there exists a hybrid approach which combines to a degree elements of AR and VR called mixed reality (MR) (Hughes, 2005). In this approach virtual and real environments are merged together into new, hybrid, environment in which real world and virtual objects co-exist and can interact with each other.

In Kim (Kim, 2012) the authors emphasized that the user-based evaluations, either formative or summative or both of them, need to be taken into account in the design and development of AR and VR research in order to produce more usable outcomes for their users. As time went by, the scientists began to set new, more difficult goals in deepening the experience of both, VR and AR worlds. They went further away and investigated how to add somatosensory input in multiple sensory inputs. They questioned whether the haptic perception in AR was any different from haptic perception in VR, like Gaffary *et.al.* in (Gaffary, 2017). The presence of real objects in AR influence the way people interact with virtual objects, and the way they perceive them. The researchers studied how haptic perception of stiffness of virtual object is influenced by displaying the scene in AR versus in VR. The results showed that participants perceived the virtual objects stiffer in the virtual environment than in the augmented environment. The simulated world does not necessarily have to obey natural laws of behaviour, as stated in (Gobetti, 1998) where Gobetti and Scateni concluded that nearly every area of human activity can be a candidate for virtual reality application. Even Augmented Representation of Cultural Objects (ARCO) system has been developed as a part of EU ICT project (Sylaiou, 2009), which provides museum curators with software and interface tools to develop web-based virtual museum exhibitions by integrating augmented reality (AR) and 3D computer graphics. In this manner museum can reach much wider audience (at lower cost), while visitors that otherwise would not be able to attend the exhibition (due to distance and cost related issues) are able to enjoy it, with low cost and better experience for visitors.

Today, VR or AR applications are present in virtual prototyping (Choi, 2015, Ottosson, 2002), simulators and training (Hsu, 2013, Roy, 2017), telepresence and teleoperation (Jankowski, 2015), military training (Lele, 2011, Rizzo, 2005), medical systems (Khor, 2016, Pensieri, 2014), engineering and consumer design (Park, 2008), robotics (Mourtzis, 2017, Nee, 2013), manufacturing (Choi, 2015), maintenance and repair (Mourtzis, 2017). By introducing one more sensation *i.e.* the olfactory feedback to the user, VR and AR are pushed to the new, more challenging level. Devices that can collect and interpret odors are called artificial or electronic noses. They are based on technologies like chromatography, mass spectrometry and chemical array sensors (Gobetti, 1998). For odor delivery, the odorant storage can be used as they can be stored either like liquid, gels or waxes. Usually, they are microencapsulated on flat surfaces, and the system releases the odors by scratching the desired amount of capsules, controlling the dosage.

Considering all the above, the user feedback of effectiveness and efficiency is probably the best way how developers can manage the development and acceptance of this technologies and how the world population will look at them. This is why in this paper the two technologies were compared through ODG R7 AR glasses and HTC VIVE VR glasses in practical application scenario(s). The comparison is made on several levels: ease of installation and usage, technical characteristics, price and most importantly user experience. Furthermore, a user study on 40 test subjects was performed. Each test subject performed predefined tasks with AR and VR system after which she or he completed a short survey. Obtained results were statistically analysed, and based on them and other comparison criteria, conclusions were drawn.

2. Materials and Methods

For the AR system ODG R7 smart glasses made by Osterhout group were chosen. For the purpose of this research they were combined with Vuforia to create an AR application. Various AR applications, both demo and the ones specially created for this purpose were tested. Also, navigation, model tracking, application response time and visual representation of the model were considered.

For the VR system HTC VIVE headset was chosen. The testing was also performed on various VR applications like the default Home for the VR, several Virtual Environments (VE), and finally the sample game. At the end the test subjects had to fill in the survey answering the questions which can be found in *Appendix A*, Table 1.

Thus, the paper tried to answer two main research questions: Which of the two tested state of the art systems is better from the point of view of the user and of the developer? What are the main advantages/disadvantages of each system from the user's point of view and how they relate to user experience?

2.1 Augmented reality hardware – ODG glasses

ODG R7 AR Smart glasses are advertised like the world's most advanced AR glasses¹. They are said to be designed to be the wearable computer of tomorrow, untethered, powerful, fully - integrated platform, with ultra - transparent HD stereoscopic 3D displays that redefines what can be done on the go for Enterprise and Industrial customers. ODG R7 features are as follows: Qualcomm Snapdragon 805 2.7GHz quad - core processor, 3GB Pop LP-DDR3 RAM, 64 GB storage, dual 720p 16:9 stereoscopic see-through displays at up to 80fps and dual 650 mAh lithium-ion batteries. At the same time software specification are as follows: Reticle OS Android Marshmallow Framework optimized for ODG smart glasses compatible with a number of SDKs, Reticle OS Developer Program. Multiple integrated inertial measuring units with 3-axis accelerometer, 3-axis gyroscope, 3-axis magnetometer perform on the behalf of the sensors. They also include altitude sensor, humidity sensor, and ambient light sensor. Single autofocus 4MP camera is available in portrait or landscape orientation. Optic specs are: dual 720p stereoscopic see - through displays at up to 80 fps, 60% see - thru transmission, high see - thru capability, autofocus camera (1080p at 60 fps, 720 p at 120fps), magnetically swappable photochromic shield lenses and magnetic stereo ear buds. Communication can be realized by Bluetooth 4.1 (basic rate, EDR – Enhanced Data Rate, BLE – Bluetooth Low Energy), by WiFi dual band 802.11ac (a, b, g, n, ac) and it includes GNSS (Global Navigation Satellite System) - based location (includes GPS – Global Positioning System and GLONASS - Globalnaya Navigatsionnaya Sputnikovaya Sistema). For input and output options 2 digital microphones, magnetic charging port with USB on the go and magnetic stereo audio ports with ear buds are included. Optional accessories: wireless keyboard, portable back - up power supply, corrective lens inserts, replacement nose pads and ear horns, tinted and blackout shields. ODG R7 glasses can be bought for 2,750.00 USD plus shipping and taxes. ODG set used in this study is shown in Figure 1.

2.2 Virtual reality hardware – HTC VIVE

VIVE VR System is fully immersive first - person experience which has the ability of featuring SteamVR Tracking. It gives the user ability to teleport around boundless virtual worlds sitting at the desk or creating a dedicated room-scale play area where one can physically walk around. SteamVR Tracking provides the best experience possible, so one can play the way that works best for him/her: seated, standing or room-scaled. Precise, 360° controller and headset tracking is included into kit with realistic graphics, directional audio

¹ www.osterhoutgroup.com

and HD haptic feedback meaning realistic movement and actions in the virtual world. The *Chaperone* system (colored borders) warns the player about the boundaries of the playing area, so that the user can stay immersed in VR without worrying about the real - world. The front - facing camera also gives a glimpse of the real world. VIVE Video is also included as an immersive, cinematic VR video player for standard, 3D, 180° and 360° videos saved on personal computer. Nevertheless, it has the tremendous support for SteamVR and VIVEPORT. The headset has adjustable straps and interchangeable inserts. On the front it has a camera and eye relief adjustments. It can fit most glasses. The controllers are designed exclusively for VR and they give realistic HD haptic feedback to the user. The base stations cover the 360° of play area and they fit standard threaded mounting points².



Figure 1 ODG and user testing ODG set

According to manufacturer, to run the HTC System recommended computer specifications must be as follows: NVIDIA GeForce GTX 1060 or AMD Raedon RX 480 or newer versions, Intel Core i5-4590 or AMD FX 8350 processor equivalent or better, 4 GB RAM or more, HDMI 1.4 DisplayPort 1.2 or newer, Windows 7 SP1, Windows 8.1 or later, Windows 10.

VIVE specs are as following: Dual AMOLED 3.6" diagonal screen with 1080x1200 pixels per eye (2160x1200 pixels combined) resolution, refresh rate of 90 Hz with the field of view 110°. Chaperon play are boundaries and front facing camera are installed as safety features. Sensors are equipped with SteamVR tracking, G - sensors, gyroscope and proximity. Available connections are HDMI, USB 2.0, stereo 3.5 mm headphone jack, power and Bluetooth. Microphone is integrated. For eye relief interpupillary distance and lens distance adjustment is available on the headset.

Controllers are equipped with SteamVR tracking system, multifunction trackpad, grip buttons, dual-stage trigger, system button and menu button. They can run approximately for 6 hours and are chargeable with Micro - USB charging port. There are no minimum space requirements. Preferable room size is 2 m x 1.5 m with maximum 5m between base stations.

VIVE VR System Includes (Figure 2): headset, 2 face cushions, 1 nose rest, 2 wireless controllers, 2 base stations, 3 - in - 1 cable, Link box, ear-buds, cables, chargers and accessories, code to redeem free content, free trail to VIVEPORT subscription. The total price of the system is 699,00 EUR plus shipping and taxes.

² www.vive.com/us/product/vive-virtual-reality-system

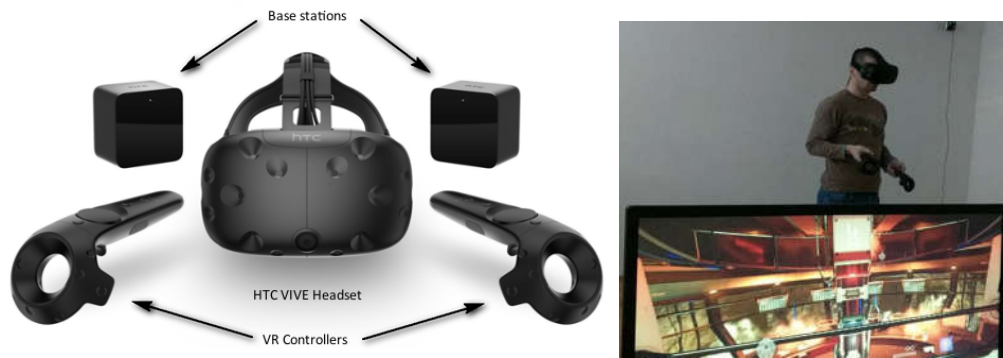


Figure 2 HTC and user testing HTC set

3. Experimental Setup and Procedure

3.1 VIVE setup

VIVE Setup is straightforward. It consists of picking the play area, installing the VIVE and Steam software on the machine, and setting up the VIVE system and room setup. VIVE was originally designed for room scaled seated or standing, but can accommodate most spaces. Mounting the base stations in the play area was achieved by brackets placing them in opposite corners of the walls. The combined field of view (FOV) needed to cover the entire play area so that the distance between them is not bigger than 5 m. In this research they were placed with distance of 7m and the system tracking was still performing normally. Installing VIVE and Steam software was also straightforward, quick and easy. VIVEPORT Desktop application guides user with VIVE hardware installation. The overall process had been made utterly easy, even the video guide is available on-line for users. After software installation, the first contact with VR experience was easy and user friendly.

3.2 ODG setup

ODG setup took a while and impressions of the most important and most remarkable things gained after the first usage are a bit sluggish. The user manual is quite starkly and gives only basic information. Plenty of things are left to self-management and research, and given the price of the glasses themselves and the number of user feedback information, it was quite difficult to get relevant information from the manufacturer's website and from the Internet itself. To connect the eyeglasses with the computer the MTP or FTP transfer protocol should be enabled in the lock bar, which was not mentioned anywhere in the instructions and it was supposed to be done by independent research. The battery on the glasses lasts a rather short time, and above all, the magnetic charging cable is too short so that working and charging at the same time is impossible. Even after a short time, the weight of the glasses on the head, the redness of the nose and the warming up of the eyes occurs. A big problem is the field of view and the inability to manually adjust the 3D screen to the user's head and interpupillary distance. It is obvious even to the initial user that the technology and the applications and their availability on the market is in its early stages. One should note that installed applications on the first do not work properly as they should. Even demo applications that should be installed and running properly have their own bugs. Hence, the software upgrade is necessary in this way or any other. For performance testing some default samples downloaded from ODG website were used and one sample was created especially for this research. This all points to the fact that VIVE system is more mature and easier for the developer to work with out of the box (thus answering our first research question).

3.3 Creating personal augmented model – Making Vuforia AR application in Unity

For the purpose of this user study the modelling of 3D model was made in Blender, Figure 3. The model was St. Paul's cathedral with 57,615 triangles (usually called *tris*). Model had to be triangulated beforehand since Unity or any other engine is set to do that by default. Triangulation is a process of converting *quad* to *tris* since every engine is using *tris* to display 3D models or mesh in general. The *tris* are easier to calculate. By doing this in advance the requirements towards Unity engine are lightened and the triangulation is enabled to be done in a way that suits ones' needs.

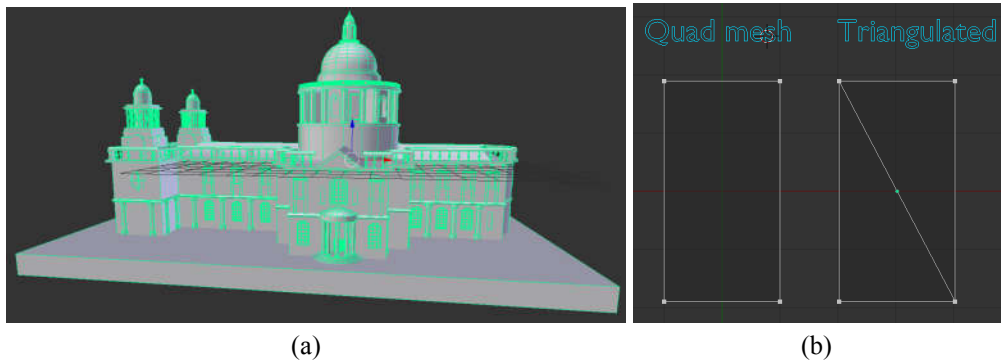


Figure 3 (a) St. Paul's cathedral made in Blender, (b) *Quad* and *tris*

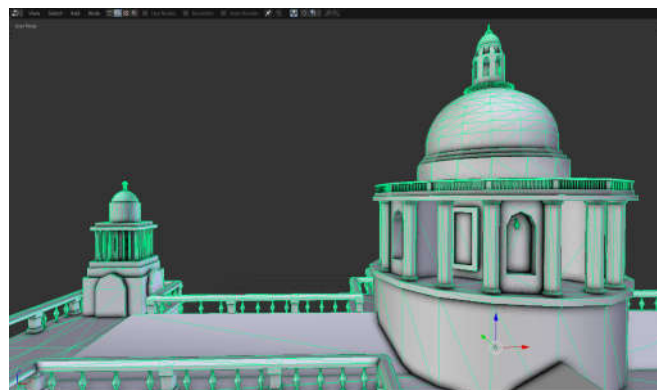


Figure 4 Triangulated cathedral

The image of triangulated cathedral can be seen in Figure 4. After modelling, the 3D object needs to be imported into Unity. Unity can import a lot of model types, but fortunately, user oriented Unity also accepts pure *.blend* files. Hence the *cathedral.blend* just needs to be dragged and dropped into Unity.

Unity 5 comes with **Vuforia** by default. However, the target license and target database is still needed. This can be made on Vuforia web page³. On a web page, one needs to provide the image which will be used as a marker (target). The more stars it gets the tracking will be better. During tracking, Vuforia relies heavily on contrast, therefore images that look really poor when desaturated should not be used. For this research a cathedral 2D image was made and uploaded into web page and can be seen in Figure 5. In Unity, Vuforia needs to be enabled. After that, all objects in Unity default scene need to be deleted and AR camera imported: *Game object* → *Vuforia* → *AR camera*.

Database also needs to be activated in inspector. Digital eyewear needs to be set as digital eyewear or video see-through (for older Unity versions). With this camera setup done, Vuforia image needs to be imported: *Game object* → *Vuforia* → *Image* and for image texture

³ <https://developer.vuforia.com/target-manager>

the cathedral target chosen from selector (cathedral image is downloaded by default with database from Vuforia). After that, all that was left to do was to drag and drop cathedral model that was imported at the beginning as *blend* file, scale the model and position it correctly over the target image, as shown in Figure 6.

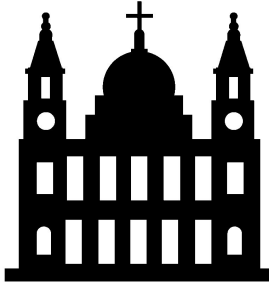


Figure 5 Marker (target) image

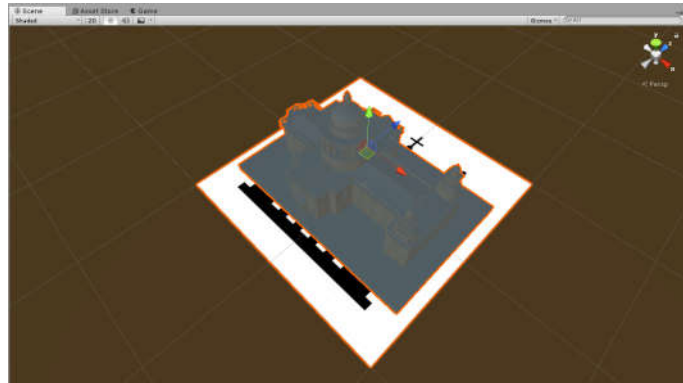


Figure 6 Model over target image

Running application on Android is really simple and straightforward. To set up the platform, in build settings one should set the platform to Android and run build. If device is connected to PC it will install and start automatically or user can download *.apk* to AR glasses and install it manually. After that, when looking into marker image user should see rendered 3D model. These kind of glasses use stereoscopic rendering which means that each image will be rendered for one eye, meaning that it will be the same image (or 3D model) with a little offset for each eye, Figure 7.



Figure 7 ODG stereoscopic reader

3.4 Experimental procedure

The test subjects were first introduced to HTC VIVE. The controllers, headset and functioning of the equipment was explained to them. They were immersed in virtual home and given the brief tutorial. After that they were set in couple of virtual environments which they could freely explore and test concepts seen in previous tutorial. Finally, after the subjects felt comfortable interacting with the virtual environment they were placed inside the example VR game (*superhot vr*). In the game the emphasis is placed on mastering the motor skills.

As for the ODG system, the general facts regarding augmented reality were explained to the users. They were shown a Reticle OS, introduced to a Reticle mouse and Bluetooth keyboard, and finally shown a couple of AR applications, among which one was *St. Paul's Cathedral* made especially for this paper purposes. In both cases they were left for some time to explore on their own and to create their own experience. Finally, when users felt that they understood all presented concepts and that they had enough augmented reality time to form an opinion about the system/technology, they were asked to fill out the survey.

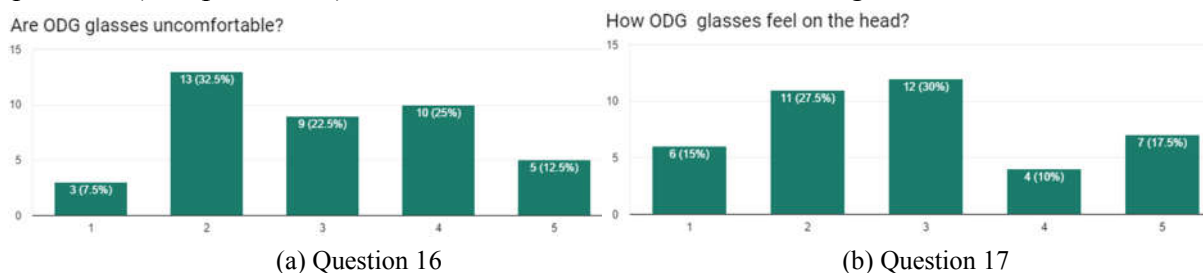
4. Results and Discussion

The complete list and numeration of questions used in the survey (which are analysed in more detail in this section) can be found in Table 1 in *Appendix A*.

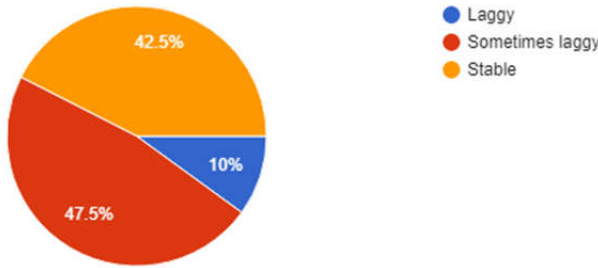
There were 40 test subjects in total out of which 9 (22.5%) were female, and 31 (77.5%) were male. The age of test subjects ranged from 19 to 55, with mean age being 29.6 and standard deviation 9.89. Some other relevant test subject statistics to note: 1.) 20 test subjects (50%) wore prescription glasses, 2.) 36 test subjects (90%) were right-handed, and 3.) 12 test subjects (12%) had some previous experience with augmented reality systems, and 13 test subjects (32.5%) had some previous experience with virtual reality systems. It is interesting to note that out of 20 test subjects that wore prescription glasses, 5 of them (or 25%) had some problems adjusting focus with either of the tested systems while 15 of them (or 75%) did not report any problem.

Out of 40 test subjects, and after using both systems, 38 of them (or 95%) stated that they prefer virtual reality headset. This was not surprising since average grade for virtual reality was 4.75 (out of 5) with standard deviation of 0.49, while mean grade for augmented reality system was 3.73 with standard deviation of 1.28. The statistical significance of the difference between grades for augmented and virtual reality headsets at 5% significance level was confirmed with paired-sample *t*-test ($t(39)=-5.02$, $p=1.17e-05$). It is interesting to explore if previous experience with similar AR and/or VR systems had influence on user grading of particular system. Users who had experience with AR systems gave an average grade of 3.42 (± 1.44), while users who did not have any previous experience graded the system with an average grade of 3.86 (± 1.21). For the VR case, average grade for users with previous experience was 4.71 (± 0.61), while average rate given by users with no previous VR experience was 4.77 (± 0.43). When comparing the means, it seems that previous experience (for both AR and VR system) did not have any effect on given average grade. This observation was confirmed by two-sample *t*-test at 5% significance level for both the AR and VR cases (AR: $p = 0.32$; VR: $p=0.74$).

Possible reasons for such results in terms of general mean values can be found in some of questions related to ease of use of ODG glasses, as is presented in Figure 8. The figure seems to suggest that users found ODG glasses to have bad ergonomic design making it cumbersome and heavy on the head. This was not helped by the fact that 70% of test subjects noted that the device heated up. Additionally, while the user in general liked the experience, around 60% of test subjects noted certain level of lag in model marker tracking. This is further reinforced by the comments provided by the subjects in the free form question in the survey. Users generally had objections in regards to ODG glasses technical specs, while they had no major objections for the HTC headset. For example, users noted the following for the ODG glasses: *'They are a bit heavy and uncomfortable to use.'*, *'Not a finished product.'*, *'Innovative, but need more development.'*, *'Good, but it can be much better.'*, and *'Touch mouse on ODG smart glasses could be better.'* At the same time, summary of exact similar questions (except for Q14) for VIVE headset can be seen in the Figure 9.

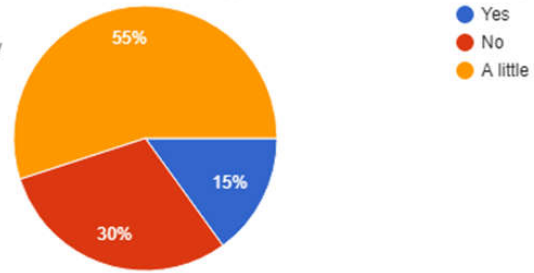


How does model track the marker?



(c) Question 14

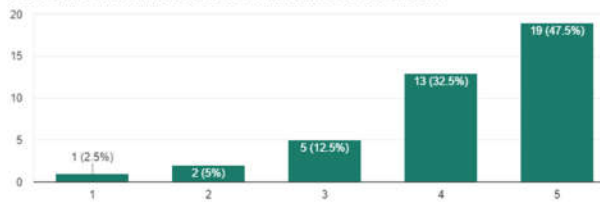
After some usage time did ODG heat up?



(d) Question 18

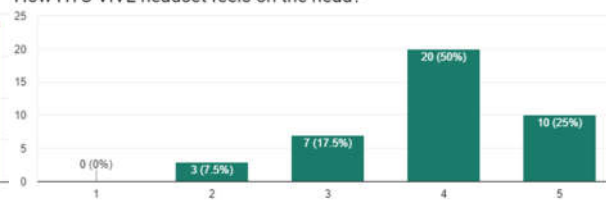
Figure 8 Summary of user study responses indicating ODG glasses most significant issues (1-lowest score (*i.e.* uncomfortable glasses and heavy on the head) and 5-highest score (*i.e.* not uncomfortable and not heavy))

Is the HTC VIVE headset uncomfortable on the head?



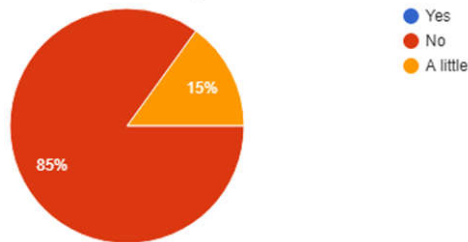
(a) Question 27

How HTC VIVE headset feels on the head?



(b) Question 28

After some usage time did the HTC headset overheat?



(c) Question 29

Figure 9 Comparing summary of user responses for questions presented in Figure 8 for HTC VIVE (1-lowest score (*i.e.* uncomfortable glasses and heavy on the head) and 5-highest score (*i.e.* not uncomfortable and not heavy))

Comparing the results from Figure 8 and Figure 9 better performance of VIVE headset for all three questions can be observed. This was also confirmed by statistical testing by means of paired-sample *t*-test for Q16-Q27 and Q17-Q28 pairs ($t(39)=-27.67$, $p=3.03e-27$ and $t(39)=6.83$, $p=3.70e-8$, respectively). Again this was backed up by subjective user feedback in free from question in comments such as: 'HTC is much better than ODG although it is not wireless.', 'HTC headset is excellent piece of equipment, great for use on a computer.', 'HTC VIVE was better than ODG smart glasses.' and 'Amazing, it was really impressive and realistic.'. Thus it is clear why overall user impression of virtual reality through VIVE headset was better than of augmented reality through ODG headset. Despite that, lower number of test subjects (28 or 70%) stated they would prefer to live in virtual reality as opposed to augmented reality. This might indicate that the reason for low user preference of augmented reality headset is not in the nature of augmented reality but rather in technological limitations of the current headset. This in turns answers our second research question.

It is also worth noting that both systems had similar level of fatigue for the users, as is depicted in Figure 10 *i.e.* around 80% of test subjects felt some level of fatigue while using ODG glasses, and around 75% test subject felt fatigue while using HTC VIVE.

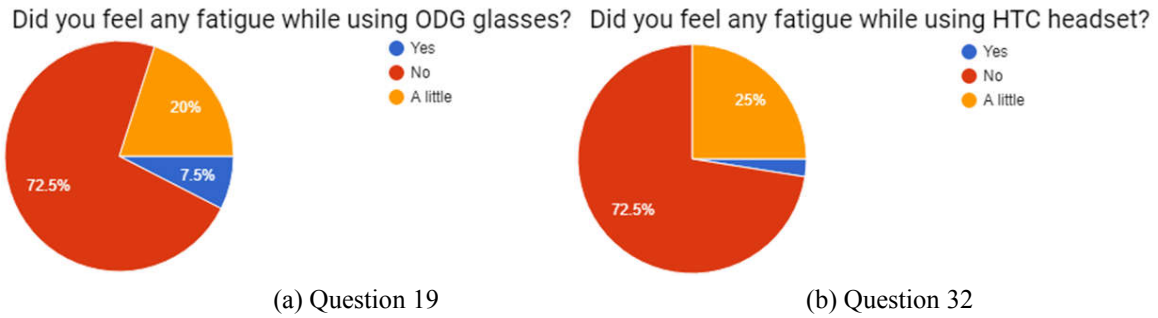


Figure 10 Comparison of fatigue levels for HTC VIVE and ODG smart glasses

Summary of some of the remaining questions from the survey can be seen in Figure 11. From there it can be observed that on average the users were moderately satisfied with Reticle OS and Reticle mouse (Q8), while their satisfaction with ODG based navigation was slightly higher (Q9). Mean value of \$4.2\$ was obtained for Q10, indicating that users were content with our test application, and reasonably content (mean value of 3.95) with application start time. In general higher satisfaction with similar question for HTC VIVE (Q22-Q26) can be seen. It is finally interesting to see if differences in response means for Q7 and Q22 pertaining to immersion rate of two systems (3.45 and 4.48, respectively) have any statistical significance. Again, paired-sample *t*-test was used, which confirmed the significance of the mean difference at 5% level ($t(39)=-2.69, p=0.01$).

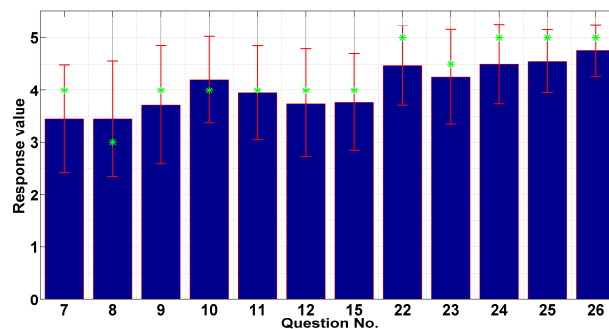


Figure 11 Summary statistics of other interesting questions from the survey. Please note that bar height represents the mean value, whiskers represent standard deviation, and green asterisks represent median values

5. Conclusions

A good user interface should be "user friendly" or "easy to use" and the best way how to generate one like that is to have feedback from the same users. Furthermore, to test equipment and to modify it according to the user feedback, which fully agrees with Myers in (Myers, 1993). Considering the whole survey and gained results, it seems like VR research has taken more into account the user study than the AR research. Sincerely speaking, VR seems to have taken into count the user feedback of effectiveness and efficiency, which is probably the reason why this technology is far more developed and user friendly than AR. AR developers have focused more on technological advancement and computer vision problems than on the user satisfaction.

This research of VR and AR was performed on 40 human users. As much as the VR actually satisfied user's needs, AR smart glasses failed to fulfil the expectations and generally resulted in user frustration and unsatisfactory experience. We believe that AR in future will focus more on user experience and satisfaction which can be traced through detailed user studies. Hopefully, in future the choice of question answer: *Virtual or Augmented Reality: In Which One Would You Like to Live in?*, will not be one-sided as it seems to be now, especially due to significant improvements in the area of MR which takes the best from both worlds.

Appendix A

Table 1 The survey questions

No.	Question	No.	Question
1	Are you male or female?	19	Did you feel any fatigue while using ODG?
2	How old are you?	20	Have you ever tried before any kind of virtual headset?
3	Do you wear glasses or lenses?	21	What is your first impression of HTC VIVE?
4	Are you right or left handed?	22	How would you describe the immersion rate?
5	Have you ever had any kind of augmented experience before?	23	How would you describe the resolution rate on HTC VIVE?
6	What is your first impression of ODG R7 smart glasses?	24	Was it hard for you to find your way around in the virtual reality by HTC?
7	How would you describe the immersion rate?	25	How long it takes to start VR application?
8	What do you think of Reticle OS and Reticle mouse?	26	How long does it take for the sensors to pick up your location?
9	How navigation feels on ODG?	27	Is the HTC VIVE headset uncomfortable on the head?
10	How hard was for you to find Vuforia Test app?	28	How HTC VIVE headset feels on the head?
11	How long it takes to start AR Vuforia application?	29	After some usage time did the HTC headset overheat?
12	How long it takes to detect the AR marker?	30	Did you feel any fatigue while using HTC?
13	- How would you describe the visual representation of the model?	31	How would you rate your overall experience with ODG glasses?
14	How does model track the marker?	32	How would you rate your overall experience with HTC VIVE?
15	How would you describe the resolution rate on ODG R7 smart glasses?	33	Did you experience any problems with your prescription glasses while using ODG or HTC headset?
16	How ODG glasses feel on the head?	34	Which one would you prefer to have: ODG smartglasses or HTC VIVE?
17	Are ODG glasses uncomfortable?	35	If you had to choose, where would you like to live in: augmented or virtual reality?
18	After some usage time did ODG heat up?	36	Do you have any additional comments about your experience?

REFERENCES

- Choi, S., Jung, K., & Noh, S. D. (2015). Virtual reality applications in manufacturing industries: Past research, present findings, and future directions. *Concurrent Engineering*, 23 (1), 40-63.
- Gaffary, Y., Le Gouis, B., Marchal, M., Argelaguet, F., Arnaldi, B., & Lecuyer, A. (2017). AR Feels Softer than VR: Haptic Perception of Stiffness in Augmented versus Virtual Reality. *IEEE Transactions on Visualization & Computer Graphics*, 23(11), 2372-2377.
- Gobbetti, E., & Scateni, R. (1998). Virtual reality: past, present, and future. *Studies in Health Technology and Informatics*, 58, 3-20.
- Hsu, E. B., Li, Y., Bayram, J. D., Levinson, D., Yang, S., & Monahan, C. (2013). State of Virtual Reality Based Disaster Preparedness and Response Training. *PLOS Currents Disaster*, 5.
- Hughes, C. E., Stapleton, C., Hughes, D. E., & Smith, E. (2005). Mixed Reality in Education, Entertainment, and Training. *IEEE Computer Graphics and Applications*, 25 (6), 24-30.
- Jankowski, J., & Grabowski, A. (2015). Usability Evaluation of VR Interface for Mobile Robot Teleoperation. *International Journal of Human Computer Interaction*, 31 (12), 882-889.
- Khor, W. S., Baker, B., Amin, K., Chan, A., Patel, K., & Wong, J. (2016). Augmented and virtual reality in surgery the digital surgical environment: applications, limitations and legal pitfalls. *Annals of Translational Medicine*, 4(23), 454.
- Kim, S.J.J. (2012). A User Study Trends in Augmented Reality and Virtual Reality Research: A Qualitative Study with the Past Three Years of the ISMAR and IEEE VR Conference Papers, In *2012 International Symposium on Ubiquitous Virtual Reality*. Adaejeon: IEEE.
- Lele, A. (2011). Virtual reality and its military utility. *Journal of Ambient Intelligence and Humanized Computing* 4(1), 17-26.
- Li, X., Yi, W., Chi, H-L., Wang, X., & Chan, A. P. C. (2018). A Critical Review of Virtual and Augmented Reality (VR/AR) applications in construction safety. *Automation in Construction*, 86, 150-162.
- Mekni, M., & Lemieux, A. (2014). Augmented Reality: Applications, Challenges and Future Trends. In *13th International Conference on Applied Computer and Applied Computational Science* (pp. 205-214). Kuala Lumpur: WSEAS.
- Mourtzis, D., Zogopoulos, V., & Vlachou, E. (2017). Augmented Reality Application to Support Remote Maintenance as a Service in the Robotics Industry. *Procedia CIRP*, 63, 46 51.
- Myers, B. A. (1993). *Why Are Human-Computer Interfaces Difficult to Design and Implement?* Technical report, Carnegie Mellon University, USA.
- Nee, A. Y. C., & Ong, S. K. (2013). Virtual and Augmented Reality Applications in Manufacturing. *IFAC Proceedings Volumes*, 46 (9), 15-26.
- Ottosson, S. (2002). Virtual reality in the product development process. *Journal of Engineering Design*, 13 (2), 159 – 172.
- Park, H., Son, J. S., & Lee, K. H. (2008). Design evaluation of digital consumer products using virtual reality-based functional behavior simulation. *Journal of Engineering Design*, 19 (4), 359 - 375.
- Pensieri, C., & Pennacchini, M. (2014). Overview: Virtual Reality in Medicine. *Journal of Virtual Worlds Research*, 7 (1), 1-34.
- Rizzo, A., Ford Morie, J., Williams, J., Pair, J., & Galen Buckwalter, J. (2005). Human Emotional State and its Relevance for Military VR Training. In *11th International Conference on Human Computer Interaction*. Las Vegas: ERCIM.
- Roy, E., Bakr, M. M., & George, R. (2017). The need for virtual reality simulators in dental education: A review. *The Saudi Dental Journal*, 29 (2), 41-47.
- Rubio-Tamayo, J. L., Barrio, M. G., & Garcia, F. G. (2017). Immersive Environments and Virtual Reality; Systematic Review and Advances in Communication, Interaction and Simulation. *Multimodal Technologies and Interaction*, 1 (21), 1-20.
- Sutherland, I. E. (1965). The ultimate display. In *Proceedings of Congress of the International Federation of Information Processing (IFIP): Vol. 2* (pp. 506-508.). New York City.
- Sylaiou, S., Mania, K., Karoulis, A., & White, M. (2009). Exploring the relationship between presence and enjoyment in a virtual museum. *International Journal of Human-Computer Studies*, 68 (5), 243-253.

Loading factors within the strength calculation procedure for involute marine gears with parallel axes

Davor Mrsić

University College for Practical Studies (student), Split, Croatia
davor_mrsic@live.com

Marko Vulić

Adria Winch Group, Split, Croatia
vulic@adriawinch.com

Nenad Vulić

Faculty of Maritime Studies, Split, Croatia
nenad.vulic@pfst.hr

Abstract. Unified Requirement UR M56, prescribing the calculation of geometry, surface durability (pitting) and tooth root bending strength of gear pairs implemented in marine propulsion and auxiliary machinery was revised by the International Association of Classification Societies (IACS) in 2013. In the previous paper, published at the CIET 2014 Conference, the author who had taken place in the development of the UR M56 within the task of the IACS Machinery Panel, presented the background of that task, the results, its final outcome and the benefits gained. The most important benefit was the development of the verified and validated MS Excel/VBA calculation program based upon UR M56, developed by that author, which was handed over to the IACS Machinery Panel members to verify the UR M56 proposed calculation procedure itself. One of the drawbacks of the calculation procedure prescribed in UR M56 is that it does not present the way to calculate the loading factors (so called *K*-factors) for a gear pair, other than referring to the ISO 6336-1 standard. This standard has also inherited the problem of certain ambiguities in the calculations of loading factors. The calculation procedure itself is rather extensive and complicated, so the *K*-factors were also omitted in the then developed version of the MS Excel/VBA calculation program. For this reason, additional efforts have been made later to improve the program introducing the entire calculation of loading factors, with all the necessary details. The aim of the present paper is to present the methodology used in the development of this part of the program, methodology of the verification (based upon the recently published technical report ISO/TR 6336-30:2017) and the future validation of the program results.

Key words: *gearing, IACS Unified Requirement UR M56, gear strength, ISO 6336 standards series*

1. Introduction

International Association of Classification Societies (IACS), gathering all the internationally recognised ships and maritime objects classification and technical supervision organisations, published the Unified Requirement UR M56 *Marine gears—load capacity of involute parallel axis spur and helical gears*, Rev. 3 (2015) [1]. The document covers the strength calculation procedure for gear pairs operating in marine propulsion and auxiliary machinery. The procedure may be applied to gear pairs of cylindrical shape with straight or helical, external or internal teeth. It prescribes calculation of geometry, surface durability (pitting) actual and allowable stresses, tooth root bending actual and allowable stress, as well as the strength related to surface durability and tooth root bending, obtained by comparison of calculated and minimal safety factors. The calculation procedure is mainly based upon the actual edition of international standard series ISO 6336, published in 2006, as corrected in 2008.

The previous paper entitled *Amended calculation procedure for involute marine gears with parallel axis*, published at CIET 2014 conference [2], described the why-and-how of the development of the mentioned IACS UR M56 revision of from 2011 to 2013. That paper also describes the development, testing, verification and validation of the Microsoft Excel/Visual Basic for Applications (abbr. Excel/VBA) computer program, needed to check the proposed UR M56 on practical examples. However, at that time, the developed program did not contain calculation of the *service loading factors*, so-called the *K-factors*. The reason was that the procedure prescribed by the ISO 6336 standards to calculate *K-factors* is extensive and complicated. Consequently, programming of the calculation of these factors would have consume too much time, which would not fit within the time frame scheduled IACS Machinery Panel to complete the task of revising the IACS UR M56. In addition to this, regarding calculation of the *K-factors*, the revised edition of IACS UR M56, which was finally adopted by IACS Council, provides only a reference to ISO 6336 standards, not describing the entire procedure (with a single exception, to be mentioned later on).

The present paper describes the on-going development of the Excel/VBA computer program, presently entitled as *S10CylGears_IACS*. The program has been jointly developed within a final assignment task of the first author at the Mechanical Engineering B. Eng. study at the College of Practical Studies of the University of Split. The completed finalised program is expected to be implemented in teaching courses at the Marine Engineering M. Eng. study programme at the Faculty of Maritime Studies of the University of Split, as well as at Adria Winch Group Design and Development Division (in their engineers' everyday tasks of design and strength calculations of cylindrical gear pairs) and by the Croatian Register of Shipping technical specialists in the Machinery and Automation Department, working on their plan approval tasks of marine gearboxes designs.

The present version (3.0) of the program *S10CylGears_IACS*, calculates all the individual gear and gears pair dimensions and other geometry values, as well as all the contact strength and tooth root bending strength related service stresses, allowable stresses and safety factors with a minimum entry of only the necessary input data. This also means that the program itself calculates all the factors (including the *K-factors*), without any need for entering their estimated value. For the reasons explained, the procedure for the calculation of *K-factors* will be presented in the present paper in more details than in the earlier paper.

The developed *S10CylGears_IACS* program has first been tested on examples presented in the previous (CIET 2014) paper and then verified on the eight examples provided in the ISO/TR 6336-30:2017 technical report [3]. It has to be pointed out that the *International Organisation for Standardisation* Technical Committees introduced an excellent practice of developing and publishing technical specifications (TS) and technical reports (TR) presenting practical calculation examples for their computationally extensive standards, providing thus basis to clear possible ambiguities and disputes. Verification results show an excellent agreement of the results obtained by *S10CylGears_IACS* program with those in the ISO/TR 6336-30. Owing to the possibility of implementation of Excel built in *what-if* analysis capability, the program enables the user not only to check the strength of an already developed gear pair, but also to obtain such a design solution meeting a certain prescribed criterion, what can be very important to cylindrical gear pair designers.

2. Gear dimensions and strength calculations

Design and strength calculation of a cylindrical gear pair, similarly to the design and strength calculation of any engineering design component, completely and practically relies upon the definition and selection of the following items:

- Structural design shape;
- Dimensions (geometry and scantlings);
- Material and its production process; and
- Service loading.

Within the present development task the structural design shape is the spur or helical gear pair (pinion and gear wheel) with external or internal toothing, where the term *internal* means that the pinion has external teeth and the gear wheel has internal teeth. Typical design shapes, all covered by the developed program, are presented in Figure 1.

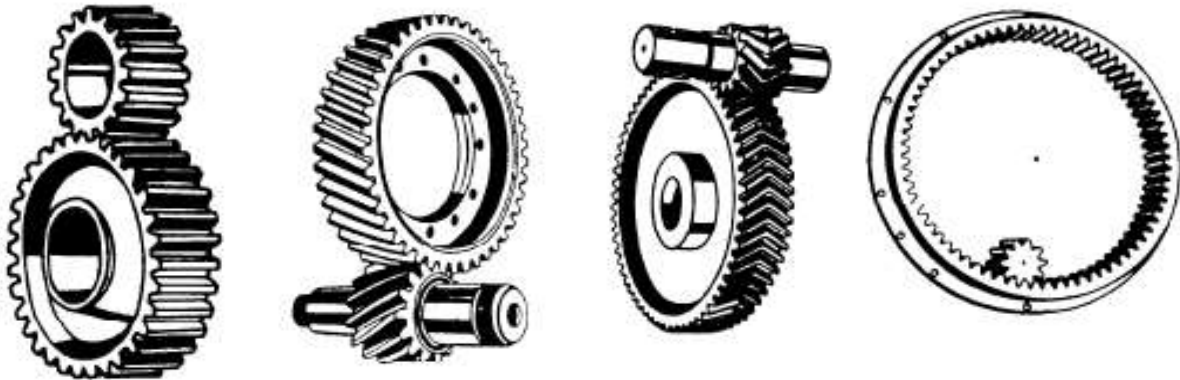


Figure 1 Spur and helical gears design shapes

Dimensions (geometry and scantlings) comprise another important topic to be defined. These have been based upon definitions in the actual standard ISO 21771:2007 [4]. Figure 2 from this standard illustrates a typical set of gear dimensions important for other geometry calculation values.

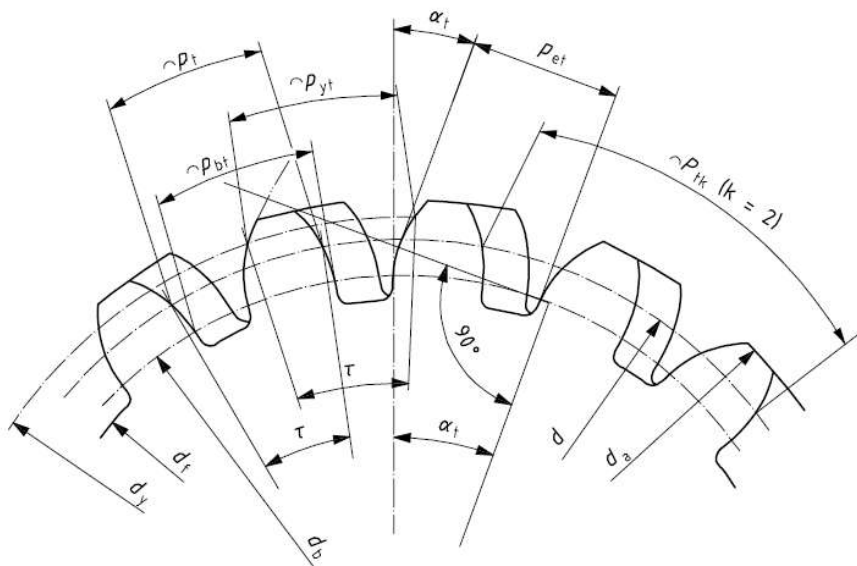


Figure 2 Typical gear geometric values – dimensions (diameters, pitches and angles [4])

The next item is the material and its production process. Material production process means both mechanical and thermic processing (heat treatment). The gear materials have been subdivided into eight categories as presented in Table 1.

Table 1 Gear material types (material; abbreviation; surface hardness)

1 - case hardened steel; Eh; 660-800 HV	5 - alloyed through hardened steel; V; 200-360 HV
2 - nitriding steel, nitrided; NT(nitr.); 650-900 HV	6 - carbon through hardened steel; V; 135-210 HV
3 - through hardening steel, nitrided; NV(nitr.); 450-650 HV	7 - normalized low carbon steel; St; 110-210 HB
4 - flame or induction hardened steel; IF; 500-615 HV	8 - cast steel; St (cast); 140-210 HB

Service loading of gear pair is normally defined upon maximal continuous power transmitted by the gear set P , (in kW) and the rotational speed of pinion (n_1 , in rpm). Instead of power, the service loading can also be specified by means of the torque in way of pinion (T_1 , in kNm) or gear wheel (T_2 , in kNm). In addition to this, service loading strongly depends upon the characteristics of driving and driven machines, as explained further on.

Gear strength calculations, in accordance with the IACS UR M56 [1], as well as the ISO 6336 standards series, comprise calculation of tooth contact stresses (based upon the so-called Z -factors) as described in ISO 6336-2 [5] and tooth root stresses (based upon the Y -factors) from ISO 6336-3 [6]. Both types of strength calculations require the service loading factors (K -factors) to be calculated in accordance with the standard ISO 6336-1 [7].

3. Methods for the calculation of service loading factors

Strength of a cylindrical gear pair strongly depends upon its service loading. In the calculation procedure, according to the standards ISO 6336 series, service loading is expressed by the above mentioned nominal values of mechanical loading values (power, rotational speed, torque), which are increased by the service loading factors. These factors are defined by the standard ISO 6336-1:2006 Corr. 2008 [7]. The IACS UR M56 contains only the verbal reference to the ISO 6336-1 standard [1]. Loading factors refer to the gear pair, i.e. they are not calculated separately for the pinion or the wheel in the gear pair, though the input data of the calculation procedure requires some values entered separately for each gear in the pair. The service loading factors can be combined into the two values by the following equations:

$$K_H = K_A \cdot K_\gamma \cdot K_v \cdot K_{H\alpha} \cdot K_{H\beta} \quad (1)$$

$$K_F = K_A \cdot K_\gamma \cdot K_v \cdot K_{F\alpha} \cdot K_{F\beta} \quad (2)$$

where:

K_H – combined service loading factor for the contact strength;

K_F – combined service loading factor for the tooth root strength.

The particular service loading factors in the equations (1) and (2) will be briefly described hereafter. The complete explanation and reference to these factors can be found in the ISO 6336-1 standard [7].

3.1 Application factor K_A

The application factor K_A adjusts the nominal load F in order to compensate for incremental gear loads from external sources. These additional loads are largely dependent on the characteristics of the driving and driven machines, as well as the masses and stiffness of the system, including shafts and couplings used in service.

The quote from ISO 6336-1 [7] states: *For applications such as marine gears and others subjected to cyclic peak torque (torsional vibrations) and designed for infinite life, the*

application factor can be defined as the ratio between the peak cyclic torques and the nominal rated torque. The nominal rated torque is defined by the rated power and speed. It is the torque used in the load capacity calculations.

From the above definition it is essential to understand why *...it is recommended that the purchaser and manufacturer/designer agree on the value of the application factor...* (as also stated in the ISO 6336-1 [7]). The gearbox designer designs gear pairs specifying nominal torque in way of pinion, T_1 (which may be expressed by the nominal transmitted power and pinion corresponding rotational speed) and the application factor K_A . In the gearbox design phase the application factor normally cannot be determined in accordance with its exact definition, i.e. ratio of torque maximal value (equal to nominal torque plus the torque amplitude due to torsional vibrations) and the nominal torque. At this phase, the complete mechanical system does not yet exist at all, so it is not possible to perform torsional vibration calculations to obtain the actual torque amplitude. Consequently, the gearbox will be specified, designed and delivered for the specified maximal application factor K_A , which can be exactly determined and checked later on, once the whole mechanical system (e.g. all the components of the ship propulsion system) has been specified, with all the details necessary for the calculation of torsional vibrations.

3.2 Load sharing factor K_γ

This factor accounts for the unequal distribution of load in multiple-path transmissions (e.g. epicyclical or dual tandem, etc.) [8]. Calculation of this factor is based upon a very simple formula according to [7] or [8]. E.g. for epicyclical gearboxes with 3; 4; 5 or 6 planetary gears, load sharing factor amounts to 1,00; 1,25; 1,35 or 1,43 respectively.

3.3 Dynamic factor K_v

Dynamic factor accounts for internally generated dynamic loads due to vibrations of pinion and wheel against each other [7], taking into account internally generated dynamic loads due to mesh errors and tooth deformations [8].

The succession of factors in course of calculation is essential to understand the sequence of calculating each of the remaining service loading factors. It is based upon the nominal tangential loading force F_t (equal for both pinion and wheel in the gear pair), and shall be performed as follows [7]:

- a) dynamic factor K_v calculated with the load $F_t \cdot K_A$;
- b) face load distribution factors ($K_{H\beta}$ and $K_{F\beta}$) with the load $F_t \cdot K_A \cdot K_v$;
- c) transverse load distribution factors ($K_{H\alpha}$ and $K_{F\alpha}$) with the load $F_t \cdot K_A \cdot K_v \cdot K_{H\beta}$.

There is another important point to be stated: calculation method by the range of its complexity and accuracy. Methods are the following: Method A, Method B or Method C *Method A factors are derived from the results of full scale load tests, precise measurements or comprehensive mathematical analysis of the transmission system on the basis of proven operating experience, or any combination of these* [7]. In everyday engineering tasks, this method is obviously not of practical importance. Method B calculates factors with sufficient accuracy for most of the gear pair applications. However, this approach may also be very complex, especially with respect to the service loading factors. Method C provides simplified approximations for the calculations of some factors, but it can be subject to some presumptions and conditions, which are not always complied with.

In accordance with [1], the dynamic factor K_v can be calculated by either Method B or Method C, where the Method C is completely specified and described in [1], with all of its assumptions. However, Method B has only been referred to in [1], so just a short description

will be given hereafter. The complete reference to the Method B has been provided in the standard ISO 6336-1 [7], with all the details.

Determination of the dynamic factor using Method B requires calculation of running speed ranges, because the loading excitation frequencies (e.g. tooth meshing frequency and its harmonics) may come very near to the natural frequency of vibration of the gearing system, thus causing resonance with an extremely high tooth loading.

For this reason, at the beginning of the calculation, the speed ranges shall be subdivided into the following running speed ranges: subcritical range, main resonance range and supercritical range [7]. These ranges are dependent upon the resonance speed of the pinion n_{E1} , further on dependent upon the mean value of mesh stiffness per unit face width ($c_{\gamma\alpha}$) and reduced gear pair mass per unit face width referenced to the line of action (m_{red}) as follows [7]:

$$n_{E1} = \frac{30000}{\pi z_1} \sqrt{\frac{c_{\gamma\alpha}}{m_{red}}} \quad (3)$$

Dynamic factor in the e.g. subcritical range is calculated upon the expression [7]:

$$K_v = 1 + N \cdot (C_{V1} \cdot B_p + C_{V2} \cdot B_f + C_{V3} \cdot B_k) \quad (4)$$

In equation (4), factor N stands for the ratio of the pinion speed n_1 to its resonance speed n_{E1} . C_V factors (C_{V1} , C_{V2} , and C_{V3}) account for the pitch deviation effects, tooth profile deviation effects and cyclic variation effect in mesh stiffness respectively. These are dependent mostly upon the total overlap ratio ε_γ , obtained from the gear pair geometry calculations.

However, the non-dimensional B -factors in equation (4), i.e. B_p , B_f , and B_k , as defined in [7] require gear pair single pitch, f_{pb} , and profile deviations, f_{fa} , to be determined, prior to their evaluation. These deviations are determined from their maximal values specified in the ISO 1328-1:1995 standard [5] (obsolete and withdrawn, but used as the reference in the technical report ISO/TR 6336-30 [3], or their tolerances specified in the ISO 1328-1:2013 standard [6]. The approach based upon ISO 1328-1:1995 requires ranges of reference diameter, normal module and gear width to be taken into account, instead of the actual values. However, the technical report ISO/TR 6336-30, though published in 2017, has been based upon the withdrawn standard ISO 1328-1:1995 and actual values of diameters, modules and widths, instead of the ones based upon ranges, what is not in-line with the ISO 1328-1:1995.

For the explained reasons, finally developed calculation program shall contain calculations of deviations and tolerances, in accordance with both editions of ISO 1328-1, [9] and [10].

3.4 Face load distribution factors $K_{H\beta}$ and $K_{F\beta}$

These factors account for the effects of non-uniform distribution of load across the face width. Calculation of the $K_{H\beta}$ factor for the contact stress is very complex and is performed in accordance with the procedure specified as Method C as described in the ISO 6336-1 standard [7]. Method A and Method B, as specified in the standard [7] would be too complex for the normal engineering calculations), so the Method C essentials are briefly presented hereafter.

Factor $K_{H\beta}$ is evaluated from the following formula [7]:

$$K_{H\beta} = \begin{cases} \sqrt{\frac{2F_{\beta y} c_{\gamma\beta}}{F_m / b}} \geq 2; & \text{when } \frac{F_{\beta y} c_{\gamma\beta}}{2F_m / b} \geq 1 \\ 1 + \frac{F_{\beta y} c_{\gamma\beta}}{2F_m / b} \geq 2; & \text{when } \frac{F_{\beta y} c_{\gamma\beta}}{2F_m / b} < 1 \end{cases} \quad (5)$$

Evaluation of the values in equation (5), such as effective equivalent misalignment after running-in ($F_{\beta\gamma}$) or mean value of mesh stiffness per unit face width, $c_{\gamma\alpha}$, has to be performed in accordance with a complex procedure as specified in ISO 6336-1 [7]. This procedure also involves evaluation of gear teeth deviations and tolerances as described in 3.3. Additionally, the position of the pinion on its shaft, defined by bearings arrangement on the shaft, bearing span and bearing offset, shall also be taken into account. Further details about the calculation of $K_{H\beta}$ factor are presented in [7] and are too complicated to be presented here.

On the other hand, calculation of the $K_{F\beta}$ factor for the tooth root bending stress requires only a simple formula, taking into account the tooth height (h) and the gear width (b), once the $K_{H\beta}$ factor has been evaluated, specified as follows [7]:

$$K_{F\beta} = (K_{H\beta})^{N_F}; \text{ where } N_F = \frac{1}{1 + h/b + (h/b)^2} \quad (6)$$

3.5 Transverse load distribution factors $K_{H\alpha}$ and $K_{F\alpha}$

Transverse load distribution factors, $K_{H\alpha}$ for contact stress and $K_{F\alpha}$ for tooth root stress, account for the effects of pitch and profile errors on the transversal load distribution between two or more pairs of teeth in mesh [1]. Both factors mainly depend upon the total mesh stiffness, total tangential load, base pitch error, tip relief and running-in allowances. They are determined by Method B in the ISO 6336-1 standard [7] from the following equation:

$$K_{H\alpha} = K_{F\alpha} = \begin{cases} \frac{\varepsilon_\gamma}{2} \left[0,9 + 0,4 \frac{c_{\gamma\alpha} (f_{pb} - y_\alpha)}{F_t K_A K_v K_{H\beta} / b} \right]; & \text{when } \varepsilon_\gamma \leq 2 \\ 0,9 + 0,4 \sqrt{\frac{2(\varepsilon_\gamma - 1)}{\varepsilon_\gamma} \frac{c_{\gamma\alpha} (f_{pb} - y_\alpha)}{F_t K_A K_v K_{H\beta} / b}}; & \text{when } \varepsilon_\gamma > 2 \end{cases} \quad (7)$$

At the phase of calculation of both transverse load distribution factors, the values of mesh stiffness, $c_{\gamma\alpha}$, base pitch deviation, f_{pb} , and running-in allowance, y_α have been already calculated within the scope of the $K_{H\beta}$ factor calculation. Moreover, the formula (7) explicitly requires the $K_{H\beta}$ factor in the applied total tangential load.

4. Methods for the calculation of actual stresses, allowable stresses and safety factors

Calculation of actual contact stresses, allowable contact stresses and the relevant safety factor has been specified in the ISO 6336-2 standard [5]. Calculation of actual tooth root stresses, allowable tooth root stresses and the relevant safety factor follows the ISO 6336-3 standard [6]. These calculations have been presented in the previous conference CIET 2014 paper [2] and have been completely covered by the-then developed program *S10CilZ_IACS*, so they will not be repeated again.

5. Results and discussion

The first important outcome of this research was the program *S10CylGears_IACS* version 3.0 itself. This is actually the previously developed program *S10CilZ_IACS*, from [2] upgraded with the calculation of tolerances and deviations according to both editions of ISO 1328-1 standards, [9] and [10], as well as with the additional input data and function subprograms necessary for the calculation of all of the service loading factors.

Based upon the input data, all the required factors, including the service loading factors, are now calculated automatically in the program.

The program has been developed in Excel/VBA, where all of the factors have been calculated by means of the *Function* type VBA subprograms. The use of *Sub* type subprograms has been deliberately avoided, in order to keep up with the possibility of using *What-If*, previously *Goal-Seek* analysis in Excel. Thus all the *Function* VBA subprograms may be treated only as an Excel extensions, allowing the use of any of Excel advanced analysis and optimisation features, important to gear designers in this case.

Typical results are presented in Tables 2 to 8 presented hereafter.

Table 2 Geometry input data

UNIVERSITY OF SPLIT - FACULTY OF MARITIME STUDIES		
CYLINDRICAL GEARS - GEOMETRY AND LOAD CAPACITY CALCULATION		
in accordance with IACS UR M56 Rev. 3 (Oct, 2015)		
Program: S10CylGears_IACS.xlsm	Authors: N.Vulić / D.Mrsić / M.Vulić	ver. 3.0 (07 MAY 2018)

Gear pair: **ISO/TR 6336-30:2017, Example 1**

Job id.: **CIET 2018**

Normal pressure angle at reference cylinder	$\alpha_n =$	20 °
Helix angle at reference cylinder	$\beta =$	15,8 °
Normal module	$m_n =$	8 mm
Centre distance	$a =$	500 mm

Note: for internal gear pair, center distance a and number of teeth z_2 shall be input as negative values

	<u>Pinion</u>	<u>Wheel</u>
Number of teeth	$z_1 =$ 17 (external toothing)	$z_2 =$ 103 (external toothing)
Face width of gears	$b_1 =$ 100 mm	$b_2 =$ 100 mm
Transverse pressure angle at reference cylinder	$\alpha_t =$	20,720 °
Transverse pressure angle at working pitch cylinder	$\alpha_{tw} =$	21,066 °
Helix angle at base cylinder	$\beta_b =$	14,825 °
Transverse module	$m_t =$	8,314 mm
Sum of radii at reference circle	$a_d =$	498,85 mm
Gear ratio	$u =$	6,0588
Sum of addendum modification coefficients, Σx	$x_1 + x_2 =$	0,1452
Tip shortening factor	$k =$	-0,0012
Common facewidth of gear pair at reference cylinder	$b =$	100 mm
Double helical gears:	no	

	<u>Pinion</u>	<u>Wheel</u>
Virtual number of teeth	$z_{n1} =$ 18,905	$z_{n2} =$ 114,543
Reference diameter	$d_1 =$ 141,34 mm	$d_2 =$ 856,35 mm
Working diameter	$d_{w1} =$ 141,67 mm	$d_{w2} =$ 858,33 mm
Base diameter	$d_{b1} =$ 132,20 mm	$d_{b2} =$ 800,97 mm

Table 3 Geometry results

To finish the gear design, addendum modification coefficient of **pinion** has been selected and input

		recom. x_1	recom. x_2
Chosen addendum modification coefficient	x_1 or $x_2 =$	0,145222	0,367
Addendum of the standard basic rack tooth profile	$h_{ap}/m_n =$	1,0008	
Dedendum of the standard basic rack tooth profile	$h_{fp}/m_n =$	1,4	
Tip clearance	$c_p/m_n =$	0,2566121	Internal toothing cutter
Basic rack fillet root radius (ISO 53:1998)	$\rho_{fp}/m_n =$	0,390	$z_0 =$
Residual undercut	$S_{pr}/m_n =$	0	$x_0 =$
	<u>Pinion</u>		<u>Wheel</u>
Addendum modification (profile shi)	$x_1 =$	0,145222	$x_2 =$
Addendum of cylindrical gear	$h_{a1} =$	9,16 mm	$h_{a2} =$
Dendum of cylindrical gear	$h_{f1} =$	10,04 mm	$h_{f2} =$
Tip diameter	$d_{a1} =$	159,66 mm	$d_{a2} =$
Root diameter	$d_{f1} =$	121,26 mm	$d_{f2} =$
Transverse contact ratio	$\epsilon_\alpha =$	1,5490	
Overlap ratio	$\epsilon_\beta =$	1,0834	
Total contact ratio	$\epsilon_\gamma =$	2,6323	

Table 4 Tolerances and deviations according to ISO 1328-1:2013 standard

	<u>Pinion</u>	<u>Wheel</u>
ISO accuracy grades (3-8)	$Q_{ISO1} =$ 5	$Q_{ISO2} =$ 5
Standard	ISO 1328-1:2013	
	<u>Pinion</u>	<u>Wheel</u>
Single pitch tolerance	$f_{pT1} =$ 8,3 μm	$f_{pT2} =$ 9,1 μm
Cumulative pitch (index) tolerance, total	$F_{pT1} =$ 24,4 μm	$F_{pT2} =$ 35,4 μm
Profile tolerances		
Profile slope tolerance	$f_{H\alpha T1} =$ 7,3 μm	$f_{H\alpha T2} =$ 8,1 μm
Profile form tolerance	$f_{F\alpha T1} =$ 9,4 μm	$f_{F\alpha T2} =$ 9,4 μm
Profile tolerance, total	$F_{\alpha T1} =$ 11,9 μm	$F_{\alpha T2} =$ 12,4 μm
Helix tolerances		
Helix slope tolerance	$f_{H\beta T1} =$ 8,1 μm	$f_{H\beta T2} =$ 9,0 μm
Helix form tolerance	$f_{F\beta T1} =$ 9,3 μm	$f_{F\beta T2} =$ 10,5 μm
Helix tolerance, total	$F_{\beta T1} =$ 12,4 μm	$F_{\beta T2} =$ 13,8 μm

Table 5 Input data for strength calculations

Application (main propulsion gears- 1, auxiliary gears- 2, min. safety- 0)		0
Contact pattern (imperfect / favourable / ideal)		imperfect
Helix modification (none - 1, central crowning with $C_\beta=0,5f_{ma}$ - 2, central crowning $C_\beta=0,5(f_{ma}+f_{sh})$ - 3, helix correction only - 4, helix correction plus central crowning - 5, end relief - 6)		1 (ISO 6336-1, Table 8)
Lubricating oil kinem. viscosity at temperature $t =$	40 °C	$\nu =$ 320 mm^2/s
Initial tip relief (before running-in)		$C_a =$ 70 μm
Surface roughness (approximate relation $R_z = 6R_a$)	<u>Pinion</u>	<u>Wheel</u>
... of tooth flank	$R_{zH1} =$ 6 μm	$R_{zH2} =$ 6 μm
... of tooth fillet	$R_{zF1} =$ 18 μm	$R_{zF2} =$ 18 μm

Table 6 Gear material and loading data

	Pinion	Wheel
<u>Gear material properties</u>	Eh - MQ	Eh - MQ
Specific density	$\rho_1 = 7850 \text{ kg/m}^3$	$\rho_2 = 7850 \text{ kg/m}^3$
Gear material type	$Mat_1 = 1$	$Mat_2 = 1$
Tensile strength of gear material	$R_{m1} = 1000 \text{ N/mm}^2$	$R_{m2} = 1000 \text{ N/mm}^2$
Yield strength of gear material	$R_{e1} = 500 \text{ N/mm}^2$	$R_{e2} = 500 \text{ N/mm}^2$
Surface hardness	$H_{S1} = 60 \text{ HRc}$	$H_{S2} = 60 \text{ HRc}$
Endurance limit for contact stress*	$\sigma_{Hlim1} =$	$\sigma_{Hlim2} =$
Tooth root endurance limit, $\sigma_{FE} = Y_{ST} \sigma_{Hlim}^*$	$\sigma_{Flim1} =$	$\sigma_{Flim2} =$
*) if blank or zero, calculated according to ISO 6336-5:2016		
Rim thickness (zero for no rim, i.e. solid gears)	$s_{R1} = 0 \text{ mm}$	$s_{R2} = 0 \text{ mm}$
Design factor (in general- 1 ; part load reversed- 0,9 ; idler gears- 0,7)	$Y_{d1} = 1$	$Y_{d2} = 1$
Max. continuous power transmitted by gear set	$P = 339,29201 \text{ kW}$	
Rotational speed of pinion	$n_1 = 360 \text{ rpm}$	
Required life (in hours)	$L_h = 50000 \text{ h}$	
Application factor	$K_A = 1$	
Load sharing factor (number of planetary gears is up to 3)	$K_V = 1,0$	
CALCULATED DYNAMIC VALUES		
Rotational speed of wheel		$n_2 = 59,417 \text{ rpm}$
Torque, in way of	$T_1 = 9,000 \text{ kNm}$	$T_2 = 54,529 \text{ kNm}$
Loading on reference diameter		
Tangential load	$F_t = 127,352 \text{ kN}$	
Radial load	$F_r = 48,173 \text{ kN}$	
Axial load	$F_a = 36,037 \text{ kN}$	
Linear velocity at pitch diameter	$v = 2,664 \text{ m/s}$	

Table 7 Service loading factors for contact stresses

Application factor	$K_A = 1,000$	
Load sharing factor	$K_V = 1,000$	
Tolerances and deviations calculation standard	ISO 1328-1: 1995	
Mesh misalignment	$f_{ma} = 13,1 \mu\text{m}$	
	<u>Pinion</u>	<u>Wheel</u>
Base pitch tolerance (deviation)	$f_{pb1} = 7,4 \mu\text{m}$	$f_{pb2} = 9,0 \mu\text{m}$
Profile form tolerance (deviation)	$f_{fa1} = 9,8 \mu\text{m}$	$f_{fa2} = 12,1 \mu\text{m}$
Internal dynamic factor ...		
... in accordance with ISO 6336-1, Method B	$K_{v-B} = 1,003$	
... in accordance with ISO 6336-1, Method C	$K_{v-C} = 1,012$ (conditions satisfied)	
... value actually taken further on: Method B	$K_V = 1,003$	
Pinion shaft arrangement (ISO 6336-1, Figure 13)	Case = 1 (see the last sheet)	
... bearing span	$l = 125 \text{ mm}$	
... bearing span offset	$s = 0 \text{ mm}$	
External diameter of pinion shaft	$d_{ext} = 100 \text{ mm}$	
Face load distribution factor	$K_{H\beta} = 1,161$ (ISO 6336-1, Method C)	
Transverse load factor for contact stress	$K_{H\alpha} = 1,000$ (ISO 6336-1, Method B)	
Overall load factor, surface	$K_H = K_A K_V K_V K_{H\alpha} K_{H\beta} = 1,165$	

Table 8 Service loading factors for tooth root stresses

Application factor	$K_A=$	1,000
Load sharing factor	$K_V=$	1,000
Internal dynamic factor	$K_{V'}=$	1,003 (ISO 6336-1, Method B)
Face load distribution factor	$K_{F\beta}=$	1,129 (ISO 6336-1, Method C)
Transverse load distribution factor	$K_{F\alpha}=$	1,000 (ISO 6336-1, Method B)
Overall load factor, tooth root	$K_F=K_A K_V K_{V'} K_{F\alpha} K_{F\beta}=$	1,133

Tooth form Y_F and stress corection factor Y_S calculated in accordance with:

ISO 6336-3:2006 & Corr. 1:2008

The developed program *S10CylGears_IACS*, version 3.0, has been verified on the eight examples showed in the technical report ISO/TR 6336-30 [7]. The first example in [7] is presented there with all the calculation and formulae details. All the results show excellent agreement with the ones in [7], so there is no need to comment them separately hereafter.

Program validation is still pending. It is expected to be performed in Adria Winch Group and the Croatian Register of Shipping on actual practical examples in everyday work of their designers and technical specialists. The authors will use feedback from this validation to improve the program in future.

6. Conclusion

The aim of this paper is to present important issues and solutions to problems that were faced with during the development, testing and verification of the Excel/VBA computer program *S10CylGears_IACS*, for the calculation of spur (straight teeth) or helical (oblique teeth) cylindrical gear pairs with external or internal teeth. The task was to develop the program capable of calculation of gear pair dimensions, overlap ratios, tolerances and deviations required for the strength calculations, as well as the calculation of actual service stresses, allowable stresses and safety factors, both for the contact strength and tooth root strength.

Calculations of the service loading factors (K -factors) follow the extensive and complicated procedure described in ISO 6336-1 [7]. Calculations also require evaluation of deviations and tolerances based upon the ISO 1328-1 standards [9], [10], as they are used to calculate several K -factors. Due to this, K -factors calculations were not implemented in the previous program versions, as described in CIET 2014 paper [10], but the K -factors had to be supposed and entered directly into the program. For this reason, the calculation procedures for the K -factors is presented in some more details necessary to understand its basic concepts.

Developed program *S10CylGears_IACS* (version 3.0) enables the user (a mechanical or a marine engineering student, a design engineer who designs gears and/or gearboxes, or a class society engineering technical specialists) to quickly obtain all the necessary geometry definition and strength check calculation values. The program is developed in Microsoft Excel/Visual Basic for Applications (Excel/VBA) implementing only *Function* type subprograms in VBA. Regardless of the complexness of these subprograms, they can in each case be understood as the extension of the Excel itself, thus leaving enabled the possibility of using some extended Excel features of its what-if-analysis. This is of a special practical importance during the conceptual design phase of the gears and gear pairs.

The program has been tested on all the examples presented in the technical report ISO/TR 6336-30:2017 [7]. The results obtained by the program have been compared with the results in the technical report and show excellent agreement for each and every of the eight calculation results presented in the report.

This proves that the idea of assigning such a development task to the mechanical engineering student as the final assignment, proposing the Excel/VBA as the development tool, finally brought out a useful tool for mechanical engineers in their practical everyday life tasks of designing and checking cylindrical gears and gear pairs strength and safety.

Further development of the program will rely upon the requirements of the engineers that will be using it, as well as the problems they will encounter in their work using the program. There are no obstacles to implement a similar development concept to a similar program for bevel and hypoid gear pairs, based upon other ISO standards. This has already been commenced with a group of Marine Engineering students attending their final year of the master's degree study at the Faculty of Maritime Studies, Split.

REFERENCES

- [1] ... (2015) IACS Unified Requirement UR M56 Marine gears—load capacity of involute parallel axis spur and helical gears, (Rev. 3, October 2015). *IACS Blue Book*, pp. 1-23, Retrieved April 15, 2018, from <http://www.iacs.org.uk/blue-book/>
- [2] Vulić, N. (2014) *Amended calculation procedure for involute marine gears with parallel axis* (paper TR03_P01). *Contemporary Issues in Economy & Technology (CIET 2014), June 19th -20th 2014, Conference Proceedings* (pp. P303-P312), Split, Croatia
- [3] ... ISO/TR 6336-30 (2017) *Calculation of load capacity of spur and helical gears-Part 30: Calculation examples for the application of ISO 6336 parts 1,2,3,5*. Geneva, Switzerland: International Organization for Standardization.
- [4] ... ISO 21771 (2007), *Gears-Cylindrical involute gears and gear pairs-Concepts and geometry*. Geneva, Switzerland: International Organization for Standardization.
- [5] ... ISO 6336-2:2006 & Corr. 1 (2008) *Calculation of load capacity of spur and helical gears-Part 2: Calculation of surface durability (pitting)*. Geneva, Switzerland: International Organization for Standardization.
- [6] ... ISO 6336-3:2006 & Corr. 1 (2008) *Calculation of load capacity of spur and helical gears-Part 3: Calculation of tooth bending strength*. Geneva, Switzerland: International Organization for Standardization
- [7] ... ISO 6336-1:2006 & Corr. (2008) *Calculation of load capacity of spur and helical gears-Part 2: Calculation of surface durability (pitting)*. Geneva, Switzerland: International Organization for Standardization.
- [8] ... (2013) *Rules for the Classification of Ships, Part 9-Machinery*. Split, Croatia: Croatian Register of Shipping.
- [9] ... ISO 1328-1 (1995) *Cylindrical gears - ISO system of accuracy - Part 1: Definitions and allowable values of deviations relevant to corresponding flanks of gear teeth*. Geneva, Switzerland: International Organization for Standardization.
- [10] ... ISO 1328-1 (2013) *Cylindrical gears - ISO system of flank tolerance classification - Part 1: Definitions and allowable values of deviations relevant to flanks of gear teeth*. Geneva, Switzerland: International Organization for Standardization.

Using Croatian Qualification Framework and Organizational Growth Model to help SME's specify job qualifications

Igor Nazor

University Department of Professional Studies, University of Split, Split, Croatia
inazor@oss.unist.hr

Karmen Klarin

University Department of Professional Studies, University of Split, Split, Croatia
igor.nazor@oss.unist.hr

Abstract. Since joining the EU Croatia increasingly started with the implementation of Croatian Qualification Framework (CROQF) with the main aim of standardising the qualifications and competencies. Such standard will serve as a base for connecting various educational and study programmes. It will also be directed towards the marketplace. Other goals of CROQF include establishing the Register of Occupational Standards and the Register of Qualifications Standards, taxonomies which use competencies to establish connection between occupations and qualifications. Organizational Growth Model (OGM) is a methodology developed with the aim of automating the process of selection of ERP systems for small and medium enterprises (SME) by using a knowledge base to specify functional requirements. One of the phases of OGM is specification of business processes within the SME. The proposal is to establish a link between the individual processes generated by OGM and appropriate competencies in Register of Qualifications Standards in order to obtain a new ontology. Appropriate tools, standards and procedures can be applied to the obtained ontology in order to extract the knowledge about occupations required by a particular SME.

Key words: *Croatian Qualification Framework, Organizational Growth Model, qualifications requirements*

1. Introduction

This article describes an implementation of *Organizational growth model* [1] and ontology for knowledge representation with the aim of facilitating the process of identifying the right employees for small and medium enterprises (SME).

SMEs, because of their size, often lack expertise and infrastructure for adequately performing the hiring process. They usually don't have human resources (HR) department to manage the lengthy process of candidate selection. The selection process includes posting job openings, processing applications, conducting multiple rounds of interviews and giving an objective assessment of each candidate's competence. SMEs often take shortcuts in this process, often relying on subjective opinion of a candidate rather than grading them based on a set of objective criteria.

In the process of developing an automated methodology for describing the *as-is* state in SMEs, a hierarchical decomposition of business processes is generated during interaction between the user and knowledge base.

Development of standardized format for storing and retrieving the knowledge in the domain of Human resources led to the definition of a cluster of ontologies [1] [2] which formalize representation of both job seekers' skills and employers' requirements.

In [2] [3] an ontologies cluster for Human resources management has been developed. With the aim of standardizing skills and competencies across the domain of job seekers and job offers. The underlying idea is that skills and competencies of job seekers and job requirements of employers are represented in a standardized way. Such representation will lead to a standardized format of storing the knowledge and a standardized way of querying such knowledge bases.

1.1 Domain of interest

This research covers several aspects of SMEs: organizational structure, employees, business processes and competencies needed to execute the processes. The main aim is to formalize the competencies needed to execute a business processes and match them to formalized specification of job-seekers competencies.

Job-seekers obtain their competencies from education, training, and work experience. Competencies also come from certain desirable personality traits, talents and preferences needed for a specific job position.

There are several existing standards and taxonomies that cover parts of the researched domain, such as standards for business processes, workplaces, or education (Figure 1).

Additional motivator for this research is the current development of Croatian qualifications framework (CROQF) [4], which is based on European skills, competencies and occupations taxonomy (ESCO) [5], a multilingual classification of occupations, skills, competencies and qualifications. The aim of CROQF is to standardize two domains: qualifications, which arise from educational process; and occupations, which represent needs of employers. Structure of the taxonomies mentioned and relations between their elements is shown in the upper section of Figure 6.

2. Small and Medium Enterprises (SME)

There are different definitions of SME, depending on which of their aspects is considered. The European commission defines SMEs as companies that have fewer than 250 employees and either an annual turnover of less than 40 M€ or an annual balance-sheet total of less than 27 M€ while conforming to certain criterions of independence [1].

Generally, there are certain characteristics that apply to most SMEs. They often operate from one or just a few locations, have a flexible organizational structure and are often led by a single person (usually the owner) who is aware of most details of day-to-day business within the company. As SMEs usually operate in a competitive environment, most resources, both financial and human, are directed towards surviving and thriving on the market, leaving insufficient resources for "non-critical" activities, such as human resources management or selection of an appropriate business information system.

3. Ontology

Research on the application of ontologies in knowledge engineering and artificial intelligence for storing and displaying information about the real started in the 1990's.

In order to perform value-adding tasks, an information system must be capable of reasoning. Most ontologies experts agree that ontologies are main enabler in helping information systems achieve that task.

The building blocks of an ontology are concepts, definitions, relations, and rules. Vocabularies and taxonomies [6] are the main structures used for building an ontology-based knowledge base.

Vocabulary is an alphabetical index of words containing information about a specific word: its meaning, forms, pronunciation, function, etymology, and syntax. Taxonomy, in general, is a set of classification rules.

Concepts and relations that form a vocabulary can be defined either using free-form text or using a formal syntax, such as *first order logic* (FOL) or *descriptive logic* (DL). While use of formal syntax is preferred as it enables automated reasoning (inferring a conclusion based on a formalized set of rules), it is often a demanding task to formalize definitions of all vocabulary items, therefore it is rarely done for the full set of vocabulary items.

A big challenge when creating an ontology is to make its parts reusable. Utilizing reusable parts of existing ontologies significantly simplifies the process of defining new ontologies that cover a wide domain.

4. Organizational Growth Model

Considering SME's general lack of resources for non-critical activities, within the project of Development of feasibility assessment methodology for implementation of ERP systems in SMEs [11][1], based on the results of researching organizational behaviour of SMEs in various industry verticals, a semi-automated method called *In-depth decomposition model* (DDM) was developed, supported by a set of software tools, with the aim to assist SMEs in selecting a new ERP system. DDM stores formally described knowledge about organizational characteristics of SMEs, namely how their organizational structure changes with increase in number of employees.

Company's main industry vertical and its size (number of employees) are used as initial parameters. DDM has four main steps: 1) automatic generation of company's organizational structure; 2) generation of process model; 3) generation of functional requirements list; 4) assessment of available alternatives by querying services that contain knowledge about characteristics of different ERP systems.

4.1 Describing organizational structure

Algorithm called *Organizational growth model* is used in the initial step where the user provides basic information about SME: industry vertical and number of employees. The software tool, using the OGM and stored knowledge, proposes the model of SME's organizational structure (Figure 1). User can adjust the proposed model by editing the nodes in the hierarchy and entering correct information about actual names of departments or changing the number of employees in each node.

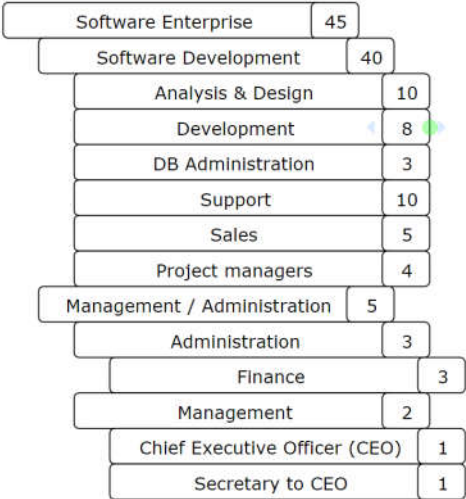


Figure 1 SME's organizational structure generated by the OGM

4.2 Modelling business processes

The second step is modelling business processes based on the organizational structure created in the previous step and formalized expert knowledge of business processes that are supported by a company's organization unit. The knowledge base implements a proprietary ontology of business processes based on the existing business process ontologies: Process classification framework [7] and Catalogue of common business processes [8]. It also contains formalized knowledge of the business processes that each organizational unit must support. An excerpt from the hierarchy describing business processes developed in [1] is shown in Figure 2.

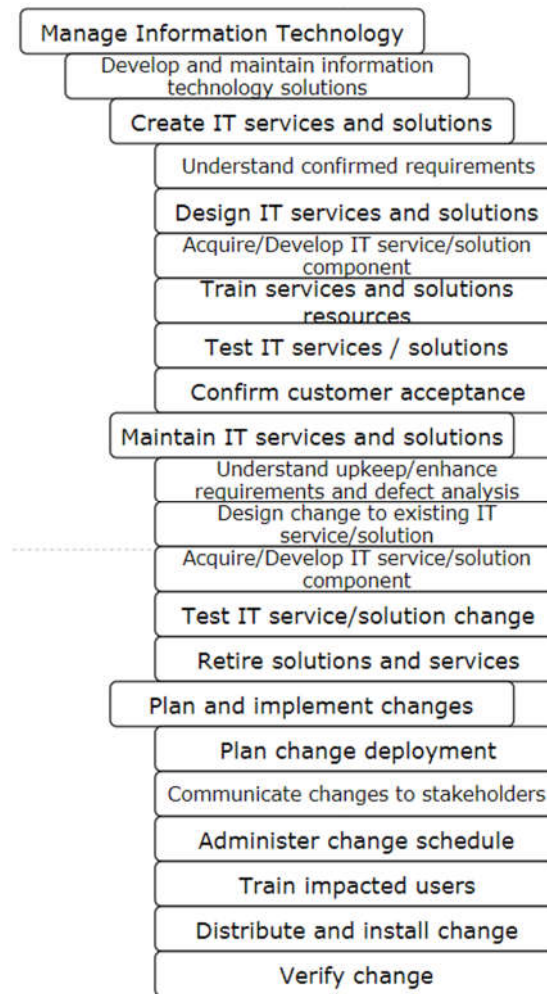


Figure 2 Business process taxonomy

Figure 3 shows the connections between elements of taxonomy of organizational units (left side) and elements of taxonomy of business processes (right side). The knowledge is represented by lines connecting elements from the two taxonomies. Elements of the ontology are organized in a hierarchical fashion and connections can be made between elements at different levels of decomposition, making it possible for the algorithm to return meaningful results even when there are no direct connections between the leaf elements, based on connections that their parent elements have.

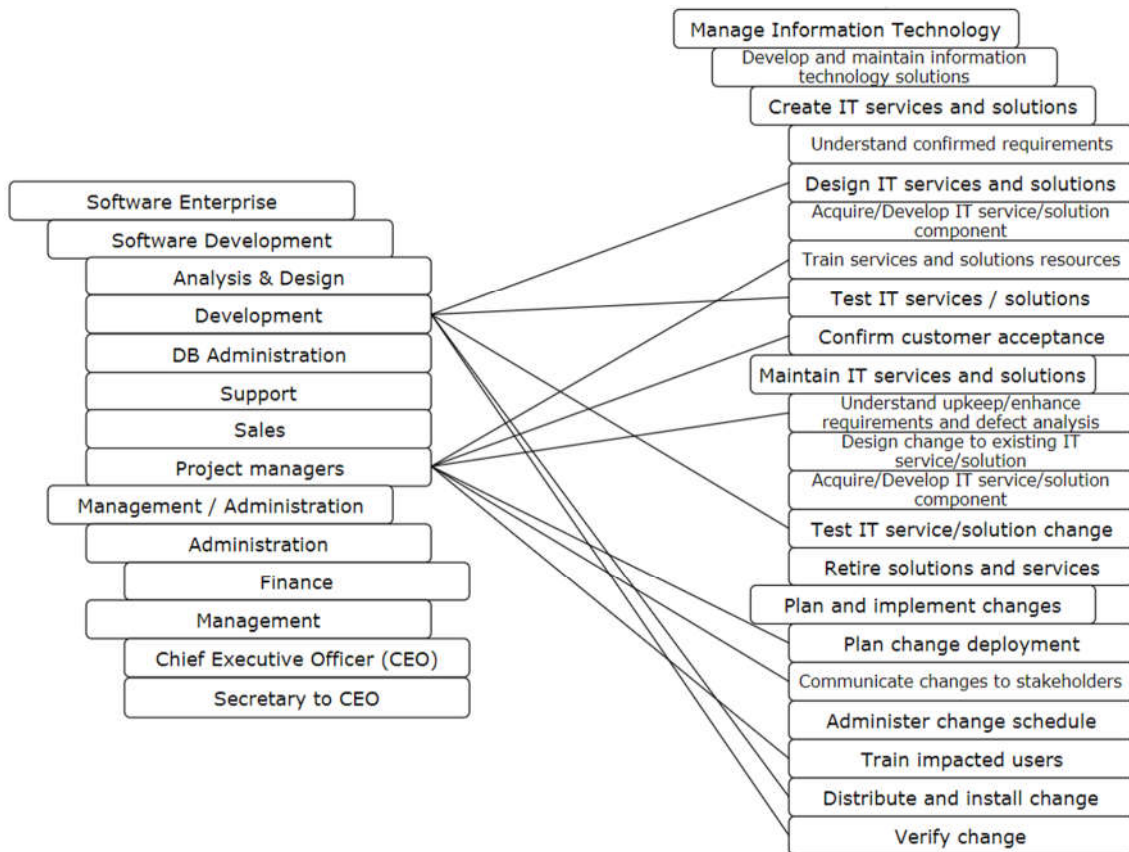


Figure 3 Relation between Organizational structure and Process model

4.3 Interfacing to Skills & Competencies Ontology

To be able to execute a business process, one must have the required skills and competencies. To formally describe such a requirement, a connection must be made between elements of Business process taxonomy and elements of Skills & Competencies taxonomy.

Competency [4] is a mix of knowledge, skills, attitudes, and personal traits enabling a person to actively and efficiently participate in a specific business situation. It means having the ability to apply knowledge, skills, or social interaction techniques in both personal and professional life. Competencies can be: a) generic, which include knowledge, skills, and abilities that a person should have after completing a certain degree of education, independently of the domain of study, or b) specific, which are related to a professional domain.

Let P be a set of all business processes in all enterprises and C the set of all elements of the Skills & Competencies Ontology. Let $P(C)$ be the partitive set of C .

Function PC assigns the subset of vertices of graph C to the business process $p \in P$:

$$PC : P \rightarrow P(C).$$

Function PC is shown on Figure 3 as links between nodes of two hierarchies. A link between two elements means that a process (left side) needs a competency (right side) to be executed.



Figure 4 Relation between Process model and Skills/Competencies Ontology

5. Connecting the Ontologies

To implement ontologies in practice, one must address the issue of interoperability, which arises when different information systems need to exchange content and functionalities in a meaningful way. Practical solutions to the problem of connecting functionally different information systems are [9]:

- Classical approach, creation of unique interpreters between each of the two communicating information systems. This approach requires creating $n^2 - n$ unique interpreters for n communicating systems (left side of Figure 5).
- Creation of an ontology as semantic base for a mid-tier language. Using this approach, n communicating systems require only $2n$ interpreters, since each system only needs an interpreter for the common ontology (right side of Figure 5).

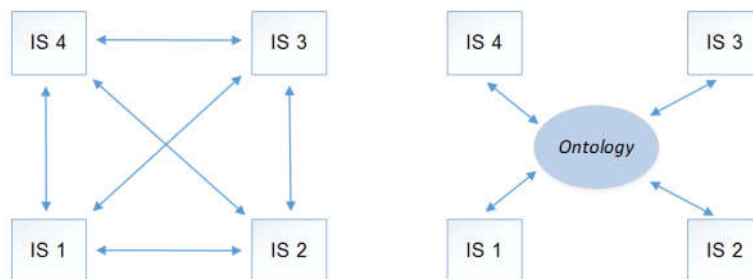


Figure 5 Variation of interoperability approach; classical (left) and with ontology (right)

A part of the practical implementation of interoperability is *semantic web*, which is an extension of common web with techniques and mechanisms for efficient detection and connecting various sources of information (in the case of DDI, databases that contain knowledge about information systems for SMEs). Main purpose of semantic web is to tag the information using *metadata*, which further defines its meaning, characteristics, and relations to other pieces of information.

Ontologies have a key role in functioning of semantic web because they define dictionaries of metadata and improve management of knowledge by significantly improving searching, refinement, and maintenance of data. Using reasoning mechanisms, the knowledge embedded in ontologies can be used to detect advanced relations between pieces of information.

The metadata structure that represents framework for generation of queries from specific SME's information systems is defined in previous section. These structures must be implemented in the database of a specific information system to act as translator when creating a query to other information systems that "speak" the language used in the query (right side of Figure 5). Main connector between all the elements of the system developed in this paper is the set of ESCO taxonomies.

Figure 6 shows the content and structure of SME's Business Domain that needs to be constructed and connected with other standards. Two main problems arise: constructing taxonomies for Organization ontology and Business process ontology and creating queries from business information systems that can be recognized and understood by the recipient information systems.

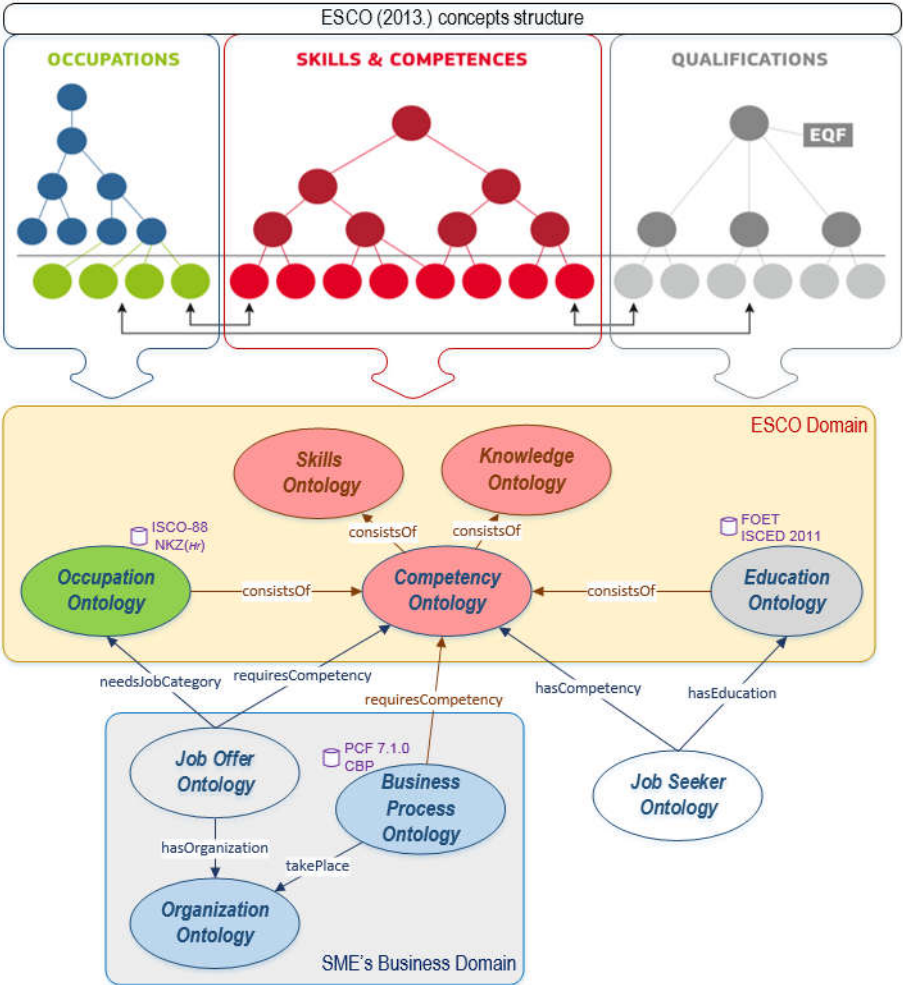


Figure 6 Ontology cluster for occupation and education systems with SME's business domain

First problem has been solved in the previous chapter with the emphasis on the Skills and Competencies ontology which represents a common language in communication of SME's information system with other ontologies of ESCO standard, primarily with the ontology of Occupations [10].

The second problem, creation of a query, is solved by a procedure that enables selecting one or more business processes with the attached skills and competencies. The query should be formed as an RDF/XML structure, which is a standard for to the ontological communication languages

6. Querying for Skilled Workers; an Example

Figure 7 shows examples for ESCO domain taxonomies with Computer Science knowledge area [11] [12]. In a practical application, level of granularity of ontology elements is a matter of collective agreement between all interested parties. Decomposition in Figure 7 enables communication between different information systems via an RDF/XML request. Content shown on Figure 7 is generated by *CoGui* [13] [6], a visual editor for graph-based ontology representation and reasoning.

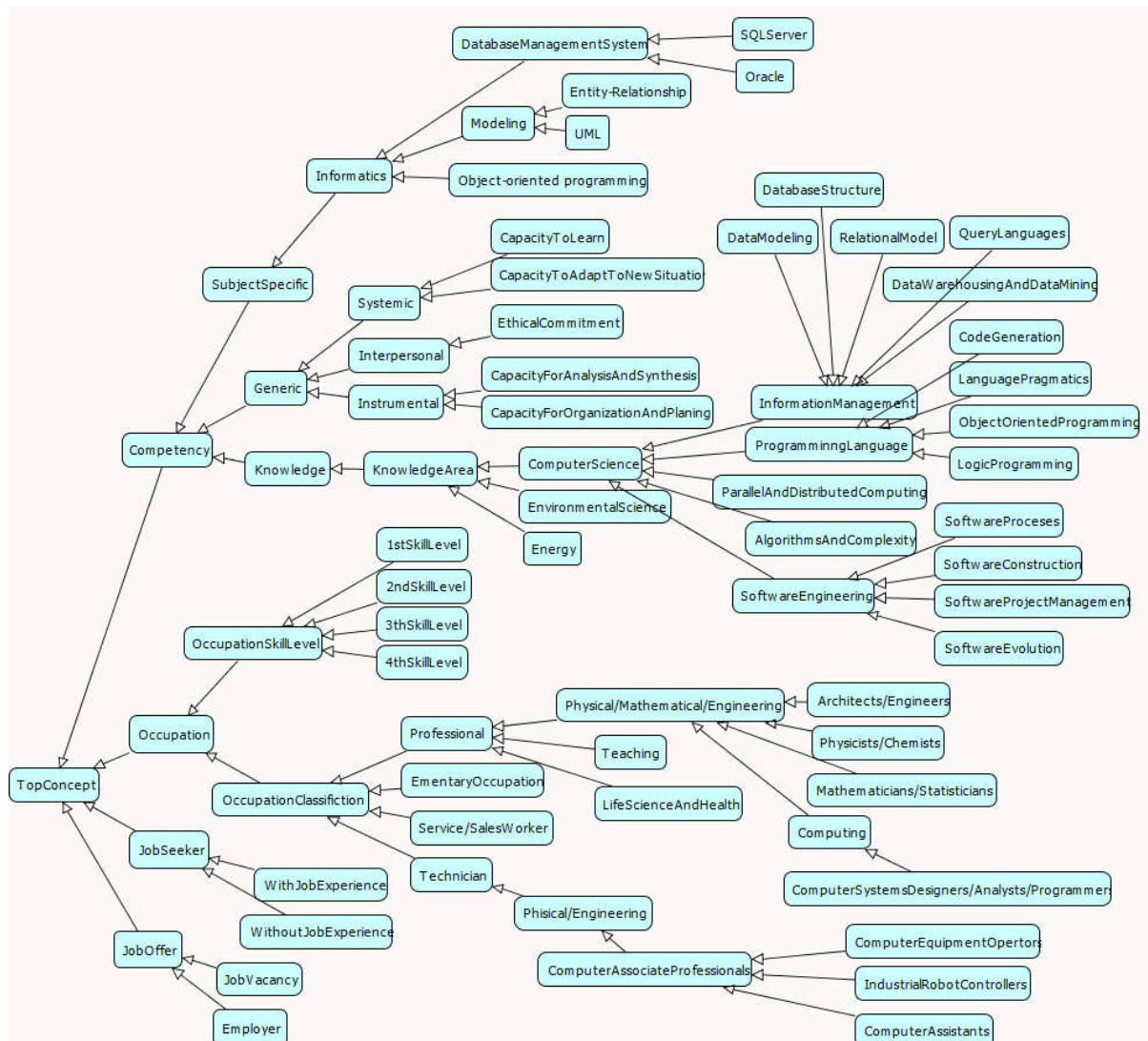


Figure 7 Concepts taxonomy for Competence & Occupation ontology

The taxonomy of concepts (shown in Figure 7 as the node *TopConcept*) and the taxonomy of relations are basic elements used for formalizing an ontology. For an ontology to be a

knowledge base, it must also contain facts, queries, axioms, and other elements necessary for efficient knowledge representation and reasoning.

The graph shown on Figure 8 can be interpreted by the following statement: *Competencies defined in the Competency ontology are standardized in both the JobOffer ontology and the Occupation ontology.* In the example described in this paper, standardization of competencies in JobOffer ontology is arises from the requirement of business processes to have competencies (Figure 4).

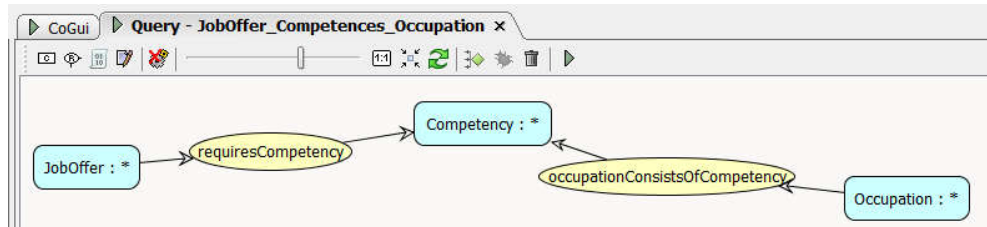


Figure 8 Graph for query: *Competencies required by JobOffer and are part of Occupation*

The first step in the process of SME querying for job-seekers with required competencies is to create a query from SME based on the business processes that are being executed (Figure 2) and required competencies (Figure 3). Visual representation of such request would be similar to the one shown in Figure 8.

The query-answering mechanism that returns results from generated queries based on the embedded elements of ontology, facts and rules has following steps:

- Loading the query that originates from SME (upper part of Figure 9)
- Querying of existing facts that represent occupations with the matching skills and competencies (lower part of Figure 9).
- Graph-based knowledge representation and reasoning tools have built-in procedures such as connecting multiple graphs, which is demonstrated by connecting the graphs shown in Figure 9. The described process connects the elements that describe business processes in SME with the taxonomy of jobs using the Skills & Competencies ontology as a common language for communication (Figures 10 and 11).
- The queries that are usually made by the companies looking for employees are formed as a job posting in specialized papers or portals, can be written into the database that supports the described ontology. An example of such query is shown on Figure 8, and the corresponding reply is shown on Figure 12.

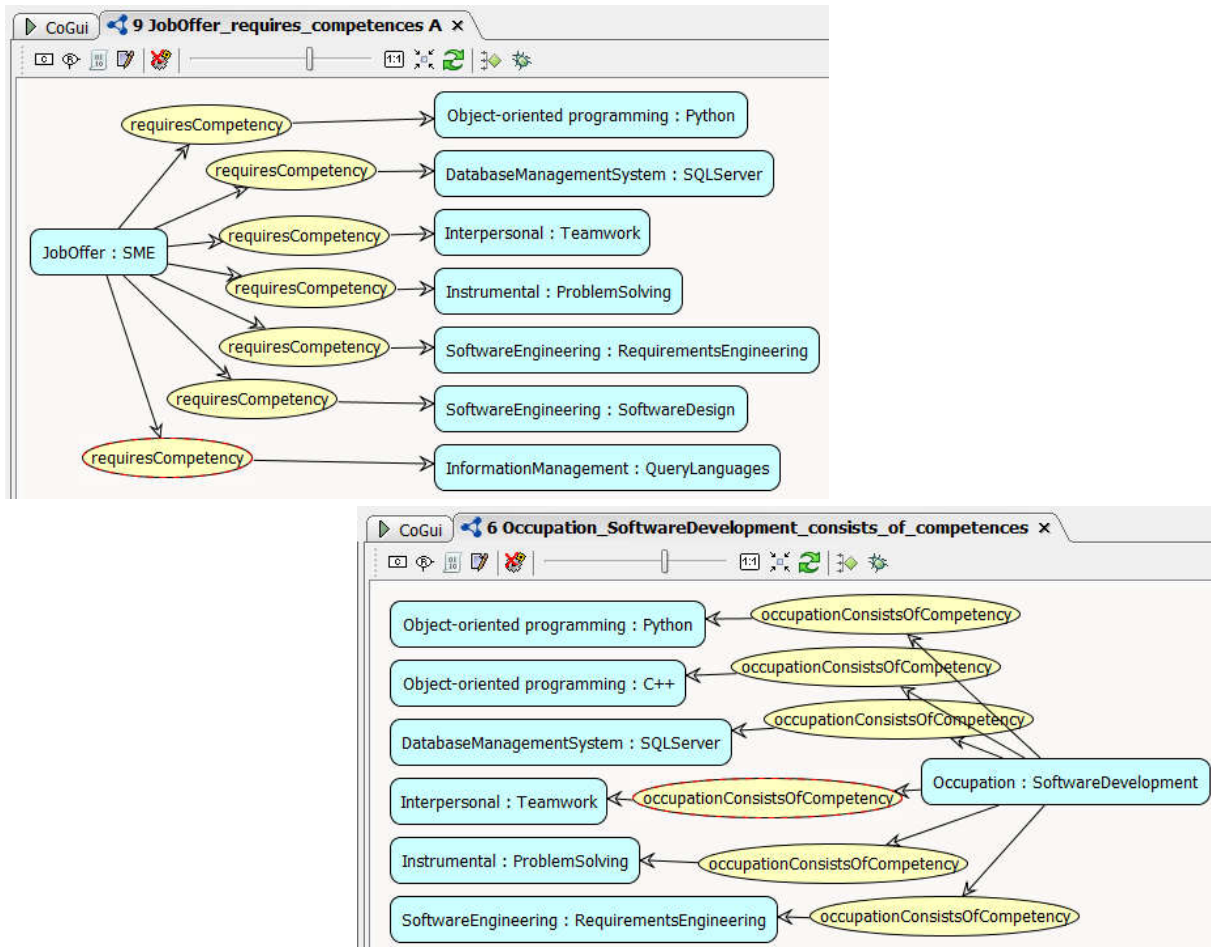


Figure 9 Query from SME (top) is compared with knowledge base of Occupation ontology (bottom)

Example described in this paragraph illustrates querying for a software developer. The procedure is executed using *CoGui*.

First step is loading all the necessary information in the system: Ontologies Job Offer, Skills & Competencies and Occupation, as well as facts connecting ontologies Occupation and Skills & Competencies.

As shown on Figure 9 (bottom part), occupation Software developer consist of the following competencies: Python, C++, SQL Server, teamwork, problem solving and requirements engineering.

Procedure *Sum and normalize facts* (Figure 10) creates a union of required queries in order to obtain all required information (Figure 11) to be used as a base for query formation (Figure 12).



Figure 10 Interface for *Sum and Normalize facts* procedure

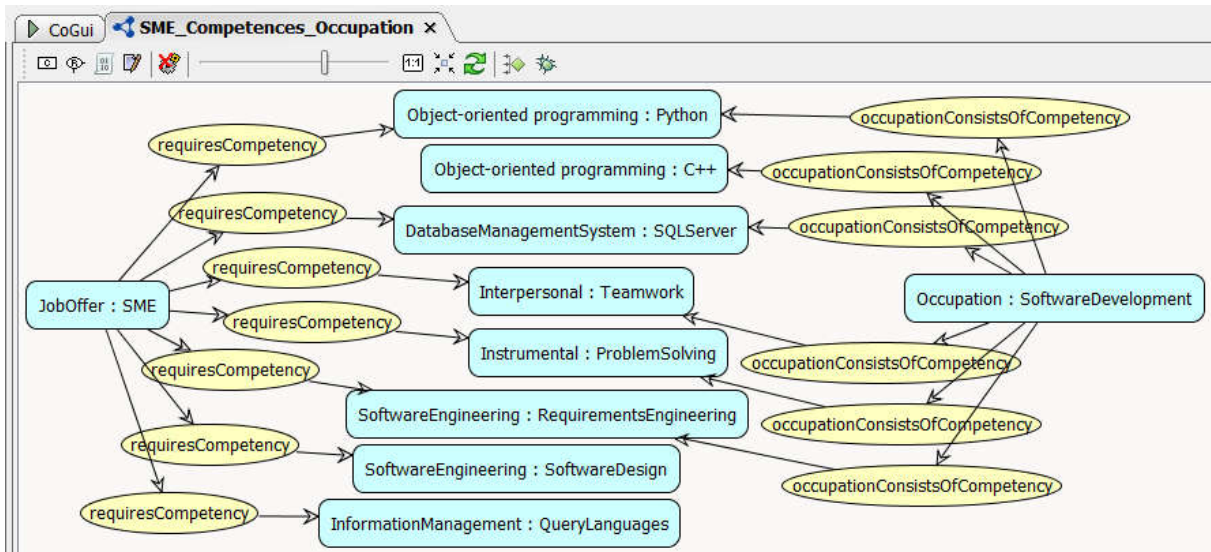


Figure 11 Union of two facts: Competencies for JobOffer request and Competencies for Software Development occupation

Procedure *Query facts* returns the set of Occupations that match the required Skills and Competencies (Figure 13). In the example shown on Figure 13 five competencies were matched. *CoGui* tool, used in this example, enables the ontology engineer to view and store all the responses, as well as export the query result in RDF/XML format.

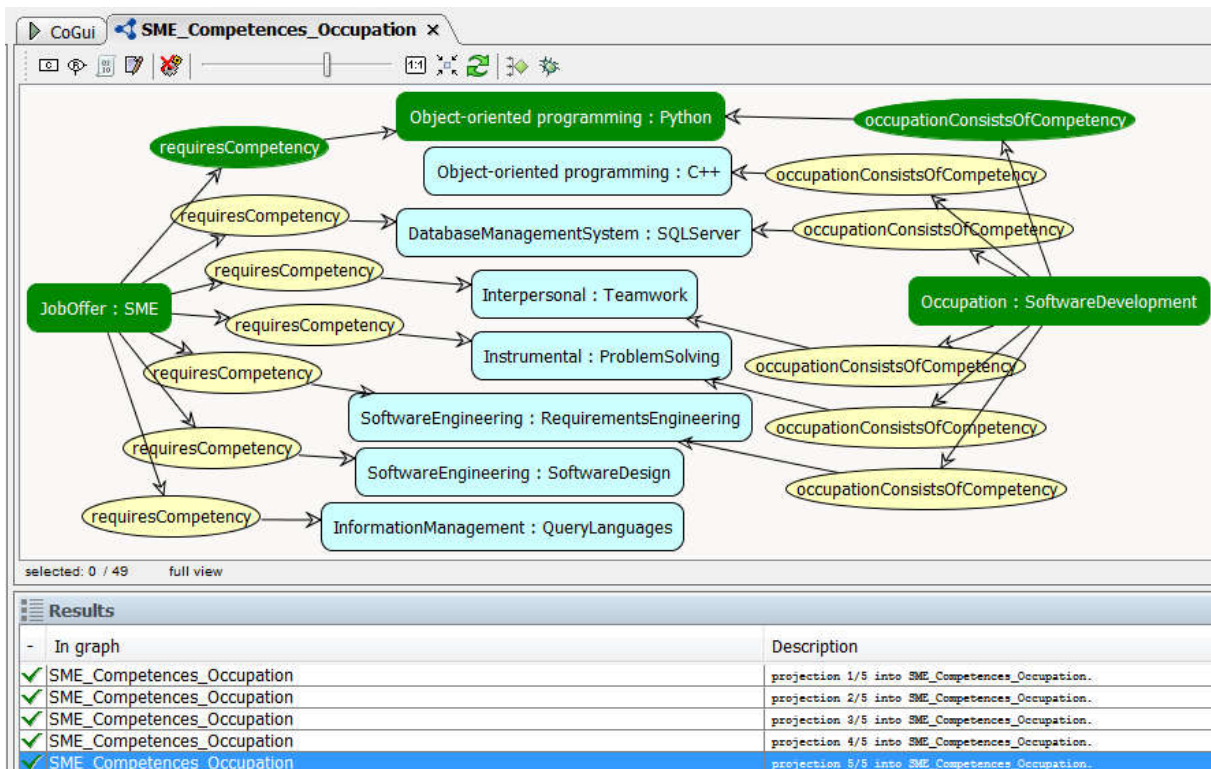


Figure 12 Five answers to the query with graph-based representation

7. Conclusion

This paper illustrates the concept of documenting a complex domain by using ontologies and proved its application as a concrete help for SMEs. Although specifications of ontologies and user-friendliness of software tools described in this paper are not sophisticated enough for a

large-scale use, they prove the usefulness of unambiguously defining taxonomies over a wide domain. Unification of taxonomies, initiated by ESCO project and continued in Croatia with CROQF, once they reach a higher level of maturity, can be a good motivator for commercial enterprises to join the effort of standardizing the offer and demand for jobs. Job portals, such as *moj-posao.net* or *posao.hr*, could create the appropriate freely-accessible application program interfaces (API) to allow other similar services or their clients to share information in a standardized way.

It is the opinion of authors of this paper that global (or at least pan-European) standardization of the process of job-offering and job-seeking can lead to a much higher work-force mobility.

Automation on the side of employers is a challenging task as it would require a detailed specification of processes that are being executed within their company, as well as a detailed specification of skills and competencies that each process requires, which is one of implementations of the *Organizational Growth Model*.

REFERENCES

- [1] Nazor, I. (2015.). Development of feasibility assessment methodology for implementation of ERP systems in small and medium enterprises. Zagreb, Croatia
- [2] Klarin, K., & Celar, S. (2016.). Knowledge representation in the ontological engineering using conceptual modeling and graph-based reasoning. Proceedings of Contemporary Issues in Economy and Technology, (pp. S153-S164). Split, Croatia.
- [3] Gomez-Perez, A., Ramirez, J., & Villazon-Terrazas, B. (2007.). An Ontology for Modelling Human Resources Management Based on Standards. International Conference on Knowledge-Based and Intelligent Information and Engineering Systems, (pp. 534-541). Vietri sul Mare, Italy.
- [4] Croatian Qualification Framework. (2018., February 12). Retrieved from <http://www.kvalifikacije.hr/en>
- [5] ESCO. European classification of skills/competencies, qualifications and occupations. (2013.). (The first public release). European Union. doi:10.2767/76494
- [6] Baget, J., Chein, M., Croitoru, M., Gutierrez, A., Lecl'ere, M., & Mugnier, M.-L. (2010.). Logical, graph based knowledge representation with CoGui. Graphes et Appariement d'Objets Complexes en conjonction avec EGC'10, (pp. 15-25). Hammamet, Tunisia.
- [7] Process Classification Framework. (2017., September 30). Retrieved from <https://www.apqc.org/>
- [8] Levine P., McLure M. ebXML Catalog of Common Business Processes v1.0, (2018., February 10). Retrieved from <http://ebxml.org/specs/bpPROC.pdf>
- [9] Storga, M. (2005.). The Design Ontology, Contribution to the Design Knowledge Exchange and Management. Doctoral thesis, University of Electrical Engineering and Computing, Zagreb, Croatia.
- [10] ISCO. The International Standard Classification of Occupation. (2017., September 30). Retrieved from <http://www.ilo.org/public/english/bureau/stat/isco/index.htm>
- [11] Computer Science Curricula 2013. (2013.). The Joint Task Force on Computing Curricula ACM and IEEE Computer Society. doi:10.1145/2534860
- [12] Bourque, P., & Fairley, R. (Eds.). (2014.). SWEBOK V3. Guide to the Software Engineering Body of Knowledge. IEEE Computer Society.
- [13] CoGui. A Conceptual Graph Editor. (2017., September 15). Retrieved from <http://www.lirmm.fr/cogui>

CIET | **Split**
2018 | **Track 4**

**Interdisciplinary
Teaching and Learning**

Implementing Project Work in an ESP classroom

Silvana Kosanović

University of Split, University Department of Professional Studies, Split, Croatia
skosanov@oss.unist.hr

Abstract. Project work has long been considered an effective medium for incorporating language and content learning and providing a holistic approach to teaching EFL. The use of project work is strongly supported in conceptualizing language teaching because it requires active student involvement, stimulates higher-level thinking skills, and gives students responsibility for their own learning. It includes authentic student collaboration, communication and cooperative learning, promotes interdisciplinarity and focuses on student-centered instruction as opposed to the more prevailing teacher-dominated instruction. The above present sufficient motive for undertaking project work, especially if the instructor aspires to maximize student engagement, to integrate content knowledge and to create some type of natural communicative expansion of the language and grammatical forms taught in previous EFL classes at the Department of Professional Studies. This article will present a small-scale preliminary study of a semester-long process of implementing and developing student projects in English for Specific Purposes class (ESP) in the first year of Specialist (Master) Business Trade study program at the Department. Different stages of the process leading to students' written reports and oral presentations will be outlined including steps to facilitate understanding of the task and interpreting information. The instruments for descriptive data collection were the instructor's observations before, during and after the process, students' written reports and power point presentations that supported the oral presentations, as well as post-activity questionnaire. The results support the rationale for further use of student projects as a valuable complement to the pre-designed syllabus. Finally, some general conclusions of putting project work into practice will be offered.

Key words: *project work, ESP, student collaboration, student-centered instruction*

1. Introduction

The past two decades in foreign language instruction have been marked by rapid change in the way we teach, assess learning and learn. An increasing number of innovative ways and approaches to teaching, learning, and acquiring knowledge have led to shifting from teacher-centered settings, which have mainly defined our classrooms for the past 70 years, to self-directed student learning. Learning exclusively from teacher-as-authority model at an era of the easy access to the Internet, plethora of sources of "knowledge" and instructional media is not sufficient any longer. In today's digitally shrunken world, readily available at students' fingertips, the overall nature of teaching and learning has transformed towards the needs of individual learners and their self-realization. Furthermore, using technology to facilitate the learning process (Moodle, the Internet, MOOCs), to demonstrate students' learning and creativity using technology (Power point presentations, blogs, webpages, videos, vlogs...) and to share with others (Moodle, apps) is becoming an integral part of the very process of learning. The aforementioned advances can be implemented by, for instance, student-centered learning through work on projects where students demonstrate responsibility for their own learning while teachers act as facilitators, counselors and supervisors during the course of learning. Acquiring language productively in real-life communication requires a shift in the teaching methods as the instructors cope with multiple, simultaneous projects that necessitate

different linguistic inputs. Consequently, the instructional situation develops into joint venture of all parties involved where analytic type of syllabuses provide for more collaborative efforts of students and teachers.

Additionally, with the adoption of Common European Framework of Reference for Languages (CEF or CEFR levels), developed by the Council of Europe, benchmark systems and frameworks have been implemented. This has shown that the language assessment has shifted from teacher's determination of students' outcomes to an open and flexible system that recognizes students' abilities to understand, use and produce language in diverse forms and for a variety of purposes, at the same time trying to be neutral, non-dogmatic and not favoring any approach to language learning. It promotes "methods of modern language teaching which will strengthen independence of thought, judgment and action, combined with social skills and responsibility" (Common European Framework of Reference for Languages, 2002: 13).

Given this backdrop, the author of this paper believes that project work has the potential to play an important role in the process of second language acquisition. Therefore, this small-scale, preliminary study attempts to describe, compare and interpret findings that have emerged as a result of implementing project work in an ESP classroom. The key activities focused around productive and authentic communicative language skills that included self-directed learning and cooperative learning. A brief theoretical framework and background on project work and an overview of strategies employed in the classroom will be provided in the subsequent sections. A description of the implementation of a semester-long, in-class project work will precede the evaluation of its application. The final part of the paper will concentrate on discussion, and will offer some guidelines for future use of the project work in the field of English for specific purposes.

2. Theoretical background

An integral part of theoretical framework of psycholinguistics, second language acquisition (SLA), is "a complex cognitive skill, which, like other such skills, engages cognitive systems (such as perception, memory, and information processing) to overcome limitations in human mental capacity which may inhibit performance" (Ellis, 2000: 175), (Kosanovic & Bakaric, 2015: 63). The path of learner's language acquisition is expansive and it encompasses many different factors ranging from student's individual differences and cognitive capacity, L2 motivation, learning strategies and self-involvement, previous knowledge, psychological, societal and background factors. Copious factors take place in the acquisition process, and despite the abundance of research and theory conducted by linguists, psychologists, and L2 acquisition theoreticians there is still no generally accepted theory of foreign language acquisition (Pavičić Takač, 2008: 4) that would successfully encompass all predictable and unpredictable aspects of language development. According to Norris and Ortega, in 2000 there have been 79 studies conducted on how to best facilitate language learning (Norris and Ortega in Ellis, 2005: 1), but as there are no general rules of instructed language acquisition, there is no prescriptive syllabus (Ellis, 2005: 2). Hence, project-based learning (PBL) is just one of multiple teaching configurations whose short theoretical insight will be presented in the following pages.

Project-based learning (PBL) pedagogically stems from constructivism with roots in philosophy, psychology and cybernetics. At the time it entered theoretical discussions, the approach to constructivist learning offered a significant paradigmatic shift from classical teaching. The underlying premise of the constructivist theory states that knowledge, as a dynamic process, must be constructed by the learner and not supplied by the teacher. While the teacher ensures the effective learning environment through coaching and facilitating, the learner controls the learning and is engaged in problem-solving situations. Psychologist Ernst von Glasersfeld explains that the very process of "learning is not a stimulus-response

phenomenon” but “requires self-regulation and building of conceptual structures through reflection and abstraction” (Glaserfeld, 1995, in Murphy, 1997:5) where “the function of cognition is adaptive and serves the organization of the experiential world” (Glaserfeld, 1995: 18). Such cognitive construction entails an individual process of active building of knowledge rather than reproduction, where higher-order thinking skills are emphasized and multiple perspectives encouraged. However, because of this dynamic nature of learning, it is hard to predict the success of learning as it a never-ending process, which pertains to individual experience and interpretation. Constructivist approach can be summarized in David Kolb’s learning cycle, which explains how “knowledge is created through the transformation of experience” (Kolb, 1984: 38). Kolb stated that the learners learn in four different stages. Even though a learner can start learning at any stage, experiencing a new situation or reinterpreting an existing experience followed by reflecting on the experience is the best way to launch the process. Learning from experience through reflection gives rise to formation of new concepts or modifying of an abstract concept (analysis). Finally, the new idea or concept is applied through active experimentation (Fig.1). Effective learning occurs when all four stages are executed. Such holistic perspective of learning as journey combines experience, perception, cognition and behavior.

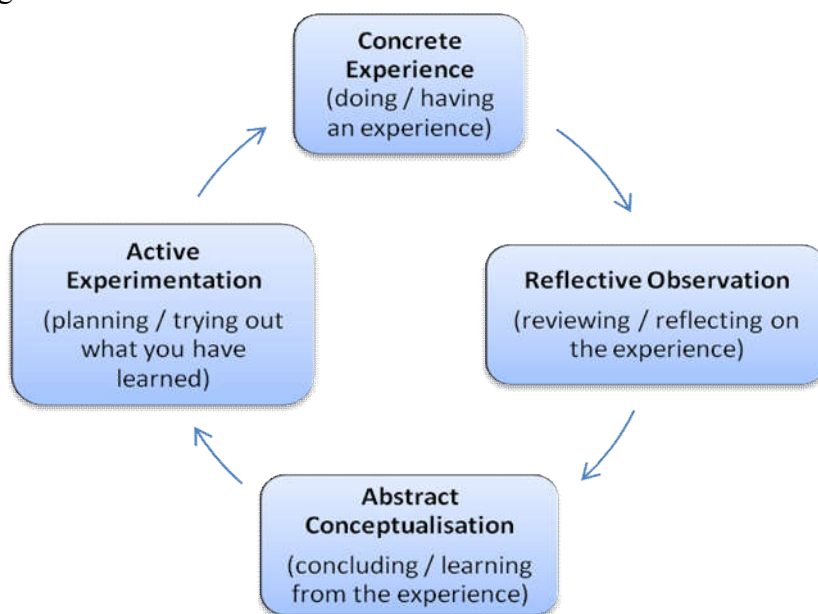


Figure 1 Kolb’s learning cycle

Just as there are different theoretical approaches, there are diverse methods of classroom implementation of PBL. Starting with the late seventies of the past century theoreticians Wilkins (1976, 2-13), Nunan, (1988:28-39), White (1988) and others discussed the definition of “syllabus”, which denotes an adherence to structuring the classroom in a particular way. Beglar & Hunt (2002) draw a distinction between two broad types of syllabuses: the structural “synthetic syllabus”, where learners gradually try to accumulate discrete linguistic points such as grammar, lexis and forms, and the “analytic syllabus” which centers on real-life communication and learner-centered language acquisition thus promoting communicative purpose in controlled conditions. Here the language forms are of secondary importance and are presented to learners when dictated by the content itself (Nunan, 1988: 28).

“This is a problem-posing type of education which emphasizes dialogue between learners and teachers and between learners themselves. The purpose of the dialogue is to stimulate new ideas, opinions, and perceptions rather than simply to exchange them or regurgitate what others have said.” (Beglar & Hunt, 2002: 96)

Emphasis in the PBL methodology, which is just one facet of analytic syllabus, is in organizing learning around projects, and in creating meaningful, real-life communication rather than practicing language for its own sake. It is about constructive learning that provides opportunities for students to embark on a never-ending journey of self-study with project work fostering curiosity and creativity in that passage. In English for Academic Purposes (EAP) or English for Specific Purposes (ESP) classes it can be perceived as an extension of what already takes place in the classroom and can be conceived as “a natural outgrowth of the curriculum” (Stoller, 2002: 109).

Fredricka L. Stoller made a summary of what many language educators understood to be its main features:

1. Project work focuses on real-life content rather than on linguistic targets
2. Project work is student-driven while the teachers offer support and guidance
3. Project work is cooperative rather than competitive
4. Project work mirrors real-life tasks as it involves processing and constructing information from different sources
5. Although the value of the project work lies in the very process of working, it closes with an end product
6. Project work is stimulating and it often ends in building student confidence, self-esteem and autonomy as well as overall language skills (Stoller, 2002: 110).

Thomas (2000) added that it should be central part of the curriculum and not peripheral, that it should focus on key concepts and problems of a discipline with students being involved in constructive investigation of realistic problems (Thomas, 2000:4).

3. Method

3.1 Aim of the study

Since the number of participants is rather small (16) this is considered to be a trial - and - error type of study to see the effects of PBL implementation on students, instructors and learning outcomes. The aim of this preliminary study is to present phases of developing project work, and to examine the process and its outcomes through instructor’s longitudinal observation and interpretation of post-activity questionnaire completed by the students. Besides, the paper engages in comparing pretest and posttest scores of the group of students who served as the single sample to assess whether there are differences between the experimental and control group.

The research questions for the study are as follows:

1. What are the perceived benefits and drawbacks of implementing project-based learning, from the instructor’s and the students’ point of view?
2. Are there any statistical differences in final grades obtained after having followed a PBL approach (experimental) as opposed to the traditional approach to language teaching (control group)?

The following hypotheses will be tested:

H1: Students are more actively involved in their learning through PBL. PBL improves cooperative learning and collaboration. Students’ negative attitude towards this type of teaching approach is a major disadvantage. In addition, students that are more proficient will like this approach more than the low- or middle- scoring ones.

H2: There are significant differences in final grades in favor of PBL approach.

3.2 Sample

The project work was implemented at the University Department of Professional Studies of the University of Split with 16 first-year full-time and part-time students of specialist study program of Business Trade (Master level) enrolled in Business English for Specialists course, who served as single sample control and experimental group. All students were native Croatian speakers who have learned English throughout elementary and high school, passed English test at the state-matura exam, and had three more semesters of Business English at the Department prior to enrolling in the abovementioned course.

The project took the entire 15 weeks of the winter semester to complete (30 hours). Along the weekly two-hour in-class project work (experimental group), the students were engaged in other curricular activities of the course (30 hours) unrelated to the project, following the traditional curriculum design of Business English for Specialists courses (control group). The traditional curriculum is structural and focuses on operating with linguistic features through a combination of communicative and task-based activities.

3.3 Instruments

The instruments for qualitative and quantitative data collection were the instructor's observations before, during and after the process, students' written reports and power-point presentations that supported the oral presentations, as well as post-activity questionnaire, administered in the last session. The qualitative approach was perceived as the most suitable to test the first hypothesis as it focused on students' feelings, thoughts, activities and behavior. For the second research question the sample group was tested twice to assess whether the mean ranks differ. Students' final grades from the previous Business English class, obtained through the questionnaire, served as the pretest for both groups. After having completed the project work (experimental) and having completed traditional curricular activities (control), the final grades were obtained and served as posttest measurements. The quantitative analysis was completed by using SPSS, version 10, Wilcoxon Signed Ranks Test, which is a non-parametric statistical hypothesis test used, among other things, for comparing repeated measurements on a single sample.

3.4 Procedure

Lessons design and participatory structure

Lesson design of project-based learning was chronologically divided into three principal phases, as shown in Table 1: pre-task phase, which related to undertaking activities prior to the actual work; during project phase, which centered on performing the project and the post-task phase, which included the follow-up of the performance.

Table 1 A framework for designing a 15-week (30 hours) project-based plan

Phase	Activities
1. Pre-task (2 hours)	Framing the activity and setting outcomes Fine tuning of topic choices Establishing group norms Assigning roles Setting time
2 During project (26 hours)	Research phase Report writing Presenting
3. Post-task (2 hours)	Follow up and students' response

Pre-task phase

The students were divided into groups of three or four and chose the topic of their interest. The offered topics were interdisciplinary in nature and related to other courses previously offered at Business Trade department, thus keeping students focused on central concepts of their chosen academic discipline. Students of tourism had to create a tourist agency and travel arrangement plan based on a 7-day visit to the Split-Dalmatia County, where they could freely choose the potential traveler and the type of travel. One group decided on arranging travel itinerary for adrenaline junkies, another for Italian students and the third for eco-tourists. Students of Business Trade had to make a business plan and could choose the business of their liking. The wedding planning agency, the beauty parlor and the hair salon were chosen. General objectives of the project were to synthesize entrepreneurial knowledge previously acquired in the related subjects at the undergraduate level while simultaneously using authentic English for an extended period on variety of activities, at the same time constructing a potential start-up company. Particular linguistic objectives included enhancing writing, speaking and presentation skills. After the preliminary lesson, the students were introduced to the project, shown examples and given practical guidance to the work. Also, the outcomes of the project and the evaluation of the project work were presented. Choosing topic, deciding how to structure and present the data, how to assign roles and work in collaboration were some of the steps students undertook during the pre-task phase.

During project phase

Even though the pre-phase was not obligatory in the project work, the author believes that guiding, preparing and motivating students for the task influences the effectiveness and the flow of the main phase.

The project itself unveiled in three phases: 1. research phase, 2. report writing and 3. presenting. This phase was predominantly marked by the negotiation of meaning among the peers and the instructor, as well as fine-tuning of reports and power point presentations. As the activities unveiled, the instructor brought students' attention to contextualized linguistic functions, conversational gambits and presentation tips, addressing demands of the project.

The research phase lasted for four sessions (8 hours) and included choosing the topic through brainstorming ideas, assigning team roles and duties. Students had to make clear objectives of their project and create a schedule with allocated tasks and work, distributed among the peers. The instructor gave advice on the ways to proceed with the projects. The next phase included reading the theoretical background and studying practical examples. During this stage, students read different "texts" (reports, contracts, brochures, itineraries, videos, examples of business plans) and then analyzed and compiled data for further use during report writing. The key headings that had to be included in the business plan/ travel agency were an executive summary and an objective statement, where the students explained the company goals. They also had to include a statement of purpose and an explanation of how the company planned to achieve the stated goals through the business strategy. The reports included a mission statement of the company's purpose and the scope of its operations: what kind of product or service it provided, its primary customers or market. It could also include a short statement of such fundamental matters as the organization's values or philosophies, business's main competitive advantages, or a desired future state – the vision. Tourism students created the travel contract between the agency (themselves) and the travelers, a detailed day-to-day itinerary and set the price. Business trade students made a business plan where they presented their own company. Besides that, they incorporated company ownership and management summary, and a financial plan including market analysis and sales forecast of projected profit and loss. As compiling, analyzing, constructing and synthesizing information and negotiating of meaning took place in-class, the teacher had an opportunity again to assist groups with particular linguistic demands that appeared in the particular content, such as providing tips for

writing reports. This phase lasted through six sessions (12 hours) when the written reports were submitted to the instructor by e-mail. The instructor revised the reports and gave feedback to each group by e-mail and in-class during the next session. Before the third phase, which included work on power point presentations and oral presentation of the outcomes, the teacher went through the organization of power point slides, use of visual aids and presentations skills and language points, containing also the use of gestures, eye contact, tone of voice etc. This phase took place during three sessions (6 hours).

Post-task phase

After the students made formal presentations of the work, the project work was evaluated and the post-activity questionnaire administered in duration of 15 minutes. The student self-evaluation of the project work marks the final stage in the process, and is used for interpretation of students' attitude towards this type of approach as well as the pretest data for the Wilcoxon test.

Simultaneously, students were involved in the existing syllabus, where developing language occurred through a series of reading, listening and speaking tasks, by using a variety of strategies, stretching from incidental (inductive and deductive inference from reading and listening) to formal learning strategies. Learning synonyms, antonyms, collocations, idioms, as well as grammar items were integrated into the context of the particular topic studied. Having completed the aforementioned activities students received final grades, which served as control group data for investigating whether there were differences between the two approaches.

4. Results

Instructors' observations as well as students' post-activity questionnaire¹ corroborate the hypothesis that students were more actively involved in their learning through PBL, which improved cooperative learning and collaboration. All the students said that they liked working in collaborative groups (Q.4=100%) and 88% think that the teamwork is stimulating (Q.6). All of them also believe that they can communicate better with peers and teachers through project work (Q.9=100%). Again, 88% think they have learned better working through PBL and 25% feel the reason for this is because they gathered information themselves instead of the teacher just giving them the information (Q. 10).

¹1. Now that you have completed your project, please circle the three words below which best sum up your feelings about it: challenging, tedious, enjoyable, unrewarding, worthwhile, straightforward, scary, exasperating, useful, time-consuming, interesting, hard, rushed, exciting, grueling. 4. Do you like to work in collaborative groups? I like working in groups. I like working in groups most of the time. I do not like working in groups. 5. What is your least favorite aspect of working in a group? There is too much noise. Some students who do not work still get credit for the work done. It is difficult to figure out the responsibility of each group member. I prefer to work by myself. 6. What is your favorite aspect of working in a group? 1. It is better to share the workload. The group gets the assignment done faster and easier. The teamwork is stimulating. There was nothing I liked about working in a group. 8. Which method of learning do you like best? Traditional classroom with a teacher directing the learning. PBL classroom working in collaborative groups. 9. Through student project, I feel that I can communicate with my peers and teachers. Better now than before. Less now than before. 10. What are your overall feelings about student project? I loved learning through a project classroom this year. I enjoyed working in groups, and I felt that I learned better this way. I learned more because I gathered the information myself instead of the teacher just giving the information. I did not learn as much this year because project work is confusing. I did not learn as much this year because my group members did not do their fair share. 11. Were your grades affected by student project? My grades were better. My grades were worse. My grades did not change.

While 50% of students said that they prefer traditional classroom curriculum to PBL method of learning (Q.8), there was only one negative student remark stating the PBL approach was unrewarding (Q.1). Other students described PBL as challenging (50%), enjoyable (25%), interesting (75%), exciting, useful (63%) and worthwhile (25%). Therefore, the hypothesis about the negative attitude towards PBL was not confirmed, nor was the correlation between higher-scoring students and the method preference. Of the 50% of high-scorers, half opted for PBL and half for traditional classroom approach; one student whose grades were worse opted for PBL, and out of the 38% of those whose grades did not change, 66% prefer PBL over traditional classroom (Q.11), indicating that this aspect relates to individual students learning preferences and not grades. Question 5 in the post-activity questionnaire asked about the least favorite aspect of working in a group, where 63% of students answered: “some students who do not work still get credit for the work done”, 25% claimed that it was hard to figure out the responsibility of each group member, while 12% thought that there was too much noise. While the instructor has also observed that positive group experiences and equal sharing of the workload among peers contribute to higher group motivation for work, there were instances where students were not equally engaged in project work, which negatively affected the group dynamic and, finally, successfulness of the outcome. Results of the Wilcoxon Signed Ranks test revealed that the second hypothesis, favoring higher grades after PBL, was not confirmed. There were no significant statistical differences between control and PBL group, even though final grades were slightly better on the average in the PBL group (3, 06) than in the control group (2, 68).

Table 2 Wilcoxon Signed Ranks Test results

Descriptive Statistics					
		Mean	Std. Deviation	Minimum	Maximum
Pretest		68,38	10,164	55	95
Control group	6				
Pretest		68,38	10,164	55	95
PBL	6				
Posttest		66,94	7,962	55	82
Control group	6				
Posttest		69,00	6,861	59	82
PBL	6				

Test Statistics ^a		
	posttest control – pretest control	posttest PBL – pretest PBL
Z	-,597 ^b	-,130 ^b
Asymp. Sig. (2-tailed)	,550	,897

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

5. Discussion

Although the statistical results did not show significant differences in results between the control and the PBL group, which might be due to the small number of participants of this trial-and-error study, the results of the descriptive analysis suggest that there are many positive aspects of implementing this approach. Contrary to the initial instructor's beliefs, majority of students welcome and enjoy the PBL approach and find the experience to be interesting, useful and stimulating. Findings demonstrate that involving students in structured PBL type of learning promotes greater learner autonomy and responsibility, generates higher level of collaboration among group members and promotes teamwork, which can be considered one of its greatest strengths. Collaborative work stimulates greater negotiation of meaning across disciplines while simultaneously contextualizing and integrating major language skills in communicative context, proving to be a distinct feature of this type of approach to teaching. What is more, and very important for motivation, PBL brings vibrant atmosphere into the classroom and as multiple real-life communicative situations unveil (analyzing, deciding, editing, rejecting, organizing, delegating...) both, students and the teacher, often find themselves involved in utilizing multi-disciplinary skills to come to a solution. In those instances, intermingling of Croatian and English language occurs, but the benefits of the creation process far excel potential negative sides of mother tongue use. In addition, there is much higher level of "classroom democracy" observed, contributing to the students' feeling of controlling their own learning and activities. The work becomes fun and the process stimulating as it promotes higher level of thinking; which is something that often lacks in traditional, teacher-oriented classrooms.

From the linguistic perspective, focusing primarily on the achievement of realistic objectives (which is our natural inclination), and then secondarily on the language that is needed to achieve those objectives, might be perceived as the drawback, although, removing conscious attention from the linguistic input might be considered as stress-reducing and facilitating factor in the language use. Arguably, treating language as an instrument to complete a given objective rather than an isolated grammar point or lexical set to learn and practice, with students who are not proficient users of L2 language, could remove the difficulty-inducing factors that inhibit the language acquisition such as language anxiety, affective states (e.g. presence or lack of self-confidence) and language aptitude. Additionally, concentrating on the area of expertise of future professionals and integrating valuable content knowledge across disciplines may as well fit the operational proficiency of the CEF levels.

6. Limitations and implications for future implementations

Even though the study was small-scale, the following drawbacks were noticed regarding the learning outcomes, pedagogical and procedural mistakes, from which suggestions for future implementation and research should derive.

1. Although explicit language instruction of specific linguistic items was provided in the preparatory and during the project phase, and corrections in the written reports made by the instructor, struggling students still found themselves entangled in a web of wrong grammar and lexis use. Also, as there was no heightened attention on accurate language usage in the oral presentation phase, students with limited language accuracy, tended to provoke fossilization - "the fossilization of incorrect lexicalized language which is acquired relatively early in the process of acquiring productive language skills" (Skehan in Beglar & Hunt, 2002 : 103). This downside could be improved in future implementations by emphasizing form again in the post-activity phase so that the students self-reflect on individual linguistic weaknesses and hopefully consolidate their accuracy, which then could be further tested in prospect research, large scale study.

2. Rather than drawing instruction from given pedagogical tasks, language teachers rely on their intuition about how well students deal with project-based type of learning, including specific content tasks. They have to speculate on factors such as students' familiarity with the project topic, their expertise and the amount of knowledge they possess in the content area and adjust their workload accordingly. While this approach brings more unpredictability in teaching, a feature which can be refreshing for instructors, it also requires thorough and careful planning as teachers oversee and approve each step of the process, and further studies offering general teacher support through planning of the process would be welcomed. In addition, coordination and cooperation of content instructors with language teachers would definitely be a more rewarding and educationally more beneficial experience for all parties involved.

3. Another implementation problem seems to stem from situations where not all students contribute equally in the workload, and where potential poor involvement of students and their negative attitude towards this type of work might hinder the whole process. This problem might be addressed by requiring each student to complete a portion of group work individually and to report after each phase, and/or to establish strict(er) group norms. In addition, encouraging working colleagues to put higher level of peer pressure on those students who do not demonstrate accountability for their share, might also be an idea to minimize this problem. Finally, learning how to work effectively with others is a valuable life lesson and essential skill if one is to succeed in any work environment.

7. Conclusion

The concern of this preliminary study was the process of implementing PBL into classroom. Regardless of its small number of participants it indicated that there are many pedagogical benefits of its use in language acquisition. It proved to be stimulating and motivating for students and the instructor alike and it brought greater negotiation of meaning to the classroom. However, to better understand to what extent and in what instances in the process of language acquisition the PBL approach could be the most effective, a large-scale research is required. Such study could also bear improvements to future implementations of project based learning.

REFERENCES

- Beglar, D. & Hunt, A., (2002). Implementing Task-Based Language Teaching in Richards, J.C. & Renandya, W.A. (Ed.). *Methodology in Language Teaching: An Anthology of Current Practice* (pp.96-106). Cambridge. Cambridge University Press.
- Common European Framework of Reference for Languages: Learning, Teaching, Assessment.* Language Policy Unit, Strasbourg. Cambridge University Press. Retrieved, January 20, 2018, from https://www.coe.int/t/dg4/linguistic/source/framework_en.pdf
- Ellis, R. (2000). *Instructed Second Language Acquisition*. Oxford, UK and Cambridge USA: Blackwell
- Ellis, R. (2005). Principles of Instructed Language Learning. *Asian EFL Journal*, Retrieved March 20, 2018, from http://asian-efl-journal.com/sept_05_re.pdf
- Glaserfeld, von E. (1995). *Radical Constructivism: A Way of Knowing and Learning*. The Falmer Press. London. Washington D.C. Retrieved March 19, 2018, from <https://files.eric.ed.gov/fulltext/ED381352.pdf>
- Kolb, D. A. (1984). *Experiential Learning: Experience as the Source of Learning and Development*. Prentice-Hall, Inc., Englewood Cliffs, N.J.

- Kosanovic, S., & Bakaric Grgicevic, P., (2015). Foreign Language Vocabulary Acquisition: A Continuum of Knowledge. *Crossing Boundaries in Culture and Communication*, vol 6, no 2, (pp. 60-76), Bucharest, Romania, Romanian-American University.
- Murphy, E. (1997). *Constructivism: From Philosophy to Practice*. Retrieved February, 2, 2018, from <https://files.eric.ed.gov/fulltext/ED444966.pdf>
- Nunan, D. (1988). *Syllabus Design*. Oxford. Oxford University Press.
- Pavičić Takač, V. (2008). *Vocabulary Learning Strategies and Foreign Language Acquisition*. Clevedon-Buffalo-Toronto: Multilingual Matters.
- Richards, J.C. & Renandya, W.A. (Ed.). (2002). *Methodology in Language Teaching: An Anthology of Current Practice* Cambridge. Cambridge University Press.
- Stoller, F.L. (2002). Project Work: A Means to Promote Language and Content. In Richards, J.C. & Renandya, W.A. (Ed.). *Methodology in Language Teaching: An Anthology of Current Practice* (pp.107-118). Cambridge. Cambridge University Press.
- Thomas, J.W. (2000). A Review of Research on Project-Based Learning. Retrieved March 4, 2018, from <http://www.bie.org/images/uploads/general/9d06758fd346969cb63653d00dca55c0.pdf>
- White, R. V. (1988). *The ELT Curriculum: Design, Innovation and Management*. Cambridge. MA: Basil Blackwell.
- Wilkins, D.A. (1976). *Notional Syllabuses*. Oxford. Oxford University Press.

Individual Variables and English Language Performance

Ivana Čizmić

University Department of Professional Studies, University of Split, Croatia
icizmic@oss.unist.hr

Jasmina Rogulj

University Department of Professional Studies, University of Split, Croatia
jrogulj@oss.unist.hr

Abstract. There has been a vast body of research in second language acquisition with a focus on the area of individual differences (ID) as one of its most thoroughly studied psychological aspects. According to these studies, second language learning achievement can often be predicted by IDs. For the purpose of this research, the authors decided to focus on the following individual variables: personality, foreign language classroom anxiety (FLCA) and general English language competence (GELC) measured by a *cloze* test. This research aims to investigate the relationship between the aforementioned variables across four study programmes, i.e. Business, Information Technology, Electrical Engineering and Medicine. The sample was composed of 150 students from the University of Split. Data were collected by means of questionnaires and a *cloze* test. Our hypotheses were partly confirmed. The results of the study show that GELC is significantly negatively related to Extraversion and Conscientiousness and positively to Intellect. The findings also reveal that students experiencing lower anxiety levels score higher on Emotional Stability scale. Further, FLCA was found to be the strongest predictor of GELC. With reference to differences in personality dimensions, Conscientiousness, Emotional Stability and Intellect, business students tend to have higher anxiety levels and are significantly more conscientious than IT students who, in turn, obtained significantly better results on *cloze* test. At the same time, business students demonstrate significantly lower Intellect levels in comparison to medical students. In conclusion, several practical classroom implications arise from this research. Teachers should take into consideration students' personality traits and anxiety levels when developing their teaching and assessment methods and providing anxiety-free classroom environment.

Key words: *personality, foreign language classroom anxiety, general English language competence, cloze test*

1. Introduction

Some people learn languages quickly, some make a slow progress, even in what seem to be favourable learning conditions. The existence of such human variation can, to a large extent, be attributed to individual difference (ID) factors. There is a whole range of learner characteristics traditionally treated as ID variables (see Dörnyei, 2005). According to Dörnyei, they are defined as “characteristics or traits in respect of which individuals may be shown to differ from each other” (Dörnyei, 2005: 1). Educational and personality psychologists have long been trying to understand the role of ID variables in academic achievement, among which personality traits, as non-cognitive variables, have strong implications for learning and education. However, compared to the huge interest in some ID factors in the field of second language acquisition (SLA), e.g. motivation, language aptitude, learning strategies, or anxiety, little research has been done on the effects of personality traits. In the last three decades, the „*the five factor model*“ or „*the Big Five*“ has become the most

widely acknowledged personality paradigm comprising the following traits: Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Openness to Experience/Intellect (e.g. Goldberg, 1993; McCrae & Costa, 1992; McCrae & John, 1992; Sauciere & Goldberg, 1998) SLA researchers that have integrated personality factors in their research designs have made attempts to identify specific personality traits that are related to success in foreign or second language learning. Yet, the studies yielded rather inconclusive results. The first Big Five trait most frequently researched in SLA is Extraversion (vs. Introversion). Based on the research which included 3145 learners, Ehrman (2008) found that the best language learners were, on the whole, characterized by introverted personalities. Similarly, introverts were reported to perform better on written tasks (Robinson, Gabriel & Katchan, 1994) and L2 vocabulary test performance (Carell, Prince, & Astika, 1996). These findings, however, do not corroborate those in Deweale (2009) and Ockey (2011) indicating that extraverts were better in oral fluency. Further, Agreeableness has been found to be least related to academic performance. The studies undertaken by Verhoeven and Vermeer (2002) and Rogulj (2016) did not show any correlation between agreeableness and language achievement, whereas Pavičić Takač and Požega (2012) revealed that Agreeableness was significantly negatively linked to oral proficiency in English. Conscientiousness seems to be the personality trait most consistently associated with academic achievement (Bratko, Chamorro & Saks, 2006). In SLA research, positive correlations were found between Conscientiousness and skills in listening, reading and language use (Zabihi, 2011) on the one hand, and organizational competence and communication planning (Verhoeven & Vermeer, 2002), on the other. Contrary to the aforementioned results, Pavičić Takač and Požega (2012) reported no significant correlation between Conscientiousness and oral proficiency in English, whereas Rogulj (2016) found that Conscientiousness was significantly negatively correlated with general English language competence measured by *cloze* test.

Although students with higher Neuroticism levels tend to experience greater foreign language anxiety (FLA) (e.g. Deweale, 2002; Deweale, 2011), which has been shown to result in poorer foreign language performance (eg. Deweale, 2007; Gardner & MacIntyre, 1993; Horwitz, Horwitz & Hope, 1986; MacIntyre & Gregensen, 2012b; Mihaljević Djigunović, 2002), Neuroticism was not always found to be related to language learning achievement (e.g. Deweale, 2007; Rogulj, 2016).

With reference to Openness (or Intellect), some research studies have not shown the association between this trait and different aspects of language learning proficiency (e.g. Carel et.al., 1996; Pavičić Takač & Požega, 2012; Rogulj, 2016). Yet, several studies have suggested that Intellect has been positively associated with some indicators of language performance, such as scores on listening, reading and language use (Zabihi, 2011) or communication competence (Verhoeven & Vermeer, 2002).

As for foreign language anxiety, it has been regarded as a situation-specific emotional reaction that potentially impedes foreign language learning. Research has shown that FLA occurs very often among foreign language learners, and also has various negative effects on foreign language learning (Han, 2013). The construct of foreign language anxiety was proposed by Horwitz, et al. (1986). They defined foreign language anxiety as “a distinct complex of self-perceptions, beliefs, feelings, and behaviours related to classroom language learning arising from the uniqueness of the language learning process” (p. 128). They identified three anxieties related to foreign language anxiety: communication apprehension, fear of negative evaluation, and test anxiety. In addition, they developed an instrument known as the Foreign Language Classroom Anxiety Scale (FLCAS), to measure foreign language anxiety, which has been widely adopted in foreign language anxiety research.

The study of anxiety in second language learning started as a result of an upsurge of research into various individual learner differences anticipated to affect language learning success

(Toth, 2007). Most language learners experience a feeling of anxiety in the process of language learning. The number of students who report that they feel anxious while learning a second/foreign language is surprising (Riasati, 2011). Moreover, language anxiety is experienced by one third to one half of foreign language learners (Worde, 1998).

For the purpose of this study the effects of personality and foreign language classroom anxiety (FLCA) on general language competence (GELC) will be explored. Thus, the following research questions have been put forth:

1. What are the relationships among personality, FLCA and GELC across three disciplines?
2. Which are the most significant correlates and predictors of GELC?

In line with the literature on the subject, the following hypotheses will be tested:

H1: GELC will be significantly negatively correlated with Extraversion and significantly positively correlated with Intellect.

H2: The students will differ in GELC by discipline.

H3: There will be no significant correlation between FLCA and Emotional Stability.

H4: Anxiety will be the best predictor of GELC.

2. Method

Participants

A total of 184 (96 females and 88 males) students from the University Department of Professional Studies and School of Medicine, University of Split, Croatia, participated in this research. Participants' age ranged from 18 to 21 ($M=19.44$, $SD=1.47$) years. The sample comprised 54 business students (29,3%), 39 electrical engineering students (21,2%), 36 information technology students (19,6%), and 55 medical students (29,9%). All students were native Croatian speakers. They have been learning English in elementary and high school from nine to thirteen years ($M=11.15$, $SD=1.79$). The mean grade in English they obtained at high school was 3.95 ($SD=0.89$). Besides learning English at school, 29,3% of the participants learned English as an extracurricular activity as well. Furthermore, 77% of students learned a second foreign language, primarily German or Italian. Most them (88,5%) reported using English in everyday situations, such as for entertainment (listening to music, playing online games, etc.), communicating with friends and acquaintances from abroad, and for educational and business purposes.

Measures

IPIP Big Five Personality Test

In the current study, the 100-item version of the IPIP Personality Test (Goldberg, 1999) is used comprising 20 items for each of the following Big Five personality traits: Extraversion (E), Agreeableness (A), Conscientiousness (C), Emotional Stability (ES), and Intellect (I). IPIP items were administered with a 5-point Likert scale ranging from "very inaccurate" (1) to "very accurate" (5). The internal consistency reliability estimates (Cronbach's alpha coefficients) of the original version were: .91 for Extraversion, .88 for Agreeableness, .88 for Conscientiousness, .91 for Emotional Stability, and .90 for Intellect.

Foreign Language Classroom Anxiety Scale (FLCAS)

The FLCAS is the most widely used scale for measuring foreign language anxiety and has been translated into many languages and used to measure learners' foreign language anxiety in various countries all over the world. This instrument was chosen for several reasons: on the

one hand, it is one of the most valid instruments used for measuring general classroom foreign language anxiety which is a situation-specific construct; on the other hand. It was designed by Horwitz, et al. (1986) and is a 33-item self-report measure that consists of items scored on a 5-point Likert Scale, ranging from strongly agree to strongly disagree. The 33 items assess a learner's level of foreign language anxiety, as evidenced by subjective feelings, perceptions, negative attitudes towards foreign language classes, and avoidance behaviours (Horwitz et al, 1986). In terms of specific language skills, the FLCAS mainly addresses anxiety associated with speaking in foreign language learn. It comprises three constructs, namely communication apprehension, test anxiety and fear of negative evaluation. For the purpose of this research, the adapted Croatian version of the questionnaire (Mihaljević Djigunović, 2006) was administered to the students.

Cloze test

Instead of a final grade, a *cloze* test was used as an outcome measure. It was designed for the purpose of this study to measure general English language competence. The test comprised 50 items with each 7th word deleted. It was chosen as a language proficiency measure because this type of test is commonly referred to as an integrative test which requires simultaneous processing of language components similar to everyday language use (Hughes, 1989 as cited in Kong, 2009). The topics selected for *cloze* tests to be used in this study, were related to students' fields of study, but the texts themselves were not known to students. The scoring procedure was based on the acceptable word method.

Procedure

Based on students' field of study, they had 2 lesson hours of Business English, Technical English, and Medical English per week. Two instruments, IPIP and FLCAS, were administered at the end of the course during regular classes. Each student completed IPIP (Goldberg, 1999) and FLCAS (Horwitz et al, 1986) in 40 – 50 minutes. The students voluntarily took part in the research after the main purpose and the significance of the study had been explained to them. In the last week of the course, a *cloze* test was used to measure general language competence. It took them 35 – 45 minutes to complete the test. The *cloze* test results were matched with the data collected by means of questionnaires. The background questionnaire was designed to collect demographic data (age and gender).

Data Analysis

Data analysis was started with the calculation of the instruments' reliability followed by descriptive and inferential statistics. *Cloze* test percentage scores were calculated and the means and standard deviations of the questionnaires computed. In order to explore the relationships among target variables, Pearson product-moment correlations were used. Next, one-way analysis of variance (ANOVA) with post-hoc tests was applied to investigate differences across four disciplines in personality traits on the one hand, and FLCA and GELC, on the other. Finally, hierarchical regressions were conducted to test the predictability of GELC by personality and FLCA.

3. Results

Descriptive data

Table 1 presents the means (M), standard deviations (SD), minimum (Min.) and maximum (Max.) values and internal reliability coefficients (Cronbach's α) for all measures in the study.

Table 1 Descriptive statistics and Cronbach's alphas for all variables

	M	SD	MIN.	MAX.	α
E	68.29	12.74	34	95	.92
A	74.05	10.97	43	96	.87
C	72.23	13.32	33	99	.91
ES	67.11	12.61	32	95	.90
I	71.96	10.08	46	97	.87
FLCAS	76.92	23.14	40	136	.94

Note: N=184; E - Extraversion; A – Agreeableness; C – Conscientiousness; ES – Emotional stability; I – Intellect; FLCAS – Foreign Language Classroom Anxiety Scale

Table 1 shows that the alpha coefficients indicate excellent internal consistency. The reliability estimates for the sample showed Cronbach a's of .92, .87, .91, .90, and .87 for self-reported Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Intellect scales, respectively. As for FLCAS, it had an alpha reliability coefficient of .94. It is evident from the descriptive statistics that the highest means were recorded for the personality dimensions of Agreeableness (M=74.05, SD=10.97) followed by Conscientiousness (M=72.23, SD=13.32) and Intellect (M=71.96, SD=10.08), whereas the lowest means were reported for Emotional Stability (M=67.11, SD=12.61) and Extraversion (M=68.29, SD=12.74). With reference to FLCAS, the mean score of 76.92 (SD=23.14) was indicative of moderate anxiety. According to Mihaljević Djigunović (2002), there is a generally accepted distribution of scores on FLCAS comprising 3 levels: low (below a score of 76), moderate (between 76 and 119) and high (above a score of 119). Based on this distribution, the scores on FLCAS show that the participants in our study tend to experience low anxiety levels in the English classroom.

Correlations

In the second stage of the analysis, correlations were computed on the data in order to investigate the relationship between personality traits, FLCA and GELC. Correlation coefficients are presented in Table 2.

Table 2 Correlation coefficients between personality traits, FLCA and GELC

	E	A	C	ES	I	FLCA	GELC
E	1	0.46**	0.26**	0.40**	0.23**	-0.003	-0.16*
A		1	0.32**	0.09	0.25**	0.06	-0.04
C			1	0.10	0.20**	0.07	-0.15*
ES				1	-0.03	-0.20**	0.02
I					1	-0.30**	0.16*
FLCA						1	-0.47**
GELC							1

Note: N=184; *p<0.05; **p<0.001; E - Extraversion; A – Agreeableness; C – Conscientiousness; ES – Emotional Stability; I – Intellect; FLCAS – Foreign Language Classroom Anxiety Scale; GELC – General English Language Competence

As predicted, there were several significant correlations between personality, FLCA and GELC. In other words, Extraversion was significantly negatively correlated with GELC, whereas there was a significant positive correlation between Intellect and GELC. This finding was consistent with H1. Although differences in Agreeableness, Conscientiousness

and Emotional Stability were not predicted, the results revealed a significant negative correlation between Conscientiousness and GELC, and no significant correlation between Agreeableness and Emotional Stability on the one hand, and GELC on the other. The hypothesis related to the absence of a significant relation between FLCA and Emotional Stability (H3) was not confirmed by the results. Namely, the students with higher scores on Emotional Stability scale reported lower levels of FLCA.

Regressions

Hierarchical regressions were performed on the data in order to test the predictability of GELC by personality traits and FLCA. Table 3 presents the standardized β coefficients and t values for the multiple regressions.

Table 3 Hierarchical regressions: Personality traits and FLCA as predictors of GELC

GELC			
Step 1	St. β	t	Model summary
Gender	-0.05	-0.67	Adj. $R^2 = 0.02$ F (2,181) = 1.83
Age	0.13	1.69	
Step 2			
Gender	0.02	0.20	Adj. $R^2 = 0.09$ F (7,186) = 3.44** R square change (ΔR) $\Delta R = 0.10^{**}$
Age	0.12	1.64	
Extraversion	-0.26	-2.88**	
Agreeableness	0.05	0.56	
Conscientiousness	-0.15	-1.93	
Emotional stability	0.14	1.78	
Intellect	0.25	3.30**	
Step 3			
Gender	0.11	1.60	Adj. $R^2 = 0.25$ F (8,175) = 8.59*** R square change (ΔR) $\Delta R = 0.16^{***}$
Age	0.09	1.43	
Extraversion	-0.19	-2.39*	
Agreeableness	0.07	0.88	
Conscientiousness	-0.12	-1.69	
Emotional stability	0.03	0.36	
Intellect	0.09	1.29	
FLCA	-0.46	-6.28***	

Note. N=184; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.0005$

As can be observed, gender and age were introduced in the first step and accounted for 2% of the variance in GELC. Big Five personality traits were entered in the second step and accounted for an additional 10% of the variance in GELC. In this model, only Extraversion and Intellect were significant predictors of GELC. When FLCA was added in the third step, the amount of explained variance increased by 16%. FLCA was the strongest predictor in this model, which confirmed H4.

One-way analysis of variance (ANOVA)

In order to answer the research question referring to potential differences in personality traits, levels of FLCA and GELC across disciplines, Business, Electrical Engineering, IT and Medicine, one-way between-groups ANOVA with post-hoc tests was used.

As can be seen in Figure 1, the results show that there is a significant difference in three out of five personality dimensions, i.e. in Conscientiousness (F = 4.17, $p = 0.007$), Emotional

Stability ($F = 3.38, p = 0.02$) and Intellect ($F = 5.43, p = 0.001$) across disciplines, which partly confirmed H4. Precisely, there is a statistically significant difference in Conscientiousness between Business ($M=75.94, SD=12.04$) and IT students ($M=66.22, SD=14.73$) and in Emotional Stability between the aforementioned groups of students (Business: $M=64.35, SD=12.53$; IT: $M=72.44, SD=10.94$). A statistically significant difference was also found in Intellect levels between Business ($M=68.13, SD=6.88$) and Medical students ($M=75.62, SD=10.43$).

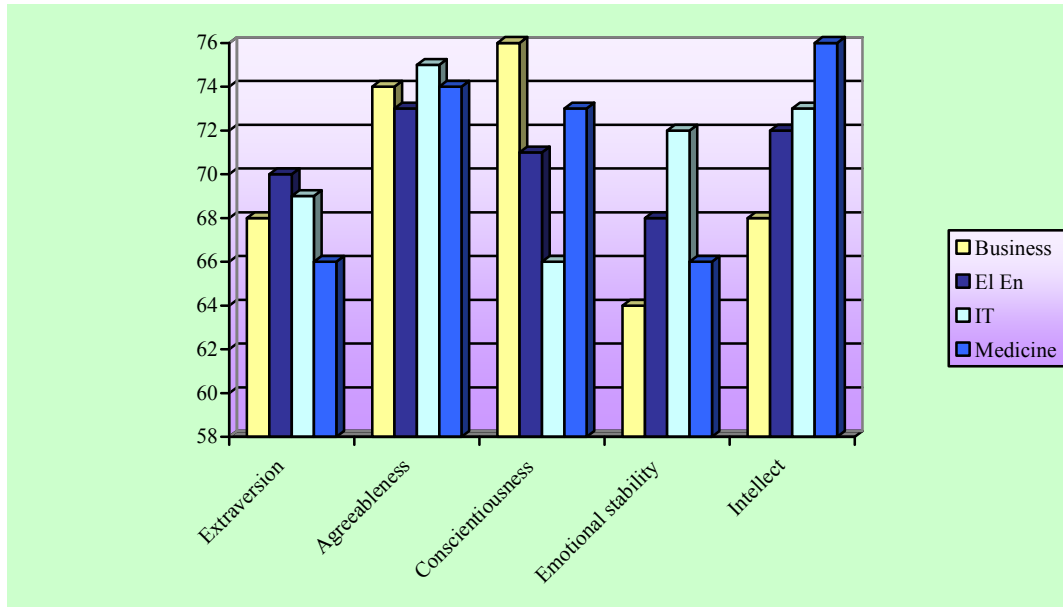


Figure 1 Personality traits by discipline

A one-way analysis of variance (ANOVA) revealed statistically significant differences ($F=4.96, p=0.002$) in GELC across disciplines (Figure 2). Specifically, there was a statistically significant difference between Business ($M=64.85, SD=15.80$) and IT students ($M=75.39, SD=17.73$) as well as between IT and Electrical Engineering students ($M=62.72, SD=17.21$). A statistically significant difference was also found in FLCA across disciplines ($F=4.033, p=0.008$). Business students reported to have higher levels of anxiety ($M=85.33, SD=24.44$) compared to IT ($M=70.89, SD=19.36$) and Electrical Engineering ($M=71.82, SD=21.68$) students.

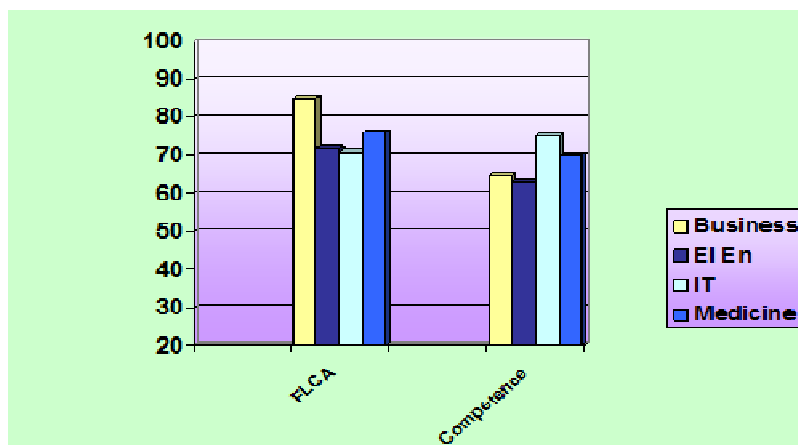


Figure 2 Anxiety and competence by discipline

4. Discussion

In this study, the relationship between personality traits, FLCA and general English competence across four study programmes (Business, Electrical Engineering, Information Technology and Medicine) was investigated. Extraversion was found to be negatively correlated with and predictive of general English competence measured by *cloze* test, leading to the conclusion that more sociable, active and talkative students tend to perform less successfully on written assessment of language competence, which is in line with the results reported in some studies (e.g. Robinson et al, 1994; Carell et al, 1996) and adds support to the idea that best language learners are hard-working and quiet introverted students (Ehrmann, 2008). Contrary to these findings, some studies suggest that more extravert students tend to perform better on oral fluency measures (e.g. Deweale & Furnham, 1999; Ockey, 2011), demonstrate higher levels of strategic competence (as a component of communication competence) (Verhoeven & Vermeer, 2002) and are more willing to communicate (MacIntyre & Charos, 1996; Pavičić Takač & Požega, 2012). Such inconsistent findings in the literature may well point to the conclusion that, based on their personality attributes, "extraverts and introverts seem to follow different routes to success in the L2" (Deweale, 2012: 45), thus showing a natural inclination towards different forms of language assessment.

Not surprisingly, the results further supported the hypothesis that students with higher scores on **Intellect** would show higher levels of general English competence, which corroborates the findings reported by Zabihi (2011) and Verhoeven and Vermeer (2002) and is in agreement with Deweale's (2012) view that Intellect seems to be a good predictor of language proficiency. Students scoring high on this dimension tend to be open to new experience, curious, imaginative, non-conventional, resourceful and intellectually curious. In educational psychology, Intellect has frequently been associated with intelligence, especially crystallized intelligence (Gc) (Ackermann & Heggestadt, 1997), a form of intelligence encouraging individuals to engage in those intellectual activities that facilitate knowledge acquisition (e.g. Chamorro-Premuzic & Furnham, 2004, 2006) as well as with intrinsic motivation (Komarraju, Karau & Schmeck, 2009) and achievement motivation (Komarraju & Karau, 2005). Moreover, this personality trait has been found to be a good predictor of foreign language aptitude (Biedroń, A., 2011).

Although a specific hypothesis on the relationship between Conscientiousness and general English competence was not suggested, the finding that this personality dimension was significantly negatively correlated with GELC seems to be well worth considering. A vast amount of research illustrates that students with higher Conscientiousness levels, described as hard-working, well organized, self-disciplined and ambitious, tend to achieve greater academic success (e.g. Bratko et al, 2006; Busato, Prince, Elshout, & Hamaker 2000; Chamorro-Premuzic, 2006; Chamorro-Premuzic & Furnham, 2003a, 2003b, Conrad, 2006; De Raad, 1996; Furnham & Chamorro-Premuzic, 2004). However, some studies reveal that extremely high Conscientiousness may have a negative effect on academic achievement (Cucina & Vasilopoulos, 2005), which might be explained by inability of highly conscientious students to engage simultaneously in a number of tasks resulting in a failure to exploit their full cognitive potentials (De la Casa i sur., 1998 as cited in Cucina i Vasilopoulos, 2005). In the field of SLA, findings have been rather inconsistent. Conscientiousness has been shown to be positively correlated with different forms of language assessment (e.g. Ockey, 2011; Verhoeven & Vermeer, 2002; Zabihi, 2011) on the one hand, and not to be associated with oral production in English (Pavičić Takač & Požega, 2012) on the other. However, the present results replicate the finding reported by Rogulj (2016) on the significantly negative correlation between Conscientiousness and general English language proficiency measured by *cloze* test. As explained by the aforementioned

author, this finding might be attributed to the application of *cloze* test as an integrative measure of general English competence. This type of instrument does not measure the reproduction of knowledge learned from the course, but the ability to process and understand text in which some pieces of information are missing by integrating current and prior knowledge and making inferences by using context clues. Thus, it may be possible that conscientious students would be more likely to succeed if language competence was measured by conventional and continuous assessment methods (Rogulj, 2016). It is also worth noticing that Business students who scored significantly higher than IT students on Conscientiousness scale, obtained significantly lower results on *cloze* test compared to IT students.

Very few SLA research studies have explored the effects of Emotional Stability (or Neuroticism) on language performance (Deweale, 2012), particularly because SLA researchers have been primarily interested in language anxiety, as a specific form of anxiety occurring in the context of foreign language learning. The results of the current study reveal no association between Emotional Stability and general English language proficiency, which corroborates the findings of some previous research (Pavičić Takač & Požega, 2012; Rogulj, 2016; Verhoeven & Vermeer, 2002). Since foreign language classroom anxiety has in this research, in contrast to Emotional Stability, been found to be significantly negatively related and predictive of GELC, it might be concluded that anxiety as a Neuroticism trait on the one hand, and language anxiety as a situational concept on the other, are two different independent anxiety dimensions, as suggested by MacIntyre and Gardner (1989) and MacIntyre and Charos (1996). However, the discussion on the relationship between these two dimensions does not seem to be so straightforward. The results of the current research indicating significantly negative correlation between Emotional Stability and foreign language anxiety replicate the findings reported by Deweale (2002, 2012, 2013) suggesting that although language anxiety seems to be a stable, unique construct, it is not completely independent of the broader Neuroticism/Emotional Stability trait.

Foreign language anxiety has been found to be one of the best predictors of success in the second/foreign language learning (Gardner & MacIntyre, 1993; MacIntyre & Gardner, 1991). A large number of studies have investigated the relationship between foreign language anxiety and second/foreign language achievement. These studies have generally reported a consistent moderate negative relationship between language anxiety and language achievement (Horwitz, 2001). Gardner and MacIntyre (1993) used a *cloze* test, a composition task, and an objective test to measure students' language achievement and found English-speaking students' foreign language anxiety to be significantly and negatively correlated with scores of the above mentioned three tests. Consistent with the results presented in literature (MacIntyre, 1999), FLCA was, as expected (H4), found to be the best predictor of GELC. In addition, the scores on FLCAS show that the participants in our study tend to experience low anxiety levels in the English classroom. As discussed previously, a large number of studies have investigated the relationship between foreign language anxiety and second/foreign language achievement and generally reported a consistent moderate negative relationship between language anxiety and language achievement (Horwitz, 2001).

5. Conclusion

The aim of this research was to investigate the relationship between personality, foreign language classroom anxiety and general English language competence across disciplines. Our hypotheses were partly confirmed. The results of the study show that GELC is significantly negatively related to Extraversion and Conscientiousness and positively to Intellect. The findings also reveal that students with higher scores on Emotional Stability tend to experience

lower anxiety levels. When it comes to the predictability of GELC, FLCA was shown to be the strongest predictor. Furthermore, students were found to differ in three personality dimensions, namely Conscientiousness, Emotional Stability and Intellect. Business students tend to be significantly more conscientious and have higher anxiety levels than IT students who, in turn, obtained significantly better results on *cloze* test. At the same time, business students demonstrate significantly lower Intellect levels in comparison to medical students.

To conclude, several practical classroom implications arise from this research. Within the framework of much proclaimed learner-centred approach, teachers should take into account students' individual differences in personality and integrate a variety of activities, tasks and assessment methods into the teaching process. In addition, they should work on establishing anxiety-free classroom environment to encourage students' active participation resulting in better language performance.

6. Implications for further research

Based on the findings of this study, several implications for future research can be suggested. It may be recommended that future studies involve a larger number of students from different educational levels. Further, in future studies, it would be beneficial to apply different language assessment methods (oral presentations, written assignments, vocabulary and grammar tests, etc.) in order to provide deeper insight into students' preferences based on their personality attributes and anxiety levels. The current research was based on the quantitative analysis only. However, in order to gain broader perspective, quantitative and qualitative research analysis should be used, i.e. classroom observations, interviews, think-aloud protocols, etc.

REFERENCES

- Ackerman, P. L. i Heggstad, E. D. (1997). Intelligence, personality, and interests: Evidence for overlapping traits. *Psychological Bulletin*, 121, 219-245.
- Biedroń, A. (2011). Personality factors as predictors of foreign language aptitude. *Studies in Second Language Learning and Teaching*, 1(4), 467-489.
- Bratko, D., Chamorro-Premuzic, T. i Saks, Z. (2006). Personality and school performance: Incremental validity of self- and peer-ratings over intelligence. *Personality and Individual Differences*, 41, 131-142.
- Busato, V. V., Prince, F. J., Elshout, J. J. i Hamaker, C. (2000). Intellectual ability, learning style, personality, achievement motivation and academic success of psychology students in higher education. *Personality and Individual Differences*, 29, 1057-1068.
- Carell, P. L., Prince, M. S. i Astika, G. G. (1996). Personality Types and Language Learning in an EFL Context. *Language Learning*, 46(1), 75-99.
- Chamorro-Premuzic, T. i Furnham, A. (2004). A possible model for understanding the personality-intelligence interface. *British Journal of Psychology*, 95, 249-264.
- Chamorro-Premuzic, T. i Furnham, A. (2006). Intellectual Competence and the Intelligent Personality: A Third Way in Differential Psychology. *Review of General Psychology*, 10(3), 251-267.
- Chamorro-Premuzic, T. i Furnham, A. (2003a). Personality traits and academic examination performance. *European Journal of Personality*, 17, 237-250.
- Chamorro-Premuzic, T. i Furnham, A. (2003b). Personality predicts academic performance: Evidence from two longitudinal university samples. *Journal of Research in Personality*, 37, 319-338.
- Conrad, M. A. (2006). Aptitude is not enough: How personality and behaviour predict academic performance. *Journal of Research in Personality*, 40, 339-346.

- Cucina, J. M. i Vasilopoulos, N. L. (2005). Nonlinear Personality–Performance Relationships and the Spurious Moderating Effects of Trait-ness. *Journal of Personality*, 73(1), 227-260.
- Dewaele, J.-M. (2002). Psychological and sociodemographic correlates of communicative anxiety in L2 and L3 production. *The International Journal of Bilingualism*, 6 (1), 23-29.
- Dewaele, J.-M. (2007). Predicting language learners' grades in the L1, L2, L3 and L4: the effect of some psychological and sociocognitive variables. *International Journal of Multilingualism* 4(3), 169-197.
- Dewaele, J.-M. (2012). Personality. Personality traits as independent and dependent variables. U S. Mercer, S. Ryan i M. Williams (Ur.) *Psychology For Language Learning: Insights from Research, Theory and Practice* (str. 42-58). Basingstoke: Palgrave Macmillan.
- Dewaele, J.-M. (2013). The link between Foreign Language Classroom Anxiety and Psychoticism, Extraversion, and Neuroticism among adult bi- and multilinguals. *The Modern Language Journal*, 97(3), 670-684.
- Dewaele, J.-M. i Furnham, A. (1999). Extraversion: The Unloved Variable in Applied Linguistic Research. *Language Learning*, 49(3), 509-544.
- De Raad, B. (1996). Personality traits in learning and education. *European Journal of Personality*, 10, 185–200.
- Dörnyei, Z. (2005). *The Psychology of the Language Learner: Individual Differences in Second Language Acquisition*. Mahwah, NJ: Lawrence Erlbaum.
- Ehrman, M. E. (2008). Personality and good language learners. U C. Griffiths (Ur.) *Lessons from good language learners* (str. 61– 73). Cambridge: Cambridge University Press.
- Furnham, A. i Chamorro-Premuzic, T. (2004). Personality and intelligence as predictors of statistics examination grades. *Personality and Individual Differences*, 37, 943-955.
- Gardner, R.C., & MacIntyre, P.D. (1993). On the measurement of affective variables in second language learning. *Language Learning*, 43(2), 157-194.
- Goldberg, L. R. (1993). The structure of phenotypic personality traits. *American Psychologist*, 48, 26-34.
- Goldberg, L. R. (1999). A broad-bandwidth, public-domain, personality inventory measuring the lower-level facets of several five-factor models. U I. Mervielde, I. J. Deary, F. De Fruyt i F. Ostendorf (Ur.) *Personality Psychology in Europe*, 7 (str. 7-28). Tilburg, The Netherlands: Tilburg University Press.
- Han, L. (2013). Foreign Language Anxiety: Past and Future. *Chinese Journal of Applied Linguistics* 36(4), 442-518.
- Horwitz, E.K., Horwitz, M., & Cope, J. (1986). Foreign language classroom anxiety. *The Modern Language Journal* 1, 125-132.
- Horwitz, E. K. (2001). Language anxiety and achievement. *Annual Review of Applied Linguistics*, 21, 112-126.
- Komarraju, M. i Karau, S. J. (2005). The relationship between the big five personality traits and academic motivation. *Personality and Individual Differences*, 39(3), 557-567.
- Komarraju, M., Karau, S. J. i Schmeck, R. P. (2009). Role of the big five personality traits in predicting college students academic motivation and achievement. *Learning and Individual Differences*, 19, 47-52.
- Kong, Y. (2009). A comparative study on the multiple choice cloze test and the standard cloze test. *Asian Social Science (Canadian Centre of Science and Education)*, 5(2), 93-96.
- MacIntyre, P.D (1999). Language anxiety: A review of the research for language teachers. In D.J. Young (Ed.). *Affect in foreign language and second language learning: A practical guide to creating a low-anxiety classroom atmosphere* (pp. 24-45). Boston: McGraw-Hill College.
- MacIntyre, P.D., & Charos, C. (1996). Personality, attitudes, and affect as predictors of second language communication. *Journal of Language and Social Psychology*, 15 (1), 3-26.

- MacIntyre, P. D. i Gardner, R. C. (1989). Anxiety and second language learning: Toward a theoretical clarification. *Language Learning*, 39, 251-275.
- MacIntyre, P. D. i Gardner, R. C. (1991). Language anxiety: Its relation to other anxieties and to processing in native and second languages. *Language Learning*, 41, 513-534.
- McCrae, R. R. i John, O. P. (1992). An introduction to the five-factor model and its applications. *Journal of Personality*, 60, 175-215.
- Mihaljević Djigunović, J., (2002). Strah od stranoga jezika: Kako nastaje, kako se očituje i kako ga se osloboditi. Zagreb: Naklada Ljevak.
- Mihaljević Djigunović, J., (2006). Language anxiety and language processing. In S. Foster-Cohen, M. Medved Krajnović & J. Mihaljević Djigunović (Eds.). *EUROSLA Yearbook 6* (pp. 191-212). Amsterdam/Philadelphia: John Benjamins Publishing Company.
- Ockey, G. (2011). Self-consciousness and Assertiveness as Explanatory Variables of L2 Oral Ability: A Latent Variable Approach. *Language Learning*, 61(3), 968–989.
- Pavičić Takač, V., & Požega, D. (2012). Personality traits, willingness to communicate and oral proficiency in English as a foreign language. In L. Pon, V. Karabalić, & S. Cimer (Eds.), *Applied Linguistics Today: Research and Perspectives* (pp. 67-83). Frankfurt am Main: Peter Lang International Academic Publishers.
- Riasati, M. (2011). Language Learning Anxiety from EFL Learners' Perspective. *Middle-East Journal of Scientific Research* 7 (6), 907-914.
- Robinson, D., Gabriel, N. i Katchan, O. (1994). Personality and second language learning. *Personality and Individual Differences*, 16, 143-157.
- Rogulj (2016). Odnos između ličnosti, strategija učenja, strategija poučavanja i znanja engleskog jezika. Unpublished Doctoral Thesis. Zagreb: University of Zagreb
- Sauciere, G. i Goldberg, L. R. (1998). What is Beyond the Big Five? *Journal of Personality*, 66, 495-524.
- Toth, Z. (2007). Predictors of Foreign-Language Anxiety: Examining the Relationship Between Anxiety and Other Individual Learner Variables. In J. Horvath & N. Nikolov (Eds.), *UPRT 2007: Empirical Studies in English applied linguistics* (pp.123-148). Pecs: Lingua Franca Csoport.
- Verhoeven, L. i Vermeer, A. (2002). Communicative competence and personality dimensions in first and second language learners. *Applied Psycholinguistics*, 23, 361-374.
- Worde, R. (1998). An investigation of students' Perspectives on Foreign language anxiety. Doctoral Dissertation, George Mason University.
- Zabihi, R. (2011). Personality in English Language Proficiency and Achievement. *Continental Journal of Education Research*, 4, 1-6.

CIET | **Split**
2018 | **Track 1**

Finance & Accounting

The Construction Sector at the Zagreb Stock Exchange (ZSE)

Branko Sorić

University Department of Professional Studies, Split, Croatia
bsoric@oss.unist.hr

Magdalena Gustin

University Department of Professional Studies, Split, Croatia
mgustin@oss.unist.hr

Abstract. Construction is an important part of any economy that employs a significant part of the workforce and has a number of accompanying activities. The construction sector is very sensitive to investment cycles, and it has been through a turbulent period in the last ten years. The impact of the crisis on construction is mostly reflected in the decline in real estate demand, resulting in a fall in the construction sector itself. The aim of this paper is to analyze the movement of shares of construction companies on the Zagreb Stock Exchange and to observe and analyze the reasons why very few companies from this sector are included in the same. Although construction companies find it difficult to find favorable bank loans because banks are reluctant to follow project funding, it is still difficult to open up capital and attract investors through the IPO, which would greatly facilitate financing of business and growth.

Keywords: *construction, Zagreb Stock Exchange, closed capital, IPO*

1. Introduction

Construction is an extremely important sector of the economy which directly and indirectly employs a large number of people and significantly affects the GDP. It is estimated that the construction sectors contribution to the total GDP in the European Union is 10%. The construction sector has major multiplier effects on the production and sale and has often impacts on the shift in the business cycle. The condition of the construction sector is often an indicator of the total investment and economic activity of a society. The sources of problems in the construction sectors around the world have primarily been the consequences of the formation of the real estate bubbles related to mortgage loans increase. In the Republic of Croatia the construction sector had an unrealistic growth through government investments in the network of motorways and housing. The consequence of this was an excessive construction sector which did not adapt to the new circumstances after the government investments had terminated. The large construction companies have, due to high profit earning during the investment boom, left the former foreign markets and now they experience difficulties in re-entering them.

Such tendencies have led to devastating results; in this activity, during the reference period, more than 53 thousands jobs had been lost (34,4 thousands in the case of juridical entities and 18,7 thousands in the case of craft enterprises), the share of the construction industry in GDP decreased from 8,5% to 5,1%, the volume of constructional work has been reduced by 46,6 %, the value of carried out work has been reduced by 49,9%, the number of completed apartments by 69,2% and the number of issued building permits is lower by 46,3%. This way, the Croatian construction industry has been halved, and its competitiveness has been reduced due to the loss

of the competent workforce and the absence of the references in building the major and complexed building facilities.¹

The Government is aware of the importance of the construction sector and has thus adopted numerous measures in order to support construction activity. These are plans for building the infrastructure facilities, social housing (POS), energetic refurbishment of the buildings, energy infrastructure related to the protection of the environment, stimulating the first real estate purchase for young families and similar. One part of these investments will be able to be funded through European Union structural funds.

Also, one part of the investments will be aimed towards tourism capacity increase (mainly private investments). All this will re-stimulate the investment cycle. Whereas the banks cautiously grant the loans to the construction sector, the question is why such a small number of the construction sector companies tries to find alternative ways of financing on the stock exchange. Also, the question arises why the construction sector companies do not open capital, recapitalize themselves and this way create the grounds for a stronger stepping forward towards the foreign markets.

2. The Significance of the Construction Sector for the Croatian Economy

The construction industry in the Republic of Croatia, according to the National Classification of Activities (NKD, 2007) is defined in the field F- The construction industry and it includes general and specialized construction activities of construction of the buildings and civil engineering structures. It includes works on the new structures, repairs, upgrading and modifications, lifting the prefabricated buildings or other structures on the construction site from the priory manufactured elements and the construction of the temporary buildings.² In the years before the crisis, the share of the construction industry in GDP of the Republic of Croatia was significantly larger.

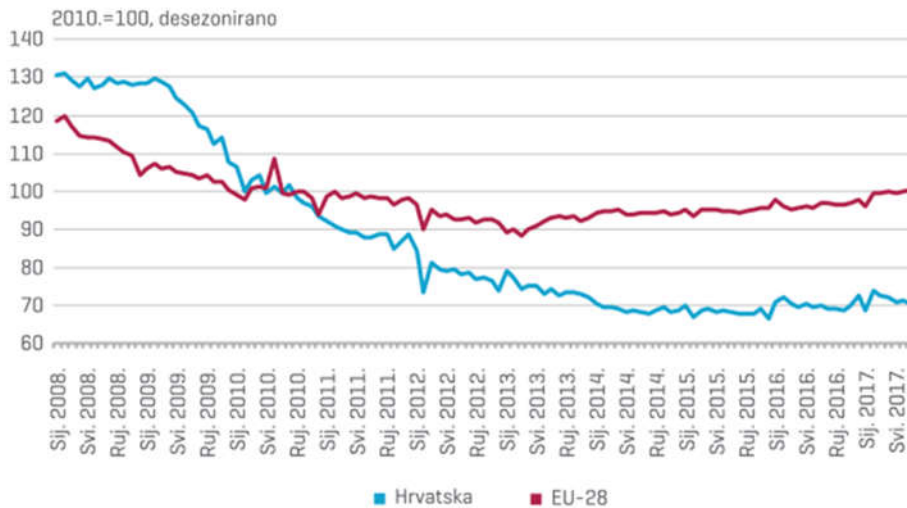
The main construction sector indicators in 2016 and over the first half of 2017 indicate a mild recovery of this activity. Although the activity level in the construction industry has significantly decreased over the past few years of the recession, this sector still occupies an important place in the Croatian economy. According to the latest available data of the Croatian Bureau of the Statistics, the share of the construction industry in the structure of the total economy over the first half of 2017 was 4,6%. Besides the impact on the aggregate production, the contribution of the construction industry to the total employment rate is also inevitable. The number of persons employed in this activity in August 2017 was 88.412 which is 6,3% of the total number of employed persons in the Republic of Croatia. At the same time, 77,2% of the total number of the persons employed in the construction sector was employed by juridical entities and 22,8% in the craft enterprises.³

¹ <https://www.hgk.hr/documents/gradevinski-sektor-eu-i-hrvatske-od-recesije-doopravka57b6e421116a4.pdf> (viewed 12.03.2018.)

² https://narodne-novine.nn.hr/clanci/sluzbeni/2007_06_58_1870.html (viewed 12.03.2018.)

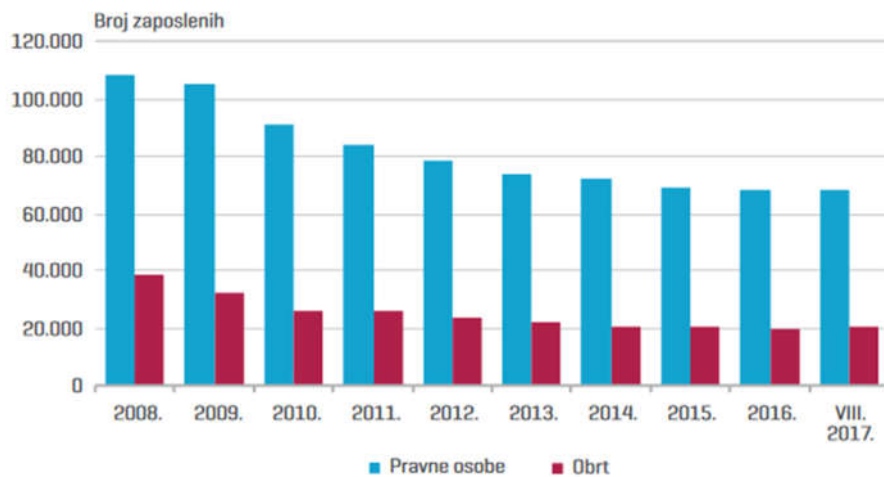
³ http://www.eizg.hr/userdocsimages/publikacije/serijske-publikacije/sektorske-analize/SA_gradevinarstvo_listopad-2017.pdf (viewed 12.03.2018.)

Graph 1: Volume of construction works in the Republic of Croatia and EU-28



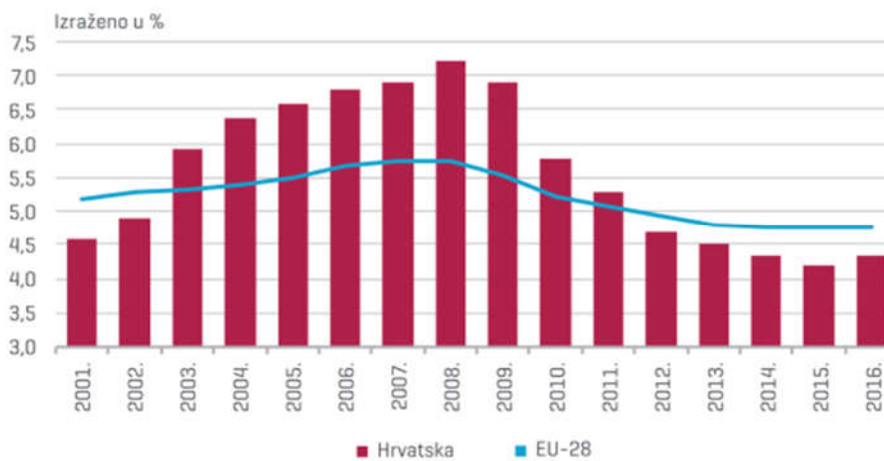
Source: http://www.eizg.hr/userdocsimages/publikacije/serijske-publikacije/sektorske-analize/SA_gradevinarstvo_listopad-2017.pdf

Graph 2: Number of employed persons in construction in the Republic of Croatia



Source: http://www.eizg.hr/userdocsimages/publikacije/serijske-publikacije/sektorske-analize/SA_gradevinarstvo_listopad-2017.pdf

Graph 3: The share of construction in GDP of the Republic of Croatia and EU-28



Source: http://www.eizg.hr/userdocsimages/publikacije/serijske-publikacije/sektorske-analize/SA_gradevinarstvo_listopad-2017.pdf

3. The Construction Industry and Zagreb Stock Exchange

The stock exchange is an organized place of trade whose primary function is to enable the meeting of the supply and the demand of the securities under the same terms for all participants.⁴ Zagreb stock exchange is a central place of trading with the securities in the Republic of Croatia which includes more than 150 companies, and the stock manages two markets: Regulated Market and Multilateral Trade Platform.⁵ The basic functions of each capital market are: the provision of capital required for the business financing and expansion of the company, market valuation of the company, mobilizing the decentralized saving in economic purposes and increasing the degree of mobility of the investments.⁶ The decision on financing the company is a significant category which can mark a turning point in the further company development. There are different ways of obtaining additional financial means, most frequently these are retained earnings from past years, bank loans, issuing bonds, strategic partners or through the procedure of initial public offering. The process of initial public offering (IPO) presents a way of obtaining additional financial means which are invested in the business growth by the company. There are numerous reasons for companies to decide to obtain additional financial means through the process of initial public offering (IPO), which are most frequently obtaining financial means without maturity and interest rates, as well as debt reduction.

For the purposes of the division of the company on sectors based on main activity, Zagreb stock exchange uses National Classification of Activities 2007 (NN 58/07, 72/07) which is led by the Croatian Bureau of the Statistics.⁷ In the field F- The construction industry following companies are listed on Zagreb stock exchange: Dalekovod d.d., Hidroelektra niskogradnja dioničko društvo za graditeljstvo, Tehnika dioničko društvo za graditeljstvo, inženjering, proizvodnju i trgovinu and Vodoprivreda Zagreb d.d.. Pursuant to the EU Regulation 2017/1005, on March 2nd 2018 the financial instruments of the companies Gabarit d.d. and Radnik d.d. were excluded from the trade due to long-term inactivity on the market. Given that there was no trade with the shares of the Gabarit d.d. company during the period longer than 6 months, the long-term inactivity on the market has been established. The shares of Gabarit d.d. company were not subjected to trade from their receipt until the adoption of the decision on inactivity.

According to Register of Business Entities of the Republic of Croatia which represents an integrated database on all Croatian companies registered at the Commercial Court from the establishment of the Republic of Croatia, 12. 696 companies operate in the activity F- The construction industry and all of them submitted the Annual financial reports for 2016.

Table 1. Entities by size of enterprise and legal form

	D.D.	D.O.O.	OTHER	TOTAL
LARGE	12	13	0	25
MEDIUM	19	89	4	112
SMALL	28	915	10	953
MICRO	30	9.406	2.170	11.606

Source: Creation of authors according to data from the Register of Business Entities of the Republic of Croatia (viewed 14.03.2018.)

⁴ <https://sh.wikipedia.org/wiki/Burza> (viewed 13.03.2018.)

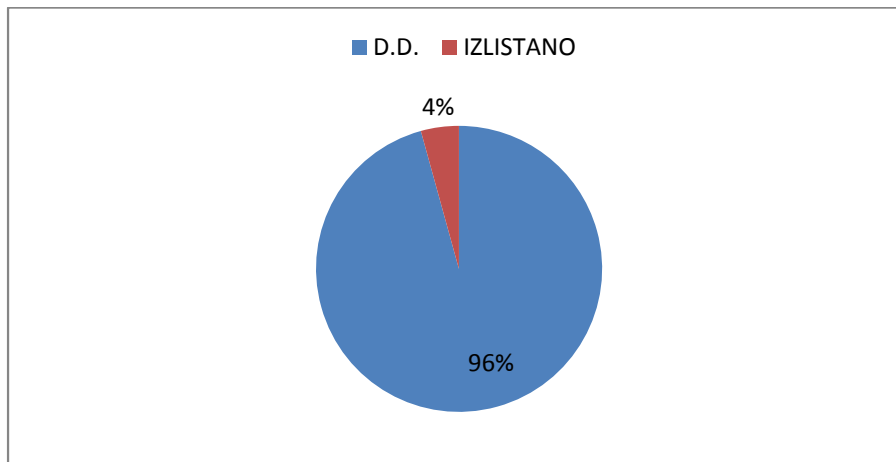
⁵ <http://www.zse.hr/default.aspx?id=64271> (viewed 13.03.2018.)

⁶ Jakšić, S., Primjena Markowitzve teorije na tržište dionica Zagrebačke burze, available at <https://hrcak.srce.hr/> (viewed 14.03.2018.)

⁷ <http://www.zse.hr/default.aspx?id=64271> (viewed 13.03.2018.)

Out of the total number of companies whose main activity is construction industry, securities of 4 companies, that is 4% out of total number of public limited liability companies, have been listed on the Zagreb stock exchange, which proves that there is a lack of usage of the benefits brought by securities listing on the stock exchange. The question is why the large companies which can bear the financial burden required by IPO (the process of initial public offering) do not finance their projects through financial markets.

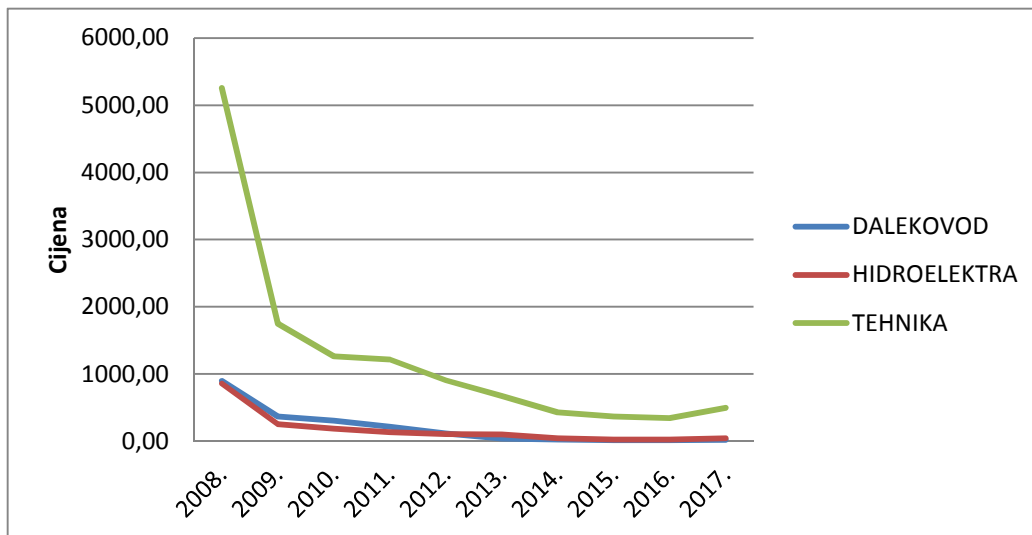
Graph 4: Share of joint stock companies whose shares are listed on the Zagreb Stock Exchange



Source: Creation of authors according to the data of the Registry of Business Entities of the Republic of Croatia and the Zagreb Stock Exchange (viewed 14.03.2018.)

In the following we have given the review of the shares prices development of the above mentioned companies whose shares have been listed on the Zagreb stock exchange from 2008 to 2017.

Graph 5: Movement of average stock price of listed companies 2008-2017



Source: creation of authors according to the data available at <http://www.zse.hr/>

The shares of company Vodoprivreda Zagreb d.d. have been listed on Regular market of the Zagreb stock exchange, but they have not been submitted to trade. The average share price of company Dalekovod d.d. in 2008 was 894, 53 kn. Afterwards there was a continuous share price decrease where the average share price of the observed company in 2016 was 12, 75 kn. The share price of the company Hidroelektra also followed the negative trend, where the share

price decreased from 856, 08 kn in 2008 to 24, 59 kn in 2016. The share price of the company Tehnika d.d. continues to show the continuous decreasing, as well as in two priory analyzed companies. The average share price has dramatically decreased from 5.255,45 in 2008 to only 341, 42 kn in 2016. The negative trend affected the companies whose shares have been listed in the stock exchange, but it should be noted that there was a slight recovery in 2017.

4. Credit Versus Equity Finance

The main task of a financial manager is making the good investment and financial decisions. The investment decision starts with recognizing the investment possibilities which are often called the capital investment projects.⁸

Financial decisions include:⁹

- How much means to obtain from the external resources,
- Is the company going to reinvest the profit or pay out the dividends, and, if it pays out, how high is the payout ratio going to be,
- Do the means need to be obtained from the securities market or on the banking market, national, foreign or European market; domestic or foreign currency,
- Do the means need to be obtained on short or long term,
- Do the equity or credit securities need to be broadcasted, what types of securities to broadcast and when.

These questions are not easy to answer unambiguously. The financial managers, by building an optimal capital structure, need, in every moment, to be aware of the advantages and disadvantages of credit versus equity finance.

Table 2: Basic differences between credit and ownership financing

The characteristic	The credit sources	Joint stock
The control	Provisions of Agreement on bonds/Agreement on credit	The right to vote
The cost of the source	Interest rate	The dividend
The tax treatment of the cost	The interest rates are the cost of business activity and deductible for tax purposes	The dividends are not the cost of business – they are paid out from the profit after the tax calculation
The consequences of cost non-payment	Bankruptcy	No legal consequences

Source: Vidučić, Lj., *Financijski menadžment, teorija i politika*, RRIF Plus, Zagreb, 2000., pg.189

The first condition in order to a company even think about the equity finance is that the manager of the company understands the manner of capital market functioning. Many managers in the Republic of Croatia hesitate from the equity finance. Namely, if the process of initial public offering (IPO) fails, that is primarily the failure of the management because the market did not recognize the current value and the potential of the company. Logically, after such failure, the management bears the consequences. Alternatively, the relation between the manager of the company and the banker is not public and the rejection of the loan request remains a trade secret.

⁸ Brealey, R.A., Myers, S.C., Marcus, A.J., *Osnove korporativnih financija*, MATE, 2007., pg. 4

⁹ Vidučić, Lj., *Financijski menadžment, teorija i politika*, RRIF Plus, Zagreb, 2000., pg. 175

The management simply addresses another bank which may have a different credit policy. The second significant reason is a narrow and shallow secondary capital market in the Republic of Croatia. In order that the marketing rules reach its full effect on the stock exchange, the market capitalization should at least be 100 mil US dollars. On a small stock exchange with a low turnover, you may have a feeling that the stronger players effect the market forces. Therefore, the company owners and their agents, managers rarely decide for the process of initial public offering (IPO). In a bank centered financial system such as Croatian, the bank is the most important creditor. However, the bank is also a conservative institution with its own rules and quite strict regulations. In Croatia the type of the banks is universal and, besides the credit rating and feasibility of the project, they require strong collaterals (most often mortgages). Due to a small number of companies with liquid, non-encumbered mortgages, the possibility of long-term credit financing is limited. Many companies have the credit rating and projects with a positive present net value, but are unable to get an affordable investment loan.

The Government of the Republic of Croatia seems to become aware of this facts. The Minister of finance Zdravko Marić has announced changes to the Law on capital markets in order to attract small and medium-sized entrepreneurs. The Minister has emphasized that the capital market situation in the Republic of Croatia requires not only this legislative framework, but also a whole sequence of other measures in order to stimulate it. He also announced that the Government and the Ministry of Finance will work on certain measures and activities which will contribute the revival of the capital market.

“A platform for the growing market of the small and medium-sized entrepreneurs is foreseen in the Law”, continued the Minister and explained that one of the chronic problems which face the small and medium-sized entrepreneurs is a lack of capital and quality sources of means for growth, development and investments, and that this Law opens a possibility to enhance and facilitate the accessibility of the means through the capital market. Also, the Minister emphasized that a great emphasis is placed on the protection of the investors. “Besides this amendments, other corrections which go past the MiFID II Directive and which concern other directives and regulations regarding the monitoring of financial reporting of the issuer, have also been made and HANFA gets far greater powers, but also responsibilities.”, said Minister Marić.¹⁰

5. Conclusion

The construction sector is a significant part of the economy of every country. Since it has major multiplier effects on economy, the crisis in this sector has multiple implications on all macroeconomic indicators. The construction sector has, during the last ten years, been in a major crisis which is a result of both external and internal factors. However, recently, by the increase of the investments in the tourism and housing, this sector is awakening. Regarding that the companies in this business have aggregated difficulties which have an effect on not such good balances of the companies, the possibility of financing the new projects using bank loans is reduced. This is understandable since the banks, as the most important financial mediator in the Republic of Croatia, are conservative institutions which stick to “Holy Trinity”: credit rating, feasibility and collaterals. The question is why the companies from this sector rarely use financial markets as a place of financing their projects? The reasons are numerous, from ignorance and fear to lack of transparency and legislative framework. The Government of the Republic of Croatia seems to become aware of this facts, therefore, the change of legislative framework in order to attract small and medium- sized companies is in preparation.

¹⁰ <https://vlada.gov.hr/vijesti/ministar-maric-o-zakonu-o-trzistu-kapitala-brojne-novosti-za-sve-sudionike-na-trzistu-kapitala/23554> (viewed 24.03.2018.)

REFERENCES

Books:

Brealey, R.A., Myers, S.C., Marcus, A.J., Osnove korporativnih financija, MATE, 2007.

Vidučić, Lj., Financijski menadžment, teorija i politika, RRIF Plus, Zagreb, 2000.

Other sources:

<https://www.hgk.hr/documents/gradevinski-sektor-eu-i-hrvatske-od-recesije-dopporavka57b6e421116a4.pdf>

http://www.eizg.hr/userdocsimages/publikacije/serijske-publikacije/sektorske-analize/SA_gradevinarstvo_listopad-2017.pdf

<https://sh.wikipedia.org/wiki/Burza>

<http://www.zse.hr/default.aspx?id=64271>

Jakšić, S., Primjena Markowitzeve teorije na tržište dionica Zagrebačke burze, dostupno na <https://hrcak.srce.hr/>

<https://vlada.gov.hr/vijesti/ministar-maric-o-zakonu-o-trzistu-kapitala-brojne-novosti-za-sve-sudionike-na-trzistu-kapitala/23554>

Accounting and Legal Aspects of Clearing

Ivica Filipović

University Department for Forensic Sciences, Split, Croatia
ivica.filipovic@unist.hr

Marijana Bartulović

University Department for Forensic Sciences, Split, Croatia
marijana.bartulovic@unist.hr

Toni Šušak

University Department for Forensic Sciences, Split, Croatia
toni.susak@unist.hr

Abstract. Under the Croatian civil law system legal entities can apply certain legal concepts to settle mutual claims and liabilities without using cash. Companies with liquidity issues can use this form of payment to settle their current liabilities without unnecessary increase of debt. Relevant forms of clearing elaborated in this paper are *set-off (compensation)*, *assignment of claim (cession)*, *assumption of debt* and *assignment (assignation)*. Primary focus will be directed on accounting journal entries used to record these transactions in business books and legal provisions which constitute the framework for such activities. Aforementioned forms of clearing are regulated by Croatian *Civil Obligations Act (OG 35/05, 41/08, 125/11, 78/15)* in Title VI – *Alterations in Obligations* and Title VII – *Termination of Obligation*.

Key words: *accounting, cashless payment, civil law, clearing, liquidity*

1. Introduction

Forms of clearing are regulated by Croatian Civil Obligations Act – COA (OG 35/05, 41/08, 125/11, 78/15) in Title VI – Alterations in Obligations and Title VII – Termination of Obligation. Primary focus of this paper will be directed on accounting journal entries used to record these transactions in business books and legal provisions which constitute the framework for such activities.

Relevant forms of clearing are:

- 1) set-off (compensation)
- 2) assignment of claim (cession)
- 3) assumption of debt
- 4) assignment (assignation).

It is important to notify that clearing is not allowed if account is blocked (Law on execution of monetary resources of 2010, art 14 [2]). If it were otherwise, legal person shall be punished with 50.000,00 to 500.000,00 Kuna fine (Law on execution of monetary resources of 2010, art 30 [1]).

2. Set-off (Compensation)

2.1. Definition and characteristics

“A debtor may set off a claim against the claim of the creditor provided that both claims are payable in money or other fungible property identical in kind or quality and both are due” (COA of 2005, art 195). The effect of set-off starts from the moment all preconditions are met, but after the statement of set-off has been made (COA of 2005, art 196 [1] to [2]).

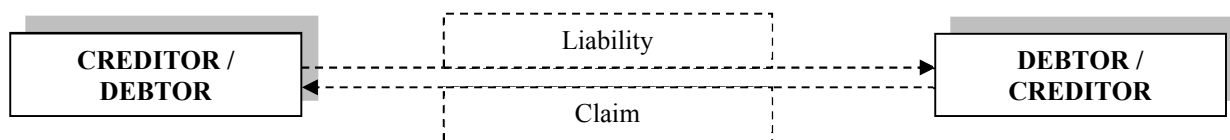


Figure 1 Set-off (Compensation)

There are certain cases where set-off is excluded – it cannot terminate “a claim that cannot be seized, a claim of things or values that have been given to the debtor for safekeeping or loaned or that have been taken or retained illegally by the debtor, a claim arising from wilful damage, a claim for compensation of damage caused by injury to health or by causing death and a claim which arises from the legal obligation of support” (COA of 2005, art 200).

2.2. Example of compensation – accounting records

- 1) Company A has rendered promotion service to company B.
- 2) Company B issued invoice for intellectual services rendered to company A.
- 3) Set-off is implemented on basis of set-off decision.

Table 1 Accounting entries – Company A

No	Description	Account No ¹	Debit	Credit
1	Trade receivables	120	1.250,00	
	Liabilities for value added taxes – 25%	240		250,00
	Revenue from the rendering of services <i>Revenues from promotion services</i>	751		1.000,00
2	Value added tax – 25%	140	200,00	
	Domestic trade payables	220		1.000,00
	Intellectual services <i>Costs of intellectual services</i>	416	800,00	
3	Trade receivables	120		1.000,00
	Domestic trade payables <i>Compensation</i>	220	1.000,00	

Table 2 Accounting entries – Company B

No	Description	Account No	Debit	Credit
1	Value added tax – 25%	140	250,00	
	Domestic trade payables	220		1.250,00
	Promotion costs <i>Costs of promotion services</i>	415	1.000,00	
2	Trade receivables	120	1.000,00	
	Liabilities for value added taxes – 25%	240		200,00
	Revenue from the rendering of services <i>Revenues from intellectual services</i>	751		800,00

¹ Account numbers and descriptions in this paper are from Računovodstvo, revizija i financije (2017).

3	Trade receivables Domestic trade payables <i>Compensation</i>	120 220	1.000,00	1.000,00
---	---	------------	----------	----------

3. Assignment of claim (Cession)

3.1. Definition and characteristics

“A creditor may assign his claim by a contract entered into with a third party with the exception of a claim whose transfer not permitted by law, or which is strictly personal in nature, or whose very nature is incompatible with assignment to another” (COA of 2005, art 80 [1]). “A contract of assignment shall have no effect for a debtor if he and the creditor stipulated that the latter shall not be able to transfer the claim to another person, or that he shall not be able to transfer the claim to another person without the debtor's consent” (COA of 2005, art 80 [2]).

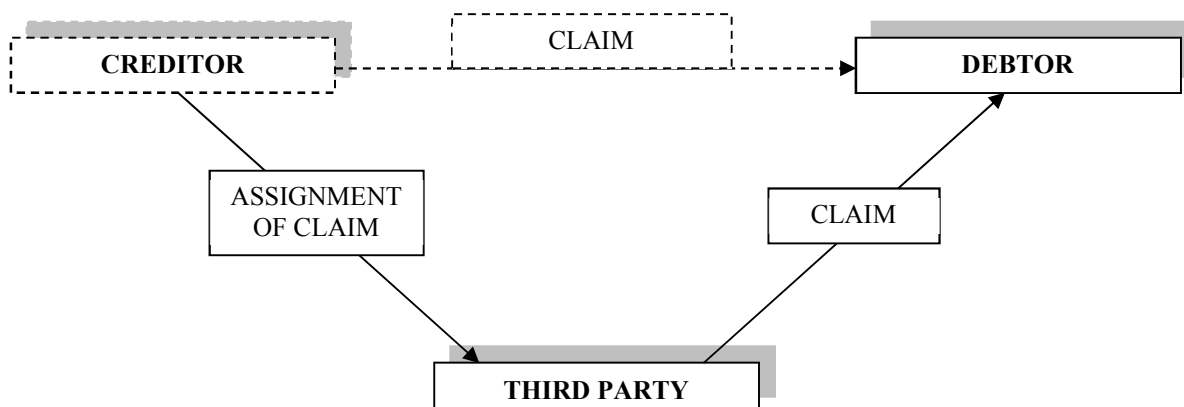


Figure 2 Assignment of claim (Cession)

Debtor's consent is not required and the assignor has to notify the debtor about the assignment (COA of 2005, art 82 [1]).

3.2. Example of cession – accounting records

- 1) Company A sold merchandise to company B.
- 2) Company C sold finished goods to company A.
- 3) Under a contract on assignment, company A assigned its claim on company B to company C.
- 4) Company B paid obligation under a contract on assignment to company C.

Table 3 Accounting entries – Company A

No	Description	Account No	Debit	Credit
1	Trade receivables	120	1.250,00	
	Liabilities for value added taxes – 25%	240		250,00
	Revenue from sale of goods	760		1.000,00
	<i>Merchandise sold to company B</i>			
2	Value added tax – 25%	140	250,00	
	Domestic trade payables	220		1.250,00
	Finished goods in warehouse	630	1.000,00	
	<i>Purchase of goods from company C</i>			
3	Trade receivables	120		1.250,00

	Domestic trade payables <i>Cession</i>	220	1.250,00	
--	---	-----	----------	--

Table 4 Accounting entries – Company B

No	Description	Account No	Debit	Credit
1	Value added tax – 25%	140	250,00	
	Domestic trade payables	220		1.250,00
	Merchandise goods	660	1.000,00	
	<i>Purchase of merchandise from company A</i>			
3	Domestic trade payables	220	1.250,00	
	Current liabilities from cession	231		1.250,00
	<i>Cession</i>			
4	Cash in bank (transaction accounts)	100		1.250,00
	Current liabilities from cession	231	1.250,00	
	<i>Settlement of residual liabilities from cession</i>			

Table 5 Accounting entries – Company C

No	Description	Account No	Debit	Credit
2	Trade receivables	120	1.250,00	
	Liabilities for value added taxes – 25%	240		250,00
	Sale of goods	750		1.000,00
	<i>Goods sold to company A</i>			
3	Trade receivables	120		1.250,00
	Current receivables from cession	128	1.250,00	
	<i>Cession</i>			
4	Cash in bank (transaction accounts)	100	1.250,00	
	Current receivables from cession	128		1.250,00
	<i>Recovery of claims from cession</i>			

4. Assumption of debt

4.1. Definition and characteristics

„A debt shall be assumed by a contract between a debtor and a person assuming the debt provided the creditor gave his consent” (COA of 2005, art 96 [1]).

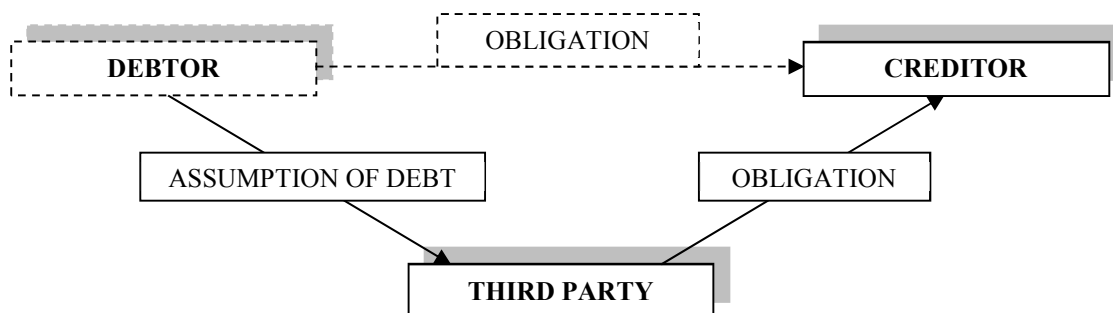


Figure 3 Assumption of debt

“It shall be deemed that the creditor has given his consent if he has, without reservations, received performance from the person who assumed the debt effected on its own behalf” (COA of 2005, art 96 [3]). “The contracting parties, as well as each of them individually, may request from the creditor to give a statement within a stipulated time limit on whether or not he consents to the assumption of debt, should the creditor fail to give a statement within the set time limit, it shall be presumed that he has not given his consent.” (COA of 2005, art 96 [4]).

4.2. Example of assumption of debt – accounting records

- 1) Company B has rendered maintenance services to company A.
- 2) Company A has rendered intellectual services to company C.
- 3) Under a contract on assumption of debt and after creditor's consent, company C assumed company A's liabilities to company B.
- 4) Company C settled the obligation to company B.

Table 6 Accounting entries – Company A

No	Description	Account No	Debit	Credit
1	Value added tax – 25%	140	250,00	
	Domestic trade payables	220		1.250,00
	Maintenance services	412	1.000,00	
	<i>Cost of maintenance</i>			
2	Trade receivables	120	1.250,00	
	Liabilities for value added taxes – 25%	240		250,00
	Revenue from the rendering of services	751		1.000,00
	<i>Revenues from intellectual services</i>			
3	Trade receivables	120		1.250,00
	Domestic trade payables	220	1.250,00	
	<i>Assumption of debt</i>			

Table 7 Accounting entries – Company B

No	Description	Account No	Debit	Credit
1	Trade receivables	120	1.250,00	
	Liabilities for value added taxes – 25%	240		250,00
	Revenue from the rendering of services	751		1.000,00
	<i>Revenues from maintenance services</i>			
3	Trade receivables	120		1.250,00
	Current receivables from assumption of debt	128	1.250,00	
	<i>Assumption of debt</i>			
4	Cash in bank (transaction accounts)	100	1.250,00	
	Current receivables from assumption of debt	128		1.250,00
	<i>Recovery of claims</i>			

Table 8 Accounting entries – Company C

No	Description	Account No	Debit	Credit
2	Value added tax – 25%	140	250,00	

	Domestic trade payables	220		1.250,00
	Intellectual services	416	1.000,00	
	<i>Costs of intellectual services</i>			
3	Domestic trade payables	220	1.250,00	
	Current liabilities from assumption of debt	231		1.250,00
	<i>Assumption of debt</i>			
4	Cash in bank (transaction accounts)	100		1.250,00
	Current liabilities from assumption of debt	231	1.250,00	
	<i>Settlement of liabilities</i>			

5. Assignment (Assignment)

5.1. Definition and characteristics

„By assignment, one person, the assigner, authorises the other person, the assignee, to perform a thing in his account to a third person, the recipient of the assignment, and authorises him to receive this performance in his own name” (COA of 2005, art 130).

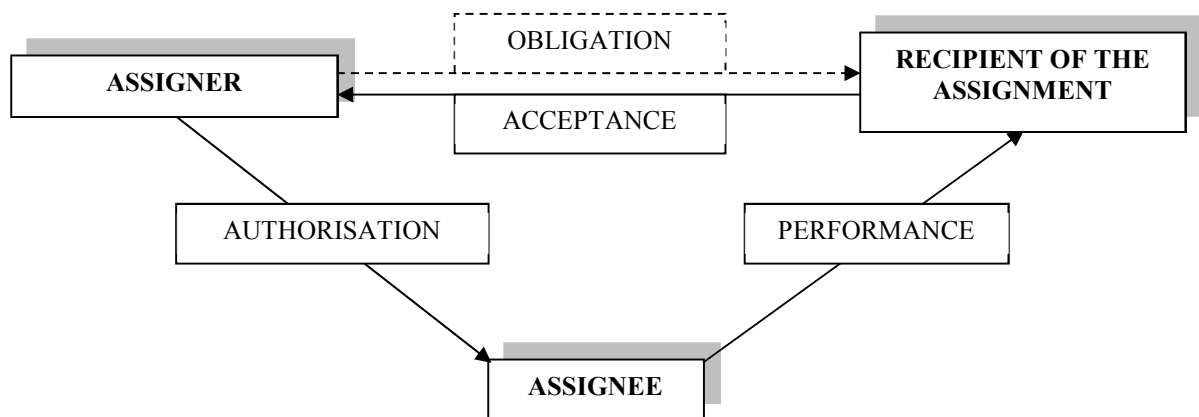


Figure 4 Assignment (Assignment)

“A recipient of the assignment shall acquire the right to request performance from the assignee when he intimates that he accepts the assignment” (COA of 2005, art 131 [1]). „Acceptance of assignment may not be revoked“ (COA of 2005, art 131 [2]).

5.2. Example of assignment – accounting records

- 1) Company C sold transportation service to company A.
- 2) Company A sold finished goods to company B.
- 3) Under a contract on assignation company A has given authorisation to company B to settle liabilities to company C.
- 4) Company B settled the obligation to company C.

Table 9 Accounting entries – Company A

No	Description	Account No	Debit	Credit
1	Value added tax – 25%	140	250,00	
	Domestic trade payables	220		1.250,00
	Transportation costs	410	1.000,00	

	<i>Costs of transportation</i>			
2	Trade receivables	120	1.250,00	
	Liabilities for value added taxes – 25%	240		250,00
	Sale of goods	750		1.000,00
	<i>Finished goods sold to company B</i>			
3a	Trade receivables	120		1.250,00
	Current receivables from assignment	128	1.250,00	
	<i>Assignment</i>			
3b	Domestic trade payables	220	1.250,00	
	Current liabilities from assignment	231		1.250,00
	<i>Assignment</i>			
4	Current receivables from assignment	128		1.250,00
	Current liabilities from assignment	231	1.250,00	
	<i>Assignment</i>			

Table 20 Accounting entries – Company B

No	Description	Account No	Debit	Credit
2	Value added tax – 25%	140	250,00	
	Domestic trade payables	220		1.250,00
	Finished goods in warehouse	630	1.000,00	
	<i>Finished goods purchased from company A</i>			
3	Domestic trade payables	220	1.250,00	
	Current liabilities from assignment	231		1.250,00
	<i>Assignment</i>			
4	Cash in bank (transaction accounts)	100		1.250,00
	Current liabilities from assignment	231	1.250,00	
	<i>Assignment</i>			

Table 31 Accounting entries – Company C

No	Description	Account No	Debit	Credit
1	Trade receivables	120	1.250,00	
	Liabilities for value added taxes – 25%	240		250,00
	Revenue from the rendering of services	751		1.000,00
	<i>Revenues from transportation services</i>			
3	Trade receivables	120		1.250,00
	Current receivables from assignment	128	1.250,00	
	<i>Assignment</i>			
4	Cash in bank (transaction accounts)	100	1.250,00	
	Current receivables from assignment	128		1.250,00
	<i>Assignment</i>			

6. Conclusion

Under the Croatian civil law system legal entities can apply certain legal concepts to settle mutual claims and liabilities without using cash. Companies with liquidity issues can use this form of payment to settle their current liabilities without unnecessary increase of debt. Clearing is not allowed if legal person's account is blocked.

REFERENCES

Official Gazette, 2005. *Civil Obligations Act*. Zagreb: Official Gazette, 35/05, 41/08, 125/11, 78/15.

Official Gazette, 2010. *Law on execution of monetary resources*. Zagreb: Official Gazette, 91/10, 112/12.

Računovodstvo, revizija i financije, 2017. RRiF's Chart of Accounts for Entrepreneurs. 22nd edition. Zagreb: Računovodstvo, revizija i financije. Retrieved from <http://www.rrif.hr/dok/preuzimanje/RRIF-RP2018-XXII-ENG.pdf> [March 22, 2018].

Insurance Market of Moldova: Problems and Trends of Development

Tatiana Sandutsa, Lecturer, PhD
Trade Co-operative University of Moldova
Chisinau, Republic of Moldova
santatyana@yandex.ru

Galina Caraganciu, Associate Prof., PhD
International Management Institute „IMI- NOVA”
Chisinau, Republic of Moldova
g.caraganciu@gmail.com

Abstract. Insurance is a significant sector of the non-banking financial market in the Republic of Moldova. The main function of the insurance is to manage the risks, and the correct management of the risks contributes to the economic development, maintaining the financial stability and increasing the welfare of the population. Insurance is a very effective technique to spray individual losses on a wide range, making them easier to handle by covering as many people as possible. Insurance is a form of risk protection, a service that is sold and bought in the insurance market, a market that is an important component of the financial services market. Currently, the insurance market in the Republic of Moldova represents a profitable sector of the non-banking financial market, which shows dynamic growth rates but also has development reserves. The importance of the development of the financial market in Moldova also implies a solid and rapid development of the insurance segment due to its role in the economy. Practice shows that the insurance market contributes to economic growth by improving the investment climate and promoting more efficient activities than in the absence of this risk management tool.

Key words: *insurance, the insurance market, risk management, insurance digitization, the insurance company*

1. Introduction

Throughout the years of development, the insurance sector was under the influence of changes and refinements, becoming an important economic component. Currently, insurance is a significant sector of the non-banking financial market in the Republic of Moldova. Given the importance of insurance for the continuity of production processes and for the supply of long-term financial resources to the economic sectors, there is a need to analyze the trends of the insurance sector in the Republic of Moldova.

The insurance market is a framework in which insurance operations are carried out only on a contractual basis. In the insurance market the demand for insurance comes from the natural and legal persons who want to conclude different types of insurance and the insurance offer coming from the legal entities, namely, organizations, specialized companies, which are authorized to work in the field insurers and carry out such an activity, of course, financially.[1]

The main function of the insurance is to manage the risks, and the correct management of the risks contributes to the economic development, maintaining the financial stability and increasing the welfare of the population. Despite the local economic realities, the Moldovan insurance market has managed to maintain a positive trend in recent years, regardless of the fact that its volume is not impressive.

According to statistics, in the current period, seventeen asset insurance companies share a market of over 66 million euros, dominated by car insurance, about 68 percent of the market. The number of participants on the insurance market in the Republic of Moldova denotes significant fluctuations due to the change in the regulatory framework, especially the minimum capital requirements and mandatory reserves. In addition to insurance companies, over 70 insurance / reinsurance brokers and nearly 40 bancassurance agents operate on the market.

2. Analysis of the Activity of the Insurance Market in the Republic of Moldova

The degree of penetration of insurance in the economy is a synthetic indicator showing the contribution of the insurance sector to the creation of Gross Domestic Product (GDP), which is calculated as a ratio between the volume of gross direct insurance premiums and GDP. In Moldova, the value of this indicator decreased from 1.36% (2007) to 1.11% (2017). Such a small penetration shows that the importance of the sector is not yet perceived by the authorities and the population, thus demonstrating that there is untapped potential in the field of insurance. This is confirmed by the experience of other countries where the degree of penetration of insurance in GDP can reach 20-40%. Insurance density is expressed as gross direct premiums earned per capita. The value of this indicator in the Republic of Moldova has steadily increased to 345 lei / inhabitant. Compared to other countries, there is a low level of development of the insurance industry in our country. [3]

The volume of gross premiums written by insurers in our country is only 0.005% of that of the EU-15 and only 3.81% of that of Romania. Even if the main indicators of the insurance market are far behind the global average, it is worth appreciating the steady nature of market developments, reflected by the volume of premiums earned, but also by the size of net assets. According to the data published by the National Commission of the Financial Market, the insurance market in Moldova registered in 2017 a volume of gross written premiums increasing by 4.8 percent compared to 2016. The insurance industry recorded the most spectacular increases in the period after the 2006 regulatory framework.

Gross premiums written on the non-life insurance segment increased moderately in 2017 in almost all countries. Globally, this market growth was set at 3% in 2017, after the 2.3% increase in 2016. The large number of catastrophic events in the second half of 2017 - Hurricanes Harvey, Irma, Maria, earthquakes in Mexico and fires in California - has brought many losses for non-life insurers. Thus, the losses incurred by insurers as a result of the three hurricanes and earthquakes in Mexico were estimated at about US \$ 95 billion, and the underwriting of the general insurance for the whole year is affected. According to estimates, the combined US Property and Casualty Claim is expected to increase in 2017 to 109%, from 101% in 2016. For the global reinsurance market, Swiss Re expects the damage rate to reach to 115%, from 92% in 2016.

In advanced economies, underwritings increased by about 2% in 2017, compared with 1.5% in 2016. Calculated in USD, premiums rose 4.0% this year, up from 1.7% in the previous year. The US market grew by 4.7%, driven by strong auto growth. In Western Europe, strong growth in the automotive segment in Germany, France, Spain and the UK has boosted premiums in the region.

At the same time, gross premiums written on emerging markets increased by about 6% in 2017 compared to 2016 and 2015. Emerging Asian subscriptions grew by almost 10% as a result of the two-digit advance in the largest markets - China and India. In Central and Eastern Europe, premiums grew by less than 5%.

Tabel 1 The results of the activity of insurance companies on the insurance market in Moldova (lei)

The name of the insurance company	Profit (loss) 2017	Profit (loss) 2016
GRAWE CARAT Asigurari	35461434	51228525
MOLDASIG	19916562	13031300
KLASSIKA ASIGURARI	14440743	20625852
DONARIS VIG	9400553	6033591
ACORD GRUP	9033205	7873762
TRANSELIT	6526559	423330
ALLIANCE INSURANCE GROUP	6475741	10671341
MOLDCARGO	4129763	2535228
ASITO	3955494	-9750850
GALAS	3265167	1537031
MOLDOVA-ASTROVAZ	1250808	-671344
AUTO-SIGURANTA	300462	491653
GARANTIE	-705864	9337477
ASTERRA GRUP	-4248883	-3214998
INTACT ASIGURARI GENERALE	-4519946	0
GENERAL ASIGURARI	-11621498	-2506178
SIGUR-ASIGUR	-25667640	1144681
TOTAL	67392660	108790401

Source: elaborated by the author based on data from the statistics department

The Moldovan insurance market reached 1.44 billion lei in the previous year, up almost 4.5% compared to 2016. The insurance companies registered a gross profit of 67.4 million lei in 2017, decreasing by more than 38% or 41.4 million lei less than in 2016. The top companies are headed by GRAWE CARAT Asigurari - 35.46 million lei, followed by MOLDASIG (20 million lei), KLASSIKA Asigurari (14.4 million lei), DONARIS VIG (9.4 million lei) and ACORD Grup (9 million lei). Of the total number of active companies, a total of 12 companies registered a profit while 5 companies lost.

Tabel 2 Registered by insurance classes in Moldova in 2017

Types of insurance	Gross written premiums (%)	Damages paid (%)
Life insurance	6.58	3.81
Property insurance	6.26	2.55
CASCO	20.11	33.34
MTPL	24.55	33.01
Green Card	22.14	16.10
Third party civil liability	3.57	2.86
Other types of insurance	16.7	8.33

Source: elaborated by the author based on data from the statistics department

Regarding the results registered by insurance classes, the market was dominated by motor insurance, so the MTPL occupies a share of 24.5% (353.9 million lei), followed by Green Card - 22.5% (319.2 million lei) and CASCO - 20.1% (289.9 million lei). The share of life insurance in the total gross premiums written remains at a low of only 6.58%. Property insurance - 6.26% and third party civil liability - 3.57%.

In terms of claims paid by insurers in 2017, they reached a total of 507.9 million lei (24.9 million euros), with 2.15% less than in 2016. Insurances holding the most important market share have accumulated the most damage. Thus, CASCO and MTPL recorded 33.3% (169.3 million lei) and 33% (167.6 million lei) of the total amount of damages paid, followed by the Green Card segment - 16.1% (81, 7 million lei). [4]

The aggregate structure of the insurance portfolio of the Republic of Moldova denotes the preponderance of compulsory insurance. The most popular insurance is the Motor Third Party Liability Insurance, which holds a 48% share of the total subscribed premiums. The lowest share in the insurance portfolio is held by voluntary insurance, including life, health and goods insurance. It is noticed that the population appeals to insurance companies only when it is forced by legislation. Compared to European countries where life insurance accounts for 66% of the portfolio, in the Republic of Moldova just over 6% are life insurance policies and 93.6% are general insurance. The poor development of life insurance in the Republic of Moldova is caused not only by the modest initiation of the population in the insurance issue, as it is not aware of the way in which it must manage its risks, but also because the population consciousness still has confidence in state as insurer. At the same time, the retirement system is not reformed so as to diversify risks in pension insurance. Taking into account the trends in developed countries, we can assume that life insurance will become more and more popular with us, with this sector having great development prospects and opportunities for investment revenue accumulation.

The attractiveness of the Moldovan insurance sector for foreign investors is expressed by the volume of foreign investments in the capital of the Moldovan companies. The main investment countries in the insurance sector in our country are Austria with a 58% share of total foreign investment, followed by the UK (23%), Cyprus (8%) and the Netherlands (7%). The share of non-residents in the total paid-up share capital of insurance companies is 35%. [2]

Legislative changes, aimed at adjusting the legislative framework to the EU's requirements, have allowed the development of operational infrastructure and the provision of better quality insurance products. Critical activity criteria for participants have removed unsafe companies from the market. Changes in the economic and financial environment have led to a new approach, oriented towards transparency, consumer protection, financial education and, last but not least, high standards of professionalism in insurance. Investors in Europe have thus gained the confidence that they can invest in the Republic of Moldova.

Among other trends identified by the analysis of the evolution of the last decade, we mention the development of the insurance market infrastructure (corporate governance, certified actuaries and auditors, the functioning of internal control and internal audit, adequate risk management), increased requirements for professional participants in professional training, compliance with international reporting standards, risk-based supervision, development of public-private partnerships in the field of insurance, promotion of tax incentives (including for life insurance services).

3. The Ways and Methods of Developing the Insurance Market

Currently, the insurance market in the Republic of Moldova represents a profitable sector of the non-banking financial market, which shows dynamic growth rates but also has development reserves. However, the insurance market is underdeveloped compared to the existing potential and the level of development in other states, including neighboring ones. The factors that negatively influence market development are the modest incomes of the population, the low level of the insurance culture in society, the skills of the population to rely on state aid in difficult situations, and the poor diversification of the insurance services offered on the market.

In order to achieve a higher level of stability and transparency of the insurance market, capable of protecting the interests of citizens and economic agents, as well as becoming an important source of investment for the country's economic development, we still need reforms, the implementation of information technologies and a fair competition in this field. In this context, the most preferable solutions would be:

- applying additional tax incentives to promote voluntary insurance;
- to improve the current medical insurance model, including in order to fulfill its quality control function of the medical services provided;
- promoting life insurance packages with savings possibilities to provide an alternative to pension funds that do not work in the Republic of Moldova;
- the development of Internet sales services, which has all the chances of becoming one of the main marketing tools.

Digitization radically transforms the insurance industry, generating new products, services and business models. This transformation forces insurance companies to act quickly and adopt new technologies as a sustainable business strategy. The emergence of Google, Facebook, digital tablets, applications and smart phones has led to a major change in consumer behavior, especially in their requirements. The digital transformation of the insurance industry is undoubtedly an opportunity for the development of the insurance market in the Republic of Moldova, but it is also a challenge for the insurance companies that have to invest in the implementation of the software and the means necessary for the digitization.

There are many innovations in the world in the field of insurance that are due to the digitization of society in general. An example of this is the drones insurance service, which in turn can be used for risk inspection and damage assessment, including in the agricultural sector. At the same time, technology has become more and more connected with health in recent years. The wearables devices monitor our heart rate, sleep quality, day-to-day distance, and in many countries under a health insurance contract, these devices' data are taken into account, giving customers the opportunity to obtain discounts.

Digitizing insurance brings changes by offering the following possibilities:

- analyzing customer data to better understand market needs and risks;
- accurately determining health risks by using smart accessories;
- the transformation of insurance services into an activity initiated by the insurer, not by the client who comes to claim insurance;
- reducing the time to solve the demands due to location services (especially in the case of road accidents);
- 24-hour availability for customer service;
- use of IoT sensors as a warning system to reduce the frequency and severity of complaints.

Insurance digitization creates a number of opportunities for market development:

- increasing customer numbers, increasing demand;
- diversification of service portfolios;
- increasing the efficiency of backoffice functions through faster, more transparent transactions;
- improving customer relationships through the use of robotic and chatbot consulting applications, etc.

Global trends in insurance reflect a clear focus on digitization. New information technologies are becoming more and more popular. Globally, 37.1% of consumers of insurance services use digital access channels for services at least once a month.

Traditional ways of spreading insurance services are increasingly giving way to digital technologies. Thus, every 5th insurance policy in the world is purchased through digital channels.

In the Republic of Moldova, with the emergence of mobile internet at affordable prices, every person has the possibility to benefit from different types of services directly from the mobile phone in just a few seconds. Over the past few years, online channels for distributing insurance services have appeared in the Republic of Moldova. Portals have been launched to allow calculating, purchasing and paying insurance policies via the Internet. At the same time, these portals contain chatbot with the possibility of non-stop communication with the insurance agents. This new type of service is very convenient for customers and is mainly used for MTPL insurance, which has the highest frequency, the validity of which is only 12 months.

Starting February 1, 2013, the State Automated Information System MTPL Data, launched in accordance with a government decision, was launched. Through this information system, claims, contracts and policies / certificates of compulsory motor third party liability are processed, the online information and claims files are communicated and transmitted online to the single data base of the National Commission for the Financial Market. The State Automated Information System allows the insurance premium to be fairly and transparently determined on the basis of individual risk factors, in particular through the bonus-malus system, which is intended to grant legal bonuses for disciplined drivers and to apply premium increases for those who have caused road accidents due to their fault. At the same time, the Information System allows the exchange of information with the internal affairs bodies for the purpose of exercising the control function regarding the possession of the MTPL and the Green Card.

The digitization of the MTPL policy issuance process helps counter fraud in connection with the conclusion of insurance contracts with data prior to road accidents.

4. Conclusions

The evolution and structural changes of the insurance claim are subject to the socio-economic conditions of the reference period, the legal conditions, the legal and financial facilities offered, and the interest in promoting various forms of insurance both on the part of the insurance and policyholders.

The Moldovan insurance market is characterized by a wide variety of insurance companies' preferences for insurance products offered to customers. Insurance companies actually have, in most cases, a portfolio of non-diversified insurance products and more focused on specific products. Of these, auto insurance products are the most popular, and life insurance products are the least attractive for portfolios of insurance companies in that they do not meet the licensing requirements.

Agricultural insurance is an important link to insurance in Moldova. The protection of agricultural crops and investments in this sector is therefore essential to Moldova's economy. For this reason, agricultural insurance is subsidized by the state by law. The potential of agricultural insurance in the Republic of Moldova remains at an early stage of capitalization, with the insured agricultural areas being only 5% of the total agricultural land. The distribution of agricultural insurance by region does not differ according to the popularity of the insurance but better after the share of agricultural land in the region in the total agricultural land of the country.

Digitization radically transforms the insurance industry, generating new products, services and business models. This transformation forces insurance companies to act quickly and adopt new technologies as a sustainable business strategy. In order to achieve a higher level of stability and transparency of the insurance market, capable of protecting the interests of citizens and economic agents, as well as becoming an important source of investment for the country's economic development, we still need reforms, , the implementation of information technologies and a fair competition in this field.

The regulatory framework for insurance is partly in line with EU regulations and will require key adjustments in all areas of insurance to focus on important topics such as: guarantee funds, tighter prudential regulation for technical reserves, solvency margins, social capital minimum, minimum compensation rates for compulsory third party liability insurance including professional liability, widening the skills of insurance intermediaries, effective implementation of the actuarial institution, strengthening in the medium term the capacities of the national control authority, including in areas related to cooperation with other similar authorities in the EU Member States and the European Commission, modification of national legislation on primary and secondary establishment and freedom of movement of services. The main beneficiaries of restructuring in the insurance sector will be consumers of such services.

REFERENCES

1. Legea cu privire la asigurări, Nr. 407 din 21.12.2006 Publicat : 06.04.2007 în Monitorul Oficial Nr. 47-49 from www.cnpf.md
2. Tricia Hobson of Norton Rose Fulbright (2016). The Changing Face of the Insurance Market: What It Means For Lawyers. *Journal of INSURANCE & REINSURANCE*, May 2016, from <http://whoswholegal.com>
3. <http://www.xprimm.md>
4. <http://www.cnpf.md>
5. Ulian, G., Caprian, Iu., Vişanu, T. (2012). Piaţa de asigurări în Republica Moldova. În: Studia Universitatis. Seria „Ştiinţe exacte şi economice”. Chişinău: CEP USM, nr.7(57), p.161-166.

Tax Adjustment in Dynamic Global Development

Dumitru Girdea

Trade Co-operative University of Moldova, Chisinau, Republic of Moldova
d.girdea@gmail.com

Elena Fuior

Trade Co-operative University of Moldova, Chisinau, Republic of Moldova
fuiorelena@gmail.com

Ion Maxim

Competition Council, Chisinau, Republic of Moldova
ionmaxim@yandex.com

Abstract. World states with developed national economies are geared towards efficient organization of the entire economic process in order to achieve the best results at minimum costs, which implies the implementation of strict rules with the achievement of efficient performance indicators, including in the fiscal field. Given the fact that the Republic of Moldova has signed the Association Agreement with the European Union, this situation requires the amendment of the national legislation in the field of taxation, and in particular the implementation of the European Community legislation in the field of State aid. The assessment of State aid is based on the criteria deriving from the application of competition rules applicable in the European Community, in particular art. 107 of the Treaty on the Functioning of the European Union, and the interpretative instruments adopted by the institutions of the European Union. Thus, in the context of the implementation of European Community tax provisions on State aid, national legislation is to be amended, which in itself implies compliance with the global fiscal adjustment trend.

Key words: *State aid, tax incentives, alignment*

1. Introduction

This paper focuses on examining the issue of granting tax incentives in the form of State aid and aligning these incentives to the provisions of the *acquis communautaire*.

The actuality of the problem under examination stems from the global trends in the efficiency of state spending by rationalizing the use of public money and the concomitant orientation of financial resources towards higher value-added economic sectors. The aim of the paper is to highlight the most important difficulties encountered in the process of using public financial resources, focusing on the fiscal incentives in the form of State aid granted in the Republic of Moldova. Based on this study, in the general political context of harmonizing national legislation with the provisions of the *acquis communautaire*, it is intended to propose solutions to remedy the situation in order to overcome the economic and financial disparities.

This paper is divided into three chapters. The first chapter is aimed at describing the topic regarding the fiscal incentives granted in the Republic of Moldova in terms of State aid. Chapter two describes the problems Republic of Moldova is facing and faced by the member countries of the European Union during the pre-accession period in the process of alignment of the fiscal legislation in the field of State aid according to the provisions of the European Community legislation. Chapter three proposes solutions to overcome problematic issues in the complex process of aligning tax legislation in the field of State aid.

2. The Problems in Regulating Fiscal Incentives in the Republic of Moldova from State Aid Perspective

At the present stage, the country's economic strategy needs to be developed and implemented in conjunction with the fiscal policy, part of which are measures to stimulate entrepreneurial activity. From a conceptual point of view, the fiscal policy of the state must be the same for all forms of ownership, also by granting and combining fiscal incentives, especially in the form of State aid, so as to contribute to sustainable economic growth.

For these reasons, tax incentives are the mandatory component of fiscal policy, being in the same time a mechanism for regulating the activity of the undertaking. Thus, from a theoretical and practical point of view, in examining the fiscal policy and the problems regarding the granted incentives, a particular attention is paid to the questions regarding the impact of taxation on the reproduction process, and the reform of enforcing must regulate these incentives, ensuring their consistency with the economic policy of the state and, at the same time, to design a reduction in the amount of tax incentives.

As practice shows, tax incentives are appropriate when there is a well-thought-out and regulated tax mechanism that includes a limited number of incentives, because they occur simultaneously in a double hypostasis: as an element of taxation, i.e. of the structure of the tax and as an instrument of the fiscal policy. For this reason, fiscal policy must be directed towards reducing the number of incentives, which would be aimed at stimulating producers while granting the biggest incentives for the implementation of modern technologies, innovations, scientific research, etc. At the same time, it is worth mentioning that, it would be useful to give entrepreneurs the right to choose the forms of tax incentives used.

The need to reduce the types of tax incentives is caused by two reasons: first, to compensate budget losses related to the reduction of the tax quota, and the second is to increase the influence of the liberal-monetarist school, which argued the necessity of reducing the state's role in the economy, giving priority to market relations.

According to art. 2 of the Fiscal Code of the Republic of Moldova, the fiscal system represents the totality of taxes and duties, principles, forms and methods of establishing, modifying and canceling them, as well as the totality of the measures that ensure their payment. [2]

Also, pursuant to art. 6 par. (8) let. g) the fiscal incentives as elements to be taken into account when estimating the taxable object, when determining the amount of the tax or duty, as well as its collection, in the form of: partial or total exemption from tax or duty; partial or total exemption from payment of taxes or duties; reduced rates; reducing the taxable object; delays in the payment of taxes or duties; tax breaks, which theoretically can be divided into three large groups, namely: exemptions, deductions and tax credit [2].

Tax incentives can be examined in a broad and narrow sense. In the broad sense, they include all tax incentives: tax amnesty, return of tax paid previously, tax break, tax cuts, tax credits, etc. In a narrow sense, tax incentives include tax deductions and tax credits.

Regarding the tax exemptions, we mention that they provide, for the taxpayer, to be released from the payment of mandatory payments to the budget. It includes: fiscal amnesty, incentives in the form of total tax exemption, return of previously paid taxes, including advance payments, surplus over the amount of tax paid in connection with technical calculation errors, tax breaks, tax deduction and so on. As a way to allow tax incentives, widely applied in developed countries, is to grant fiscal premium for investing, which is given to enterprises at the time of commencement of investments. This measure is correlated with the whole system of capital transfer regulation. [4]

Of particular interest is the tax deductions, as these are incentives that allow the taxable base to be reduced by the expenditure allowed by the legislation and some income categories in

order to stimulate them. They have a greater degree of complicity and provide different conditions to be respected.

At the same time, we mention that the most complicated element of the tax relief system is the tax credit. Unlike other facilities, the tax credit is legalized by a credit agreement between the enterprise and the tax authorities. It is necessary to distinguish the credit category of the credit category as a form of transfer of the borrowed capital. The following categories of incentives must be assigned to the tax credits: postponement of taxes, transfer of tax, special purpose tax credit, investment tax credit. It is intended to stimulate the investment and innovation activity of the enterprise.

The tax credit is granted for a certain period and offers companies the possibility to benefit from the reduction of the amounts related to the income tax with subsequent repayment of the loan amount plus a certain interest, corresponding to the refinancing rate of the central national bank. But these incentives are less stimulating, which is why the postponement of payments must be strictly regulated. Characteristically, fiscal credit is a category of incentives aimed at reducing tax liabilities in order to stimulate taxpayers to develop their production and social support and also to avoid double taxation.

Its popularity in developed countries is determined by the opportunities provided by the tax credit compared to other categories of incentives, as it implies the direct reduction of the taxpayer's tax liabilities, which is combined with the postponement of the tax payment. In case of correct application of the granted incentives, they become advantageous to both the taxpayer and the state, because in the case of their orientation towards the development of the productive sector, they contribute to the increase of the enterprise's income and, consequently, to the increase of the budgets in the future.

It is worth noting that fiscal credit is easier to predict when planning the budget. Secondly, when granting this credit, increased attention is drawn to the patrimonial situation of the taxpayer as compared to other types of incentives. But it is characteristic that tax credit can be granted to subjects who urgently need resources.

At the same time, the entrepreneurial structures may opt to obtain the special purpose tax credit, a fiscal incentive that involves replacing the payment of taxes with the execution by the taxpayer of some services or works on the order of the public authorities. In order to be able to obtain the incentive, the firm must conclude a contract with the authorized public administration body. It may be granted to the taxpayer in connection with his economic activity or depending on the type of activity, in order to promote modern technologies or social support. The amount of credit is determined either as a share of the price of the purchased equipment or depending on the negotiations with the territorial tax authorities.

Tax incentives, including those related to State aid granted to taxpayers in connection with different taxes, depend on their specificity. For fiscal purposes, tax incentives can be grouped into incentives to stimulate entrepreneurial activity, they mostly relate to income taxation and the second is to solve social problems, they are largely related to indirect taxes, which are ultimately paid by consumers.

According to point 1 of the National Competition and State Aid Program for the years 2017-2020, Republic of Moldova, with the proclamation of independence on 27 August 1991, proceeded to implement a new economic model, based on the demand and supply mechanism, private property, freedom and entrepreneurial initiative, competition between economic operators [13].

In turn, in the Constitution of the Republic of Moldova, at art. 9 par. (3) it is mentioned that the market, free economic initiative, fair competition are the basic factors of the economy, and according to art. 126 par. (2) let. b) freedom of trade and entrepreneurship, the protection of fair competition and the creation of a favorable framework necessary for the capitalization of all the factors of production are provided by the state. [1]

It is characteristic that the Republic of Moldova, through a series of political initiatives, has adhered to several international agreements and adopted laws, normative acts aimed at accelerating the transformation of the economic system into a functioning market economy. Here it can be mentioned especially Law no. 166/2012 on the approval of the „Moldova 2020” National Development Strategy and the Association Agreement between the Republic of Moldova, on the one hand, and the European Union and the European Atomic Energy Community and their Member States on the other, approved by the Parliament of the Republic of Moldova by Law no. 112/2014. [14, 11]

Consequently, in order to implement the competition provisions of the National Development Strategy „Moldova 2020”, the National Competition and State Aid Program for the years 2017-2020 was elaborated. The elaboration of this Program aims at ensuring the more coherent application of the Competition Law no. 183/2012 and Law no. 139/2012 on State aid in accordance with the provisions of Chapter 10 „Competition” in Title V of the Association Agreement. [13]

From an economic point of view, the development and implementation of this document stems from the need to open up the economic sectors to competition, to increase the level of transparency and market accessibility, to make efficient use of public resources to increase consumer welfare. The overall objective of the Program is to develop a loyal competitive environment by opening up the economic sectors to competition and effective monitoring of State aid.

Conceptually, State aid is an important instrument of state competition policy, significantly determining the behavior of economic agents, contributing to creating the premises for a balance between compliance with competition rules and the exercise of its functions by the state. The constant control and monitoring of State aid helps to eliminate unjustified distortion of competition, targeting support measures more effectively, thus contributing to the development of the whole economy.

The notion of State aid ”comprises not only positive benefits but also measures which, in various forms, diminish the charges which are normally included in the budget of an undertaking and measures which, without being subsidies in the strict sense of the word, are similar in character”. A typical example of a measure that is not a subsidy in the strict sense, but which gives an advantage to an enterprise would be tax-related measures that reduce taxes for certain businesses.

The analysis of the legislation of the Republic of Moldova denotes the fact that the regulation of the fiscal incentives is of a fragmentary nature, in particular, the procedure for the granting of tax incentives by the local public authorities is not regulated, being necessary to reform the system of granting the tax incentives by increasing transparency, minimizing the negative impact on competition and trade.

The facilities provided by the state through fiscal policy are an incentive for investment, as it is given the chance to obtain additional sources for expanding business. Incentives can be effective in the case of a rational and regulated taxation mechanism with a limited number of facilities [4].

At the current stage very acutely it is a question of streamlining the use of state resources granted in the form of tax incentives, including State aid fiscal incentives, which have a significant impact on the national economy.

According to the Court of Accounts’ Report on the audit of conformity to the performance audit of the fiscal and customs facility system adopted by the Decision no. 34 of 29 July 2016, based on the significance of the value and impact of the tax and customs incentives on the national public budget revenues, 50 types of tax incentives, including customs, are constantly applied for more than 19 years, without any changes, revisions or adjustments being made. At the same time, as a share in gross domestic product, fiscal and customs incentives constitute

12,1% and 37,1%, respectively, in the national public budget, and in the state budget and the budgets of the territorial administrative units - about 50,9%. [15]

The constant increase in the volume of fiscal and customs incentives in the last 5 years is due to the extension of the range of granted incentives, which at the end of 2015 constituted 105 types of duties and tax exemptions. At the same time, the number of tax and customs facilities provided for in the national legislation of 2018 is about 110. Thus, the number of facilities has increased in recent years, with the trend of increasing their total volume.

Also, as a key issue, it is highlighted that the institutions with the right to administer the tax and customs incentives do not monitor according to the process of execution of the respective facilities, and the functionality of their controls is limited by the lack of full application of all legal instruments available to them. The lack of tools for the full, correct and operative identification of the beneficiaries of the fiscal incentives, as well as of their volume, did provide non-submission by the State Tax Service. The tools available to the Customs Service and the State Tax Service do not provide a guarantee that the beneficiaries will comply with the necessary conditions for obtaining tax and customs facilities.

Starting from the fact that the fiscal and customs facilities have a significant impact on state revenues, there are still no plans to monitor and meet the objectives of the proper facilities established at the time of their legal approval. No central authority has an exhaustively determined task to assess the economic and social impact of tax and customs facilities. At the same time, the Ministry of Finance, being responsible for elaborating and ensuring the implementation of fiscal-fiscal policy, does not have a methodological framework (including an institutional one) that would establish the way of planning and approving the fiscal and customs facilities in line with good practices. At the same time, being responsible for the monitoring of tax and customs facilities, it did not analyze the impact or outcome of the granting of those facilities, but only limited to generalizing and systematizing information at the cost level. [21]

Regarding the justification or substantiation of the necessities of granting the tax and customs facilities, we mention that in the elaboration of the fiscal and customs policy measures, as part of the Medium-Term Budgetary Framework, in most cases, no expertise, justification or economic analysis regarding the opportunity of including new facilities or the maintaining of existing tax and customs facilities. From this point of view, in order to ensure the efficiency of the management of the fiscal, customs, and especially fiscal facilities in the form of State aid, must be laid down the principles that should regulate:

- justification and motivation of the request for the granting of tax incentives;
- the basis for calculating the tax allowances, including those related to state and customs aid;
- the quantification of the cost of granting tax benefits and the expected result of their application;
- determining the extent of the loss of public financial resources, from taxes and duties, as a result of granting tax benefits in the current and future periods.

As regards State aid granted as fiscal incentives, it is mentioned that in 2016 in the Republic of Moldova the amount of State aid reported in the form of waivers to the budget revenues constituted 87,91% of the total amount of the State aid reported. The amount of State aid reported as budgetary expenditure was lower than in the case of budget revenue waivers. In the reported 2016 year, the value of the nominated indicator was 12,09% of the total value of the State aid reported, maintaining the trend of the previous years. The amount of State aid reported as budgetary expenditure declined significantly in 2016 compared to 2015 and 2014.

It is noted that the value of the indicator mentioned in 2016 decreased by 43,26% compared to 2015 and by 61,74% as compared to 2014. This decrease was also influenced by the decrease in 2016 of the State aid granted in the form of subsidies and / or subsidies.

Although the share of State aid in GDP in the period 2014-2016 registered an oscillating trend, the level reached is still high. In order to take best practice in the field of state aid, the value of the indicator should be reduced to 1,0% of GDP without compromising the purpose of the support measures, namely the correction of market failures [16].

In the Republic of Moldova, in the structure of the distribution of State aid, according to the forms of granting, the largest share was held by the fiscal facilities, these being about 75-80% of the total amount of the State aid reported.

The amount of State aid in terms of budgeted expenditures and waivers in the period 2014-2016 is presented in table no.1.

Table 1 Value and structure of the State aid reported (including SGEI) in terms of budgeted expenditure / waivers in 2014-2016

No.	Category	2014		2015		2016	
		Thousand Euro	%	Thousand Euro	%	Thousand Euro	%
1.	Waiver of budget revenue	191 880	79.71	251 668	88.78	105 709	87.27
2.	Budgetary expenditure	48 856	20.29	631799	11.22	15 414	12.73
Total		240 736	100	553 467	100	121 123	100

Source: Report on State aid granted in the Republic of Moldova for 2016.

The largest share of State aid reported for the period 2014-2016 was granted in the form of exemptions, reductions, delays or tax breaks, accounting for 75,65% of the total amount of State aid reported. Although in 2016 there were changes in the amount of State aid reported in various forms, its structure continued to remain the same as in the previous years.

Figure 1 shows the structure of State aid reported in the period 2014-2016, depending on the granting form.

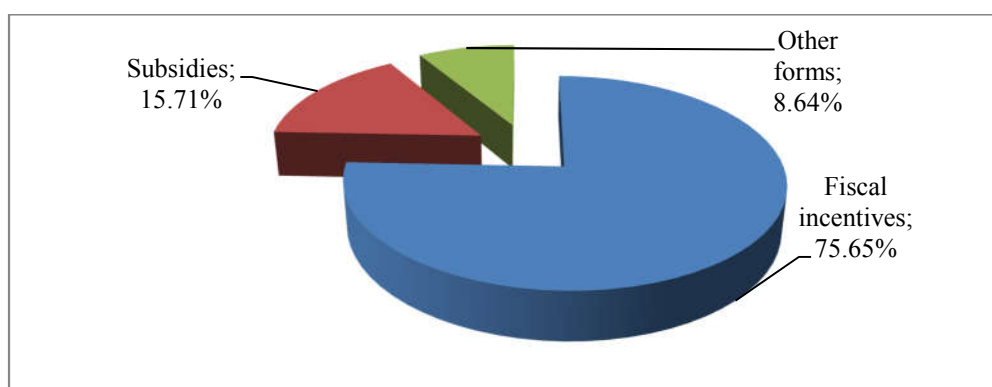


Figure 1 The structure of State aid reported in the period 2014-2016, depending on the form of granting

Source: Report on State aid granted in the Republic of Moldova for 2016.

In 2016, the amount of State aid reported in the form of exemptions, reductions, delays or tax breaks decreased by 38,50% compared to 2015 and increased by 4,85% compared to 2014. These support measures represent existing aid and therefore have not been notified to the Competition Council and have not been examined under the provisions of the Law on State Aid no. 139 of 15 June 2012.

The significant share of State aid as waiver of budget revenue recorded in 2016 was due in particular to the high level of State aid reported as exemptions, reductions, deferrals or lay-offs in state taxes and duties.

In the context of the above and according to the Government Action Plan for 2016-2018, it is planned that tax and customs legislation will be harmonized until quarter III 2018, by developing and adopting new legislation (Fiscal Code and Customs Code) to ensure the predictability, transparency, security, fairness and clarity of fiscal and customs policies. [19]

3. The Problems of Alignment of the Fiscal Facilities with the Provisions of the European Union Acquis in the Field of State Aid, the Republic of Moldova and the Pre-Adhesion Countries

At present, it can not be overlooked that the lack of fiscal discipline is a phenomenon that is specific to a relatively large number of countries of the world. Budget surpluses have come to represent rather a singular phenomenon, while budget deficits seem to be commonplace. Recently, the sovereign debt crisis in the Member States of the European Union suggests that things should not be developed in this way. The lesson learned from the crisis is that in all states it is necessary to implement the long-term sustainability of public finances.

It is noted that the experience of EU Member States shows that State aid such as the waiving of budgetary revenues (exemptions and reductions from taxes and duties, cancellation of penalties and late payment of state obligations, etc.) as a rule are more damaging to the market economy than those in the form of budget expenditures (subsidies, etc.). State aid in the categories of budgetary expenditure is considered less damaging to competition, more transparent and easier to quantify in the case of State aid schemes or individual aid.

The main aspects regarding the tax criteria were formulated by the Treaty of Maastricht, also known as the Treaty on European Union, which created a new stage in the formation of the European Union, based on the economic community and complemented by new forms of cooperation.

Among the main measures that are stipulated in this Treaty are:

- promoting balanced and sustainable economic and social progress by creating an area without internal frontiers, by establishing an Economic and Monetary Union that has a single currency;
- fully maintain and develop European Community legislation to examine the extent to which the policy and forms of cooperation established by the Treaty will need to be reviewed to ensure the effectiveness of Community mechanisms and institutions, etc.

At the same time, the Treaty sets out the actions in the economic field, the main ones being:

- the elimination of customs duties and quantitative restrictions between Member States on entry and exit of goods;
- an internal operation characterized by the abolition between Member States of an obstacle to the free movement of goods, persons, services and capital;
- approximation of national laws to an extent necessary for the functioning of the Common Market, etc. [9].

To achieve this goal, EU Member States have recently undertaken reforms to move from short-term national fiscal policy to long-term sustainable objectives. The most important fiscal rules applied in the EU Member States are the Maastricht fiscal criteria, as they are formulated in the Maastricht Treaty. It specifies the following rules:

1. The debt rule limiting the government debt to GDP to 60%;
2. Budget deficit rule to GDP at 3%.

Although these budget rules have been established more than two decades ago, compliance has proven to be a challenge for many European countries. However, studies show that the rules were too lenient and that fiscal policy responses to economic fluctuations proved procyclical rather than countercyclical (with budget surpluses in times of expansion and budget deficits during recessions), which led inevitably to excessive deficits during the global economic crisis. An expansionary fiscal policy stimulates aggregate demand and therefore

leads to growth, but excessive use in periods of economic expansion may reduce the fiscal space so necessary to boost the economy when the recession hits. [3]

The common market"can only be maintained by preventing occlusive business agreements, dominant position abuses, by ensuring competitive market structures, by merger control and by eliminating unjustified State aid that distorts competition, artificially maintaining non-viable businesses on the market". [5]

Taking into account the political vector adopted by the Republic of Moldova on the country's accession to the European Union, on 27 June 2014 the Association Agreement between the Republic of Moldova, on the one hand, and the European Union and the European Atomic Energy Community and the Member States of the European Union on the other hand, was signed. The Moldova-European Union Association Agreement establishes a new legal framework for the advancement of relations between the Republic of Moldova and the European Union to a higher level, the political association and the economic integration with the European Union. The Association Agreement contains binding provisions, regulatory rules and wider cooperation arrangements in all sectors of interest. Increased attention is paid to implementing and applying the provisions of the Association Agreement, by stipulating clear deadlines and establishing an appropriate institutional and administrative framework, thus creating the necessary premises for effective implementation. [11]

Some of the fundamental objectives of the European Union, as set out in art. 3 of the Treaty on European Union, are economic growth, prosperity, competitiveness, social protection, full employment, social progress and cohesion between Member States. In order to carry out these tasks, the same article provides for the establishment of the common market, the monetary union and the implementation of common policies, one of which is competition policy. [10]

The process of harmonizing the tax laws and policies of non-EU countries is to be guided by key legal and institutional requirements with regard to candidate countries to EU Member State as they set benchmarks for the more advanced stage of the process integration into the EU.

In the context of the harmonization of Moldovan tax legislation and policy, it is important to underline that this is a complex and medium-term process involving policy harmonization, correct transposition of relevant laws, if their updating is appropriate, creating and providing resources, through new organizations or other methods of the necessary institutional structures and pursuing credible and verifiable implementation and execution in terms of objectives [20].

On the eve of the 2003 accession, only Cyprus was assessed as a state fulfilling the criteria for the commitments assumed and meeting the taxation requirements established during the negotiations. In the other countries, commitments were assessed to have been met "essentially" or "for the most part". There were also some exceptions. For example, the Czech Republic has been assessed to meet the requirements as "in essence", with the exception of duty-free shops at land borders. It should be noted that Malta fully complied with the requirements for direct taxation but only partially for indirect taxation, this is when Poland meets "essentially" the requirements of direct taxation, but only partially in terms of VAT and excise duties. Slovenia has been assessed as fulfilling "essentially" the VAT and excise requirements but only partially in terms of direct taxation.

From this point of view, all new candidates have obtained different transition periods for alignment and some derogations from the *acquis*. All countries were granted exemptions from VAT and the registration threshold for small and medium-sized enterprises and exemptions for international passenger transport. Most countries have achieved different transition periods, largely by the end of 2007, but by 2011 in terms of VAT rates and procedures, as well as exemptions and excise rates. The capabilities of the new Member States to implement the *acquis* at the time of accession were assessed as being "should be able to implement" the qualification, for such countries as Cyprus, Estonia, Latvia, the rating of "should be in

measure to apply"for Lithuania, "expected to be able to implement"the Czech Republic, Hungary, Malta, Poland, Slovakia and "is expected to be in a position to implement"Slovenia. These countries have been allowed to join the European Union, although most of them have not fully met their membership requirements. In addition, even after accession, they were not fully in a position to implement the *acquis*. [7]

According to the Report on State aid granted in Romania during 2006-2008, the total national State aid (excluding agriculture, fisheries, transport, SGEI and *de minimis* aid, i.e. aid not exceeding a threshold estimated to be unfavorable to the competitive environment) expressed in current prices shows a general downward trend, from 1,749 billion lei in 2006 to 0,947 billion lei in 2008, registering a sharp fall of 0,845 billion lei in 2007. The share of GDP had a steady downward trend, from 0,51% in 2006 to 0,20% in 2007 and 0,19% in 2008.

The decrease of the national State aid between 2006 and 2008 is mainly due to the considerable reduction of aid granted for rescuing and restructuring firms in difficulty. Regarding the analysis based on the state aid targets granted in Romania between 2006 and 2008, it can be noticed that in 2008 the largest share in the total national state aid (excluding agriculture, fisheries, transport, SGEI and *de minimis* aid) was held by State aid with horizontal objectives of 44,82%, this figure being also close to that recorded in 2007. [15]

With regard to the distribution of national State aid between the financial instruments used, its structure is the following:

- 96,60% "Budgetary expenditure" in 2008, consisting of subsidies, allowances, bonuses, subsidized interest, as well as equity and debt conversions; the share of budget expenditures in national State aid (excluding agriculture, fisheries, transport, SGEI and *de minimis* aid) recorded an upward trend over the period under review (from 68,03% in 2006 to 85,61% in 2007).
- 3,40% "Waiver of budget revenue" in 2008, which consists of exemptions and indemnities for the payment of tax liabilities to the State, exemptions and allowances from the payment of additional expenses for late payment, state guarantees; (with the exception of agriculture, fisheries, transport, SGEI and *de minimis* aid) recorded a decreasing trend over the period 2006-2008 (from 31,97% in 2006 to 14,39% in 2007).

This situation is in line with the requirements of the European Commission to reduce State aid, as these aid could affect trade within the community. The downward trend in tax aid reflects at the same time the correct application of the *acquis communautaire*, and Romania is fully complemented with Community state aid policies. [16]

Romania's alignment with Community policies and practices in the field of State aid was made possible by elaborating policies targeting less distortive State aid and better-targeted, effective and efficient control of State aid and the implementation of Community State aid law in the field of State aid pre-accession period. The implementation of the *acquis communautaire* in competition and State aid prior to accession was necessary for Romanian companies to adapt to the new rules and be prepared to cope with the competitive forces of the European single market.

Adaptation to the single European market has been stepped up since 1 January 2007, with Romania's accession to the European Union, when Community rules began to apply directly to State aid. The results of this intense process of adapting to the single market have not failed. Thus, the years 2006, 2007 and 2008 are characterized by two features:

- reducing the share of national State aid as a share of GDP;
- diminishing State aid in the form of tax incentives that could distort competition and affect trade between Romania and the Member States.

Non-compliance with Moldovan State aid law may lead to the initiation of the return process of illegally granted or abusive State aid. According to art. 3 par. (1) of the Law no. 139 of 15 June 2012 on State aid, illegal aid is any State aid other than the existing or exempted aid from the notification obligation, which was granted without authorization by the Competition

Council or was granted in the conditions when the Competition Council has been notified but has not taken a decision on this in the legal term. Also, according to Law no. 139 of 15 June 2012 on State aid, the abusive aid is the State aid used by the beneficiary in violation of the Competition Council decision. [12]

According to art. 13 par. (3) of the Law on State aid, if the Competition Council issues a negative decision, the supplier and/or the initiator of the State aid must take the necessary measures for the modification or cancellation of the act under which the State aid was granted, respectively for the recovery or the reimbursement of the aid already granted, including the interest on its amount.

The failure to properly apply European Union law on State aid is often accompanied by sanctions. In this respect, it is worth to mention the European Commission which sanctioned the beneficiaries of State aid which was granted in violation of the provisions of the Community legislation, in the following cases:

- Belgium. The European Commission has concluded that the Belgian tax system applicable to "surplus profits" is illegal so that approximately EUR 700 million must be recovered from 35 multinational companies;
- Ireland. The European Commission has come to the conclusion that Ireland has granted Apple undue tax benefits of up to EUR 13 billion, which has to be recovered. This is illegal from the perspective of EU State aid rules as it allows Apple to pay substantially lower taxes than other businesses;
- Luxembourg and the Netherlands. The European Commission has decided that the selective tax advantages granted to Fiat in Luxembourg and to Starbucks in the Netherlands are illegal under EU State aid rules. The amount of State aid is estimated at around EUR 20-30 million for both Fiat and Starbucks.

Granting of fiscal incentives in general and fiscal incentives in the form of State aid is an instrument for stimulating the economic activity of economic agents, which contributes to the economic and financial objectives of the enterprise. However, due to the lack of transparency it is created an environment favored for the economic activity of some entities, which reduces motivation for others.

For these reasons, when granting tax incentives it is necessary to respect the principles of fiscal equity and the transparency mechanism, as their non-compliance adversely influences the decision-making process, the functioning of the market mechanism. At the same time, distortion of competition and trade conflicts arise, which entails the inefficient use of resources and the reduction of social welfare.

4. Conclusions

With reference to the presented and in order to take into account the best international practices in the field of granting the fiscal facilities, especially the fiscal facilities in the form of State aid, it is proposed to carry out the following:

1. the facilities provided by the state through the fiscal policy are an incentive for investment, as it is given the chance to obtain additional sources for the expansion of the activity;
2. tax incentives can be effective if there is a well-thought-out and regulated taxation mechanism with a limited number of facilities, as these are, on the one hand, an element of fiscal policy and, on the other hand, a fiscal policy instrument;
3. the redistribution of State aid, namely the gradual decrease of the value of State aid granted in the form of waiving of budget revenues and the increase of those granted in the form of budgetary expenditures, considered more transparent, easier to quantify and less harmful for the competitive environment;
4. in the Republic of Moldova it is welcome to organize an optimal system for functioning of the fiscal facilities in order to achieve stability, in the development of the national

- economy, stimulation of the investment and technical-scientific activities, offering the possibility of influencing some spheres of the economy;
5. the analysis of the legislation of the Republic of Moldova denotes the fact that the regulation of the fiscal facilities has a fragmentary character and the legal norms necessary for solving the marked problems are missing. In particular, the procedure for granting tax incentives by local public authorities is not regulated. To this end, it is necessary to reform the system of granting tax incentives by increasing transparency, minimizing their negative impact on competition.
 6. examination of the fiscal facilities included in the State aid Register granted during the years 2011-2013, a period under which the inventory of State aid were granted until the entry into force of Law no. 139 of 15 June 2012 on State aid, in order to identify support measures that are not State aid;
 7. make efforts to bring State aid schemes put in place before 16 August 2013 to the EU State aid acquis within 8 years of the entry into force of the Association Agreement. An exception is the State aid schemes established under the Law no. 440 of 27 July 2001 on free economic zones for which the period was extended to 10 years from the date of entry into force of the Association Agreement (limitation of State aid schemes over time, reduction in the volume of State aid as a percentage of value of eligible costs);
 8. targeting State aid to horizontal objectives (i.e. granting aid for research, development, innovation, support for small and medium-sized enterprises, granting State aid to the environment, etc.);
 9. the granting of State aid in the form of State aid schemes and less the allocation of state resources to the individual support of enterprises;
 10. performing the impact / benefit analysis of the fiscal facilities;
 11. implementation of a company-record mechanism regarding the beneficiaries of State aid in the form of tax incentives;
 12. monitoring the process of the implementation of fiscal facilities;
 13. the exclusion of State aid measures incompatible with the acquis communautaire.

REFERENCES

- [1] The Constitution of the Republic of Moldova from 29 July 1994 // Official Gazette of the Republic of Moldova no. 1 from 12 August 1994.
- [2] Fiscal Code no. 1163 from 24.04.1997 // Official Gazette of the R.Moldova no. 62/522 from 18 September 1997 with subsequent modifications.
- [3] Covalschi T., Lazar S., (2016). *The sustainability of public finances in Republic of Moldova under EU fiscal rules*, from <https://www.degruyter.com/downloadpdf/j/saeb.2016.63.issue-2/saeb-2016-0112/saeb-2016-0112.pdf>.
- [4] Fuior E., Maxim I. (2013). *Fiscal facilities: issue, opportunities*. International Scientific and Practical Conference VIII – th edition “Economic growth in conditions of global Lotion”, Chisinau: INCE, p. 63-69, ISBN 978-9975-4185-0-8.
- [5] Nicolaidis, Kekelekis, Kleis, (2008). *State Aid Policy in the European Community, Principles and Practice*, Second Edition, Kluwer Law International, p. 2.
- [6] Ogresta E. (2017). *The notion of advantage in EU state aid law and its recent development*, Faculty of Law Jean Monnet Chair of European Public Law, Zagreb din https://www.pravo.unizg.hr/download/repository/DIPLOMSKI_Edita_Ogresta.pdf.
- [7] Ott K. (2008). *The tax alignment process in the new European Union member states: how might Croatia fare?* din <https://bib.irb.hr/datoteka/364868.ott.pdf>.
- [8] Stuart E. (2010). *Tax Legislation and Policy, Harmonization of Moldovan Legislation with EU Standards*, Publishing: IBF International Consulting in consortium with DMI, IRZ, Nomisma, INCOM and the Institute of Public Policies, Chisinau.
- [9] The Treaty of Maastricht (1992). from <https://www.scribd.com/doc/121770914/Tratatul-de-la-Maastricht>.

- [10] Consolidated version of the Treaty on European Union (2012). OJ C 326, 26 October 2012, p. 13–390, Article 3 from http://eur-lex.europa.eu/resource.html?uri=cellar:2bf140bf-a3f8-4ab2-b506-fd71826e6da6.0001.02/DOC_1&format=PDF.
- [11] Law no. 112 of 02 July 2014 for the ratification of the Association Agreement between the Republic of Moldova on the one hand and the European Union and the European Atomic Energy Community and their Member States on the other part // Official Gazette of the R.Moldova no. 185-199 from 18 July 2014 from <http://lex.justice.md/md/353829/>.
- [12] Law no. 139 from 15 June 2012 on State aid // Official Gazette of the R.Moldova no. 166-169a from 16 August 2012 from <http://lex.justice.md/viewdoc.php?action=view&view=doc&id=344389&lang=1>
- [13] Law no.169 of 20 July 2017 approving the National Program for Competition and State Aid for the years 2017-2020//Official Gazette of the R.Moldova no. 301-315 from 18 August 2017 from <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=371237>
- [14] Law no. 166 of 11 July 2012 for the approval of the National Development Strategy "Moldova 2020", // Official Gazette of the R.Moldova no.245-247 from 30 November 2012 from <http://lex.justice.md/index.php?action=view&view=doc&id=345635>
- [15] Competition Council of Romania, Summary report on state aids granted in Romania between 2006 and 2008, from http://www.renascce.eu/documente/Rezumat%20Raport%202006-2008%20Engleza_18757en_643en.pdf
- [16] Competition Council of Moldova, Report on state aid granted in the Republic of Moldova for the year 2016, from <https://competition.md/public/files/Raport-ajutorul-de-stat-acordat-in-anul-201641db4.pdf>
- [17] European Commission, Case C-143/99 Adria-Wien Pipeline, (2001) ECR I-08365, ECLI:EU:C:2001:598, par. 38.
- [18] European Commission, Case C-173/73 Italy v Commission, (1974) ECR 00709, ECLI:EU:C:1974:71.
- [19] Government Action Plan for 2016-2018, approved by Government Decision no. 890 of 20 July 2016// Official Gazette of the R.Moldova no.217-229 from 22 July 2016 from <http://lex.justice.md/md/365929/>
- [20] Ministry of Finance of the Republic of Moldova, *Concept of re-writing the Fiscal Code and Customs Code*, Strategic document aimed at harmonizing the national legislative framework with the provisions of the EU directives and improving the existing legislative framework in the period 2017-2019 from http://mf.gov.md/sites/default/files/documente%20relevante/concept_fiscal_vamal_0.pdf
- [21] Court of Accounts, Decision no. 34 of 29 July 2016 on the Audit Report on Audit of Performance of the Tax and Customs Facility // Official Gazette of the R.Moldova no. 379-386 din 04 November 2016, from <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=367369>

Prediction of corporate (non)success through financial statements

Dr Jasenka Bubić, tenured college professor
University Department of Professional Studies, Split, Croatia
jbubic@oss.unist.hr

Magdalena Gustin
University Department of Professional Studies, Split, Croatia
mgustin@oss.unist.hr

Abstract. The globalisation of economics has created unstable business environment which requires both the prediction of changes and a fast adaptation. In the world of advanced technology development and continuous development of innovations, making the right and timely decisions is of crucial importance for business survival. Business crisis can be caused by bad or untimely decisions within the company or by the influence of various external factors. In order to minimize the risk of business crises, it is necessary to analyse continuously the business of the company. It is also extremely important to predict potential dangers which can harm development and business survival. The crisis endangers the company's existential goals. Therefore a timely recognition of the first crisis signals is of crucial importance to the company's future. Crisis management is a process implemented through three phases: preventive identity management and reactive management. The emphasis is put on preventive management respectively in order to identify the onset of crisis. The timely observation of crisis applying appropriate methods and instruments has for the goal to repress crisis at the very start, that is before it endangers business survival. The purpose of the conducted research, with help of financial proportions from financial statements is to determinate how much earlier a crisis signals appear, before the crisis begins and seriously jeopardizes the existence of the companies of Croatian manufacturing industry.

Key words: *business crisis, financial statements, prediction of corporate (non)success*

1. Introduction

Entrepreneurship, as a vital component of economic growth and development, contributes to national economies by the development and implementation of new technologies, by creation of new products and services, as well as by the development of educational processes and enrichment of general prosperity of societies in which it exists. It can be called an economy generator of every country. Nowadays entrepreneurship has become a global process. An important characteristic of entrepreneurship is suspense which comes from constant aspirations towards innovation and development, and because of that, it carries potential personal and financial risks within itself. The purpose of commercial activity of individuals or more partners with certain capital investments is to venture into business with the aim of making profit. These activities also mean accepting business risks.

Complexity of the surroundings, of constant environmental changes, as well as of changes in the company itself, requires detailed business studies, i.e. essential information necessary for a company to function successfully. A certain company does business in a market-driven environment and, therefore, the development and relevance on the market are by no means fixed

in advance for any company. Business crisis is often defined as an unplanned and unwanted period with limited duration and influence, and as a period which harms a company's primary goals, with an ambivalent outcome. Preservation of liquidity, achievement of success, as well as building potential for it are a company's vital goals, the failure of which leads to sanctions for a system as a whole. Business crisis is an unavoidable period in a company's development during which its fate and long-term sustainability are at stake.

Business crises are omnipresent and unavoidable, even in successful companies. However, the factors that differentiate successful companies from unsuccessful ones are methods and instruments of crisis management by means of which the crisis is spotted, recognized in time and, in the end, overcome. The way of dealing with crisis mostly depends on a phase in which it is identified. The deeper a crisis gets, the harder it is to control. Therefore, the most important thing is to recognise its first indicator, because a timely recognition is the key to a company's future. When taking into consideration the degrees of observation, consequences and time, we can distinguish between: potential, latent and acute crisis. Crisis management contains preventive controlling, identification and reactive crisis control.

Financial reports represent the final phase of accounting data processing, and they are considered accounting and financial information vessels. When it comes to business, strategic thinking requires an adequate informational background. A significant part of that background is created in accounting and is written in financial reports. Financial report analysis is one of the most important tools in bankruptcy evaluation, which is based on the analysis of financial indicators. In particular, business practice has shown that a ratio of indicators from basic financial reports, such as balance sheet and income statement, could showcase the direction of a company's business. The importance of financial indicators is based on a fact that a company is not truly successful if its financial results do not uphold its reputation. Moreover, some financial indicators do not only display past performances, but also future ones.¹

Bankruptcy represents a law-driven mechanism which secludes a business or a property owned by an individual from the economic environment and it is very important for the economy itself to properly function. Bankruptcy occurs only because of economic reasons, especially due to insolvency, i.e. impossibility of paying debts using current assets, as well as due to over-indebtedness.² Bankruptcy is declared if there are valid, law-supported reasons for it. Current Croatian Bankruptcy Law ("Official Gazette", number 71/15) predicts two reasons for declaring bankruptcy, and those include the inability to pay and over-indebtedness. Inability to pay occurs if a debtor is unable to fulfill its financial obligations in the long run. Over-indebtedness occurs when a debtor is a legal person whose liabilities are larger than its assets. Denial, crisis cover-up and negligence of symptoms could have long-term consequences for a company itself, as well as for other subjects that are connected with a company.

2. Previous Research

Research and predictions of business failures are challenging and complex areas. Bankruptcy is the last step before the collapse of a company, but it is preceded by years of non-satisfactory and weak business. Unfortunately, failure often becomes a burning issue at the moment when the research assumes unthinkable proportions.

There is a certain amount of research available on the topic of predicting business failure when it comes to the Croatian companies. With his research, Pervan (2017) confirmed the usage of

¹ Belak, V., Analiza poslovne uspješnosti, RRiF, Zagreb, 2014., pg. 2

² Škrtić, M., Tisovec, M., Predviđanje stečaja poduzeća uporabom financijskih pokazatelja uspješnosti poslovanja (I. dio), RRiF, br. 6/2006., pg. 53

accounting information based on which financial indicators are extracted, which are then used to indicate financial health of a company, as well as the possibility of bankruptcy. Increasing value of indicators, EBIT margin, current liquidity and self-financing lower the chances of bankruptcy procedure.

Zenzerović (2006) points out the importance of creating a special model for predicting bankruptcy in a transition economy such as the Croatian one. Majority of models are variable for business subjects in the USA where business conditions are essentially different in regards to transition countries. Models made in the 1960s and 1970s set good foundations for developing research on bankruptcy, but they need certain adjustments in new business market conditions.

In their work, PriskiĆ and Bačić (2012) pointed out the unavailability of bankruptcy statistics data in Croatia. They concluded that the length of bankruptcy procedure has an inversely proportional effect on keeping jobs. But, preservation of payment has the best results, making bankruptcy procedure last longer. In the Croatian economy, bankruptcy most importantly represents elimination from the society, which is confirmed by the fact that ten bankruptcy procedures took place in order to revitalize society.

According to the last available pieces of research during 2015, 620 companies in Croatia went forward with the bankruptcy procedure, which is 35,5% less than in 2014. 12 companies that came out of bankruptcy confirm the fact that bankruptcy procedure almost always means a collapse of a company. At the end of 2015, 6029 companies were in pre-bankruptcy procedure. Incomes of those companies were 23,8 billion Croatian kuna, and the companies had 44.790 employees. These numbers clearly demonstrate their importance for the economy.³

3. Description of Patterns, Variables and Methodology

For this research, the authors have selected seven companies whose shares of stocks were quoted at the Zagreb Stock Exchange, and by sectoral classification they were listed in the manufacturing industry. In order to distribute the companies into sectors, and according to their main activity, Zagreb Stock Exchange uses the National 2007 activity classification. ("Official Gazette" numbers 58/07 and 72/07) which is preceded by the Croatian Bureau of Statistics.⁴ Analysis of consolidation and revised financial reports of the selected companies has been made using the periods from 2012 to 2016. Given values are interpreted in regards to empirical measurements and they set the industry standard. In this way, the values could provide the grades of companies' financial health. In the end, values which do not significantly depart from the set industry standards were graded acceptable. It has been put in question whether those selected models of prediction, which were used in the research, could predict solid and realistic possibilities of bankruptcy in the future. In the research, three prediction models were used: Altman's Z-score, Kralicek DF-indicator and BEX model.

4. Research Results

When talking about model and bankruptcy predictions, Altman's Z-score is definitely one of the most popular and most frequently used models. Z-score is known as one of the most efficient tools for establishing which companies will end in bankruptcy. It predicts possibility of a

³ <https://www.linkedin.com/pulse/bisnode-analiza-gospodarstva-2015-manji-broj-poduze%C4%87a-hrvatska> (viewed 23.03.2018.)

⁴ <http://zse.hr/default.aspx?id=34348> (viewed 21.03.2018.)

company's bankruptcy in next 12 months.⁵ Edward I. Altman has formed a simple, practical, usable and useful company classification model on “companies which are candidates for bankruptcy” and “healthy companies”. Altman used a sample of 33 bankruptcy companies and 33 stable ones. Later in the research, Altman made two corrections. He adjusted the model according to companies whose value papers are not listed on the Stock Exchange, while the second correction was adjusting the model to non-production subjects. Discrimination function for production companies that have stocks on the Stock Market are shown in the example below:

$$Z = 1,2 X_1 + 1,4 X_2 + 3,3 X_3 + 0,6 X_4 + 1,0 X_5$$

Table 1: Altman's Z-score

Indikator	Numerator	Denominator
X_1	Working capital	Total assets
X_2	Retained earnings	Total assets
X_3	Operative profit	Total assets
X_4	Market value of capital	Bookkeeping value of obligation
X_5	Sales income	Total assets

Source: Adaptation of Authors by Škrtić, M., Tisovec, M., Predviđanje stečaja poduzeća uporabom financijskih pokazatelja uspješnosti poslovanja (II. dio), RRiF, br. 8/2006., pg. 47.

An advantage of complex models such as Altman's is that a total performance of a company can be described using one piece of information or number. In addition, their prognostic value is important in order to estimate future conditions. In continuation, they show calculations of Altman's Z- score model with the corresponding rate of a company's financial health.

Table 2: Z-score model of selected companies

Company	2012	2013	2014	2015	2016
AD Plastik	1,33	1,03	0,77	1,51	1,63
Brodogradilište V.L.	0,92	1,35	1,07	2,08	1,06
INA	3,65	3,29	4,08	3,83	3,70
Končar	2,55	2,72	2,21	2,73	2,72
Metalska industrija Varaždin	1,48	1,45	1,55	1,67	1,56
Petrokemija	1,51	1,24	0,62	1,60	1,05
Uljanik	0,85	0,54	-0,13	0,33	0,13
AVERAGE	1,75	1,66	1,45	1,96	1,69

Source: Author's calculation

Interpretation of Altman's original model, according to the obtained results, predicts bankruptcy in the following 12 months for companies whose Z-score value is smaller than 1,8, while companies whose value is from 1,8 to 3 are in the grey zone and that requires prompt restructuring action. Companies with a solid business have a Z-score above 3. According to indicated calculations, only INA d.d. has a safe future, while Končar's business is in the grey zone. Other companies that were observed have a very high possibility of going bankrupt in the

⁵ Škrtić, M., Tisovec, M., Predviđanje stečaja poduzeća uporabom financijskih pokazatelja uspješnosti poslovanja (II. dio), RRiF, br. 8/2006., pg. 47.

following 12 months. The correctness of indicators is being questioned in this particular example, regarding the prediction of bankruptcy in 2012.

Economic environment in which the company is doing business is very important for high-quality interpretation of obtained results. Taking into consideration the differences between American and European economic environment, Kralicek developed a prognostic model of the financial instability, which is adjusted to the European environment. Modelled in the same way as Altman's overall indicator, Kralicek differentiates between "healthy" and "unhealthy" companies, and has developed a model which is used for identifying a crisis in a certain company. Based on statistics and dynamic indicators from financial surveys of German, Swiss and Austrian business subjects, Kralicek put forward the following model:

$$DF = 1,5 X_1 + 0,08 X_2 + 10 X_3 + 5 X_4 + 0,3 X_5 + 0,1 X_6$$

Table 3: DF indicator

Indicator	Numerator	Denominator
X_1	Pure cash flow	Total liabilities
X_2	Total assets	Total liabilities
X_3	Profit before interest and taxes	Total assets
X_4	Profit before interest and taxes	Total income
X_5	Supplies	Total income
X_6	Business income	Total assets

Source: Žager, K., Mamić Sačer, I., Sever, S., Žager, L., Analiza financijskih izvještaja, Masmedia, Zagreb, 2008., pg. 273

In continuation, calculations of the DF indicator of the selected companies in the time period from 2012 to 2016 have been made, so that the company's financial status can be determined. Financial health has been rated using a table of value reference. Kralicek's DF indicator can take positive and negative value, in which negative values show insolvency of a business subject.

Table 4: DF indicator of the selected companies

Company	2012	2013	2014	2015	2016
AD Plastik	2,06	1,56	1,23	3,16	2,65
Brodogradilište V.L.	-0,95	0,81	0,72	2,29	0,88
INA	1,66	-0,21	-0,43	-0,16	1,56
Končar	2,04	2,07	1,68	2,03	2,05
Metalska industrija Varaždin	1,17	1,29	1,49	1,16	1,73
Petrokemija	-0,60	-2,21	-2,50	0,25	-0,09
Uljanik	0,81	2,13	-2,35	1,47	1,31
AVERAGE	0,89	0,78	-0,02	1,46	1,44

Source: Author's calculation

Positive values have been noted during the whole period of observation for companies AD Plastik, Končar and Metalska industrija Varaždin which have turned out to be financially stable. The difference between results for INA is evident, and they were obtained using the Z-score and the DF indicator. The Z-score predicted a safe future for INA, while negative values of the DF indicator show insolvency of the company in the time period from 2013 to 2015.

Business excellence index, also known as the BEX indeks, created by Vinko Belak and Željana Aljinović Barać, allows quick and simple assessment of a company's business excellence on the Croatian market, but it can universally be applied on other companies as well. It has been made according to the business conditions in the Croatian economy which differs it from similar indexes, but that fact does not limit its application. The advantage of the BEX index is that it allows segment evaluation of business excellence, or, in other words, it points out areas that are non-satisfactory. The thing that substantially differs it from other known models is a prognosis of both success and failure, unlike the majority of similar models created on bankruptcy's prognosis.

$$\text{BEX} = 0,388 \text{ ex}_1 + 0,579 \text{ ex}_2 + 0,153 \text{ ex}_3 + 0,316 \text{ ex}_4$$

Table 5: BEX index

Indicator	Numerator	Denominator
ex₁ Profitability	Operating profit (EBIT)	Total assets
ex₂ Creating values	Net operating profit	Own capital*price
ex₃ Liquidity	Working capital	Total assets
ex₄ Financial strength	5 (profit + amortization + depreciation)	Total liabilities

Source: Author's quote of Bešvir, B. Bešvir, B. Kako čitati i analizirati financijske izvještaje, RRiF, Zagreb, 2008., pg. 100 – 101

The BEX index has been calculated for companies observed in order for business excellence to be rated. Besides future prognosis, BEX's specificity is that it gives recommendations for future operation of businesses, so it could keep the existing rank or improve it if necessary.

Table 6: BEX index of selected companies

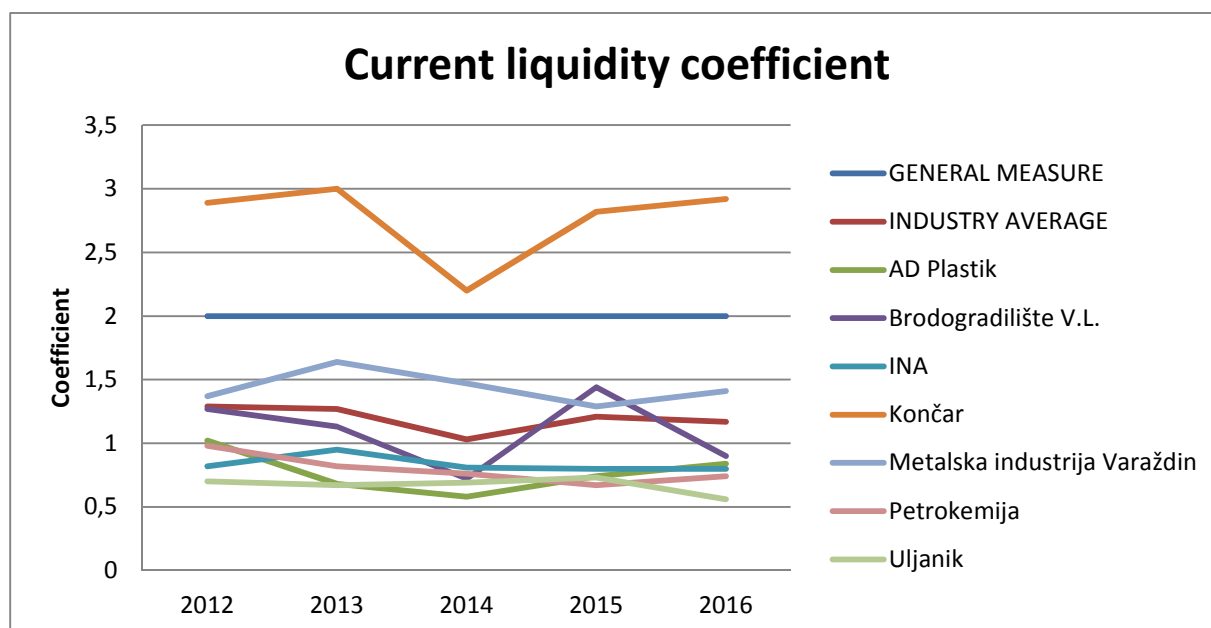
Company	2012	2013	2014	2015	2016
AD Plastik	1,62	1,25	-0,27	3,30	6,17
Brodogradilište V.L.	-3,59	0,69	1,01	6,85	2,38
INA	2,62	-4,10	-5,61	-5,45	4,42
Končar	1,60	2,45	2,13	2,92	4,16
Metalska industrija Varaždin	2,35	3,70	5,26	4,08	9,32
Petrokemija	-6,89	-24,98	-36,66	-13,04	-74,46
Uljanik	-2,06	-28,41	-97,36	6,59	-238,21
AVERAGE	-0,62	-7,05	-18,79	0,75	-40,89

Source: Author's calculation

Negative average values obtained are the result of non-satisfactory businesses of companies Uljanik and Petrokemija, which significantly influenced the forming of an average. Negative values are signs of bad business and threatened existence, which requires urgent restructuring and improvement due to the danger of failure. According to values obtained during the observation time, it is concluded that all companies aside from Metalska industrija Varaždin and Končar fall into the crisis section. Positive trend in the companies of AD Plastik and Brodogradilište Viktor Lenac is the most evident in 2015 and 2016. Those companies are classified as world-class candidates.

Every serious business analysis includes a liquidity analysis, given that it is one of the certain law-supported reasons for declaring bankruptcy. Good liquidity lowers the risk of possible financial collapse, and the liquidity indicators are of particular importance to express the times of crisis, as well as general insolvency. Current liquidity coefficient has been calculated by putting in ratio both current assets value and current liabilities, and it demonstrates how many units of current liabilities cover current assets. Motion indicators of current liquidity of the selected companies are displayed below:

Graph 1: Indicator motion of current liquidity of the selected companies



Source: Author's creation

On the branch level during the whole observation period, liquidity is placed below optimal value 2. According to the demonstrated data of current coefficient, liquidity of the Končar company during the whole observation period goes above both the average and optimal value branches. Current coefficient liquidity of Metalna industrija Varaždin has been rated as sufficient, given the fact that it is above the branch average. Obtained values of other companies show worse liquidity and possible problems with settling received liabilities.

Indebtedness analysis is necessary in every serious rating of a company's financial health. In addition to the inability of paying, indebtedness is the second reason for opening the bankruptcy procedure. For evaluation of a company's financial risk, indebtedness indicators are used. Financial indicators are used to rate levels for investment in a company since companies with a high level of indebtedness lose financial flexibility and can have problems finding new investors and are, consequently, faced with the risk of bankruptcy. It is important to emphasize that indebtedness does not necessarily have to be negative and alarming as long as the loans are kept under control and are directed to profitable projects, which could then result with multiple returns to investments. Financing with debts is very different from financing with own capital. If the owners do not get dividends or profit, the threat of execution does not exist. However, if the company cannot pay its obligations to creditors, it puts itself to the risk of a financial breakdown.

Indebtedness indicator puts into relation the values of long-term and short-term liabilities, with company's total assets. It shows to what extent a company uses indebtedness as the means of financing. The larger the difference between debts and assets, the larger the financial risk, and vice versa. In other words, lower indebtedness level enlarges an entrepreneur's ability to pay

his liabilities, and by doing so, the creditors are safe. According to the traditional way of thinking, the acceptable indebtedness value is up to 50%, while modern surveys show that the company is not completely in charge if its indebtedness level does not go over 70% of the assets value. Surveys show that companies with a high indebtedness level (70% or more), because of the inability to pay, very often declare bankruptcy.⁶

Table 7: Indebtedness level of selected companies

<i>Company</i>	2012	2013	2014	2015	2016
AD Plastik	44,19	50,08	57,73	51,68	45,11
Brodogradilište V.L.	43,45	42,05	52,00	42,02	48,45
INA	35,58	36,66	30,84	28,12	29,48
Končar	27,03	24,94	32,01	24,69	23,97
Metalska industrija Varaždin	63,54	65,35	62,37	64,69	63,58
Petrokemija	68,83	70,70	76,68	83,48	89,52
Uljanik	81,94	75,12	75,00	87,39	96,62
AVERAGE	52,08%	52,13%	55,23%	54,58%	56,68%

Source: Author's calculation

Obtained values for all companies, except for Petrokemija and Uljanik are rated as acceptable. Negative trend in Petrokemija and Uljanik reached its peak in 2016 when their indebtedness reached almost 90% or 97%, respectively.

Profitability analysis is the most important part of a financial analysis since gaining profit is the aim of every company, it is necessary for survival. Profitability analysis measures management effectiveness in the operation of business, or it measures a company's ability to fulfil certain profit levels in regards to income, assets or capital. According to many experts, refund rate of equity and profitability rate of equity or rentals of own capital represent significant profitability indicators. It shows how many monetary units of profit the company exercised on one unit of own capital. It is a significant measure for company's profitability measurement from the investor's point of view, i.e. for the person who invested their capital. It is a fundamental measurement for profit planning. Refund of own capital is a substantial success indicator of business – if ROE is bigger than that of the competition, it means a higher price of a company's stock. This is the reason why it is important to secure consistent profit making.

Table 8: Return on Equity (ROE) of selected companies

<i>Company</i>	2012	2013	2014	2015	2016
AD Plastik	7,84	3,93	0,78	7,42	7,13
Brodogradilište V.L.	-14,95	0,23	0,25	11,75	0,69
INA	4,59	-11,71	-16,27	-13,40	0,90
Končar	8,62	7,52	7,01	6,52	7,10
Metalska industrija Varaždin	1,18	1,33	7,11	2,31	7,70
Petrokemija	-31,63	-75,43	-111,36	-69,97	-193,15
Uljanik	-29,88	22,10	-295,53	-58,35	-858,09
AVERAGE	-7,75%	-7,43%	-58,29%	-16,25%	-146,82%

Source: Author's calculation

⁶ Škrtić, M., Tisovec, M., op.cit., str. 58.

For a more realistic rate of a given indicator, it is necessary to compare it with that of similar companies in the same sector. ROE above the sector does not have to be a good indicator if the value that is shown comes from disposable income. It is crucial to point out that the value of ROE mostly depends on the capital contribution in total assets. In other words, companies with low capital contribution in assets can have an exceptionally high ROE. Average refund of own capital of companies observed has shown that they do business with loss. Končar has a continuously high ROE, and taking in consideration all indicators calculated, it can be concluded that the Končar business can be ranked as safe.

5. Conclusion

Endangering a company's existence puts its development and market survival in danger. A termination of one of the subjects brings with itself a series of chain reactions. For the purpose of observation of consequences and danger that a business crisis can cause, a timely perception of changes is important in order to overcome and alleviate the cause and the influence of change. Continuous and correct analysis of financial reports can be used to rate a company's financial health, as well as to highlight critical areas in a business. In this paper, the stress is put on prediction analysis of (non)success of some Croatian manufacturing companies using three models: Z-score, DF indicator and BEX index. The obtained values are interpreted in relation to empirical measurement and standard branch normative, so the rate of a company's financial health could be obtained. The analysis using indicators and prognostic models is a useful tool which can help in a timely crisis identification. Modern company management means proactive crisis management – a never-ending cyclic process which is constantly being upgraded.

REFERENCES

1. Belak, V. (2014). *Analiza poslovne uspješnosti*. Zagreb, Hrvatska: RRiF.
2. Bešvir, B. (2008). *Kako čitati i analizirati financijske izvještaje*. Zagreb, Hrvatska: RRiF.
3. Kovačić, B. (2018). *Analiza gospodarstva*. Retrieved March 23, 2018, from <https://www.linkedin.com/pulse/bisnode-analiza-gospodarstva-2015-manji-broj-poduze%C4%87a-hrvatska>
4. Pervan, I., (2017). *Predviđanje stečaja – SME proizvodna poduzeća u Hrvatskoj*. Zbornik radova Veleučilišta u Šibeniku 33-45.
5. Priskić, E., Bačić, L. (2012). *Stečaj u funkciji revitalizacije trgovačkog društva*. Učenje za poduzetništvo 357-368.
6. Škrtić, M., Tisovec, M. (6/2006). *Predviđanje stečaja poduzeća uporabom financijskih pokazatelja uspješnosti poslovanja I.dio*. RRIF.
7. Škrtić, M., Tisovec, M. (8/2006). *Predviđanje stečaja poduzeća uporabom financijskih pokazatelja uspješnosti poslovanja II.dio*. RRIF.
8. Zagrebačka burza. *Sektorska klasifikacija*. Retrieved March 23, 2018, from: <http://zse.hr/default.aspx?id=34348>
9. Zenzerović, R., Peruško, T. (2006). *Kratki osvrt na modele za predviđanje stečaja*. Ekonomska istraživanja 132-151.
10. Žager, K., Žager L. (2008)., et. al., *Analiza financijskih izvještaja*. Zagreb, Hrvatska: MASMEDIA.

Hotels in the System of Valued Added Tax

Luka Mladineo

The University Department of Professional Studies, Split, Croatia
lmladine@oss.unist.hr

Ružica Olujić

The University Department of Professional Studies, Split, Croatia
ruzicaolujic0711@gmail.com

Abstract. The topic of this paper is the value added taxation system of the hotel industry in Croatia. Hotel trade/industry is a service activity with the main task of satisfying the needs for accommodation, drink and food. The number of hotels in Croatia is increasing year after year thanks to successful tourist seasons in the last years. Hotel is an institution, tourist establishment intended for providing services of accommodation and nourishment for their guests, the users of services. Catering industry can be done by corporation/company, cooperative society, artisans and tradesman who comply with the terms for doing the business. Specific catering services could be done by a physical person –the citizens or the members of rural economy. The present rate of valued added tax in the services of accommodation, accommodation with breakfast, half board or full board in hotels and the establishments is 13%. A caterer is obliged to make out a receipt for every service with an emphasis on type, price and the amount of provided services. In this paper a number of changes that have taken place in the value added tax taxation in the hotel industry will be shown. A sojourn tax will also be mentioned in addition. The amount of the sojourn tax, which is not taxable, must be added to each receipt for hotel accommodation.

Key words: *valued added tax, tax rate, hotel, sojourn tax*

1. Introduction

Value Added Tax is a tax which taxes all traffic stages on the way of a product or service from a producer or a service provider to a final consumer, in such a way that only a newly added value is taxed at each stage. Value added tax is the revenue of the state budget of the Republic of Croatia. The Croatian Parliament passed the Value Added Tax Law in 1995. It was supposed to come into force on 1 January 1996, but due to a series of delays, it came into force on 1 January 1998. It is this way only added value of each stage is taxed, and this is achieved in such a way that the taxpayer refuses the tax charged by other taxpayers through the purchase price.

2. Value Added Tax

According to Article 4, paragraph 1 of the Value Added Tax Act the subject of VAT is (Value Added Tax Act NN 73/13 article 4.):

- a) The supply of goods in the countryside with the fee paid by the taxpayer as such
- b) Acquisition of goods within the European Union, which are being made at home for remuneration.

2.1. Taxpayer

Taxpayer is (Value Added Tax Act NN 73/13 article 6.):

- Any person who, independently, carries out any economic activity, whatever the purpose or results of that activity.
- Any person who, on an occasional basis, supplies a new means of transport.
- Taxable person which is not established and has no fixed establishment rendering supplies, or permanent address or habitual residence in the Republic of Croatia and who supplies goods and perform services in the Country, for which the place of taxation is in the Republic of Croatia (unless if the Croatian recipient of goods and services pays VAT). Taxable persons established in the European Union may appoint a tax representative in the Republic of Croatia, while taxable persons established outside the European Union shall be obliged to appoint a tax representative as a person who will be liable for payment of the VAT.
- State government bodies, state administrative bodies, bodies and units of local and regional self-government, chambers and other legal persons with public authority if they carry out economic of other activity and non-taxation of that activities would lead to significant distortions of competition.

2.2. Value Added Tax- Rate

Value added tax is calculated at the rate applicable at the time of the taxable event. The tax rate is the amount of the tax burden in relation to the tax base, and is usually determined in percentage (%).

The VAT rate applied to the acquisition of goods within the European Union depends on the destination country and a defined tax rate for certain goods in that country is applicable. Three tax rates of 5%, 13% and 25% are applied in the Republic of Croatia.

VAT is calculated and paid at a reduced rate of 5% on deliveries of the following goods and services (Value Added Tax Act NN 73/13 article 6.):

- Bread;
- Milk;
- Daily newspapers (other than daily published newspapers with less than 50% advertising content);
- Pharmaceutical products (only approved medicines prescribed by a doctor);
- Some medical equipment;
- Cinema ticket;
- Books (excluding e-books);
- Science periodicals.

VAT is calculated and paid at a reduced rate of 13% on deliveries of the following goods and services:

- Hotel accommodation;
- Newspapers (other than daily published newspapers with less than 50% advertising content); periodicals (magazines other than science periodicals with less than 50% advertising content);
- Oils and fats for human consumption

- Children car seats
- Tickets for concerts
- Water supplies (excluding bottled water)
- Electricity,
- Collection of waste conducted as public service,
- Urns and coffins,
- Seedlings and seeds
- Fertilizers and pesticides
- Animal food (except pet food).

3. Tourist Industry

Catering activity in the sense of the Law on Catering is the preparation and serving of meals, beverages, beverages and the provision of accommodation services.

Catering activities are carried out in a facility designed, furnished and equipped for the provision of catering services and can be in:

- Building, separate part of a building or multiple buildings (building, kiosk)
- A stationary vehicle, a railway wagon, a connecting vehicle, a floating facility and a watercraft transported by a passenger during transport
- In tents, on bench, on wheelchairs and the like, equipped for the provision of catering services
- A business space where another activity is performed, so that the space intended for carrying out another activity is visibly separated from the part where the catering activity is carried out.

Catering facilities, given the type of catering services provided, are classified into groups (Law on Catering Activity (NN 85/15) Article 8.):

- a) Hotels
- b) Camps
- c) Other accommodation facilities for accommodation
- d) Bars
- e) Restaurants
- f) Catering facilities
- g) Facilities of simple services.

On January 16, 2017, there were 851 tourist objects in Croatia, of which the highest hotels, 605, 84, tourist apartments 52, tourist resorts 41, apartments 19, and marina 50. All listed tourist facilities (except small ones) have a total of more than 100,000 accommodation units and 237,000 permanent beds.

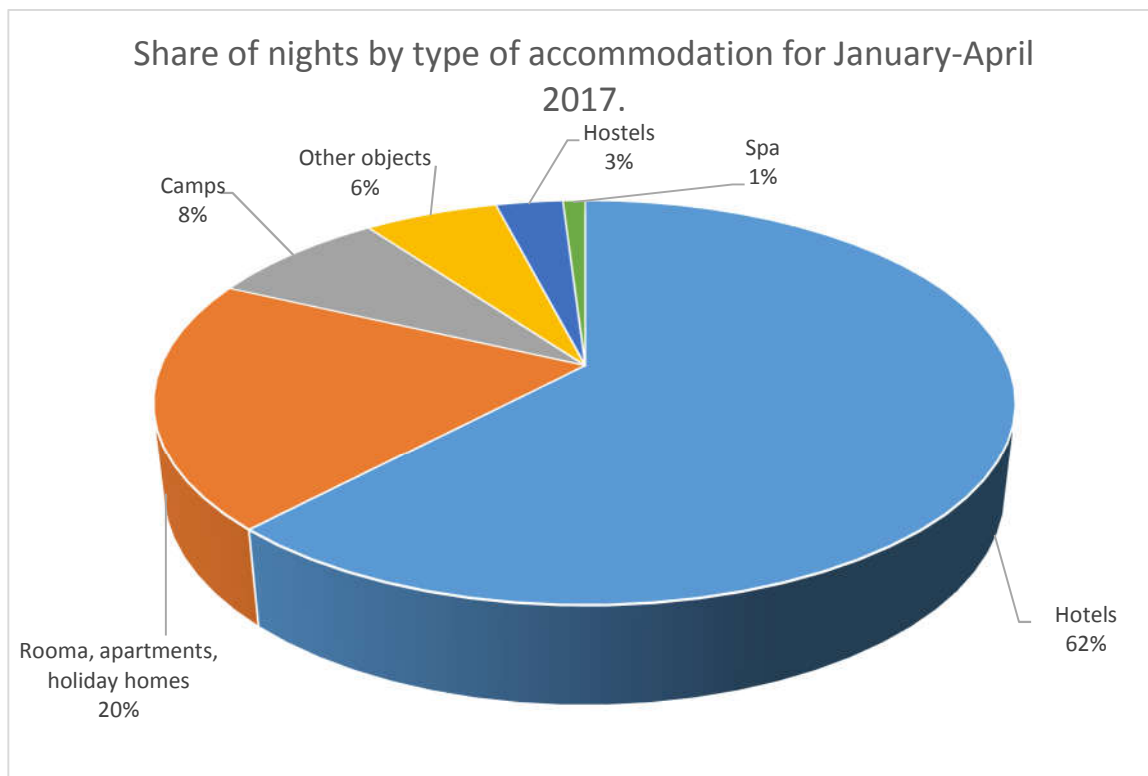


Figure 1 Share of nights by types of accommodation facilities (Source: Central Bureau of Statistics)

From the Chart 1. We can see that most of the overnight stays were realized in hotels (62.0%). Following are private accommodation with 20.0% and camps with 8.0% of total overnights. The minimum number of overnight stays was realized in the health resorts (1.0%).

3.1. Categorization of catering facilities from a group of hotels

Pursuant to the provisions of Article 27 of the Ordinance on Classification, Categorization and Special Standards for Catering Facilities in the Group of Hotels (Official Gazette No. 55/2016), facilities in the group of hotels are classified into the following types (:

- Hotel heritage,
- Diffuse hotel,
- Hotel,
- Aparthotel
- Tourist resort,
- Tourist apartments,
- Pension,
- Integral hotel (associate),
- Health resorts; spa hotel, spa hotel, spa aparthotel, health resort, spa tourism apartments, spa hotel, health resort hotel,
- Hotels of a particular standard (Hotel business, Hotel meetings, Hotel congress, Hotel club, Hotel casino, Hotel holiday resort, Hotel coastal holiday resort, Hotel family, Hotel small & friendly, Hotel senior citizens, Hotel health & fitness, Hotel driving club, Hotel motel; Hotel ski, and Hotel bike).

3.2. Categorization of hotels

Categorization of the hotel is done according to the Regulations on Classification, Categorization and Special Standards of Catering Facilities. According to Croatian standards, hotels can have two, three, four or five stars. This kind of categorization is valid for existing hotels, while newly built hotels can be categorized by three, four or five stars.

Table 1. Number of hotels by category (Source: Central Bureau of Statistics/Tourism)

Number of hotels by category (31 August 2016)					
	2015.	2016.	2015. u %	2016. u %	Index 2016./15.
Hotels in total	671	691	100	100	103.00
*****	37	38	6	5	102.7
****	243	271	36	39	111.5
***	315	311	47	45	98.7
**	76	71	11	10	93.4

4. Value Added Tax in Tourism

A tax rate of 13% is applied on accommodation or accommodation with breakfast, half board or full board in hotels or similar purposes. Also in this group of services, there are also accommodation during vacations and accommodation in the water facilities. All types of commercial catering facilities are considered objects of similar use. The pension service includes accommodation and three meals (breakfast, lunch and dinner), and half board accommodation with breakfast and one of the other meals.

Accommodation services or organization of all tourist packages (tourist services) can be provided directly to guests or through travel agencies, which is a more frequent practice. To determine the tax position, it is important to distinguish whether it is a rental service (taxed at a 25% VAT rate) or accommodation service (VAT rate of 13%). When concluding a contract, especially when it comes to providing accommodation services via travel agencies, it is important to define on who's behalf is agency acting. If a travel agency is acting on its behalf, it is mandatory, from the day of the entry of Croatia in the EU, to apply a special procedure for taxing travel agencies and there is no right to choose another tax position. For travel organization services outside the EU (the third country), the agency acts as a mediator on the tax behaviors and thus carries out mediation service and (in accordance with the tax determination, this service is exempt from VAT).

A travel agency can do business in different ways and make more types of contracts.

a) The Agency carries out accommodation services on its behalf and for its account - the hotel for the account invoiced VAT at a rate of 13% and the guest agency (domestic or foreign) applies the special taxation procedure for travel agencies in the case of the arrangement.

b) The Agency carries out a tourist service for someone else's name and for a foreign account (hotel-agent-agent) - the hotel issues an invoice directly to the guest and applies a 13% rate of VAT. The agency for mediation services calculates VAT at a rate of 25% or issues an account in the name and for the account of the renter (service provider).

c) The Agency carries out the accommodation services on its own behalf and for another account - the hotel for the accommodation service based on the invoice issued by the agency charges VAT at a rate of 13%, and the agency for the guest, in case of arrangement, a special procedure for taxing travel agencies

4.1. Value added tax rates in EU Member States

Table 2 Rates of VAT on hotel accommodation and preparation and serving of foodstuffs for beverages and beverages (Source: https://ec.europa.eu/taxation_customs/taxes-europe-database-tedb_en)

EU MEMBER COUNTRY	HOTEL ACCOMMODATION (%)	RESTAURANTS AND CATERING (%)
Belgium	6	12
Bulgaria	9	20
Czech Republic	15	21
Denmark	25	25
Germany	7	19
Estonia	9	20
Ireland	9	9
Greece	13	24
Spain	10	10
France	10	10
Croatia	13	25
Italy	10	10
Cyprus	9	9
Latvia	12	21
Lithuania	9	21
Luxembourg	3	3
Hungary	18	27
Malta	7	18
Netherlands	6	6
Austria	13	10
Poland	8	8
Portugal	6	13
Romania	9	9
Slovenia	9,5	22-9,5
Slovakia	20	20
Finland	10	14
UK	20	20
Sweden	12	12

The table shows value added tax rates for hotel accommodation and services for the preparation and serving of food, beverages and beverages in restaurants in the EU Member States. Hotel accommodation in Croatia is taxed at a rate of 13%, while food, beverage and beverage services are taxed at a 25% rate. The highest rates of VAT on hotel accommodation are in Denmark, Slovakia and the United Kingdom, while the lowest VAT rates have Portugal, Belgium, the Netherlands and Luxembourg with a tax rate of only 3%.

4.2. Sojourn tax

You must also add the amount of the sojourn tax on each hotel account invoiced. It is calculated based on the Sojourn Tax Act, in accordance with the Rulebook on Main Seasons Period, Presence, Priority and Outbound Rate in Tourism Municipalities and Cities.

The sojourn tax shall be paid (Sojourn Tax Act (Official Gazette 152/08) Article 3.):

- a) Persons who use the service of accommodation in the accommodation facility where the catering business is carried out, in a tourist town or city where they do not have a permanent residence,
- b) Passengers using the overnight stays on a nautical tourism facility,
- c) Persons providing accommodation services in the household or rural households,
- (d) The owner of a house or holiday apartment in a tourist town or town, other than a housing facility within the meaning of this Law, for himself or herself and anybody who is staying in that house or apartment,
- e) Owner of a vessel that is not a vessel of nautical tourism within the meaning of this Law, for himself or herself and all persons on board of that vessel for tourist purposes.

Hotel L issued a bill to a guest I. I. for two overnight stays (main season) in a double room with breakfast of 1709,00 HRK. Hotel L is a tourist grade A hotel (the amount of sojourn tax per night is 7,00 HRK (Regulation on determining the amount of sojourn tax for 2017 (Official Gazette 70/16)).

Table 3 Calculation of sojourn tax (Source: authoring)

	Tax base	VAT %	Tax	Total
Rent a double room with breakfast (June 16 - June 18, 2017)	1.500,00 HRK	13	195,00 HRK	1.695,00 HRK
Sojourn tax	-	-	14,00 HRK	14,00 HRK
Total	1.500,00 HRK		209,00 HRK	1.709,00 HRK

5. Conclusion

Croatia is one of the most visited and most important tourist destinations of the Mediterranean. Croatian tourism is the most developed in the coastal region, and hotel tourism is especially strong developed the Istrian County. This is why a large amount of income is realized based on rental of various types of accommodation facilities. The hotel is an object where guests are provided with accommodation and breakfast services. Value added tax is payable at a rate of 13% on accommodation or accommodation services with breakfast, half board or full board in all types of commercial catering establishments. Accommodation services or organization of travel arrangements can be provided by accommodation facilities (hotels) directly to the guest or the service can be provided by tourist agencies. From 01.01.2017. a lower 13% VAT rate does not apply to food preparation services and catering services in catering establishments and the preparation and servicing of non-alcoholic beverages, beverages, wine and beer in these facilities. Often, these services are provided to guests in combination with accommodation services and, in this case, in accordance with the provisions of the Value Added Tax Act, apply a tax rate of 13% is applied rather than a rate of 25%. The value added tax rate that is applied in Croatia for tourist accommodation and preparation and serving is higher than the rate in competing EU members, which puts tourists in a more unfavorable position.

The indisputable part of any invoice issued by the hotel is a non-taxable sojourn tax. Domestic and foreign citizens (visitors) who use the overnight stays in the accommodation facility will pay the sojourn tax on each of the overnight stays.

REFERENCES

Law on Catering Activity (NN 85/15 and 121/16). Retrieved March 12, 2018, https://narodne-novine.nn.hr/clanci/sluzbeni/2016_12_121_2626.html

Law on Sojourn Tax (NN 58/17). Retrieved March 11, 2018, https://narodne-novine.nn.hr/clanci/sluzbeni/2008_12_152_4144.html

Ordinance on Classification, Categorization and Special Standards of Catering Facilities in a Group of Hotels (NN 56/2016). Retrieved March 11, 2018, https://narodne-novine.nn.hr/clanci/sluzbeni/2016_06_56_1451.html

Regulation on determining the amount of sojourn tax for 2017 (NN 70/2016). Retrieved March 11, 2018, https://narodne-novine.nn.hr/clanci/sluzbeni/2016_07_70_1667.html

Taxes in Europe" database (TEDB), https://ec.europa.eu/taxation_customs/taxes-europe-database-tedb_en, Retrieved March 12, 2018

Value Added Tax Act (NN 73/13, 99/13, 148/13, 153/13, 143/14 and 115/16). Retrieved March 11, 2018, https://narodne-novine.nn.hr/clanci/sluzbeni/2016_12_115_2526.html

Tax Treatment of Acquisition and Costs of Using Personal Vehicles from 1 January 2018

Dijana Perkušić

University of Split, University Department of Professional Studies, Split, Croatia
pdijana@oss.unist.hr

Dijana Šimunović

University of Split, University Department of Professional Studies, Split, Croatia
dijana.simunovic96@gmail.com

Abstract. Since 1 January 2018, the way of taxation of personal vehicles used for personal transportation changed. The biggest change relates to the possibility of deducting a part of input Value Added Tax for acquisition and usage of personal vehicles. Until 31 December 2017, an input VAT deduction was not permitted for acquisition of personal vehicle; from 1 January 2018, a taxpayer may deduct 50% of input VAT for acquisition of personal vehicle when its acquisition value is not over HRK 400,000. An input VAT deduction shall not be permitted for acquisition of personal vehicles when exceeding HRK 400,000 of the acquisition value per means of transportation. Taking into account a large number of entrepreneurs who are acquiring personal vehicles and the fact that personal vehicles are an integral part of the fixed tangible assets of an entrepreneur, it is very important to know how new tax changes affect its tax liabilities and when it has the right to deduct input VAT. Most of the costs that occur during the use of personal vehicles are recurring, such as the cost of fuel, oil, maintenance and repair, servicing of vehicles, registration, etc. The aforementioned costs are increasing the taxable base of profit tax, so they have a significant impact on the entrepreneurs' tax liabilities. Regarding the above changes, this paper shows accounting and tax procedures concerning acquisition and usage of personal vehicles for personal transportation.

Key words: *acquisition of personal vehicles, costs of using personal vehicles, deduction of input VAT, profit tax*

1. Introduction

Recent changes in the Value Added Tax Act affect the tax treatment of personal vehicles used for personal transportation. According to the previously mentioned Act, personal vehicles represent motor vehicles intended for transporting people, which besides the driver's seat contain a maximum of eight seats. In the past, when a company acquired personal vehicles, the right to deduct input Value Added Tax (hereinafter: VAT) was permitted until 1 March 2012. Before that period, an input VAT deduction was permitted at the rate of 70% of acquisition value; in the other hand if the acquisition value was over HRK 400,000 on that part of the acquisition value VAT deduction was not allowed. The period from 2012 to 2018 was unfavorable for entrepreneurs because of higher costs when acquiring personal vehicles; input VAT was not deductible at all, regardless of the acquisition cost. From 2018, taxpayers have the right to deduct 50% of input VAT for acquisition of personal vehicles, when their acquisition value is not exceeding HRK 400,000. The same principle also

applies to costs associated with the use of personal vehicles such as fuel, maintenance, registration and rental of vehicles (including operating lease). Currently, entrepreneurs have the right to deduct 50% of input VAT on those costs. Regards to what is previously said, it is visible that new tax changes in VAT are positive for entrepreneurs. It is important to emphasize how the tax burden, when a company acquires personal vehicles, depends on whether the vehicles are new or used and from whom are they acquired. The aforementioned costs associated with the use of personal vehicles are increasing the taxable base of profit tax, so they have a significant impact on the entrepreneurs' tax liabilities. In 2018, the taxable base of profit tax increases for 50% of the costs associated with the use of personal vehicles, what is higher in comparison with previous years, so this new change in Profit Tax Act increases the entrepreneurs' tax liabilities.

This paper focuses on the aforementioned changes in the VAT Act and in the Profit Tax Act that affect tax treatment of acquisition and costs of using personal vehicles from 1 January 2018 in the Republic of Croatia. Tax treatment of acquisition and costs associated with the use of personal vehicles in the Republic of Croatia is regulated by the following regulations:

- Value Added Tax Act (Official Gazette n. 73/13.–115/16)
- Regulation of the Value Added Tax (Official Gazette n. 79/13–128/17)
- Special Tax on Motor Vehicles Act (Official Gazette n. 15/13–127/17.)
- Regulation of the Special Tax on Motor Vehicles (Official Gazette n. 1/17-2/18.)
- Profit Tax Act (Official Gazette n. 177/04.–115/16.)
- Regulation of the Profit Tax Act (Official Gazette n. 95/05.–2/18.)

2. Accounting and Tax Treatment of Acquisition of Personal Vehicles from 1 January 2018

Personal vehicles used for personal transport are a part of the fixed tangible assets. For that reason on them are applied provisions of national¹ and international² standards. In the beginning, personal vehicles are measured by their acquisition cost, which contains the purchase price, non-refundable taxes and other costs, which can be directly attributed to bringing the assets in place and working order for intended use. Costs, such as registration and insurance that occur every year, are not included into the acquisition cost. Equipment that becomes an integral part of a personal vehicle increases the acquisition value of the vehicle. Particular equipment, which can be removed and used on other vehicles, shall be evident separately. A large number of entrepreneurs are acquiring personal vehicles, but before the acquisition, entrepreneurs must know for what purposes are the vehicles going to be used. Knowing the intended use of a personal vehicle is important because of taxation. The tax treatment varies whether the vehicle is new or used and from whom it is acquired. However, most entrepreneurs are acquiring new vehicles and therefore this paper focuses on that fact.

2.1 Deduction of input VAT when acquiring a new vehicle in 2018

Amendments of the VAT Act, which entered into force on 1 January 2018, permit the right to deduct 50% of input VAT when entrepreneur acquires personal vehicles. The deduction depends on whether the personal vehicles are intended for personal transport or for pursuing activities, which are specially mentioned in the VAT Act. The tax treatment of personal vehicles for personal transport is unfavorable in regards to the second mentioned case. In the first case, entrepreneurs may deduct 50% of input VAT, but in the other case, they

¹ HSFI 6 – Dugotrajna materijalna imovina (Fixed tangible assets)

² IAS 16 – Property, Plant and Equipment

have the right to deduct the entire input VAT. The purpose for which the vehicle is acquired and the amount of its acquisition cost affects the possibility of deducting the input VAT on personal vehicles from 1 January 2018. Deduction of input VAT is not possible if the acquisition cost exceeds HRK 400,000. Table 1 shows the possibility of deducting input VAT according to the period in which the vehicle was acquired.

Table 1 The possibility of deducting input VAT according to the period in which the vehicle was acquired

Acquiring a personal vehicle	Deduction of input VAT
Until 31.12.2009.	Full deduction of input VAT for the acquisition cost up to HRK 400,000 per means of transportation (VAT is charged on 30% of depreciation)
	Deduction of input VAT is not possible if the acquisition cost exceeds HRK 400,000
From 1.1.2010. to 29.2.2012.	Deduction of 70% input VAT for the acquisition cost up to HRK 400,000 per means of transportation
	Deduction of input VAT is not possible if the acquisition cost exceeds HRK 400,000
From 1.3.2012. to 31.12.2017.	Input VAT is not deductible at all regardless of the acquisition cost
From 1.1.2018.	Deduction of 50% input VAT for the acquisition cost up to HRK 400,000 per means of transportation
	Deduction of input VAT is not possible if the acquisition cost exceeds HRK 400,000

Source: Vuk, J. (2018). Nabava prijevoznih sredstava od 1. siječnja 2018. godine. *Računovodstvo, revizija i financije*, 1(18), 19.

Example 2.1. Calculating the amount of deductible input VAT when acquiring a personal vehicle

Company "X" is dealing with vehicle rental, wholesaling and retailing means of transportation. In February 2018, the company acquired the following vehicles:

Vehicle	Acquisition cost of the vehicle (amount without VAT)	Total amount of input VAT	Purpose of the vehicle	The amount of deductible input VAT
A	HRK 280,000	HRK 70,000	personal transport	HRK 35,000
B	HRK 500,000	HRK 125,000	personal transport	HRK 50,000
C	HRK 470,000	HRK 117,500	rental	HRK 117,500
D	HRK 320,000	HRK 80,000	further sale	HRK 80,000

For the acquisition of vehicle "A" the amount of deductible input VAT is HRK 35,000 because the vehicle "A" is used for personal transport, therefore the company can deduct 50% of total amount of input VAT. For the acquisition of vehicle "B" the amount of deductible input VAT is HRK 50,000, because the acquisition cost exceeds HRK 400,000 and the vehicle "B" is used for personal transport. Vehicle "C" is acquired for rental purposes; therefore, the company has the right to use a full deduction of input VAT. Vehicle "D" is used for further sale; in that case, the company has the right to use a full deduction of input VAT because vehicle "D" is used for business purposes.

2.2 Special tax treatment of personal vehicles in 2018

The Act of Special Tax treatment on Motor Vehicles (hereinafter: STMV) regulates payment of special tax on motor vehicles and administrative charge on used motor vehicles intended for use in the Republic of Croatia. Article 5, paragraph 1 of the mentioned Act defines that the subject of taxation is motor vehicles on which special tax was not calculated and paid. In that category, along with the others, are mentioned personal vehicles for transport of people. Entrepreneurs become taxpayers of the STMV when they acquire motor vehicles from another EU Member State or a third country intended for use on roads in the Republic of Croatia, or when the vehicles, which have never been registered in the Republic of Croatia, are purchased from a dealer of used motor vehicles (Markota, Lj., & Vuk, J., 2018). If the purchased motor vehicle was registered before in the Republic of Croatia, then STMV shall not be calculated and paid. According to the Article 26 (1) the administrative charge are paying entrepreneurs established in the Republic of Croatia, who are purchasing used motor vehicles on which was already calculated and paid STMV, if the import is not taxable with VAT or inheritance and gift tax.

2.3 Examples of acquisition of new personal vehicles in the Republic of Croatia in 2018

The tax treatment depends on whether the vehicles, for personal transport, are new or used. New personal vehicles can be purchased from empowered dealers of motor vehicles. If the dealer is in the VAT system, on the invoice shall be calculated VAT at the rate of 25% and STMV as a transitory item which is not taxable. STMV as a nonrefundable tax is included in the acquisition cost of purchasing personal vehicles. According to the VAT Act, the taxation also depends whether the acquisition value of the personal vehicle is exceeding HRK 400,000. Some examples of acquisition of personal vehicles are presented below.

Example 2.3.1. Tax and accounting treatment of acquiring a new personal vehicle whose value does not exceed HRK 400,000 in 2018

Company acquires a new personal vehicle in 2018, vehicle value is HRK 104,000 with emission of CO² 100 g/km

Vehicle value (without VAT)	HRK 104,000
+ VAT at the rate of 25%	HRK 26,000
+ STMV	HRK 3,635
Total	HRK 133,635

Calculating the amount of deductible and nondeductible input VAT:

- Total input VAT charged at purchase
(HRK 104,000 x 25% VAT) HRK 26,000
- 50% of deductible input VAT
(HRK 26,000 x 50%) HRK 13,000
- 50% of nondeductible input VAT
(HRK 26,000 x 50%) HRK 13,000

In this Example, the acquisition cost of the vehicle is HRK 107,635, which represents the sum of vehicle value (without VAT) and the amount of STMV.

Table 2 Accounting treatment of acquiring a new personal vehicle whose value is under HRK 400,000

No.	Description	Account	Value (in HRK)	
			Debit	Credit
1.	Personal vehicle in preparation	0373	107,635	133,635
	50% of input VAT	0330	13,000	
	Input VAT - 25%	140012	13,000	
	Accounts Payable	2202		
	<i>Purchase of a personal vehicle</i>			
2.	Personal vehicle	03200	107,635	107,635
	Personal vehicles in preparation	0373		
	<i>Entry into function</i>			

Example 2.3.2. Tax and accounting treatment of acquiring a new personal vehicle whose value exceeds HRK 400,000 in 2018

Company acquires a new personal vehicle in 2018, vehicle value is HRK 562,500 with emission of CO₂ 100 g/km

Vehicle value (without VAT)	HRK 562,500
+ VAT at the rate of 25%	HRK 140,625
+ STMV	HRK 56,135
Total	HRK 759,260

Calculating the amount of deductible and nondeductible input VAT:

- Total input VAT charged at purchase
(HRK 562,500 x 25% VAT) HRK 140,625
- 50% of deductible input VAT
(HRK 400,000 x 25% VAT) x 50% HRK 50,000
- 50% of nondeductible input VAT
(HRK 400,000 x 25% VAT) x 50% HRK 50,000
- Nondeductible input VAT because of acquisition value exceeds HRK 400,000
(HRK 162,500 x 25% VAT) HRK 40,625

Table 3 Accounting treatment of acquiring a new personal vehicle whose value exceeds HRK 400,000

No.	Description	Account	Value (in HRK)	
			Debit	Credit
1.	Personal vehicle in preparation	0373	618,635	
	50% of input VAT	0330	50,000	
	100% of input VAT over HRK 400,000	0331	40,625	
	Input VAT - 25%	140012	50,000	
	Accounts Payable <i>Purchase of a personal vehicle</i>	2202		759,260
2.	Personal vehicle	03200	618,635	
	Personal vehicles in preparation <i>Entry into function</i>	0373		618,635

When a company acquires a personal vehicle the amount of nondeductible input VAT (50% input VAT for the acquisition cost up to HRK 400,000 and total amount of input VAT on the acquisition cost when it exceeds HRK 400,000) must be recorded on the special accounts due to the special tax treatment of the amortization of that input VAT (Vuk, 2018). Amortization of that input VAT is fully unrecognized cost according to the provisions of Profit Tax Act.

3. Accounting and Tax Treatment of the Costs Associated with the Use of Personal Vehicles

In this chapter, accounting and tax treatment of the costs associated with the use of personal vehicles will be analysed according to the provisions of the VAT Act and Profit Tax Act.

3.1. Accounting and tax treatment of the costs associated with the use of personal vehicles according to the provisions of the VAT Act

From 1 January 2018, a taxpayer shall not deduct 50% of input VAT charged for supplies of goods or services rendered in connection with usage of personal vehicles and other means of personal transportation. This provision shall not apply when personal vehicles and other means of personal transportation are used for the purpose of training drives, testing vehicles, repair services, taxi service, transportation of deceased persons, lease and further sale. Part of the input VAT (50%) that taxpayer can not deduct must be recorded as a cost. Some examples of accounting and tax treatment of the costs associated with the use of personal vehicles according to the provisions of the VAT Act are presented under subtitle 3.3.

3.2. Accounting and tax treatment of the costs associated with the use of personal vehicles according to the provisions of the Profit Tax Act

When using personal vehicles for personal transport, there are costs that need to be distinguished according to the provisions of the Profit Tax Act that regulate their impact on the taxable base of profit tax. Not all costs associated with the use of personal vehicles for personal transportation are entirely tax-deductible. Tax treatment of these costs is not determined by the fact when the vehicle was purchased. The taxable base of profit tax increases for 50% of the costs, except insurance and interest costs, incurred in connection with own or rented motor vehicles or other means of personal transportation used by

managerial, supervisory and other employees, provided that the use of means of personal transportation is not defined as salary. In 2018, the taxable base of profit tax increases for 50% of the costs associated with the use of personal vehicles, what is in comparison with previous years higher, so this new change in Profit Tax Act increases the entrepreneurs' tax liabilities. In the previous section was mentioned that part of the input VAT that taxpayer can't deduct must be recorded as a cost. According to the provisions of the Profit Tax Act, that nondeductible input VAT increases the taxable base of profit tax. This nondeductible input VAT is then added to the nondeductible amount of the cost incurred during the usage of personal vehicles (50% of the cost + 50% of the nondeductible input VAT).

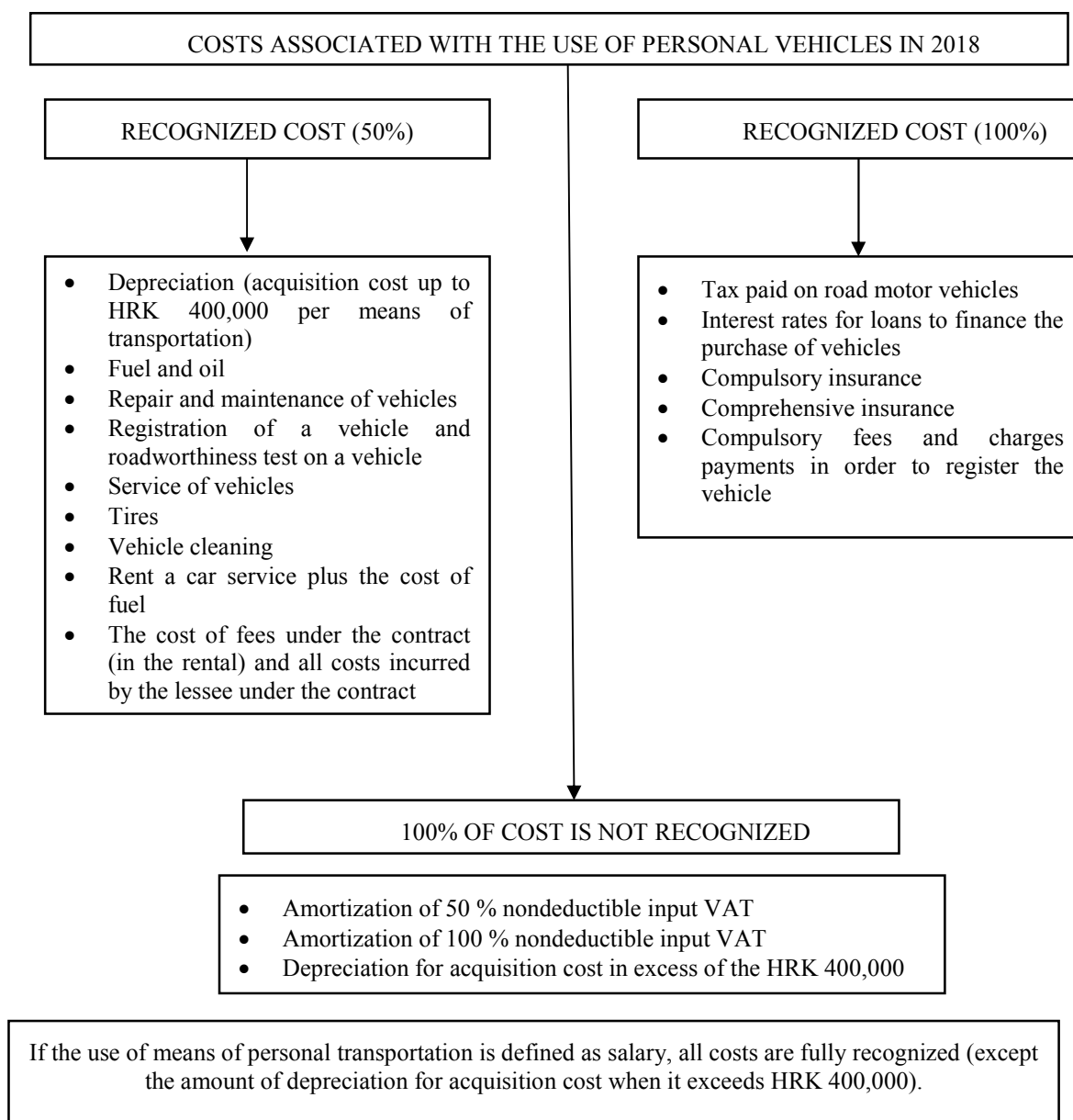


Figure 1 Allocation of the costs associated with the use of personal vehicles according to the provisions of the Profit Tax Act

Source: Vuk, J. (2018). Troškovi uporabe osobnih automobile od 1. siječnja 2018. godine. *Računovodstvo, revizija i financije*, 2(18), 26.

If the use of means of personal transportation is defined as salary, then this costs associated with the use of personal vehicles are fully recognized, so they don't increase tax base of profit tax. In the previous years the taxable base of profit tax increased for 30% of the costs associated with the use of personal vehicles, so from 2018 the entrepreneurs' profit tax liability will be higher (everything else ceteris paribus). Most of the costs that occur during the use of personal vehicles are recurring, such as the cost of fuel, oil, maintenance and repair, servicing of vehicles, registration, depreciation, etc. so their impact on the tax base is very important. Many companies were waiting 2018, respectively the new tax changes in the VAT in order to modernize the vehicle fleet, so in January and February 2018 there was nearly 40% more registered new personal vehicles than in 2017 (Gatarić, 2018). It is visible that new tax changes in VAT are positive for entrepreneurs, they reduce acquisition cost of new personal vehicles and the costs associated with the use of personal vehicles. Sales of new personal vehicles in January and February 2018 increased consumption and GDP (Gross Domestic Product) in the Republic of Croatia (Gatarić, 2018).

3.3. Examples of the costs associated with the use of personal vehicles in 2018

3.3.1. The depreciation of personal vehicles

The depreciation of personal vehicles and others means of personal transportation shall be recognized at the acquisition cost of up to HRK 400,000 per means of transportation. Recognized cost of depreciation is 50% of total amount of cost of depreciation in the case when acquisition cost is up to HRK 400,000 per means of transportation. Where the acquisition cost exceeds the stated amount, the amount of depreciation for acquisition cost in excess of the stated amount shall only be recognized if the means is exclusively used for carrying out a registered renting or transportation activity. Otherwise, according to the provisions of Profit Tax Act (article 12) the amount of depreciation for acquisition cost in excess of the HRK 400,000 is fully (100%) unrecognized, as such it increases the taxable base of profit tax. Nondeductible amount of input VAT when the acquisition cost exceeds HRK 400,000 has the same tax treatment. The amount of nondeductible input VAT must be recorded on the special accounts due to the special tax treatment of the amortization of that input VAT.

Example 3.3.1. Accounting and tax treatment of the depreciation of a personal vehicle purchased in 2018

In 2018, a company purchased a personal vehicle whose purchase value is HRK 210,120 (vehicle value HRK 205,000 and HRK 5, 120 STMV), and the amount of nondeductible input VAT is HRK 25,625. The annual rate of depreciation is 20%. For February 2018, depreciation is calculated.

Calculation:

- Depreciation of purchase value: $(210,120 \times 20) / 1,200 = \text{HRK } 3,502$
- Unrecognized cost of depreciation: $3,502 \times 50\% = \text{HRK } 1,751$
- Amortization of nondeductible input VAT: $(25,625 \times 20) / 1,200 = \text{HRK } 427.08$

Table 4 Accounting treatment of the depreciation of the personal vehicle purchased in 2018

No.	Description	Account	Value in HRK	
			Debit	Credit
1.	50% depreciation of personal vehicle	4320	1,751	
	50% depreciation of personal vehicle	4321	1,751	
	Amortization of nondeductible input VAT	4323	427.08	
	Accumulated depreciation of personal vehicle	03920		3,502
	Accumulated amortization of 50% input VAT	0395		427.08
	<i>Calculation of the depreciation for February 2018</i>			

As it can be seen from the example 3.3.1., annual amortization rate is the same for the amortization of nondeductible input VAT and for the depreciation of purchase value of personal vehicle.

3.3.2. Fuel and oil costs

Example 3.3.2. Accounting and tax treatment for the fuel and oil costs in Republic of Croatia in 2018

A company received an invoice no. 3547-10 for 40 l of Euro diesel in the amount of HRK 465 (value HRK 372 + 25% input VAT 93). Fuel is for the personal vehicle, use of that personal vehicle is not defined as salary.

Calculation:

- Recognized fuel cost: HRK 186
- Deductible input VAT: HRK 46.5
- Unrecognized fuel cost (50% of total amount of fuel cost): HRK 186
- Nondeductible input VAT (50% of total amount of input VAT): HRK 46.5
- Total amount of unrecognized cost = Unrecognized fuel cost + Nondeductible input VAT = HRK 232.5

Table 5 Accounting treatment of the cost of fuel for the personal vehicle

No.	Description	Account	Value in HRK	
			Debit	Credit
1.	50% fuel cost	4075	186	
	50% fuel cost with input VAT	4076	232.5	
	Input VAT	140012	46.5	
	Accounts Payable	2200		465
	<i>For invoice no. 3547-10</i>			

Accounting and tax treatment for oil costs is the same.

4. Conclusion

A large number of entrepreneurs are acquiring personal vehicles for the needs of the company, so any legal changes related to this subject are very important for entrepreneurs. The recent changes in the VAT Act affect the tax treatment of personal vehicles used for personal transportation. From 2018, entrepreneurs have the right to deduct 50% of input VAT for acquisition of personal vehicles, when their acquisition value is not exceeding HRK 400,000. The same principle also applies to costs associated with the use of personal vehicles such as fuel, maintenance, registration and rental of vehicles (including operating lease). Currently, entrepreneurs have the right to deduct 50% of input VAT on those costs. This cost savings from tax deductions represents the benefit to the company from owning a personal vehicle. This deduction of input VAT comes in two parts: the deduction for acquisition of the personal vehicle and deductions for costs of driving the personal vehicle. When it is about acquisition of personal vehicles and other means of personal transportation that are used for the purpose of training drives, testing vehicles, repair services, taxi service, transportation of deceased persons, lease and further sale, the total amount of input VAT is deductible. In January and February 2018 in the Republic of Croatia there was nearly 40% more registered new personal vehicles than in 2017, so these tax changes had a positive influence on companies. These tax changes in VAT have an impact on not only companies, but also on national GDP, because positive tax changes in VAT increased consumption. In 2018, the taxable base of profit tax increases for 50% of the costs associated with the use of personal vehicles, what is in comparison with previous years higher, so this new change in Profit Tax Act increases the entrepreneurs' tax liabilities. In the previous years the taxable base of profit tax increased for 30% of the costs associated with the use of personal vehicles, so from 2018 the entrepreneurs' profit tax liability will be higher (everything else ceteris paribus). If the use of means of personal transportation is defined as salary, all costs are fully recognized (except the amount of depreciation for acquisition cost when it exceeds HRK 400,000).

REFERENCES

- Gatarić, Lj. (2018). Prodaja novih auta diže BDP i potrošnju. *Večernji list*. Retrieved March 28, 2018, from <https://www.vecernji.hr/auti/prvi-kvartal-ubrzava-prodaja-novih-auta-1234719>
- Markota, Lj., & Vuk, J. (2018). Novosti u obračunu posebnog poreza na motorna vozila u 2018. godini. *Računovodstvo, revizija i financije*, 2(18), 35-40.
- Profit Tax Act (Official Gazette n. 177/04.–115/16.). Retrieved March 16, 2018, from <https://www.zakon.hr/z/99/Zakon-o-porezu-na-dobit>
- Regulation of the Value Added Tax (Official Gazette n. 79/13–128/17). Retrieved March 16, 2018, from: https://www.porezna-uprava.hr/hr_propisi/_layouts/in2.vuk.sp.propisi.intranet/propisi.aspx?id=pro1472

Value Added Tax Act (Official Gazette n. 73/13.–115/16). Retrieved March 16, 2018, from <https://www.zakon.hr/z/186/Zakon-o-porezu-na-dodanu-vrijednost>

Vuk, J. (2018). Nabava prijevoznih sredstava od 1. siječnja 2018. godine. *Računovodstvo, revizija i financije*, 1(18), 19-25.

Vuk, J. (2018). Troškovi uporabe osobnih automobila od 1. siječnja 2018. godine. *Računovodstvo, revizija i financije*, 2(18), 25-31.

Tax - Acknowledged Costs and Tax Deduction for Buying a Vehicle through Reforms

Ana Bratinčević, struc.spec.oec

External associate – Assistant - University Department of Professional Studies Split, Croatia
ana.bratincevic@gmail.com

Perinka Paleško

Student of the University's Department of professional studies Split, Croatia
perinka09@gmail.com

Mia Perica

Student of the University's Department of professional studies Split, Croatia
mia.perical10@gmail.com

Abstract. Some as soon as they start a business, some after a while, but certainly all entrepreneurs think about it: buy or rent a car to save on VAT and profit tax. A car purchased for personal use does not come with any tax benefits. Things change when entrepreneurs buys a vehicle for use in the company's business. The law has predicted that there will always be abuses, and depending on the current government and ministers, they are implementing reforms aimed at preventing the abuse of authority when purchasing expensive cars. From the 01st of January 2018, craftsmen and self-employed workers have a reason more to start new jobs or increase the fleet of existing vehicles by purchasing new vehicles. With the entry into force of the Amendments to the Value Added Tax (VAT) Act, owners of new vehicles in the status of a legal entity are exempt from paying prepayment for the purchase, maintenance and servicing of vehicles as well as a wide range of other tax-acknowledged costs in the amount of 50% of the total cost. In continuation of our work, our aim is to find out what is more profitable to firms: financial or operational leasing, what with tax-acknowledged costs and deduction of prepayment through reforms to date and comparative view of costs and taxes through tax reform years.

Keywords: *tax, reform, vehicles, VAT, entrepreneurs*

1. Introduction

Passenger cars are part of the business property, but entrepreneurs are now much more carefully study the terms and conditions of purchase of the car and the costs of individual models, and in addition to the conditions for funding, and about the costs of use and maintenance, you should take care about tax aspects of acquisition and sales.

The tax change that occurred 01.01.2018. at first glance, is going to benefit all entrepreneurs who have decided to get after that date passenger cars. After a few years again to acquire the right to a deduction of input tax when you purchase the same, but the amount of tax deductible costs will be reduced compared to the past, therefore, the question remains whether the introduction of the non-deductible input tax is good news.

Through this paper we try to get closer to the reader changes occurring in the year 2018, and give an answer to the question of whether the new situation is optimal for business owners, taxpayers, and value added tax through examples to show what is the status of any in the previous tax periods, and that the changes expected in the time that followed.

2. VAT and Income VAT Deduction of Purchase of Vehicle

2.1. Until 31.12.2009.

The purchase price of vehicles at that time was 100% tax-deductible and the taxpayer could deduct the VAT liability for the total amount of tax on car purchase and related costs. However, for the depreciation of personal cars as well as for other car expenses, the taxpayer had to issue an account calculating his own consumption by 30% of the depreciation cost (for the purchase value up to 400,000 HRK or 100% of the depreciation cost exceeding 400,000 HRK) and other costs related to car maintenance. Such a treatment of VAT was more appropriate for taxpayers because it allowed them to refuse the tax prepayment in the earlier period than they had fulfilled their VAT liability and represented a tax credit for a particular type of taxpayer. In the case of the calculation of the salary in kind, it was not necessary to calculate its own consumption at the cost of depreciation or other car costs (fuel, maintenance, etc.) In a nutshell, you could completely deduct the purchase tax when purchasing, and whether you would pay the VAT at 30% of the cost of the car was dependent on whether you were paying a salary in kind or not. If you purchased a car until 31.12.2009. the same was still amortized, the rules of the old VAT Act applied, and if you did not calculate the salary in kind, it was necessary to calculate the VAT at 30% of the depreciation costs. Of course, car costs were treated in accordance with the Act in force when they were incurred, so that the new VAT Act was applied on the expense of 4th of August 2012.

2.2. From 31.12.2009. till 29.02.2012.

In that period, the taxpayer could not refuse 30% of the prepayment charged for delivering, importing or renting personal cars and other means of personal transportation and delivering goods, services rendered or importing goods in connection with their purchase, lease or use, irrespective of whether he has paid the salary in kind or not. We notice the difference compared to the previous period because the deduction of VAT (deduction of tax liability) is reduced at present rather than through the entire lifetime of a personal car. In short, "all problems" with the deduction of overpayment are solved at the start, where no deduction of 30% of the tax on the purchase of personal cars and associated maintenance costs is allowed.

2.3. From 01.03.2012.

Legislators have introduced new, more stringent and unpopular laws on the treatment of personal cars, and according to Article 20, paragraph 11, item a) of the Value Added Tax Act, the taxpayer cannot refuse the subscription for the purchase and rental of vessels intended for recreation, aircraft, personal cars and other means of personal transportation, including the purchase of all goods and services in connection with those goods. Article 20, paragraph 12 of the Value Added Tax Act does not apply to personal cars and other personal transport equipment used for driver training, vehicle testing, service, transport of passengers and goods, transport dead, rented or purchased for resale. The Value Added Tax Regulation more specifically defines the exemptions from the deduction limit for the prepayment, and states as follows:

"(15) The limit on the deduction of overpayment referred to in Article 20 (11) (a) of the Law shall not apply to personal car and other personal transport equipment used for driver training, vehicle testing, service, taxi service, activity of transport of passengers and goods, transportation of deaths, renting or procuring for further sale. These vehicles must be used

solely for the performance of a registered activity or be specifically marked and adapted for carrying out that activity. "¹

2.4. From 01.01.2018.

Taxpayers in the purchase of a personal car can deduct 50% of the tax payable (compared to the present 0%) and tax will be recognized 50% of all expenses incurred in connection with the use of personal vehicles (compared to the current 70%) if based on usage personal vehicles do not determine pay in kind.



Graph1. View the deduction of input VAT by year

The graph tends to show how often our country's tax policy is changing, and how over a decade long period in the Republic of Croatia there has been a multiplication of tax treatment when purchasing a vehicle from a taxpayer.

The table below shows an example of different purchase prices through tax periods. From the table, it can be seen what all the changes were made and when it was most beneficial for the entrepreneur to invest in the purchase of new vehicles.

Table1. An example of the procurement of vehicles by the significant tax periods

AMOUNT	To 01.03.2012.	From 01.03.2012. to 31.12.2017.	From 01.01.2018.
purchase value 100.000,00kn (without VAT)	VAT = 25.000,00kn 70% input vat deduction (25.000,00kn * 70% = 17.500,00kn) cost for entrepreneur = 125.000,00kn - 17.500,00kn = 107.500,00kn	VAT = 25.000,00kn 0% input vat deduction cost for entrepreneur = 125.000,00kn	VAT = 25.000,00kn 50% input vat deduction (25.000,00kn * 50% = 12.500,00kn) cost for entrepreneur = 125.000,00kn - 12.500,00kn = 112.500,00kn
purchase value 300.000,00kn (without VAT)	VAT = 75.000,00kn 70% input vat deduction (75.000,00kn * 70% = 52.500,00kn) cost for entrepreneur = 375.000,00kn - 52.500,00kn = 322.500,00kn	VAT = 75.000,00kn 0% input vat deduction cost for entrepreneur = 375.000,00kn	VAT = 75.000,00kn 50% input vat deduction (75.000,00kn * 50% = 37.500,00kn) cost for entrepreneur = 375.000,00kn - 37.500,00kn = 337.500,00kn
purchase value 500.000,00kn (without VAT)	VAT = 80.000,00kn 70% input vat deduction (80.000,00kn * 70% = 56.000,00kn) cost for entrepreneur = 625.000,00kn - 56.000,00kn = 569.000,00kn **input vat can only decline to the value of 400.000,00kn ,so the vat contained in that value is 80.000,00kn, tax-acknowledged is 70%	VAT = 125.000,00kn 0% input vat deduction cost for entrepreneur = 625.000,00kn	VAT = 80.000,00kn 50% input vat deduction (80.000,00kn * 50% = 40.000,00kn) cost for entrepreneur = 625.000,00kn - 40.000,00kn = 585.000,00kn **input vat can only decline to the value of 400.000,00kn ,so the vat contained in that value is 80.000,00kn, tax-acknowledged is 50%

1 https://www.rrif.hr/Pravo_na_odbitak_PDV_a_pri_nabavi_teretnog_vozila-1875-misljenje.html
(03.04.2018.)

3. Calculation of VAT-by Selling Vehicles

In this section we will describe what happens when a vehicle is sold by an entrepreneur in his business. The article does not deal with the taxation of vehicle sales by car dealers.

When selling a car we have several possible situations:

1. Sale of vehicles purchased after 01.01.2018. will be subject to VAT of 25%. Namely, the acquisition of the right to deduct input tax is accompanied by the obligation to invoice VAT when selling a vehicle. The same applies to vehicles purchased before 01.01.2018, if the vehicle is purchased from a seller other than the VAT system. Mostly, they are used cars purchased from citizens or entrepreneurs who are not in the VAT system.
2. Sale of vehicles after 01.01.2018. were exempted from VAT if they were purchased in the period from 01.03.2012 - 31.12.2017, when (and if so) we were not able to use the overpayment for the purchase of personal vehicles, i.e. if we purchased the car from the taxpayer. The invoice is quoted as follows: Free VAT according to Art. 27th Transitional and Final Provisions of the Law on VAT. Sales of vehicles in this case are exempt from motor vehicle sales tax.
3. The sale of vehicles is exempt from VAT and if the entrepreneur carries out the activity of exempt VAT on the basis of Art. 39. St. 1 and Art. 40. St. 1. of the Act, and when purchasing the vehicle was not entitled to deduction of the tax deduction. The invoice then states that it is an exemption on the basis of Art. 40. St. 2 of the Law on VAT.

This is the procurement of vehicles for the performance of certain activities that are exempt from VAT (for example: medical services, insurance services, financial services, rental of apartments, etc.) when it is prohibited to deduct input tax when procuring them

At the beginning of 2018, the sale of personal cars will most often be exempt from VAT, as long as entrepreneurs sell personal cars purchased during the period 01.03.2012 - 31.12.2017. When they start selling vehicles purchased after 01.01.2018 most often sales will be taxable at 25%.

If an entrepreneur uses a vehicle in an operational leasing, then there is no sale of the vehicle at the end of its useful life, so there is no tax on sales of VAT. In this case, the VAT will lease the house to the next user.

In the following table, we will show an example of a sale of a vehicle depending on the time of their purchase. From the table, you can see what all the changes were made and when it was most beneficial for an entrepreneur to sell a vehicle. We must not ignore the present situation and the table shows what the situation is today.

Table2. Example the sale of vehicles depending on the time of purchase

DESCRIPTION	Sales of vehicles purchased after 01.01.2018.	Sales of vehicles purchased from 01.03.2012. to 31.12.2017.	Sales of vehicles from entrepreneurs whose activity is exempt from VAT
vehicle sales value 125.000,00kn (s PDV-om)	VAT liability = 25.000,00kn profit for entrepreneur = 100.000,00kn cost for entrepreneur = 25.000,00kn	VAT liability =0,00kn profit for entrepreneur = 125.000,00kn cost for entrepreneur = 0,00kn	VAT liability =0,00kn profit for entrepreneur = 125.000,00kn cost for entrepreneur = 0,00kn

4. Vehicle Expenses and Income VAT

Until 31/12/2017. the costs of personal cars are up to 70% of the actual costs incurred. These costs include costs such as depreciation, fuel, car maintenance, operating leasing and rental. If we take for example that these costs in the total annual amount of HRK 100,000 they decrease the profit tax base by HRK 70,000, while the remaining HRK 30,000 is calculated on the profit tax. Thus, if the pre-tax profit amounts to HRK 200,000, the profit tax will be calculated at the base of 230,000 kn (200,000 + 30,000).

From 01.01.2018. taxes are recognized for personal vehicle costs but only 50%. In the abovementioned example, when we calculated the profit tax for 2018, we would have taxed as a base with HRK 250,000 (200,000 + 50,000) resulting in a more unfavourable position for the entrepreneur than in previous years because he would have a new tax obligation ago. In the change that follows from the beginning of this year, it should be emphasized that in the calculation of wages in kind, all costs incurred with a certain vehicle are fully tax deductible, while in vehicles with a value greater than HRK 400,000 tax is recognized 50% of the cost up to the purchase value of HRK 400,000, and all the above is classified as unrecognized tax, which is why the situation is more common in practice to get more expensive cars to rent.

5. Conclusion

If the legislator does not give much room for tax planning in obtaining passenger cars, a careful analysis of the specific cost savings, however, can be achieved. Through the work we gave an overview of procurement and sales, and the costs and the calculation of wages in kind through the individual tax periods. The position of the car purchase TAX will depend on the tax status of, and the purpose of use of personal vehicle (transports of employees and members of management or perform certain professional activities).

The introduction of non-deductible input tax 50% will reduce the costs of the use of personal cars at entrepreneurs who by the nature of the work they have significant costs of this type. If the employer gives the car park at the use of their employees in their free time, then the calculation of wages in kind can be painful in the tax sense. Negative change occurred at the corporate tax, and so from 01.01.2018. we can only acknowledge 50% of the cost of a vehicle (depreciation, fuel, maintenance, operational leasing, rent).

Our advice is certainly to think about before purchasing business strategy in the way of the purchase of the vehicle fleet, ages and conditions and ways of solving the old vehicles. We recommend consulting with your accountant when planning the purchase of passenger cars.

REFERENCES

1. Novosti u Zakonu o PDV-u od 1. siječnja 2018. godine rrif - 12.2017, str. 18
2. Prodaja osobnih automobila korištenih za osobni prijevoz, rrif - 10.2017, str. 28
3. Računovodstvo financijskog leasinga osobnih automobila rrif - 4.2018, str. 21
4. Računovodstveni i porezni položaj nabave i troškova osobnih automobila od 1. ožujka 2012. rrif - 4.2012, str. 15
5. Troškovi uporabe osobnih automobila od 1. siječnja 2018. godine rrif - 2.2018, str. 25
6. <https://burza.com.hr/portal/osobni-automobili-u-2018-godini/12166>
7. <https://lider.media/znanja/poduzetnicima-50-posto-nizi-pdv-za-kupnju-osobnog-automobila/>
8. https://www.porezna-uprava.hr/HR_publicacije/Lists/misljenje33/Display.aspx?id=19589
9. https://www.rrif.hr/Pravo_na_odbitak_PDV_a_pri_nabavi_teretnog_vozila-1875misljenje.html

Limitations in Cash Transaction for Business Subjects

Jelena Vidović

University Department of Professional Studies, Split, Croatia

jvidovic@oss.unist.hr

Abstract. Enterprises in Croatia encounter various restrictions when it comes to performing payments to their employees and other business subjects in cash. Restriction is also introduced in cash collections. Enterprises can receive only limited value of cash per transaction and are allowed to keep prescribed amount of cash in their counter. Most rigorous limitation in cash operation is prescribed for enterprises which are going to process of enforcement on money funds. Besides kuna (HRK), payment transactions in foreign currency are also subject of various limitations, these limitations primary come from fact that foreign currency is not a legal mean of payment in Republic of Croatia. In this paper, various limitations in cash collections and payments are discussed.

Key words: *cash, fiscalization, foreign currency, payment transactions, money laundering and terrorist financing*

1. Introduction

One of the most appealing characteristics of cash is anonymity. Cash payer does not leave trace in the form of his/her name and personal data what happens in case of payments that are result of cashless payment such as credit card payments or payments via bank transfer. On the other hand, person that receives cash, acquires funds that cannot be seen by tax authorities. The use of large cash payments is highly vulnerable to money laundering, terrorist financing and tax evasion practices. Different laws in Croatia prescribe restrictions in form of maximum amount of cash that can be used for payment. Business subject that collect their receivables in cash have to make sure that their invoices collected in cash are recorded and certified by tax administration information system. Cash collected in cashier must be placed on company's bank account.

Paper is organized following various regulations that prescribe limitations in cash transactions, regulation are as follows; Income Tax Act, Fiscalization Act, Foreign Exchange Act, Law on Execution of Enforcement on Money funds. In the final part of the paper main conclusions are drawn.

2. Income Tax Act

The state administration and judicial authorities and other state bodies, bodies and services of local and regional self-government units, institutions, non-profit organizations, entrepreneurs - legal and natural persons, shall make payments of receipts that are deemed to be income to payers of income tax and payments of receipts that are not deemed to be income, i.e. on which no income tax is paid, to natural persons, into their transfer account in a bank and exceptionally into their current account, pursuant to special regulations, and in cash in the prescribed manner.¹ Ordinance on Income Tax prescribes in detail which payments to natural persons can be paid in cash and which on transfer or current account.

¹ Income Tax Act, "Official Gazette" no. 115/16, article 86

Generally speaking, only receipts of natural persons that are not subject of Income Tax can be paid in cash. Receipts that can be paid in cash to natural persons are²;

1. Pensions
2. Receipts of non-residents for the performance of art, artistic, entertainment, sports, literary or visual arts activities and activities in connection with the press, radio and television and entertainment shows.
3. Receipts from seasonal jobs (seasonal jobs in agriculture, picking and collecting of fruits and plants, jobs in selling of agricultural products, forest products, refreshments, ice-cream, daily press, tickets and similar, jobs relating enumeration, polling, meter reading and similar, amateur participation in the work of cultural-artistic organizations and similar works). Here the condition that these receipts when paid by single payer should not exceed 15,000 kuna per year needs to be met.
4. Receipts are not to be deemed income³: this wide category consists of various payments that are not subject of income tax, some of them are (family pensions, state awards, supports for care of disabled war veterans and members of the families of the deceased, imprisoned or missing Croatian Homeland War veterans, welfare payment, child benefits and monetary receipts for equipment for a new-born given by local and regional self-government units receipts for disabled persons, aid granted due to destruction of or damage to property, inheritance and gifts, receipts from the alienation of personal assets, indemnities unrelated to economic activity, receipts acquired in prize contests or competitions, cash allowances with pension paid to pensioners by local and regional self-government units, assistance and support which non-profit organizations pay to their members, ad hoc aid paid or given to children in case of death of a parent, receipts acquired on the basis of life insurance contracts and voluntary pension insurance. If these receipts are connected with acquiring income, they are deemed taxable income and cannot be paid in cash.
5. Receipts on which Income tax shall not be applied on.⁴ Income tax shall not be paid on: compensation for wages due to temporary incapacity for work, paid at the expense of the Croatian Health Insurance Fund, indemnities for consequences of accidents at the workplace according to a decision of a court or a settlement in the course of a court procedure, if the compensation is defined as a single amount, awards to pupils during practical work and apprenticeships up to the prescribed amount, awards to pupils and students won in competitions within the framework of the educational system and in organized school and university competitions, compensation in money during the time of unemployment, financial assistance and compensation of travel costs paid by the Croatian Employment Service according to employment regulations.

Following receipts of natural persons can only be paid on transfer (business) account in a bank:

- receipts of pupils and students in full-time study for work via pupil and student associations, according to special regulations,
- scholarships of pupils and students for regular education, up to the total prescribed amount
- sports scholarships, awards for achieved sport results and compensation paid to sport amateurs according to special regulations, up to the prescribed amount,
- receipts which natural persons have acquired in terms of donations of legal and natural persons, for health purposes (surgery, treatment, procurement of medicines

² Ordinance on Income Tax, "Official Gazette" no. 10/17, 128/17, article 92

³ Income Tax Act, "op. cit.", article 8

⁴ Ibidem, article 9

and orthopedic aids) the payment of which is not covered by the basic, supplementary, additional or private health insurance or at the burden of the funds of the natural person, under the condition that the donation, i.e. payment of the created expenses was made for that purpose to the transfer account of the recipient of the donation or a health institution based on authentic documents.⁵

These receipts are not subject to income tax when paid up to prescribed amount. If these receipt are paid in amounts above maximum amounts prescribed by Law the tax treatment of these receipts changes.

Following receipts of natural persons can be paid on current account in a bank⁶:

1. Receipts of employee arising from employment (salaries)⁷: a salary, receipts based on fees, aids, awards and other, which the employer pays out or provides to employees above the prescribed amounts⁸, remuneration to the member of the management board and/or director who as an employee in an employment relationship performs certain tasks for the employer pursuant to the act regulating work relations, insurance premiums which employers pay for their workers based on life insurance, supplementary, additional and private health insurance, voluntary pension insurance above the prescribed amount and insurance of their assets, any other receipts which the employer pays out or provides to the employee related to employment and the relationship between the employer and the employee regardless of the form and the manner of payment or the basis for payment, unless this Act regulates otherwise, entrepreneurial salary included in the expenses when determining profit tax, pensions, receipts in kind shall include the use of buildings, means of transport, favourable interest when approving loans, awarding or optionally purchasing own shares at favourable terms and other benefits which employers and payers of the receipt, i.e. salary, from give to their workers and natural persons. A receipt based on more favourable interest shall include a difference between the lower contracted rate and the interest rate of 3% per year, except for interest on loans which are provided or subsidised from the budget, but not to the management employees. Other income.⁹
2. Income from capital:¹⁰receipts based on interest, withdrawals of assets and the utilisation of services at the expense of current-period profits, capital gains, shares in profits realised by award of or optional purchase of own shares, dividends and shares in profit according to share in capital, which were realised in a taxation period shall be deemed income from capital.
3. Income from insurance¹¹

⁵ Ordinance on income Tax, op. cit., article, 92, paragraph 3, point 4

⁶ Ibidem, article 92, paragraph 2

⁷ Income Tax Act, "Official Gazette" no. 115/16, article 21

⁸ fees, aids, awards and other, which the employer pays out or provides to employees up to the prescribed amounts can be paid in cash

⁹ Income Tax Act, "Official Gazette" no. 115/16, article 39. The other income shall be generated based on the receipts which are not deemed receipts determined on the basis of employment; receipts arising from activities of the members of assemblies and supervisory committees of companies, management boards, management councils and other relevant bodies of other legal persons, members of committees and boards of these bodies and lay judges who do not have the capacity of a court official, royalties, receipts based on the activities of athletes, receipts based on activities of travelling salespersons, agents, canvassers, sports referees and delegates, interpreters, translators, tourist workers, consultants, court experts and other similar activities, receipts in kind (allready mentoioned under 1), awards to pupils, receipts of pupils and students in full-time study for work via pupil and student associations, scholarships to pupils and students for regular education at secondary schools, sports scholarships, awards for sports achievements and remuneration to amateur athletes above the prescribed amount.

¹⁰ Income Tax Act, op. cit., article 64

¹¹ Ibidem, article 72

4. Receipts not be deemed income (these receipts are given under cash payments, point 4)
5. Receipts on which Income tax shall not be applied (these receipts are given under cash payments, point 5)
6. Remuneration for election-related work whose conduction is prescribed by a special law, if paid up to 1,600.00 kuna per election.
7. Income based on the alienation of special types of property.¹²Waste in accordance with special regulations shall be deemed a special type of property. Return packaging or waste collected within organized actions and activities for the purpose of environmental protection shall not be deemed waste.

3. Fiscalization Act

Taxpayers who charge cash for the delivery of goods or performance of services are obliged to state their turnover by means of payment devices or in some other appropriate way¹³. Fiscalization Act governs the procedure of fiscalization of cash transactions. Fiscalization of cash transactions means a set of measures implemented by fiscalization subjects in order to allow for efficient oversight of generated cash turnover. Fiscalization Act also regulates the payment in cash between fiscalization subjects. Cash transaction means the payment for delivered goods or services using banknotes or coins which are considered to be legal tender, cards, cheques or other similar means of payment, except payments via transaction accounts.

Fiscalization subjects are:

- A natural person who is income tax payer for self-employed activities,
- A legal and natural person considered as profit tax payer.

Fiscalization Act also regulates the payment in cash between fiscalization subjects. The fiscalization subject may pay another fiscalization subject in cash for the acquisition of goods and services up to the amount of HRK 5,000.00 per receipt¹⁴.

The fiscalization subject may pay citizens in cash, except for purposes which are, pursuant to Income Tax provisions paid via citizen's accounts.

The fiscalization subject is obliged to deposit cash in excess of a certain cash-on-hand maximum to its bank account immediately, or at the latest, the following business day.

Pursuant to the provisions of the Small Business Development Promotion Act, size of the fiscalization subject is the criterion for setting up cash-on-hand maximum amounts. Based on it, the fiscalization subject can determine following amounts of the cash-on-hand maximum¹⁵:

- for micro enterprises and natural persons: HRK 10,000.00,
- for small enterprises: HRK 30,000.00
- for medium enterprises: HRK 50,000.00
- fiscalization subjects that exceed the limits of a small enterprises as set out in the Small Business Development Promotion Act, may define a cash-on-hand maximum at HRK 100,000.00,
- fiscalization subjects conducting money exchange business, may define a cash-on-hand maximum at HRK 100,000.00.

¹² Ibidem, article 59

¹³ General Tax Act, "Official Gazette" No. 115/16, article 62, paragraph 4

¹⁴ Fiscalization Act, "Official Gazette" no. 133/12, 115/16, article 28, paragraph 3

¹⁵ Fiscalization Act, op. cit., article 29, paragraph 2

4. Foreign Exchange Act

Foreign Exchange Act regulates amount of cash that can be carried entering or leaving the European Union. Natural persons entering or leaving the European Union through the Republic of Croatia have to declare to Ministry of Finance – Customs Administration amount of 10,000.00 EUR or more¹⁶. According to Foreign Exchange Act payments in foreign currency are primarily reserved for transaction between residents and non- residents, mean of payment established by the Law in Republic of Croatia is Kuna – HRK.

Decision about the Method Residents Withdraw and Deposit Foreign Cash and Cheques On Account Opened in the Bank¹⁷ prescribes payment transactions in foreign currency in more detail. Residents can have foreign cash and checks in foreign currency for official travel expenses for travel abroad. Residents that provide services in international goods and passenger traffic and providing emergency medical assistance may have cash and cash checks in their cashier for payment of costs related to means of transport and goods on an official travel abroad. The average daily cash balance and checks in the cashier in these situations can be up to EUR 1,500 in the quarter.

Residents who are registered for the provision of catering and tourist services (services of overnight stays, pensions, half-board and transport services), for providing services of airports, seaports, marinas, docks and freeways, and for the supply of foreign aircraft and ships with fuel and lubricants and other consumables, for the sale of goods from a customs warehouse of type "D" and for the sale of transport tickets for passengers and goods, can have cash and cash checks in order to return the rest of the money to the buyer. The average daily balance of cash and checks in the cashier in one quarter can be up to 3.000,00 EUR.

When paying invoice in cash to nonresident, residents (natural and legal persons) have to withdraw cash from their bank account. When withdrawing cash from a bank account they are obliged to submit a contract, invoice or pre – calculation. Residents have to submit to the bank evidence that such cash and/or checks are used for payment or return them to their bank account within 60 days from the day of withdrawal of cash or checks.

When collecting receivables in foreign cash, residents (natural and legal persons) have to deposit cash on their bank account within three days from collection. Limitation of the amount that can be collected in cash or paid in cash is prescribed for residents (natural and legal persons) who provide services or trade goods by Money Laundering and Terrorist Financing Prevention Act.¹⁸ A legal or natural person performing a registered activity in the Republic of Croatia shall not be liable to pay or make cash payment in the amount of 75,000.00 HRK and above, whether the transaction is carried out in a single operation or in several operations which appear to be linked.

5. Law on Execution of Enforcement on Money funds

Business subject that is going through Enforcement on Money funds should not pay its payables in cash, all the cash collected in cashier must deposit on bank account, and cannot dispose with time - restricted deposits.

¹⁶ Foreign Exchange op. cit., article 40, paragraph 1

¹⁷ Decision about the Method Residents Withdraw and Deposit Foreign Cash and Cheques On Account Opened in the Bank, "Official Gazette" no. 48/2010

¹⁸ Money Laundering And Terrorist Financing Prevention Act, "Official Gazette" 108/17, article 55, paragraph 1.

6. Conclusions

Various Laws prescribe restrictions in cash payments. Income Tax regulates that salaries and other income, as well as other receipts of natural persons which are taxable according Income Tax Act must be paid on transfer or current account. Natural persons can pay their obligations to legal persons in cash but legal persons cannot receive such payments according to restrictions prescribed by Money Laundering and Terrorist Financing Prevention Act. Legal persons can pay invoices in cash in mutual everyday transactions but this payments are restricted by Fiscalization Act prescribing that fiscalization subject may pay another fiscalization subject in cash only up to the amount of HRK 5,000.00 per receipt. Business subject that is going through Enforcement on Money funds should not pay its payables in cash, all the cash collected in cashier must deposit on bank account, and cannot dispose with time - restricted deposits. This regulation goes in favour of preserving a legal interest of creditors which have initialized process of forced collection on Money funds.

REFERENCES

Decision about the Method Residents Withdraw and Deposit Foreign Cash and Cheques On Account Opened in the Bank, "Official Gazette" no. 48/2010
Fiscalization Act, "Official Gazette" no. 133/12, 115/16
Fiscalization Act, "Official Gazette" no. 133/12, 115/16
Foreign Exchange Act, Official Gazette 96/03, 140/05, 132/06, 150/08, 92/09, 133/09, 153/09, 145/10, 76/13
General Tax Act, "Official Gazette" No. 115/16,
Income Tax Act, "Official Gazette" no. 115/16
Money Laundering And Terrorist Financing Prevention Act, "Official Gazette" 108/17
Ordinance on income Tax, "Official Gazette" no. 10/17, 128/17

Implementation of balanced scorecard model in a manufacturing company

Mario Dadić

University of Split, Department for professional studies

Kopilica 5, 21000 Split, Croatia

mdadic@oss.unist.hr

Ante Radas

International Consulting d.o.o.

Kliški put 3, 21210 Solin, Croatia

radasante5@gmail.com

Jelena Odža Radas

International Consulting d.o.o.

Kliški put 3, 21 210 Solin, Croatia

jelena.odza@gmail.com

Abstract. The underlying problem to be set up as the basis for writing this paper is reporting for the manager's internal needs based on the BSC model. Companies, if they want to get a bank loan, a letter of credit, a framework credit, etc., are often subject to strict banking rules and procedures. Banks often base their judgment of a specific placement approval on financial indicators. Such a form of analysis shows exactly the events of the past period; however, it does not show what the current state of the company is and what is to be expected in the future. That is precisely why the BSC model is needed to provide each department and each employee with an indicator of their performance. Only in this way can the bad performances be corrected and impacted on in order to lead the company to its set goals. The Balanced Scorecard model starts from defining the vision, mission and goals of the company. In accordance with these postulates, a strategy that leads the company to its set goals is defined. The advantage of the BSC model is in conveying visions, missions and goals to all employees in the company. Quality information system steers management in the direction of real problems. Partial problem monitoring often leads management into making poor decisions, which, in some situations, are unnecessary.

Key words: Balanced Scorecard, financial indicators, information system

1. Introduction

The underlying problem to be set up as the basis for writing this paper is reporting for the internal needs of the managers based on the BSC model.

The introduction of the BSC model means changing the thinking philosophy of a company. The BSC model was first presented and introduced by Robert Kaplan and David Norton in 1992. The main feature of this model is the introduction of reporting and communication models within the company with the aim of achieving better performance.

The problem that will be covered in the paper is the introduction of a new reporting system for which we will attempt to prove that it is better than the existing reporting system in the example of the company X.

In fact, this work will, first and foremost, look at an enterprise that is in crisis, the existing information system and its effects on the financial result of the introduction of the new system.

Companies, if they want to get a bank loan, a letter of credit, a framework credit, etc., are often subject to strict banking rules and procedures. Banks often base their judgment of a specific placement approval on financial indicators. Such a form of analysis shows exactly the events of the past period; however, it does not show what the current state of the company is and what is to be expected in the future. That is precisely why the BSC model is needed to provide each department and each employee with an indicator of their performance. Only in this way can the bad performances be corrected and impacted on in order to lead the company to its set goals.

The introduction of an up-to-date information system that provides timely information to the management significantly facilitates decision making. For example, if management makes decisions only based on the accounting data, it can make a decision to cut costs. However, cost cutting at the same time may also mean invasion into product quality. Lowering the quality in short-term means approaching a point of breaking even, but in long-term a loss of market. Problem of a company can be on the opposite side, that of revenue. Namely, sales do not respond promptly enough to queries, partners lose business confidence, etc.

A quality information system focuses the management in the direction of real problems. Casual monitoring of problems often leads management into a position to make decisions that are not good and that are in some cases unnecessary.

The Balanced Scorecard model starts with defining the vision, mission and goals of the company. According to these settings, a strategy is defined that leads the company towards the set goals. The advantage of the BSC model is in translating visions, missions and goals to all employees in the company. Every employee is an essential factor in achieving corporate goals. The BSC model assigns each employee a performance indicator that measures its effectiveness.

The success of introducing the BSC model depends on many factors. Here, above all, it is about the age of the company, the power of the unions, the quality of the product, etc. Because of all the different factors in each company, implementation of the BSC model is a challenge for every manager. Harmonizing a customer's perspective with internal processes, learning and growth, and the financial aspect of the enterprise, and directing these processes towards the vision, mission, and goals of the company is a real challenge for every manager.

2. BSC Modern Method of Reporting for Managers

Balanced Scorecard, as a modern reporting method, was born back in 1992 by publishing the article *Measuring and Managing Performance* by David Norton and Robert Kaplan issued in the *Harvard Business Review* (Mavrillac et al,1997) The article was created based on the performance measurement of 12 companies throughout a business year. The basic idea was to find a model that will not only measure business results based on financial results. Namely, if the business is viewed only on the basis of financial indicators, it is constantly observed what

has been done in the past period while the present and the future are not observed. Based on this, the concept of the BSC model has been developed, which seeks to direct the company's performance towards the planned goals.

2.1 History of BSC

Name Balanced Scorecard draws its roots from boxing. Specifically, during the boxing match, the referee notes punches on the so-called scorecard. If there is no knockout, decision is made on the basis of points recorded on the scorecard (Jacobson,2007) The analogy of business management with boxing is quite big. Measurement of business process efficiency must be clearly expressed like boxing punches in the match. The reason is very simple: every business process must be measurable. Just as the boxer's only goal is winning, so the company's first and foremost goal is to increase the shareholder's wealth, i.e. a positive financial result.

The first version of the Balanced Scorecard is still current and applicable. Companies that measure the efficiency of internal processes and motivate employees to learn and grow, nurture long-term and partner relationships with their customers, which ultimately reflects on the financial results.

The model of the early Balanced Scorecard emphasizes the interdependence of all four perspectives. All later models that were created based on the Balanced Scorecard also emphasize the connection of all four perspectives. Successful companies have clearly defined activity workflow from order receipt, production to invoicing. Each activity has a process owner, and thus can measure the effectiveness of each process.

2.2. Basic components of the BSC model

Balanced Scorecard model consists of four components:

- Customer perspectives
- Perspectives of learning and employee growth
- Perspectives of internal processes and
- Financial perspectives.

Establishing control over the four mentioned perspectives means that the company is actively on the market and recognized by customers as a partner, that employees are satisfied, i.e. that there is no rot, and that the processes are quick and efficient. In the end, such business is reflected through the creation of wealth for the owners and securing return on the invested capital.

In order to establish an effective Balanced Scorecard model, first it is necessary to define the company's vision to know in what direction the company should go, mission to know why the company exists, goals to know what the company wants to achieve and the strategy to know how company will reach the set goals.

Only when the vision, mission, values, goals and business strategies are defined, the Balanced Scorecard model can be constructed across four perspectives.

2.2.1. Customer perspective

The traditional organizational structure focuses on the focus of production, i.e. consumers are consuming what is produced. Due to globalization processes and increased competition between manufacturers, modern organizational structure of the center of interest is placed on the client, i.e. the products are what the client wants.

Traditional Organization vs. Customer-Oriented Organization

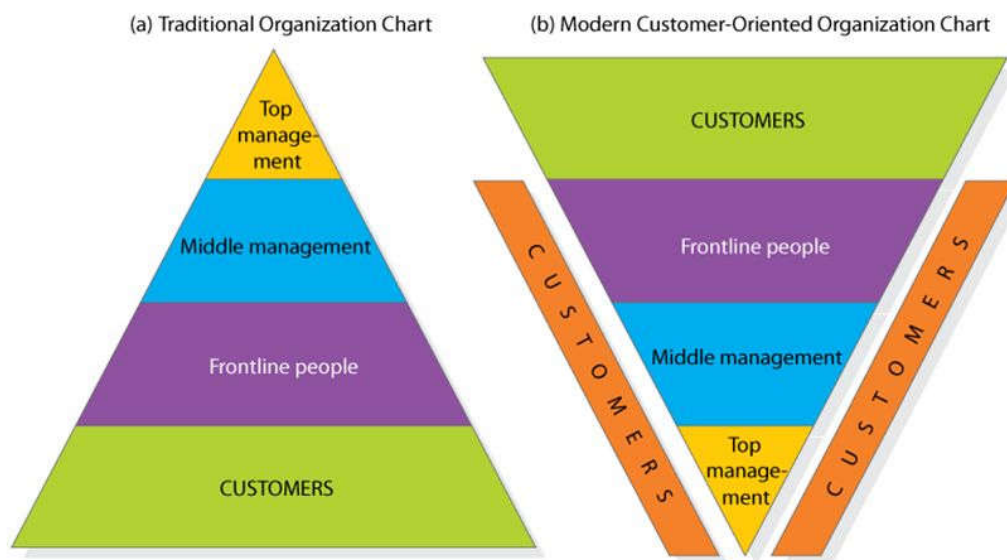


Figure 1: Traditional organization versus modern customer focused organization (Retrieved from Kotler P., Keller Kevin L., Managing Marketing, 12th Edition p.140)

By placing the client in a focus of interest, the company adjusts internal processes according to customer needs. The aim of the clients is to get a quality product and to meet the needs for which they are buying the product, i.e. to get the best ratio of invested and useful value of the product. The second objective of the client is to obtain high-quality after-sales service (warranty period, maintenance services, availability for complaints and questions about product functionality are some of the qualities that can enable the manufacturer to get the customer and create a partnership relationship).

2.2.2. Perspective of learning and employee growth

Nowadays, the availability of different sources of funding, almost all companies can achieve the same technological conditions of production and sales. However, market leaders often differ from their competitors in terms of intellectual capital.

The emphasis on intellectual capital has been frequent lately due to a simple reason that even the best set goals, visions and strategy will not be implemented unless there is a human potential that is ready to respond to the set challenges.

In the theory of human resources management, four processes are identified that are necessary for the enterprise to develop the appropriate human potential that is ready to respond to the set goals (Armstrong, 2006)

- **Selection** - choosing the right people for the job.
- **Goals** - assigning performance measures to each individual employee (performance management).
- **Rewards** - employees must be rewarded for quality work.
- **Development** - company must ensure the development of employees through education, seminars and other professional training.

In order for these four processes to be successful, the company should first and foremost have high-quality systematized jobs with precisely described tasks that an individual employee should perform. The selection of employees should be based on the competences and the psychological profile needed to perform duties stipulated by the job.

Each employee should be assigned the goals to be met in order for the company to simultaneously attain the annual goals.

In order to motivate employees to achieve goals, there must be a reward system for the goals achieved. Well thought-out reward system, which will provide a motivating salary and other benefits, achieves loyalty and commitment to the company.

In addition to determining goals and giving prizes, the company must also ensure personal development for employees. By developing competencies and career planning, apart from financial challenges, personal satisfaction is achieved, which also strengthens commitment and loyalty to the company. Only loyal and satisfied employees can work and lead the company according to the set goals.

In addition to the four mentioned processes, all employees must share the same value, vision and mission of the company. Perspectives on learning and growth of employees should be seen through several measures that will encompass operational excellence, leadership development and understanding of all processes in the company by employees. Also, employees must readily accept new technologies and acquire new knowledge as well as meet set goals (Kaplan et Norton, 2000)

2.2.3 Perspective of internal processes

Customer satisfaction is the ultimate goal of all modernly organized companies. However, in order to achieve customer satisfaction, company must have flawlessly organized internal processes. Measures to construct scorecards of internal processes that are necessary to achieve

customer satisfaction are the duration of the production cycle, employee skills, productivity, etc (Kaplan et Norton, 1992). Some other authors, such as Slack(2006), mention the most important operational processes: product quality, speed, adaptability and flexibility to customers (Collier,2003)

A company that wants to add value to its customers continually needs to identify processes that are key to achieving customer satisfaction. Also, the management of a company must see which processes are key, i.e. which processes are not good. Processes that are not good should be improved or removed and add new ones to increase efficiency.

The most important process within the manufacturing company is organization of production and product preparation for the market. Companies that have engineering, must in time draft project documentation and "put" the project into production. If it is late in the design of the project documentation, the whole project will be late, resulting in delays in delivery and additional costs for the company.

2.2.4. Financial perspective

The financial perspective measures the performance of each department and every employee and ultimately the entire company. Through the financial statements, owners see the picture of complete business performance and management performance by the managers. In addition to informing the owner, financial perspective also serves to control all other processes in the company.

The company's financial perspective needs to be organized in a way to have an organized system of reporting to the owners and the top management reporting system. The reporting system for the owners must be designed to present three basic financial statements to the owners:

- Balance sheet,
- Profit and loss account,
- Cash flow statement.

Financial statements in most countries should be compiled in accordance with International Financial Reporting Standards (IFRS) and provide fair and accurate information. IASB in its conceptual framework emphasizes three objectives of financial reporting(IASB,2005)

- Providing information on a financial position that includes property, assets, liquidity and solvency;
- Providing business performance information indicating the ability to make profits by using the invested resources;
- Providing cash flow information that can be used to predict cash flows and their use.

In addition to the basic financial statements, the owners or their representatives who oversee the operation of the management board through the supervisory board of the company, management, i.e. financial functions, can also supply an analysis of financial statements by comparing the size of the balance sheet, profit and loss and cash flow through horizontal and

vertical analysis and indicators of economy, profitability and investment. Based on this, the Supervisory Board assesses whether the management is managing the company in a good way, i.e. whether the company's strategy is good and whether good management meets the set goals. Reports for owners' needs are most often created monthly, quarterly, semi-annually and annually.

2.3. Research on the success of applying the BSC model in practice

The BSC model has in practice been tried in manufacturing and service companies, public institutions such as universities, hospitals, institutes and other departments. Each BSC model is specific and depends on the activity the company is engaged in; however, common to all models is to identify key processes in the company, determine performance measures for each process, and thus direct the company to specific goals.

This chapter will describe examples of implementation and introduction of BSC models to manufacturing and service companies and public institutions. In the second part of the chapter, we will compare research on the BSC model in different countries and how many models can come to life. Namely, the success of the BSC model implementation depends on the internal environment of the company and the socio-economic conditions in which the company operates. Also, the big difference is whether the BSC model is introduced into a privately-owned enterprise or in a company that has passed a transition. The success of the introduction of the scorecard largely depends on it.

In the following few examples, we will present the introduction of the BSC model into some of the world's leading companies. One of the successful examples is the introduction of the BSC model in COCA-COLA, TESLA Ericsson etc.

2.3.1. Implementation of Balanced Scorecard in Ericsson Nikola Tesla d.d.

Company Ericsson Nikola Tesla d.d. is 49% in foreign ownership with total revenues of 1.2 billion and 1600 employees. Net profit amounted to HRK 27,976,483.00. Employees have an average net salary of HRK 10,773.00. Also, the company's shares are quoted on the Zagreb Stock Exchange and amount to HRK 1253.00.

In 1998 Ericsson Nikola Tesla d.d. management decided to set four goals (Ravlic,2006):

1. Create a business management process;
2. Direct all of their units to the same end goal. Our Vision!;
3. Monitor the realization in order to know if we are going the right way;
4. Continually improve.

In this way, management wanted to see how it would control and manage business processes in the enterprise, and which methods and processes continue to function, and which ones need to be developed and improved.

From the aforementioned data, it is obvious that this is a highly profitable company that pays great attention to satisfying the needs of its customers, attracting top staff, and stimulating and

organizing business processes. All this makes the company a good opportunity for both creditors and investors.

2.3.2. Measures of the successful implementation of the BSC model at universities

In addition to large enterprises, the BSC model, as an important tool in the management, has been recognized by academic institutions. Mentioned as the most important goals are (Academic Balanced Scorecard Overview):

1. Faculties must be recognized as leaders in the production of new knowledge;
2. Personnel will be employed to contribute most to the creation and adoption of new knowledge;
3. Faculties must recognize and capitalize on new market opportunities;
4. All costs must be based on cost-benefit analysis.

As the main measure of success at the faculty we can state the following:

For the customer's perspective the most important measures are the following:

1. Monitoring students' performance and their success on tests and comparing with competing institutions.

For the financial perspective as a measure, the following is stated:

2. Monitoring the allocation of financial resources and comparing them with the annual plan and the strategic goals of the faculty;
3. Comparison of the financial burden with respect to institutions from the same campus or similar faculties.

For the innovation and learning perspective, the following criteria are mentioned:

4. Hiring only the best candidates who were the first and second choice when selecting candidates;
5. Measuring the progress of newly-recruited candidates through their work with students and participation in scientific-research work.

For internal processes, the following success measures are listed:

6. Monitoring the realization of tenders for project funding.

2.3.3. Application of the BSC concepts in Finnish companies

Apart from some Croatian companies, the BSC concept was also accepted by some very successful Finnish companies. Companies in Finland that have adopted the BSC concept are the following (Malmi,2001):

- Alko (Wine & Spirits)
- Borealis Polymers Oy

- Engel (Real Estate Services)
- Espoo Electric
- Fazer Confectionary Oy
- HelvarMerca Group Oy (Diversified)
- Inex Partners Oy (Retail Logistics)
- Kesko Oy (Retailing)
- Neste Oil and Gas
- Nokia Mobile Phones
- Osuuspankkikeskus (Bank)
- PostipankkiOyj (Bank)
- SanomaOsakeyhtiö (Media)
- SuomenPosti Oy (Finnish Post)
- SuomenSokeri Oy (Food & Agricultural)
- Valmet Oy (Metals)
- ViatekOyj (Engineering).

As the main effects of introducing the BSC concept, Finnish managers have pointed out that the way of understanding business has changed. As one of the examples, it is stated that companies prior to the introduction of the BSC concept mainly discussed the financial performance of the business and the growth in sales. After the introduction of the BSC concept, the know-how of the company begins to be discussed. This means that the focus is on how the company will meet the needs of the customer, to have as efficient internal processes and satisfied and motivated employees as possible. This creates the prerequisites for competitiveness in the market. Also, the importance of defining a corporate strategy is also stated, as well as the success of the implementation and introduction of the BSC.

2.3.4. Application of the BSC concept in France

Apart from Finland, French also have their version of the BSC model. Namely, the French have been using a tool called the "Tableau de bord" for the last fifty years in management. "Tableau de Bord" is a tool for top management, enabling a complete and quick overview of all business operations that take place in the company (Bourguignon,2001). The tool is over fifty years old and is used in the French industry. Since the BSC model originated in America, the French do not accept it because of the cultural differences, and because they believe the BSC has emerged from the "Tableau de bord".

The concept of the French Tableau de Bord is based on set goals and variables that affect the goals. Each goal has dependent variables, and the monitoring follows whether the company is going in the desired direction or stagnating. Each variable has an action plan that serves as a landmark, but it can also be changed if it is seen that it does not yield results that are set to goals. "Tableau de bord" is set in such a way that the main goals and their action plans are formulated by the company's management. Further responsibilities are delegated to the centers of responsibility for which the middle management is responsible and they are the ones who choose the variables that will be used to follow the realization of their own goals.

If we compare the 'Tableau de bord' with the BSC model, we can conclude that 'Tableau de bord' is more open, which means that more variables can be insert in it and more interrelationships than in the BSC. They are similar in so far that one and the other are tracking the achievement of the results and strive to act before certain phenomena reflects on the business outcome.

In France, almost 100% of companies use "Tableau de Bord" as a reporting system; however, from the survey conducted it is unknown how many companies in their Tableau de Bord integrate parts of scorecards. Relatively poor knowledge of the scorecards makes it impossible to investigate how much impact the scorecard has in practice.

2.3.5. Application of BSC models in Austria, Germany and Switzerland

Studies on the application of the BSC model were also made in the countries of the German speaking area. The study was conducted in Austria, Germany and Switzerland. The study concluded that only 26% of companies in the German speaking area use the BSC model in just certain segments. Results are presented in a way that there are companies that apply only certain perspectives of BSC and those that apply all four perspectives of the BSC model. Research has shown that only 7% of companies apply a full BSC model (Speckbacker et al,2003).

As one of the reasons why the BSC model is not accepted, it is stated that the BSC model contributes nothing more than the existing management systems. As a second reason, controlling managers of big companies that are divided into divisions, which are in different markets and operate in different circumstances, can not use the same nonfinancial indicators. Accordingly, these companies are based on pure financial performance indicators.

3. CONCLUSION

The BSC model came in use at the end of the last century and has been in use for more than twenty years. During that time many small, medium and large companies have recognized BSC as a tool to help them improve their own business.

Defining a BSC model in a company is a relatively simple process; however, the hardest part comes at the moment when this model needs to be implemented and attract employees to follow the new management model. It is particularly difficult to implement a new management system in companies that have gone through all the negative side of the transition period and have been established at some other time.

The BSC or the Balanced Scorecard model is not an unambiguous model and is not applicable to every company in the same way. However, tracking business from several different aspects can be applied to every company.

The employee stimulation model puts the human factor in the business focus and attaches great importance to achieving the company's success. Only satisfied employees can be focused on achieving company goals.

Balanced Scorecard model dynamically plans future business. Existing reporting systems detail the events that have occurred. However, when a negative event arises, it can not be corrected; Because of this, business planning and dynamic monitoring of the achievement becomes inevitable for market existence and survival.

REFERENCES

Authored book:

- Armstrong M; (2006); Strategic Human Resources Management, 3rd Edition; p. 4
- Bourguignon, A.(2001): “Balanced scorecard versus French tableau de bord: beyond dispute, a cultural and ideological perspective”; ESSEC Business School, p. 6
- Collier, M. P.,(2003), “Accounting for managers“; Wiley; p. 121
- IASB (2005): International Financial Reporting Standards. Zagreb: Croatian Association of Accountants and Financial Professionals, pp. 25-26.
- Jacobson L. : Balanced Business Scorecard (BSC) as a Success Strengthening Method, Zbornik referenata Upravljanje troškovima – povećanje konkurentnosti i uspješnosti poslovanja, Hrvatski računovođa, Zagreb, 2007
- Kaplan R., Norton D.; Having trouble with Your Strategy? Then map it; p. 171; Harvard business review, September-October 2000
- Kaplan, R., Norton, D.,(1992), “The balanced scorecard“; Harvard business review; p. 4
- Malmi, T. : “Balanced scorecards in Finnish companies: A research note“; on doi: 10.1006/mare.2000.0154 Management Accounting Research, 2001, 12, 207–220, p.218
- Mavrinac S. and Vitale M.; (1997), Where are they now? revisiting the original “balanced scorecard” firms, Perspectives on Business Innovation, Measuring Business Performance, No. 2, pp.
- Speckbacher, G., Bischof, J., Pfeiffer, T.; “A descriptive analysis on the implementation of Balanced Scorecards in German-speaking countries“; Management Accounting Research 14 (2003) 361–387; p. 381

Web site:

- Poslovna Hrvatska, retrieved on April 12,2018, from <http://www.poslovna.hr/subjekti.aspx?show=322198&tab=posl>
- Ravlić, S.:(2006) “Primjena koncepta Balanced Scorecard u Ericsson Nikoli Tesli d.d.”, p. 2,

The inequality of income distribution in the Republic of Croatia between 2010 and 2016

Lucija Laća Lakoš

Veleučilište Marko Marulić, Knin, Croatia
lucija.laca@gmail.com

Ana Laća

European Parliament, Brussels, Belgium
analaca88@gmail.com

Abstract. This paper analyzes the inequality of income distribution in the Republic of Croatia from 2010 to 2016. Today, in modern countries, people are equal in their democratic and political rights, but there are significant differences in the distribution of income and wealth. On the one hand, inequality in income distribution can stimulate economic development whereas, on the other hand, it can also cause economic damage. In the Republic of Croatia, income inequality is expressed by the Gini coefficient since 2010. Gini coefficient ranges from 0 to 1, with 0 showing complete equality and 1 complete inequality. Another known measure of inequality of income distribution is the income quintile share ratio (S80 / S20), which measures the ratio between the top fifth (20 %) and the lowest fifth (20%) incomes in a country. The purpose of the paper is to give an overview and statistical interpretation of income inequalities using the Gini coefficient and the quintile income ratio, and to analyze European commission recommendations and distribution of income in the Republic of Croatia during the pre-accession negotiations and first years of EU membership.

Key words: *inequality of income distribution, Gini's coefficient, quintile measures of inequality*

1. Introduction

Inequality emerged with the emergence of human society, since differences in power and wealth are the side effects of every human society. Nowadays, people are equal in their democratic and political rights, but there are significant differences in the distribution of income and wealth. The differences between the income of residents of one state, but also residents of different states are partly the result of uneven market distribution of income.¹ Data on inequality in income distribution are particularly important for the assessment of relative poverty.

On the one hand, inequality in income distribution can encourage people to improve their situation by working, innovating or acquiring new skills. On the other hand, it is often considered that income inequalities are related to crime, poverty and social exclusion.²

Technological progress, globalization and politics contribute to inequality. A more even distribution of capital ownership can affect the reduction of inequality as the number of middle class members increases.³ If we look at income inequalities in Croatia and the European Union, it can be seen that when inequality is measured Croatia does not deviate

¹ Nikolić, N., Žižić, K. (2016). *Porezna politika i neravnomjernost tržišne raspodjele dohotka*. Split, University of Split, Faculty of Economics, Retrieved March 3, 2018, from <https://urn.nsk.hr/urn:nbn:hr:124:665008>

² Eurostat, Statistics Explained, *Statistički podaci o raspodjeli dohotka*, Retrieved March 10, 2018, from http://ec.europa.eu/eurostat/statistics-explained/index.php/Income_distribution_statistics/hr

³ Milanović, B. (2016). *Globalna nejednakost*. Zagreb, Akademska knjiga

from other EU countries. The global financial crisis initially affected the reduction in equity due to the loss of income from the wealth of wealthy people, but as it spread, it affected unemployment and increased inequality.⁴

Recently, global inequality, and inequality in the income of all people in the world, has been decreasing for the first time ever since it is measured, that is, from the industrial revolution. This is the result of a steady increase in income for of population of China that amounts to approximately 1.3 billion people.⁵

In 2010, the European Council decided to describe income inequality in EU Member States using two indicators, the Gini coefficient and the Quintile income ratio.

At the end of each year, the Central Bureau of Statistics publishes the results of the Survey on Population Income, ie Poverty Indicators for the previous year. The first such communication in the Republic of Croatia was published in 2010. It was aligned with EU regulations and the Eurostat methodology prescribed for the EU-SILC (Statistics on Income and Living Conditions) survey.⁶ In the release, two indicators of income inequality were published, and these are the Gini coefficient and the Quintile income ratio (S80 / S20).

2. Gini Coefficient

The best-known measure for expressing income inequality in society is the Gini coefficient. Gini coefficient was developed by Italian statistician and sociologist Corrado Gini who published his first measurements in the book "Variability and Variability" in 1912.⁷ (Italian: Variabilità e mutabilità)

Gini coefficient of concentration is included in relative concentration measures or the inequality measure of the statistical sequence.⁸ It is a formula that identifies the relationships of the total population shares that are distributed according to the level of income and according to the total share of the total amount they received. If there was a perfect equality (ie, if each person received equal income) then the Gini coefficient would be 0. The closer the value is to 1, the income inequality in the country is higher.⁹

Gini coefficient is determined using a graphical representation called the Lorenz curve. The graph is constructed in the first quadrant of the coordinate system. Also, the data for which Gini coefficient is calculated should be ranked by size, from the smallest to the largest.

$$x_1 \leq x_2 \leq \dots \leq x_{i-1} \leq x_i \leq \dots \leq x_N, x_i \geq 0, \forall i, \sum_{i=1}^N x_i > 0.$$

⁴ Milanović, B. (2016). *Globalna nejednakost*. Zagreb, Akademska knjiga

⁵ Milanović, B. (2017). *Dobitnici i gubitnici -kratka i osebujna povijest globalne nejednakosti*. Zagreb, Tim press

⁶ Croatian Bureau of Statistics, (2011). *Pokazatelji siromaštva u 2010. godini*. Retrieved March 6, 2018, from https://www.dzs.hr/hrv_eng/publication/2011/14-01-02_01_2011.htm

⁷ Encyclopedia Britannica, *Corrado Gini*. Retrieved March 5, 2018, from <https://www.britannica.com/biography/Corrado-Gini>

⁸ Kovačić, B., Opačić, R., Marohnić, L., (2009). O Ginijevom koeficijentu koncentracije, *Hrvatski matematički el. zapis*, Retrieved March 2, 2018, from http://e.math.hr/math_e_article/vol22/KovacOpacicMarohnic

⁹ Pragma, Hrvatska mreža protiv siromaštva (2016). *Siromaštvo i nejednakost u EU*, Retrieved March 5, 2018, from http://www.udruga-pragma.hr/wp-content/uploads/2016/02/HMPS_publikacija-SIROMASTVO-I-NEJEDNAKOST-U-EU.pdf

The curve is generated by merging points with coordinates:

$$(0,0), \left(\frac{1}{N}, \frac{x_1}{\sum_{i=1}^N x_i} \right), \dots, \left(\frac{i}{N}, \frac{\sum_{j=1}^i x_j}{\sum_{i=1}^N x_i} \right), \dots, (1,1); \quad i = 1, 2, \dots, N \quad 10$$

The diagram also lists the Line of Equality, which is defined by the points (0,0) and (1,1).

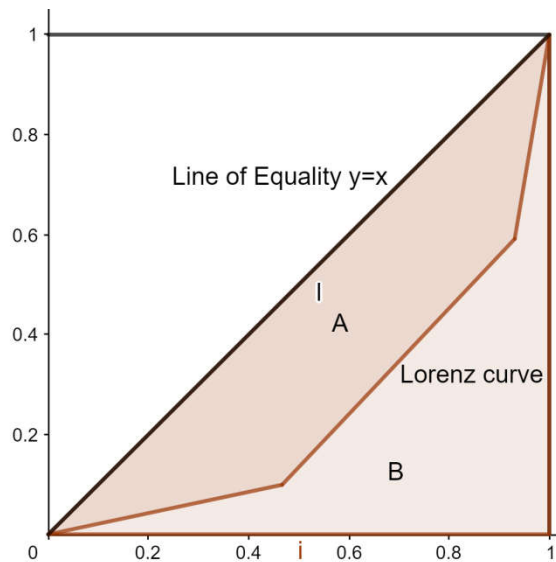


Figure 1: Lorenz curve

The Gini coefficient of concentration is the ratio of the surface which, with the Line of equality ($y = x$), closes the Lorenz curve (A) and the triangle surface below the Line of equality ($A + B$).¹¹

Using these marks, the Gini coefficient is defined by the expression:

$$G = \frac{A}{A + B} = 2 \left(\frac{1}{2} - B \right). \quad G = 1 - 2B \quad 12$$

The area under the Lorenz curve is divided into 1 triangle and N-1 trapezoid, so the total surface is equal to the sum of the triangle and trapezoidal surfaces. The resulting number is multiplied by 2 in order to get the coefficient to the interval $[0,1]$. In this way comes the Gini coefficient formula:

$$G = 1 - \sum_{i=1}^N p_i [F_T(T_i) + F_T(T_{i-1})], \quad F_T(T_0) = 0, \text{ where is}$$

$$p_i = \frac{1}{N},$$

¹⁰ Šošić, I. (2004). *Primjenjena statistika: Mjere asimetrije. Mjere zaobljenosti. Mjere koncentracije.* (124-138), Zagreb, Školska knjiga

¹¹ Bahovec, V., Dumičić, K., Erjavec, N., Čižmešija, M., Kurnoga, N., Arnerić, J., Čeh Časni, A., Jakšić, S., Sorić, P., Žmuk, B., Palić, I. & Lolić, I. (2015). *Statistika : Mjere koncentracije*, 122-142, Zagreb, Element

¹² Bahovec, V., Dumičić, K., Erjavec, N., Čižmešija, M., Kurnoga, N., Arnerić, J., Čeh Časni, A., Jakšić, S., Sorić, P., Žmuk, B., Palić, I. & Lolić, I. (2015). *Statistika : Mjere koncentracije*, 122-142, Zagreb, Element

$F_T(T_i)$ - cumulative proportions of the subtotal

Another formula for calculating Gini coefficient is

$$G = \frac{2 \sum_{i=1}^N ix_i - (N+1) \sum_{i=1}^N x_i}{N \sum_{i=1}^N x_i}$$

13

The main advantage of the Gini coefficient is that it is a measure of inequality rather than a measure of average income or some other variable that is not representative of most of the population, such as a gross domestic product. Gini coefficients can be used to compare income distribution across different population sectors, as well as in countries, and can also be followed by growth trends, ie decrease in income inequalities over the years. The insufficiency of the Gini coefficient is that it is not sensitive to the richest and the poorest.

3. Income Quintile Share Ratio

In order to define the income quintile share ratio, it is necessary to define the term quantile. In statistics, quantiles are the values of the statistical characteristic that arranged a statistical array divided into q equal parts. Quantiles are divided by the number of intervals to which a series of data is shared. Second order quantile is the mean position value and divides the ordered array of data into two equal parts, called the median. The quaternary of the third order is called tertile and divides the ordered sequence into three equal parts. Quartiles divide it into four, quintile to five, decile to ten, percentiles per hundred equal parts....

The first quintile shares the ordered array of data so that 20% of the value of the edited string is less than or equal to the first quintile, while the other 80% is greater or equal. The fifth quintile shares a set of data so that 80% of the value of the edited string is less than or equal to the first quintile, and the other 20% is greater or equal. The quintile ratio is the ratio of the fifth and first quintiles.

The Quintile income share ratio (S80 / S20) is an income inequality's indicator that measures the relationship between the fifth and first quintile of income distribution, ie the ratio of total equivalent income to 20% of the population with the highest incomes and the total equivalent income of 20% of the lowest income population.¹⁴ Quintile income ratio (S80 / S20) is the second most important way to measure income inequality in the EU. A larger ratio means greater inequality.

4. Income Inequalities in Croatia from 2010. to 2016. Measured by Gini Coefficient

Income inequalities are usually measured by the Gini coefficient. The effect of inequality on economic growth can be either incentivizing or negative. The International Monetary Fund has published a study in which it finds that income inequality is fueling economic growth if the value of Gini coefficient is less than or equal to 27%. If the value of the Gini coefficient is greater than 27, income inequalities negatively affect economic growth.¹⁵ The following diagram shows the Gini coefficient trend in Croatia from 2010 to 2016. It should be noted that

¹³ Šošić, I. (2004). *Primjenjena statistika: Mjere asimetrije. Mjere zaobljenosti. Mjere koncentracije*, 124-138, Zagreb, Školska knjiga

¹⁴ Croatian Bureau of Statistic, (2017). *Pokazatelji siromaštva u 2016. godini*. Retrieved March 6, 2018, from https://www.dzs.hr/Hrv_Eng/publication/2017/14-01-01_01_2017.htm

¹⁵ Grigoli, F., Robles, A., (2017). *Inequality overhang*, International Monetary Fund (IMF), Retrieved March 12, 2018, from <https://blogs.imf.org/2017/05/11/a-new-twist-in-the-link-between-inequality-and-economic-development/>

Gini's coefficient is expressed in values of 0% (perfect equality) to 100% (concentration of total income per one person).

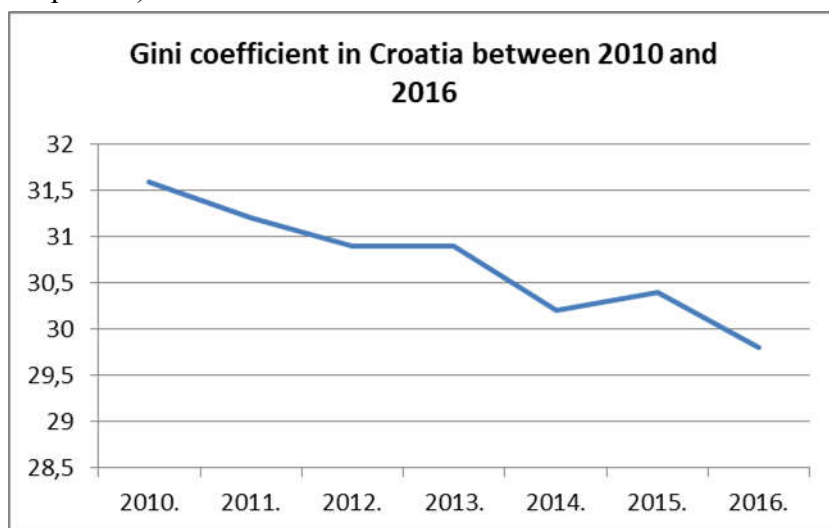


Figure 2: authors' calculation according to Eurostat

In Croatia there is a noticeable decrease in the value of the Gini coefficient. It gained the highest value in 2010, and then it was 31.6. In this period, the Gini coefficient increased only between 2014 and 2015, but this growth was minimal. In 2016 it fell below 30 and then it was 29.8. So, we notice that income inequality in Croatia over the last six years has been reduced. In order for income inequalities in Croatia to be conducive to economic development, the value of the Gini coefficient must continue this downward trend, to approximately 27.

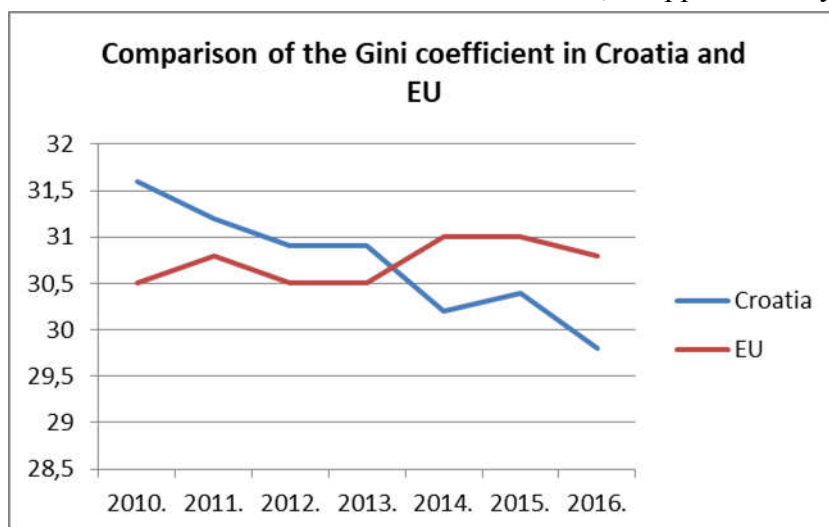


Figure 3: authors' calculation according to Eurostat

In the EU, the Gini coefficient amounts to about 30, with a slight tendency to grow. We see that in the observed period, the Gini coefficients for Croatia and the European Union were moving at similar levels, which shows that Croatia does not deviate significantly from the European average. By 2013, the Gini coefficient for Croatia was above the average of the European Union, and since 2013 the European Union has a higher value of the Gini coefficient than Croatia.

5. Income Inequalities in Croatia from 2010. to 2016. Measured by Quintile Income Share Ratio (S20/S80)

The second most important measure of income inequality is the Quintile income share ratio.

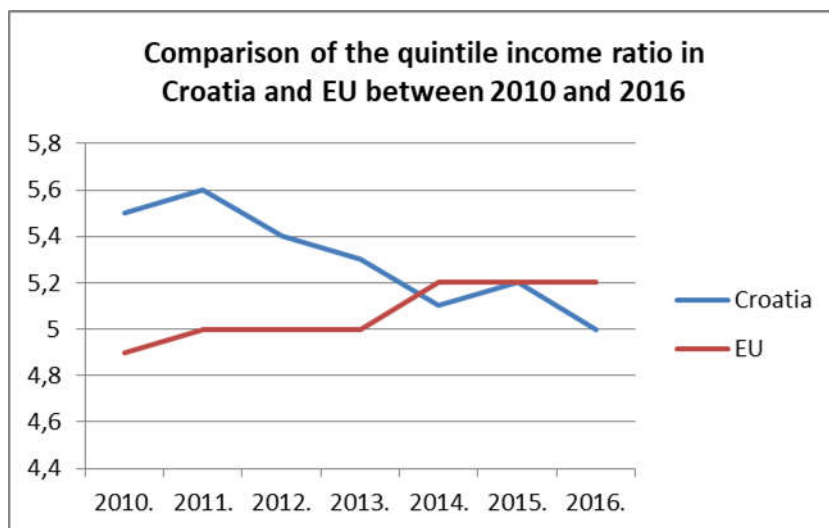


Figure 4: authors' calculation according to Eurostat

The quintile income ratio in Croatia in 2010 was 5.5, which means that 20% of the highest income population had 5.5 times more than 20% of the lowest income population. In 2011, this ratio was even higher, it amounted to 5.6, and it continued its decline since 2011, and in 2014 it was 5.1. In 2015 it again grew slightly as it amounted to 5.2, and in 2016 it fell to 5.0.

Unlike Croatia, in the European Union we can observe slight increase and stagnation of the quintile income ratio. The biggest difference was recorded in 2010, when this ratio in the European Union was 4.9, and in Croatia 5.5. In 2015, both ratios were 5.2, and in 2016. the quintile income share ratio in Croatia was 5.0, for the first time lower than in the European Union, where it was 5.2.

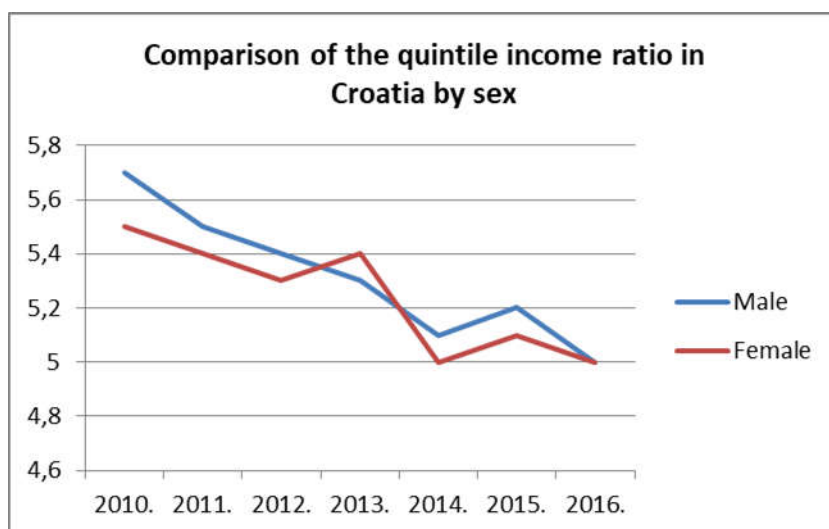


Figure 5: authors' calculation according to Eurostat

The quintile income ratio in Croatia observed for the male population records similar, decreasing trend, as well as the one observed only for the female population.

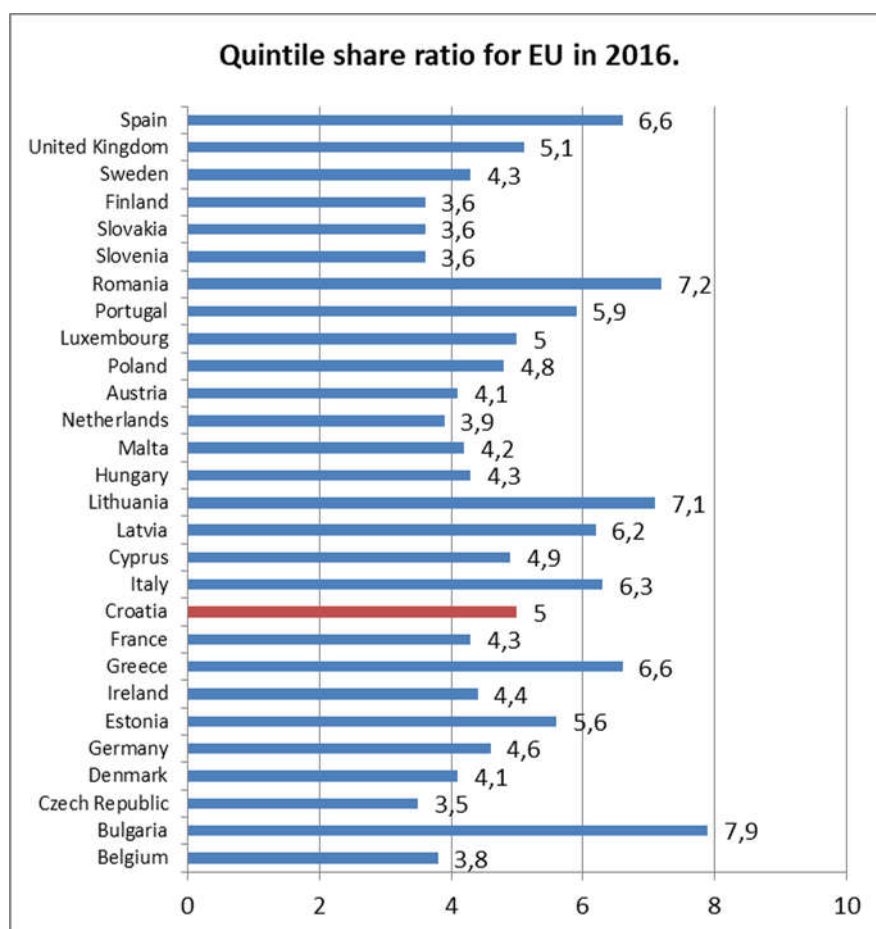


Figure 6: authors' calculation according to Eurostat

According to the afore mentioned Eurostat indicator, in 2016, Bulgaria, Romania and Lithuania are the predominant ones in income inequality distribution, with a quintile income ratio of over 7. Next, followed by Spain, Greece, Italy and Latvia. In 2016, Croatia records the quintile income ratio of 5.0, which marks the European average. The countries that were leading by equality in income distribution in 2016 were the Czech Republic, Slovenia, Slovakia and Finland.

Among countries where inequalities grow, as well as among those where it is falling, there are economically more successful and less successful countries. Thus, for example, in the growing disparity group, Cyprus is less successful and Austria is economically more successful, and in the group with decreasing inequalities, there are more economically more successful Ireland and less successful Croatia. It is difficult to record regularities and correlations in terms of economic growth and change of inequality within the EU.¹⁶

6. Negotiations on Membership of Croatia in the European Union and the Distribution of Income

Croatia's accession to the European Union was defined as a strategic foreign-political goal. Croatia began membership negotiations in October 2005, and with several political blockades and deadlocks, successfully finished negotiations on June 30, 2011. The accession

¹⁶ Šonje, V. (2018). Borite se protiv siromaštva, ne protiv nejednakosti, *Arhiva analitika – Ekonomski lab*, Retrieved March 17, 2018, from <http://arhivanalitika.hr/blog/borite-se-protiv-siromastva-ne-protiv-nejednakosti/>

treaty was signed on 9 December 2011, while the referendum on EU accession, where 67% of citizens supported the membership was held on January 22, 2012.¹⁷

Croatia has negotiated a total of 35 chapters. Chapter 19 concerned the area of social policy and employment. European legislation in this area is aimed at creating equal opportunities for all, protecting the principle of equal pay for equal work, prohibiting discrimination on any ground and strengthening social dialogue.¹⁸ As part of measures to reduce inequality, the goal of the European *acquis* in this area is, inter alia, to increase the employment levels of those groups most affected by long-term unemployment and the promotion of lifelong learning. European legislation is based and focused on creating equal opportunities for all, including the protection of equal pay for equal work, and the ban on discrimination on any ground.¹⁹

Chapter 17 on economic and monetary issues aimed at harmonizing economic policies also implies joint planning of the integration of economies, the promotion of economic growth, job security and the competitiveness of the European economy as a whole on global level.²⁰

In its 2010 Progress Report on Croatia, the Commission highlighted, inter alia, structural labor market disadvantages and a low employment rate that continues. Education improvement has been considered, but initiatives related to lifelong education have not yet resulted in a strategic approach. The Commission also highlighted some progress with regard to social inclusion and social protection and good progress in the fight against discrimination and the creation of equal opportunities. Commission referred to postponement of adoption of the new Law on Social Welfare and emphasized that impact of the economic crisis on the level of poverty still needs to be examined. In short, in 2010, the Commission assessed Croatia's progress in this area as good and stressed that preparations are in line with presented plans.²¹

The progress report for 2011 highlighted some progress in the area of social protection, the Social Welfare Act was adopted and consumption was to some extent rationalized. Nevertheless, the Commission emphasized the need for additional measures to improve the employment of older workers, to additionally protect elderly people with no income and to ensure adequate and sustainable pensions. Some progress has been made regarding the social inclusion of groups that have difficulty accessing the labor market. The Economic Recovery Program overall has resulted with limited results in overcoming structural weaknesses, including measures against long-term unemployment and youth

¹⁷Ministarstvo vanjskih i europskih poslova, *Hrvatska i Europska unija*, Retrieved March 21, 2018, from <http://www.mvep.hr/hr/hrvatska-i-europska-unija/pregovori/>

¹⁸Ministarstvo vanjskih i europskih poslova (2012). *Detailed Review of Negotiating Chapters – What makes EU accession*, 42, Retrieved March 21, 2018, from <http://www.mvep.hr/custompages/static/hrv/files/pregovori/120112-stodonosi.pdf>

¹⁹Ministarstvo vanjskih i europskih poslova (2012). *The overview of accession negotiations by chapters*, 9, Retrieved March 21, 2018, from <http://www.mvep.hr/custompages/static/hrv/files/pregovori/120112-sazeti.pdf>

²⁰Ministarstvo vanjskih i europskih poslova (2012). *Detailed Review of Negotiating Chapters – What makes EU accession*, 41, Retrieved March 22, 2018, from <http://www.mvep.hr/custompages/static/hrv/files/pregovori/120112-stodonosi.pdf>

²¹European Commission (2010). *Croatia 2010 Progress report*, 41-42, Retrieved March 22, 2018, from https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/pdf/key_documents/2010/package/hr_rapport_2010_en.pdf

unemployment that has increased significantly. In short, some progress has been made in this area, additional measures are expected to overcome structural shortcomings.²²

Given that during 2011 negotiations were completed, in 2012, the European Commission published a document for the conclusions on Croatia's preparedness for membership. In it, the Commission states that the low level of employment has further reduced, reforms were at an early stage and urgently needed to be implemented. Payment of social transfers that represent a significant part of the national budget was still not properly targeted. Commission underlined that Croatia fulfills the obligations and requirements arising from the accession negotiations and is expected to be able to implement the *acquis communautaire* of accession to the EU, inter alia, in the area of social policy and employment. Further efforts were needed, especially for full legal compliance in the area of equal opportunities, addressing structural weaknesses in the labor market, better targeted social welfare and strengthening administrative capacity.²³

7. Membership of Croatia in the European Union and Distribution of Income

By joining the European Union in 2013, Croatia has assumed membership obligations that mean the adoption of Union standards. A more balanced distribution of income as one of the basic prerequisites for combating poverty is part of the numerous strategies and recommendations of the European Commission. The fight against poverty is cited as one of the main objectives of the Europe 2020 Strategy, which presents various innovative measures and policies in order to achieve social cohesion. The goal set in 2010 is that by 2020, 20 million Union citizens live less in poverty. The achievement of this goal, taking into account the impact of the recent financial crisis on the EU's economy and the level of poverty, will be possible to measure and analyse only after 2020.

In the meantime, since the year of accession to the EU, income inequality in Croatia is decreasing according to the Gini coefficient and it is precisely in 2013 where the inequality of income distribution in Croatia falls below the average value of the inequality of distribution of income in the European Union.

In the annual reports and economic forecasts of the European Commission for Croatia, each report included a part of the level of risk exposure to poverty. The 2016 report also includes data on the inequality of income distribution.

In working document "On the National Program of Croatia's Reforms for 2014" and the opinion of the Council on the Croatian Convergence Program, it is emphasized that the increasing incidence of poverty reflects the negative trends of the economy and the labor market and highlights the constraints on the efficiency and adequacy of the social protection system. The share of people at risk of poverty and social exclusion is considerably higher than in the EU as a whole (32.3% in Croatia compared to 24.8% in the EU in 2012). In addition, total government spending on social protection was well below the EU average (20.6% of GDP in Croatia compared to 29.1% in the EU in 2012) and inclined towards disability and health care, and far from social assistance and family allowances.²⁴

²² European Commission, (2011), *Croatia 2011 Progress report*, 41-42, Retrieved March 22, 2018, from https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/pdf/key_documents/2011/package/hr_rapport_2011_en.pdf

²³ European Commission (2012). *Main Findings of the Comprehensive Monitoring Report on Croatia's state of preparedness for EU membership*, 5-26, Retrieved March 22, 2018, from https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/pdf/key_documents/2012/package/hr_rapport_2012_en.pdf

²⁴ European Commission, (2014). *Assessment of the 2014 national reform programme and convergence programme for Croatia*, 25, Retrieved March 23, 2018, from https://ec.europa.eu/info/sites/info/files/file_import/swd2014_croatia_en_0.pdf

In the annual report for 2015, the Commission emphasized that the impact of any enlargement measures on redistribution and welfare needs to be carefully taken into account, especially when the population is at risk of poverty and social exclusion.²⁵

In the same document, the Commission once again highlighted that the share of the population at risk of poverty (AROP) is around 20%. A persistent crisis puts pressure on social costs. The already low overall social protection expenditures in Croatia have been further reduced, while the social benefits reform with the aim of improving efficiency and social welfare guidance is progressing slowly. Specifically, total social protection spending in Croatia dropped from 21.2% of GDP in 2012 to 18.2% of GDP in 2013, well below the EU average (29% in 2012).²⁶

In the 2016 Annual Report, the Commission used the data on the inequality of income distribution according to the Gini coefficient and stresses that the Guaranteed Minimum Benefit Scheme (GMB) is insufficient to cover basic living needs. GMB covers only 12% of the population under the threat of poverty and only 16.2% of the poorest quintile. The unsatisfactory effect of minimum income leads to a relatively high poverty gap.²⁷

In their recommendation for 2016 Commission emphasized that overall, the tax relief system reduces inequality. This is comparable to the reduction achieved by other countries. However, inequality would increase if the available income was adjusted to indirect taxation, for example, as in the case of Croatia with high VAT.²⁸

In the European Council recommendations regarding the National Program for the Reform of Croatia for 2016 and the Opinion of the Council on the Program of the Convergence of Croatia for 2016, it is once again clearly underlined that only a small part of the total budget for social protection is spent on a national minimum income programme. The recommendations emphasize that one of the results of such inefficiency policies is the inadequate protection of the poorest. The Recommendations also highlighted that the reform of the social protection system has delayed the consolidation of various fees and the establishment of single administrative points for the provision of social protection services.²⁹

8. Conclusion

This paper analyses the topic of inequality in the distribution of income in the Republic of Croatia from 2010 to 2016. Income disadvantages in the European Union countries are measured by the Gini coefficient and the quintile income ratio, which are published annually by the Central Bureau of Statistics (Eurostat). In the observed period, the Gini coefficients

²⁵ European Commission, (2015). *Country Report Croatia 2015 Including an In-Depth Review on the prevention and correction of macroeconomic imbalances*, 46, Retrieved March 23, 2018, from https://ec.europa.eu/info/sites/info/files/file_import/cr2015_croatia_en_0.pdf

²⁶ European Commission, (2015). *Country Report Croatia 2015 Including an In-Depth Review on the prevention and correction of macroeconomic imbalances*, 67, Retrieved March 23, 2018, from https://ec.europa.eu/info/sites/info/files/file_import/cr2015_croatia_en_0.pdf

²⁷ European Commission, (2016). *Commission Staff Working rection of macroeconomic imbalances*, 85, Retrieved March 23, 2018, from https://ec.europa.eu/info/sites/info/files/cr_croatia_2016_en.pdf

²⁸ European Commission, (2016). *Commission Staff Working Document Country Report Croatia 2016 Including an In-Depth Review on the prevention and correction of macroeconomic imbalances*, 87, Retrieved March 23, 2018, from https://ec.europa.eu/info/sites/info/files/cr_croatia_2016_en.pdf

²⁹ European Commission, (2016). *Council recommendation of 12 July 2016 on the National Program of Croatia's Reforms for 2016 and the opinion fo the Council on the Program of Convergence of Croatia for 2016*, 3, Retrieved March 23, 2018, from [http://eur-lex.europa.eu/legal-content/HR/TXT/PDF/?uri=CELEX:32016H0818\(23\)&from=EN](http://eur-lex.europa.eu/legal-content/HR/TXT/PDF/?uri=CELEX:32016H0818(23)&from=EN)

and the quintile income ratios for Croatia and the European Union were at similar levels, indicating that Croatia did not deviate significantly from the European average.

It is challenging to identify regularities in terms of economic growth and change of inequality within the EU. Two thousand thirteen was the year in which the inequality of income distribution in Croatia fell below the average value of disparities in the distribution of income in the European Union.

Although during the period that this paper analyzes inequality in income distribution is decreasing (with a minimum increase of 2014), there are no clear links that accession negotiations and expected economic benefits from accession to the European union in the first years directly affected the reduction of income inequality distribution in Croatia. However, given the number of reforms of the national legislation that Croatia had to implement in order to successfully implement the European acquis, which included, inter alia, the new Labor and Social Welfare Act, it can be concluded that membership negotiations had a certain impact on the distribution of income as European legislation is founded and aiming towards creating equal opportunities for all, including the protection of equal pay for equal work and prohibition of discrimination on any basis.

REFERENCES

Authored book:

Bahovec, V., Dumičić, K., Erjavec, N., Čižmešija, M., Kurnoga, N., Amerić, J., Čeh Časni, A., Jakšić, S., Sorić, P., Žmuk, B., Palić, I. & Lolić, I. (2015). *Statistika: Analiza vremenskih nizova*. Zagreb, Element

Šošić, I. (2004). *Primjenjena statistika*. Zagreb, Školska knjiga

Milanović, B. (2017). *Dobitnici i gubitnici, kratka i osebujna povijest globalne nejednakosti*. Zagreb, TIM press

Milanović, B. (2016). *Globalna nejednakost*. Zagreb, Akademska knjiga

Journal article:

Kovačić, B., Opačić, R., Marohnić, L., (2009.), O Ginijevom koeficijentu koncentracije Hrvatski Matematički el. zapis, Retrieved March 2, 2018, from http://e.math.hr/math_e_article/vol22/KovacicOpacicMarohnic

Web site:

Croatian Bureau of Statistics, (2011). *Pokazatelji siromaštva u 2010. godini*. Retrieved March 6, 2018, from https://www.dzs.hr/hrv_eng/publication/2011/14-01-02_01_2011.htm

Eurostat, Statistics Explained, *Statistički podaci o raspodjeli dohotka*, Retrieved March 10, 2018, from

http://ec.europa.eu/eurostat/statistics-explained/index.php/Income_distribution_statistics/hr

Nikolić, N., Žižić, K. (2016). *Porezna politika i neravnomyernost tržišne raspodjele dohotka*. Split, University of Split, Faculty of Economics, Retrieved March 3, 2018, from <https://urn.nsk.hr/urn:nbn:hr:124:665008>

Encyclopedia Britannica, *Corrado Gini*. Retrieved March 5, 2018, from <https://www.britannica.com/biography/Corrado-Gini>

Pragma, Hrvatska mreža protiv siromaštva (2016). *Siromaštvo i nejednakost u EU*, Retrieved March 5, 2018, from http://www.udruga-pragma.hr/wp-content/uploads/2016/02/HMPS_publikacija-SIROMASTVO-I-NEJEDNAKOST-U-EU.pdf

Grigoli, F., Robles, A., (2017). *Inequality overhang*, International Monetary Fund (IMF), Retrieved March 12, 2018, from <https://blogs.imf.org/2017/05/11/a-new-twist-in-the-link-between-inequality-and-economic-development/>

Šonje, V. (2018). Borite se protiv siromaštva, ne protiv nejednakosti, *Arhiva analitika – Ekonomski lab*, Retrieved March 17, 2018, from <http://arhivanalitika.hr/blog/borite-se-protiv-siromastva-ne-protiv-nejednakosti/>

Ministarstvo vanjskih i europskih poslova, *Hrvatska i Europska unija*, Retrieved March 21, 2018, from <http://www.mvep.hr/hr/hrvatska-i-europska-unija/pregovori/>

Ministarstvo vanjskih i europskih poslova (2012). *Detailed Review of Negotiating Chapters – What makes EU accession*, 41-42, Retrieved March 21, 2018, from <http://www.mvep.hr/custompages/static/hrv/files/pregovori/120112-stodonosi.pdf>

Ministarstvo vanjskih i europskih poslova (2012). *The overview of accession negotiations by chapters*, 9, Retrieved March 21, 2018, from <http://www.mvep.hr/custompages/static/hrv/files/pregovori/120112-sazeti.pdf>

European Commission (2010). *Croatia 2010 Progress report*, 41-42, Retrieved March 22, 2018, from

https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/pdf/key_documents/2010/package/hr_rapport_2010_en.pdf

European Commission, (2011), *Croatia 2011 Progress report*, 41-42, Retrieved March 22, 2018, from https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/pdf/key_documents/2011/package/hr_rapport_2011_en.pdf

European Commission (2012). *Main Findings of the Comprehensive Monitoring Report on Croatia's state of preparedness for EU membership*, 5-26, Retrieved March 22, 2018, from https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/pdf/key_documents/2012/package/hr_rapport_2012_en.pdf

European Commission, (2014). *Assessment of the 2014 national reform programme and convergence programme for Croatia*, 25, Retrieved March 23, 2018, from https://ec.europa.eu/info/sites/info/files/file_import/swd2014_croatia_en_0.pdf

European Commission, (2015). *Country Report Croatia 2015 Including an In-Depth Review on the prevention and correction of macroeconomic imbalances*, 46-67, Retrieved March 23, 2018, from https://ec.europa.eu/info/sites/info/files/file_import/cr2015_croatia_en_0.pdf

European Commission, (2016). *Commission Staff Working rection of macroeconomic imbalances*, 85-87, Retrieved March 23, 2018, from https://ec.europa.eu/info/sites/info/files/cr_croatia_2016_en.pdf

European Commission, (2016). Council recommendation of 12 July 2016 on the National Program of Croatia's Reforms for 2016 and the opinion fo the Council on the Program of Convergence of Croatia for 2016, 3, Retrieved March 23, 2018, from

[http://eur-lex.europa.eu/legal-content/HR/TXT/PDF/?uri=CELEX:32016H0818\(23\)&from=EN](http://eur-lex.europa.eu/legal-content/HR/TXT/PDF/?uri=CELEX:32016H0818(23)&from=EN)

CIET
2018

Split
Track 2

**Tourism, Trade and
Entrepreneurship**

Human Resource Accounting

Anita Krolo Crvelin, MsC, senior lecturer

University of Split, University Department of Professional Studies, Split, Croatia
akroloc@oss.unist.hr

Laura Marasović

University of Split, University Department of Professional Studies, Split, Croatia
lauramarasovic1@gmail.com

Abstract. Scientists and practitioners are almost unanimous in the attitude that human resources are one of the most significant sources of competitiveness of modern enterprises, which put them in the very centre of strategic orientation of businesses. Human resources are the basis of competitive advantage; and value creation and the value of enterprises are the result of their strategic usage. Strategic human resource management is a key factor in finding solutions for business issues in order to meet ever-increasing market demands and to improve the company's competitive position. Human resources of an organization may be considered as human capital through the combination of their intelligence, skills, motivation and expertise, which makes its distinctive character. Recent contributions have suggested that knowledge and expertise are subject to increasing returns, and that wealth-creating capacity of the enterprise is based on the knowledge and capabilities of its people. But unfortunately all characteristics of human capital are invisible and intangible which make them very hard to be captured or measured using traditional metric systems. Human resource accounting is an information system that serves managers as an insight into the costs and value of the human factor of an organization. The purpose of this paper is to show concept, methods and significance of Human Resource Accounting.

Key words: *Management, Human Capital, Human Resource Accounting*

1. Introduction

It is commonly accepted by theorists as well as by practitioners that human resources have the significant role in creating and sustaining competitive advantage of business organisations in contemporary business environment. Over the past few decades there have been major changes in the global economy with the gradual decline of the industrial sector and substantial increases in the number of companies working in the service sector and using knowledge as their primary source of competitive advantage (Wall, Kirk & Martin, 2004).

There is an evident fact that market value of leading companies continues to be much higher than the value of their tangible assets. That gap is attributed to intellectual capital, or even more specific to human resources, which are the rarest and most complicated resources in knowledge-based economy. Human resources of an organization may be considered as human capital through the combination of their intelligence, skills, motivation and expertise, which makes its distinctive character. Therefore, organizations must concentrate on factors such as human and intellectual capital in order to gain competitive advantage and improve their survival (Nordhaug, 1993). Today, the most successful companies are the ones who use their intangible assets better and faster. Present and future success in competition will be based less on the strategic allocation of physical and financial resources and more on the strategic management of knowledge (Bontis, 1996).

One of the main attributes of human capital is its intangibility. It does not have hard tangible shape as physical assets, nor does it have financial value that can be easily measured. That is why it is usually referred to as the hidden value of the company. All attributes of human resources (knowledge, behaviours, motivation, and skills) are invisible and intangible, and thus are not captured very well by any of the traditional measures, accounting or otherwise, that corporations use in their everyday operations. That means that managers must manage and control their most valuable assets without having appropriate information, so they can easily underestimate their value and contribution, and thus take decisions that might prove wrong and harmful for the future of the company. What is even worse, the attention of the company will be focused on improving the efficiency of its physical assets only, because that is what gets measured, appraised and evaluated by senior managers (Hauser & Katz, 1998). When people are considered as the organization's assets, the ability to quantify the value of these assets becomes important. This fact is vital for making decisions about the management and maximizing the rate of return to investment.

The main problem lies in fact that in the past there were almost no data on human resources in the standard financial reports that are focused on success of businesses, their profitability, economic performance etc. Throughout the time, several different methods of measuring employee performance were developed and incorporated in reports. Human resource accounting was developed in 1960's, and has developed its potential in the last decade as the common practice of many organisations. That is not so in Croatia, where human resource accounting is not being used and is quite unknown as the discipline. That is the reason why Croatian companies do not value human resources in their financial reports (Marasović, 2017).

2. Human Resources Management

Human resources management, historically known as personnel management, deals with formal systems for managing people at work. It has assumed a vital strategic role in recent years as organizations attempt to compete through people, since the company can create a competitive advantage when it possesses or develops resources that are valuable, rare, inimitable and organized. Employees' talent such as good performance, flexibility, creativity, and the ability to give direct services to the customer play a key role in creating competitive advantage for the organization (Armstrong, 2008). In order to have competitive advantage, the company must distinguish their products from their competitors through employing more talented and skilled employees than the employees of the competitors, and to make all necessary activities in order to maintain high level of those characteristics within the already employed personnel. That is the main task of human resources management and its key activities: staffing, training, performance appraisal, rewards and labour relations.

All activities of human resources management have to be adjusted with organization's strategic goals, and serve as a lever in achieving overall strategy of a company. Strategic impact of human resources may be sorted in four main groups. First one is in creating value. People can increase value through their efforts to decrease costs of provide something unique for costumers, or the combination of the two. The second is that human resources are rare. People are a source of competitive advantage when their skills, knowledge, and abilities are not available to competitors. Third impact of human resources to the strategy is that they are difficult to imitate which is important for the long-term sustainable competitiveness. Finally human resources are a source of competitive advantage when their talents can be combined together and rapidly deployed to work on new assignments in short time. Teamwork and cooperation are two methods for ensuring an organized workforce with all the positive effects of their synergy.

Companies are increasingly recognizing that their success depends on what people know, that is, their knowledge and skills. Furthermore, it is no less important what people want to do, that is, their attitude and motivation. The concept of human capital (or broader term intellectual capital) is used to describe the strategic value of employee attributes such as knowledge, skill, behaviours, motivation...

There are many different approaches in defining human resources management, and perhaps one of the most comprehensive is the one given by Bahtijarević-Šiber (1999) who Human Resources Management understands as sequence of interconnected activities and tasks of management and organizations, directed to ensure adequate number and structure of employees, their knowledge, skills, interests, motivations and behaviours necessary to achieve development and strategic goals of organization.

Modern human resource management takes care not only of needs, interests and requirements of organisations, but it also takes care of those of employees that are engaged within broad spectrum of different tasks. Human resource management is taking care of employees; it develops them, leads them, manages them and pays them. Therefore, several main tasks of human resources management can be stressed out: human resources planning process, staffing and organization, employee engagement, employee development, workforce reductions, compensation, performance appraisal and administrative tasks. The bigger the organization, the bigger is the need for recruiting people in charge of managing personnel, or providing line managers with support in doing that.

Human resources are important resources of contemporary organization, and managing them is one of the key activities. Human resources are particular by their nature (opposite to other, tangible resources), which makes human resources management particular activity.

2.1 Human Capital – value and measurement

Human Capital is a part of a broader concept of intellectual capital whose first elements might be found in the Herbert Simons work Administrative Behaviour from 1945 (Kolaković, 2003). During the years, many economists, studying intangible assets, gave their contribution to the theory of intellectual and human capital.

There are three distinctive approaches to the theory of intellectual capital. First one is so called Japanese school that studied knowledge management. Main contribution of that school are emphasising the role of immaterial assets for modern companies, studying organizational knowledge and way to manage it and analysis of the relationship between organizational and individual knowledge. Second school is resource-based theory developed by the group of authors. That theory is stressing out the crucial role of efficient resources for the success of companies that are different from each other regarding their unique resources, capabilities and talents they possess. Those resources are fixed in short time, so companies have to create strategies for efficient use of their resources. Considering the fact that some of the resources are intangible, ability to gain and manage knowledge and know-how, as well as organizational learning become primary strategic tasks. Last source that contributed to the theory of intellectual capital are numerous studies of human capital, which started with the work of Adam Smith in 1776 and goes on to 1960s when strong foundations of this discipline are set (Sweetland, 1996). With the development of the theory of intellectual capital, human capital becomes its part and continues to be studied within that approach. Perhaps the greatest contribution to the theory of human capital is that of Gary Becker who founded the theory in 1964 with his book Human Capital. He defines the human capital theory as the set of activities that increase business abilities by developing the most valuable resource of all - people. There were numerous contributions in the years to come, but one of the most important, especially when it comes to measurement of human capital is so called Swedish school with its founder Karl-Erik Sveiby who was the first to recognize the need to measure

human capital, and advocated the accounting tracking of that immaterial asset. His work was followed by the work of Leif Edvinsson who, in 1995, had developed the model of managing what was previously called hidden capital, that is - intellectual capital. From that time, many companies worldwide in their annual financial report publish special addition that refers to the state of the intellectual capital in company and the ways the company uses that hidden asset to create added value.

Intellectual capital is generally identified (Dzinkowski, 2000) as being made up of elements that fall into three categories: (1) human capital – skills, abilities, knowledge, know-how; (2) relational capital – customer satisfaction, customer loyalty, supplier relationships; (3) organisational (or structural) capital – culture, intellectual property, manufacturing processes. The elements of all three categories interact and thereby add value to the organisation (Figure 1).

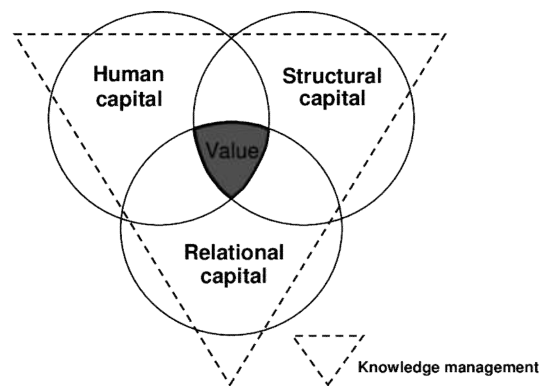


Figure 1 The value platform (Petrash, 1996)

The model recognises three main types of intellectual capital and argues that human capital acts as the building block from which one can construct the organisational capital of the firm and that both human and organisational capital then go on to interact and create customer capital. At the centre of the three forms of capital lies the value created by the interaction of these three components. The more they interact, the greater the value created (Wall, Kirk & Martin, 2004).

It is important to make clear distinction between knowledge and intellectual (human) capital. Although intellectual capital represents knowledge as a dynamic human process, but it is only when knowledge and intelligence are being used and transformed into something valuable for the organisation and its customers that knowledge becomes valuable asset, or human capital. Otherwise, that knowledge is only unused human potential.

Human capital has some distinctive characteristics that make it particular asset of an organisation. First of all it cannot be owned, it can only be rented (Edvinsson, 1997). Furthermore, it can develop, it does not lose its value by usage, other companies cannot easily copy it and they have very important social and psychological component. That makes the task of measuring and putting value to human capital extremely hard.

There have been many suggestions as how best to measure human capital (Balanced Scorecard, the Value added approach, the value creation index, Tobin's q, calculated intangible value, the Baruch Lev method, human resource accounting and many others). Unfortunately all of them have some limitations so, up to present day, there is no one that is universally (or even nationally) accepted as the best approach.

The fact is that within traditional reports, the money that enterprises spend on human resources are reported as a cost, rather than as an investment, although there are many studies that have proven that the return on investment in human capital is very high. This has been the

case even where firms have relied heavily on the knowledge and skills of their staff to generate earnings and growth and to improve efficiency and productivity (Westphalen, 1999). Better information on human capital might allow managers to allocate them more effectively and may enable them to identify all the activities necessary to bridge the gap between the existing and needed skills and abilities of the workforce. It might also facilitate the provision of more comprehensive information to investors or potential investors (Lank, 1997).

An important consequence of traditional managing and reporting practices is that, because human resource development appears as a cost rather than an investment, enterprises may be inclined to under-invest in training (Petty & Guthrie, 2000). This can lead to recruitment and retention difficulties within the company and to over-reliance on the public sector to support the required levels of training.

3. Human Resource Accounting

While considered critically important by owners and managers, the process of organizing, identifying, measuring, directing and controlling the human resources of an organization remains a difficult task for managers. Previous attempts to find tools and techniques to identify and disclose the real value of human resources as firm assets to the organization have been problematic, despite the clear dependence of an organization on its human capital for revenue creation, whether through intellectual endeavours or via physical effort (Arkan, 2016). It is widely acknowledged that human resources are key to the success or failure in any firm.

Due to the increasing importance of human capital in the economy for the development of concepts and methods of human resource valuation, human resources accounting has been developed. Human Resource Accounting seeks to quantify the intangible qualities that individuals bring to business. Human Resource Accounting helps management frame policies for human resources especially where it is necessary to identify measure and disclose data about the people within an organization. Human resource accounting is a new branch of accounting. It is based on the traditional concept that all expenditure of human capital formation is treated as a charge against the revenue of the period as it does not create any physical asset. But, this concept has changed and the cost incurred on any asset should be capitalized as it yields benefits measurable in monetary terms. In other words, human resource accounting is the art of valuing, recording and presenting systematically the work of human resources in the books of accounts of an organization (Ganta & Geddam, 2014). It is the measurement of the cost and value of people to organizations.

There are numerous definitions of human resources accounting. The American Accounting Association (1973) defined human resources accounting as the process of identifying, measuring and communicating information about human resources in order to facilitate effective management within an organization. This definition considers human resource accounting as a process of recognition and quantification of human resources for helping managers in their job. It also recognizes metrics related to placement, training and employee development and involves assessing the financial status of people in the organization. The definition is however unfinished as it is not specific as to what constitute the human resources expenditure and how it is to be recognized (Osemeke, 2017). According to Flamholtz (1999) human resource accounting is, at least in part, recognition that the skills, experience and knowledge that people possess are assets that can be termed 'human capital'. He stresses out that it is also a measure of the economic value of people in the organization.

Although there are some differences between authors in defining the term, the common for all definitions is the return of investment in human capital. Thanks to the development of human resources accounting, employees are now seen as the investment in the most liquid assets of

the company. Expenditures incurred in their recruiting, training and other activities represent the expense side, while knowledge, skills, abilities and the like of employees in carrying out business activities and achieving business profit represent the income side of the company.

Basically, human resources accounting is an information system that tells the management what changes over time are occurring to the human resources in the company and furnishes cost and value information for making management decisions about any activity regarding human resources in order to attain cost-effectiveness. It allows managers to monitor effectively the use of human resources.

Specific objectives of human resources accounting may be outlined as (Ganta & Gedam, 2014):

1. to assist the management in taking suitable decisions regarding investment on human resources;
2. to provide information to all people concerned regarding the earning potential of human resources of the organization;
3. to assess efficiency of human resources in obtaining productivity and profitability and
4. to provide comparative information regarding costs and benefits associated with investment in human assets.

Researchers have proposed three types of human resources accounting measurement models (Bontis, Dragonetti, Jacobsen & Roos, 1999):

1. cost models which consider the historical, acquisition, replacement or opportunity cost of human assets;
2. human resources value models which combine non-monetary behavioural with monetary economic value models and
3. monetary emphasis models which calculate discounted estimates of future earnings or wages.

In historical cost approach all costs incurred on recruiting, hiring, training and development the human resources are capitalized and amortized over the expected useful life of the human resources. This model records all of the mentioned human resources expenditures and a proportion of it is written off to the income of the next several years during which human resources will provide their services to the organization. This means that turnover and absenteeism negatively influence company's results, since if people leave organization prematurely the whole of the amount not written off is charged to the income of the year in which they left, not to mention appearance of new costs for recruiting, selection and other activities for the new employees. This model is very similar to the book value of the other physical assets. It is simple and easy to understand and its main benefit is that it can provide a basis of evaluating a company's return on its investment in human resources.

Similar approach is replacement cost approach where human resources are valued on the assumption of the costs that company would have if it have to replace all of their employees with new ones (with similar characteristics). It takes into consideration all costs involved in recruiting, hiring, training and developing and replacement. This approach is more realistic as it incorporates the current value of company's human resources in its financial statements prepared at the end of the year. It is more representative and logical (Ganta & Gedam, 2014).

For the companies with diverse workforce the opportunity cost model was developed. Opportunity costs are the value of an asset when there is an alternative use of it. The opportunity cost doesn't exist for those employees that are not scarce, so only scarce people should comprise the value of human resources. This method might be the base for planning, evaluating and developing human assets of a firm.

Finally there is a model that propose an economic valuation of employees based on the present value of future earnings, adjusted for the probability of their leaving of company due to death, separation or retirement. This method helps in determining what an employee's future contribution is worth today.

All of the models have some limitations and none of them has been long-run success. Trying to put it simple, those models attempt to calculate the contribution that human assets make to firms by capitalising salary (and some other) expenditures. Instead of typically classifying total wages as an expense on the income statement, a discounted cash flow of total wages is classified in the asset section of the balance sheet.

There are a lot of limitations and criticism of human resource accounting. These include the dehumanization of people where they cannot be viewed like physical assets. Then, there is the question how one amortizes the value of an employee. Does it increase or decrease over time? And in certain industry sectors, the effort to conduct human resource accounting might be questionable amid high staff turnover rates especially in volatile markets. From a process point of view, the lack of a clear-cut procedure in allocating costs and value, the lack of empirical evidence to support its use as a management tool, and some vagueness regarding exactly how the value should be presented in the financial statement all represent significant problems for its wider adoption and use (Arkan, 2016). Accounting for salaries of managers and the costs of training are one thing, but putting a value on the growth and accumulation of their knowledge is much more difficult (Bontis, Dragonetti, Jacobsen & Roos, 1999).

4. Conclusion

Human resource accounting is not a new issue in economy since accountants have recognized the value of human assets for at least seventy years. Human capital is considered a very important production factor, and as such it has to be measured, in order to enable organizations to effectively manage it.

Human resources accounting as a managerial tool can be used for effective management of human resources. Accounting treatment of human resources developed different approaches to putting a value to intangible and very particular human resources of organization. All models have some advantages, but there is also a present criticism to all of them as they suffer from subjectivity and lack reliability since their measures cannot be audited with assurance. Some other criticism include the morality of treating people as assets and whether such measures are too easily manipulated.

Nevertheless it is extremely important to recognize the value of HR in financial statements, since if their value is not recorded it leads to reducing of value of company's assets and thus loss of potential investors. Information of value of human capital are extremely important for the management of organizations since they want to calculate the best investment returns of the enormous expenditures of recruitment, training and development.

So, it is obvious need to further develop models for accounting of human capital for the need of external users such are creditors, investors and others, as well as for the needs of the management of the company in order to accomplish its strategic goals and as a starting point for future planning by recognising the core competencies of human capital. Although at an individual firm level there are already established practises of human resource accounting, future research is needed in order to develop broadly acceptable human resource reporting. Such research should be aimed at providing a consistent basis for the development of a set of guidelines for the identification, measurement, reporting and management of the value of human capital.

REFERENCES

- American Accounting Association's Committee on Human Resource Accounting (1973), Report of the Commit on Human Resource Accounting. *The Accounting Review*, 48 (Supplement), 169–185.
- Arkan, T. (2016). Human Resources Accounting: A Suggested Model for Measurement and Valuation. *Finanse, Rynki Finansowe, Ubezpieczenia*, 1 (79), 173-193.
- Armstrong, M. (2008). *Strategic Human Resource Management (4th ed.)*. London, UK. Kogan Page.
- Bahtijarević-Šiber, F. (1999). *Management ljudskih potencijala*. Zagreb, Croatia. Golden Marketing.
- Bontis, N. (1996). There's a price on your head: managing intellectual capital strategically. *Business Quarterly*. Summer, 41-47.
- Bontis, N., Dragonetti, N.C., Jacobsen, K. & Roos, G. (1999). The Knowledge Toolbox: A Review of the Tools Available to Measure and Manage Intangible Resources. *European Management Journal*. 17(4), 391-402.
- Dzinkowski, R. (2000). The measurement and management of intellectual capital: an introduction. *Management Accounting*. 78(2), 32-6.
- Edvinsson, L. (1997). Developing intellectual capital at Skandia. *Long Range Planning*. 30(3), 366-73.
- Flamholtz, E. (1999). *Human resource accounting: advances in concepts, methods and applications*. New York. Spriner Science+Business Media.
- Ganta, V.C. & Geddam, M. (2014). Human Resource Accounting. *International Journal of Academic Research*. 1(3), 54-61.
- Hauser, J.R. & Katz, G.M. (1998). Metrics: you are what you measure! *European Management Journal*, 16(5), 517-528.
- Kolaković, M. (2003). Teorija intelektualnog kapitala. *Ekonomski pregled*. 54 (11-12), 925-944.
- Lank, E. (1997). Leveraging invisible assets: the human factor. *Long Range Planning*. 30(3), 406-12.
- Marasović, L. (2017). *Human Resource Accounting*. Unpublished final thesis. University of Split, University Department of Professional Studies. Split, Croatia.
- Nordhaug, O. (1993). *Human capital in organizations: Competence, training and learning*. Oslo, Norway: Scandinavian University Press Publication.
- Osemeke, M. (2017). Human Resources Accounting: Issues, Benefits and Challenges. *International Journal of Economics, Finance and Management Sciences*. 5(3), 129-138.
- Petrash, G. (1996). Dow's journey to a knowledge value management culture. *European Management Journal*. 14(8), 365-73.
- Petty, R. & Guthrie, J. (2000). Intellectual capital literature review: measurement, reporting and management. *Journal of Intellectual Capital*. 1(2), 155-176.
- Sweetland, S.R. (1996). Human Capital Theory: Foundations of a Field of Inquiry. *Review of Educational Research*. 66(3), 341-360.
- Wall, A., Kirk, R. & Martin, G. (2004). *Intellectual Capital – Measuring the Immeasurable?* Oxford. CIMA Publishing.
- Westphalen, S. (1999). *Reporting on human capital: objectives and trends*. Paper presented at the International Symposium Measuring Reporting Intellectual Capital: Experiences, Issues and Prospects, OECD, Amsterdam.

Tourism contribution to cultural heritage

Dr. Mercedes Aznar
Florida Universitaria, Valencia, Spain
maznar@florida-uni.es

Abstract. It is generally agreed that cultural heritage plays a key role in the European economy (over 300,000 employed people and 7.8 million indirect jobs) and a foremost impact on society by bringing social cohesion and very important, intercultural dialogue. Recently, the European Commission (together with UNESCO, the Council of Europe and other European organisations) announced the official opening of 2018 as the European Year of Cultural Heritage, whereby many initiatives will be developed involving all countries across Europe. The main objective of this initiative is double-fold: on the one hand, to foster the discovery of Europe's cultural heritage; and on the other, to encourage the idea of us all being members of a common European family. There are a number of objectives to be achieved but this paper will focus on one of them, i.e. sustainability, which makes tourism responsible for preservation and good practices around cultural heritage. We will point out how tourism can contribute to strengthening small rural communities around their cultural heritage; and besides, how it can contribute greatly to sustain the local economy of those small communities, thus reinforcing a sense of belonging; and hence, how the afore-mentioned factors may impact on cultural heritage positively. But sustainability cannot develop if all the stakeholders involved in cultural heritage tourism are not aware of the dangers that can derive from overtourism, a cancerous growth in certain destinations that is making people react against the tourist visiting their homeland. This is a serious situation that cannot benefit any of the parties involved and which also, undermines intercultural dialogue, the main pillar of the European Commission.

Key words: overtourism, tourism, culture and heritage

1. Introduction

“Cultural heritage is not only a legacy from the past, but also a resource for our future.”

*Tibor Navracsics, European Commissioner in charge of
Education, Youth, Culture & Sport*

Cultural heritage plays a key role in the European economy, since it employs over 300,000 people, and 7.8 million more in indirect jobs (European Commission, 2018). Consequently, it embodies a foremost impact on society by bringing social cohesion and very important, intercultural dialogue. And tourism is a key stakeholder.

The relevance of cultural heritage tourism is widely acknowledged, since it represents the dialogue between cultures and consequently, it becomes a promoter of peace and understanding. Furthermore, tourism can enhance economic development and keep local customs and traditions, which may be at risk in such a globalized world as we are living in.

According to the UNWTO's report on tourism and culture synergies (UNWTO, 2018b), 40% of international arrivals are regarded cultural tourists, i.e. those who participate in a cultural activity as part of their stay. Therefore, it is vital to develop specific policies and practices in an integrated and sustainable way in order to ensure success in revenues but above all, widespread satisfaction.

There are many examples worldwide of successful heritage tourism initiatives but the most important one at present is certainly *The Silk Route*, a project work in collaboration with UNESCO, which was first raised at UNWTO's General Assembly in 1993. It intends to join 3 continents and cover over 12,000 km and has 34 Member States participating so far. Although war conflicts and terrorist attacks are a major threat, there is a worldwide manifest interest in this initiative (related to this, China has recently launched *The New Silk Route* – called *OBOR, One Belt, One Road* – with the objective to take advantage of the commercial benefits that can derive from this ancient route). Moreover, this is why TripAdvisor presented in March 2017 their second survey on travel trends for the silk road, a report that assesses travel preferences, habits and interests along the route (TripAdvisor, 2017). Recently, UNWTO has launched the *2025 Silk Road Tourism Agenda* (UNWTO, 2018a) aiming to highlight main strategies and policies to be carried out to further implement the route, once again focusing on this initiative as the most important tourism route across countries in the 21st century. Likewise, and in collaboration with Sunny International, they have conducted a research analysis on the impact of the different maritime routes which link distinct cultures (UNWTO, 2018c, forthcoming). The ultimate goal of this initiative is to achieve a mutual benefit between the communities and the tourism sector itself and indeed, to foster local investment and very important, the preservation of both the route's cultural and natural heritage.

Therefore, tourism is crucial to preserve heritage and also, to provide social stability and enhance local identity. Actually, this is the reason why 2018 has been nominated the European Year of Cultural Heritage, an extremely relevant initiative by the European Commission in collaboration with the European Parliament and the Council of Europe, UNESCO as well as the Committee of the Regions and the European Economic and Social Committee. The Commission's objective is double-fold: on the one hand, to encourage people to discover and enjoy the European cultural heritage; and on the other, to strengthen a sense of belonging to a common European family. This will lead to reinforce a number of issues such as, the promotion of people's engagement also focusing on children's education; sustainability and hence, responsible tourism; the protection of heritage at risk in all those areas where there is political instability and also, fighting against the illegal trade of heritage goods; and finally, innovation through education on skills related to heritage for professionals, local communities active involvement, and research, science and technology for the benefit of heritage. Many actions will be developed towards achieving this goal and small rural European regions should not ignore this great chance to the benefit of their whole communities.

However, one cannot ignore that heritage tourism has always been confronted with a number of problems as for example, insufficient levels of investment to preserve and develop cultural heritage; insufficient infrastructure at a local level, particularly in the case of small villages; or insufficient qualification regarding tourist service providers, among others (Ismagilova et al., 2015). Therefore, public funds are vital and should be easily available to sort out these challenges because the return on investment may be highly satisfactory if managed adequately (Bowitz & Ibenholt, 2009). Otherwise, a negative image is developed of both the tourist

destination and as a result, of the whole country with the consequences that may surely derive from such a situation. Hopefully, the European Year of Cultural Heritage initiative will help minimize these challenges and establish pathways to be followed in the future so as to ensure that heritage will always be there for the enjoyment of future generations.

Another significant feature of cultural heritage tourism is that it may help distribute tourist streams on the territory and level the fluctuations deriving from seasonality, among many other reasons (Ismagilova et al., 2015). It is particularly beneficial for increasing internal tourism because it appeals to regional values that a country's citizens would share; it should not be forgotten that heritage has a great potential to generate a strong sense of belonging, a regional identity and social cohesion (Taylor & Kneafsey, 2016). All these facts together influence on the development of communities. One of the most significant outcomes is the increase in the number of companies which creates an opportunity for employment of disadvantaged groups such as, women and young people. Moreover, it is commonly agreed that on the one hand, heritage is a universal resource for tourism, which already initiated as far back as among ancient civilizations (Lee & Chhabra, 2015; Timothy & Boyd, 2003) as well as a key factor to develop communities and consequently, increase quality of life (Di Pietro et al., 2015; Long, 2014) because it spreads to many other forms of tourism to enhance the tourist's experience, as culinary and wine tourism. Tourism is an old way of mingling communities and this therefore forces the sector to constantly innovate; in the case of cultural heritage, new technologies must be seen as a key factor to provide added value (Di Pietro et al., 2018). A difference must be made here between online technologies (websites and mobile applications, very widely used nowadays in major tourist destinations but not so often when it comes to rural spots) and on-site technologies (e.g. audio-guides and mobile applications, very frequently used in museums and the like). However, further analysis should be made on how to make these technologies easily available in small rural communities, as they certainly maximize the tourist's experience and make information accessible to a wide range of potential tourist segments too. Nevertheless, the threat of mass tourism must always be present because of its negative impact (Farid, 2015). In the case of heritage sites, an excess in the number of tourists certainly affect the safety of these sites; also, heavy traffic deriving from this results in pollution that can seriously damage them as well as the residents. Consequently, tourism management in World Heritage Sites is of paramount importance in order to ensure a positive effect on both the heritage itself and on the economic development of the rural area.

World Heritage Sites are among the most emblematic tourism destinations and attractions; however they also face numerous challenges due to an ongoing rise in tourism activity and related issues such as, building infrastructures to accommodate visitors. The benefits of cultural heritage tourism are amplified through revenues and their impact is much wider than just the direct spending levels, as tourist income may become highly beneficial in the preservation of the various sites. This money brought into the economy thus boosts new businesses and consequently tax revenues but also, existing businesses may profit from new clients and new money coming in (Aznar & Hoefnagels, 2018). The social benefits resulting from cultural heritage tourism should not be underestimated as they will help support local traditions and culture, which is utterly addressed in UNESCO's recognition of cultural heritage as being as important as buildings and statues; besides, it strengthens community relations and partnerships and helps boost local investment in heritage resources. Moreover, it helps encourage residents to become mindful about their impact on the cultural and natural heritage environment.

To sum up, heritage tourism is key to maximize local development through job creation and revenues, although there are cases in which the focus is placed on returns thus overlooking the negative impact that mass tourism can inflict on the community where it develops. As a result, some of those revenues are reinvested in preserving heritage sites and also, local culture and traditions, which is the ideal duality between tourism and heritage. Therefore, this paper will firstly, present a description on the relevance of heritage tourism in Spain; secondly, focus will be placed on the risks that may derive from overtourism; and finally, an example of a small village in Spain will be presented on how the link between tourism, heritage, and the local community can result in successful outcomes.

2. The Relevance of Heritage Tourism in Spain

“A nation’s culture resides in the hearts and in the soul of its people.”

Mahatma Gandhi

For a long time now, the Spanish government has realized that the country’s tourist offer is wider than just a sun and beach destination. For that reason, an important effort has been made towards developing a tourist strategy that attracts quality tourism (Aznar, 2015). It is for this reason that since 2005, the General Sub-Directorate of Statistics and Studies of the Technical Office, belonging to the Spanish Ministry of Education, Culture and Sports, publishes a *Yearbook of Cultural Statistics*. It aims to facilitate information on the state-of-affairs in the Spanish culture, its social value and its role as a source of wealth creation and economic development in the Spanish society. Cultural tourism is one important chapter where the concept of international tourist encompasses non-residents who visit the country and stay at least one night, and Spaniards who live abroad and visit Spain. According to the *Yearbook of Cultural Statistics 2017* (Ministry of Education, Culture and Sports, 2018), 8 million international tourists visited Spain in 2016 mainly for cultural reasons (about one more million compared to 2015), which represents 12.5% of total trips made for leisure, recreation or holidays in this group. However, the most significant outcome is the evident increase in the number of tourists until now, as shown in figure 1:

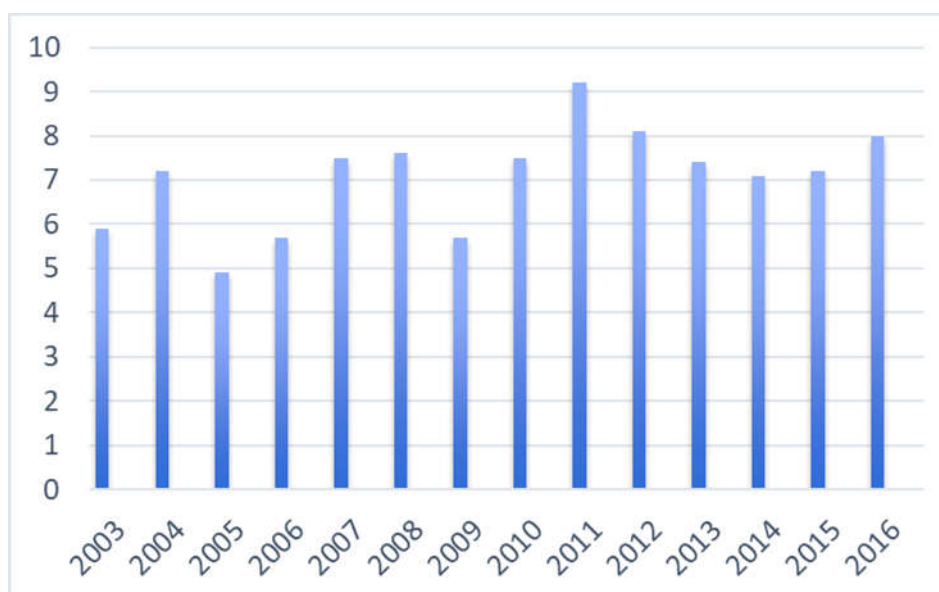


Figure 1 International arrivals based on cultural motivations

Moreover, the total tourist expenditure amounted to 8,567.1 million euro (a growth of over half a million euro compared to 2015); notwithstanding these figures, and observing the data since 2005, the most relevant outcome is that tourist expenditure experiments a continuous growth throughout the period of analysis:

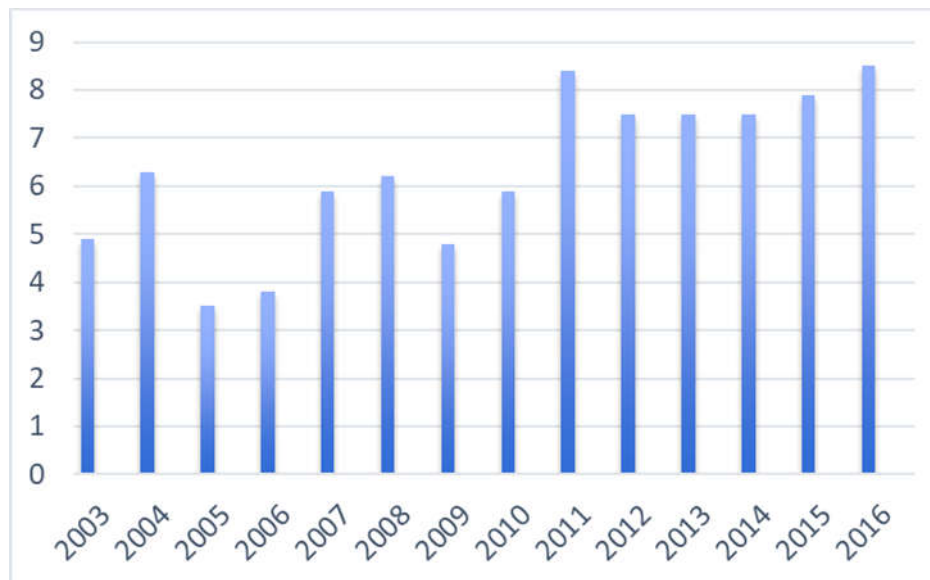


Figure 2 International tourist expenditure (in billion €)

It is therefore evident that cultural tourism has remained anti-cyclical in Spain during the period of European economic crisis up to nowadays; similarly, the expenditure has kept stable. Hence, a conclusion can be made that the target is very specific and occupies now a steady market niche.

However, heritage tourism is dangerously exposed to the impact of massive tourism, which is a new source of trouble that has newly arisen and which tourist providers should feel responsible for, i.e. the newly coined concept of overtourism (known in Spain as *tourism phobia*). Although Boissevain (1996) already warned about mass tourism 20 years ago, nowadays this problem has reached its peak, it has no clear-cut solution, and unfortunately, it is more than likely to stay for a few generations.

Overtourism can be defined as that situation in which there are too many tourists and as a result, the quality of life for the residents deteriorates and very important, the quality of the tourist's experience is irretrievably damaged. It is commonly agreed (Responsible Tourism Partnership, 2018; Euromonitor International, 2018; Tourtellot, 2017; Goodwin, 2017) that factors such as low cost of flights, disintermediation (for example, the case of Airbnb), seasonality, focus on major destinations by marketing organizations (as it is less expensive and success is guaranteed), new phenomena like hen and stag parties, tourists' behavior, and the public realm (which is free of charge), have led to local residents' reaction against tourism with an increase in the tension between locals and tourists, and even demonstrations against it, as was the case last summer in Barcelona, Balearic Islands and the Autonomous Community of Valencia (mainly in Valencia and Alicante). Some European destinations have already taken further action to minimize this problem (Montevago, 2017) by increasing tourist taxes (as Amsterdam or Balearic Islands), limiting the number of cruise ship tourists (as Santorini or Dubrovnik), or promoting off-season tourism with incentives on reservations (as Venice).

But one of the most important actions related to the aim of this paper has been, for example, the setting of a limit in the number of visitors allowed into cultural heritage sites, as has happened in Dubrovnik's ancient city center, which is a World Heritage Site; as a matter of fact, UNESCO threatened to remove this status unless the number of tourists was significantly decreased.

Likewise, there is common consensus (Francis, 2018; Goodwin, 2017; Tourtelot, 2017) that international arrivals are the wrong measure for tourism management and suggest that instead, tourist expenditure and above all, tourist and resident satisfaction should be crucial factors to consider. Besides, other issues should be worked on such as, sustainability accounting, i.e. a measure of the benefits and costs at an economic, social, and environmental level; the tax subsidy on aviation fuel which has led to a substantial fall in flight prices; the carrying capacity, as mentioned above in the case of cruises arriving in Dubrovnik; the limits of acceptable change, a key action whereby tourist private and public stakeholders should work together with the local community to identify indicators of imminent problems; de-marketing hotspots; using pricing to target specific segments and thus, target quality tourism; and surely, reducing seasonality and promoting shoulder seasons instead.

In actual facts, overtourism is the opposite of responsible tourism, since it is not intended to improve places both to live and to visit. But most importantly, it is contrary to sustainability and bearing in mind that 2017 was proclaimed as the International Year of Sustainable Tourism for Development by UNWTO, this leads to believe that there was something wrong in the initial strategy. A number of slogans were published proclaiming tourism as a catalyst for positive change or a vital contributor to social inclusion and cultural and environmental betterment and preservation (Aznar, 2018, forthcoming). However, they cannot be fully applied nowadays in a great deal of destinations, as is the case of Mediterranean honeypots. Therefore, it is a fact that unless serious actions are taken towards solving this problem, traditional destinations will keep on suffering a serious damage as well as heritage sites and their invaluable legacy.

2.1 Rural development and heritage tourism

At the end of the XX century several small rural communities in Europe were at a high risk of becoming depopulated, because young people decided to leave for urban areas in search of a job in their industrial environments. The basis of rural economies, agriculture and livestock, could not support the local economy in many cases because there were no hands to work on. Consequently, many small villages were left abandoned because they could not handle certain factors that contributed to this problem (Aznar, 2016): an aging population; a migration towards cities; or a rise in the number of isolated communities thus generating a degradation of their economic environment and as a result, leading to unemployment. Fortunately, in other cases young people with a lot of stamina and a strong will to save their habitat adopted a different strategy, particularly in those villages that enjoy, and benefit from, a rich natural or cultural heritage, or both.

Rural communities must recourse to their assets if they want to survive. Some of them benefit from a rich natural heritage and others from a valuable cultural heritage. The community selected in this paper to show a case of success in managing heritage tourism enjoys both a

natural (it is surrounded by three rivers and beautiful green meadows) and a cultural heritage (Romanesque buildings and an ancient archaeological site).

The Spanish plateau (the central part of the country) typifies a low density of population in many of its villages. For the purpose of this paper, a small village in this area has been chosen (Garray) that will illustrate the importance of heritage tourism, i.e. a typical community that had lived mainly on agriculture and some livestock until the outbreak of the Spanish Civil War (1936-1939) and in particular, throughout the 40-year postwar fascist regime which impoverished the Spanish population and had a tremendous impact on rural economy. The most direct consequence was the migration to largest urban areas, such as Madrid or Barcelona, where important industrial areas were being developed thanks to the new fascist regime's subsidies. This implied the neglect of farmland and the traditional way of life in small rural communities; too many of them completely disappeared after a few years however, the village subject of this analysis is one of those cases where a few inhabitants decided to stay.

This village enjoys one of the most important archaeological sites in Spain, i.e. *Numantia*, the most powerful stronghold in the Celtiberian history of the region (from 13th to 1st centuries BC approximately), famous for its resilience against the Romans. The site covers a vast area that has been going through field research by undergraduate students from a prestigious university in Madrid for over 30 years. Every summer these students stay in the village for about three months, not only working on the excavation but also mingling with the residents. This has had a double effect: on the one hand, villagers have become fully aware of their heritage and thus, of their own roots and history; and on the other, archaeologists treated villagers as their equals. This was the turning point in the most recent history of the community because during the fascist regime, villagers were always labelled as illiterate hillbillies, and treated as such. This consequently triggered the development that began later in time: both their self-esteem and their pride for their history and above all, their heritage increased, which led them to eagerly become creative and willing to participate in designing and developing a number of actions related to *Numantia*. Furthermore, a strong cohesion among the locals was generated since whole families participated (from new-born babies to their grandparents). Thus, at the end of the XX century a group of villagers decided to perform a historic recreation of one of those Celtiberian wars; of course, it was free of charge. It was so successful that since then, every year historic recreations take place that bring back to life the history of *Numantia* and also, inform people on the Celtiberian culture and traditions. In order to facilitate these initiatives, a non-for-profit Association was founded in 2003 aiming to promote the Celtiberian heritage, its preservation, and the community itself. It started with 20 members and nowadays it has 700 from all over Spain; also, 110 sponsors from sectorial organizations, rural hotels, and local businesses contribute towards the success of the initiative.

When the first recreation was performed (1998), the village had a population of 362 inhabitants. Since then, it has increased to 48.6%, according to the Spanish Municipal Register of Inhabitants (NSI, 2017):

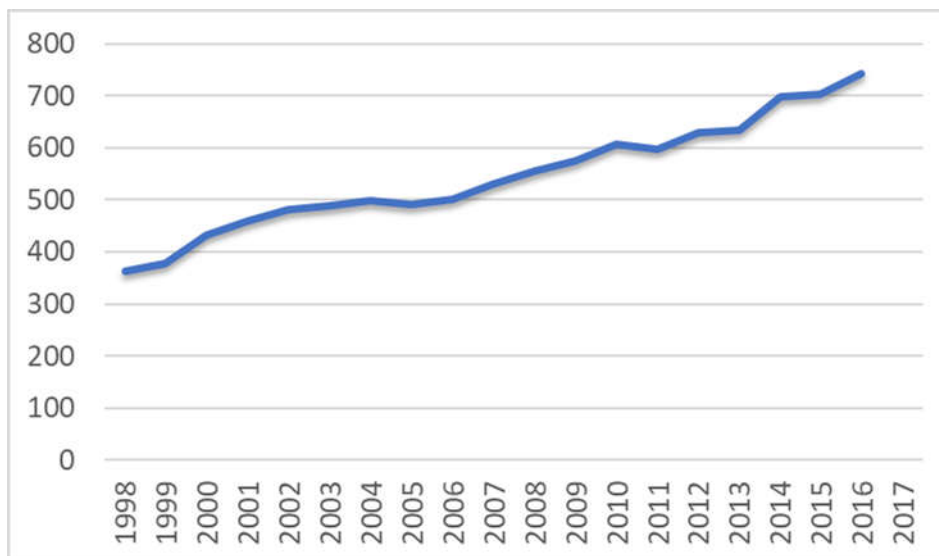


Figure 3 Evolution in the number of inhabitants

It is worth noting that 83.22% have migrated to this village from the rest of Spain; and 4.56% from other countries, mainly from Latin America (47%), Europe (38.2%) and Africa (14.7%). Undoubtedly, this is proof of economic wealth in the area. Furthermore, there has been a reverse in the demographic trend: the village is not an ageing community anymore, as the rate for active population (i.e. from young adults until retirement – 18 to 65) is 71.7%, quite evenly distributed among males and females; 14.36% belong to the bracket 0 to 18; and only 15.16% represent seniors and the elderly.

Regarding the non-for-profit Association, they have been granted official permission by the regional authorities to manage the archaeological site and also, all the information sites in the province. A small fee is charged for visiting the site and revenues are re-invested in the site's maintenance, the dissemination of information on the heritage, and jobs creation (as a matter of fact, 14 people are employed in the Association at present). In fact, a shop was open outside the site which led the association to create their own start-up dealing with the Celtiberian merchandising, i.e. manufacturing and sales at a national level.

As far as tourist numbers are concerned, 54,000 people visited *Numantia* in 2017 (ACC Tierraquemada, 2017), which shows a growth of 40% compared to the previous year. And about 4,000 people attend the various historic representations that take place throughout the year, particularly the one unfolding the Numantian Wars that happens once a year. This has led to a significant rise in the number of new small businesses since the year 2003 (+64.81%):

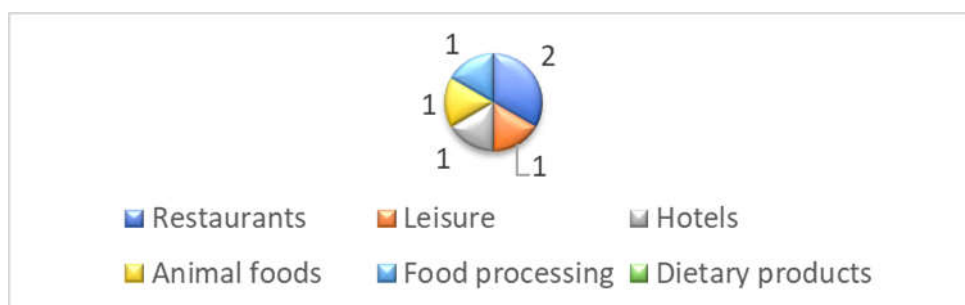


Figure 4 Number of companies before 2003

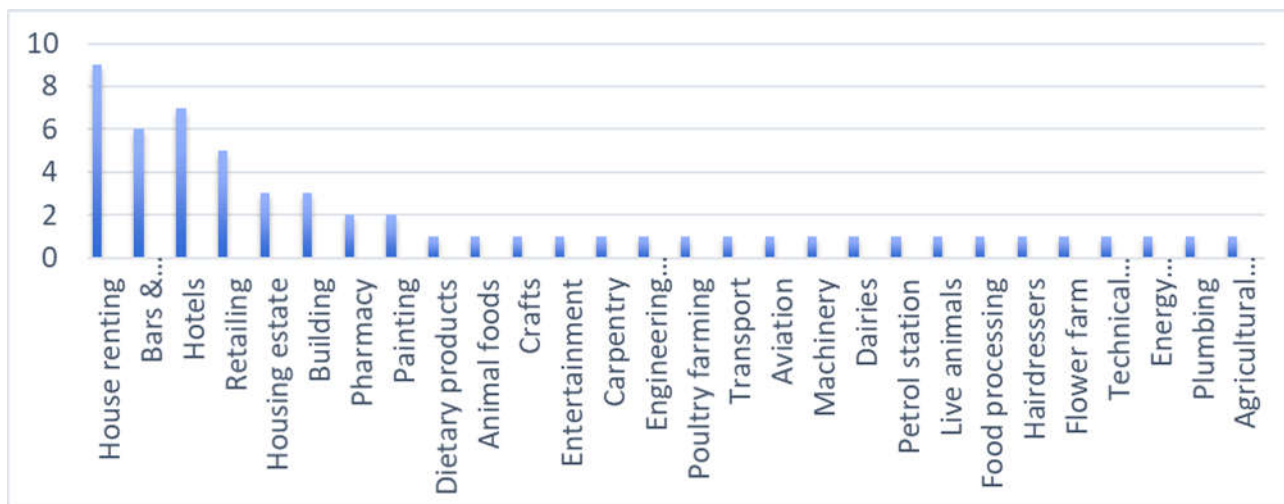


Figure 5 Number of companies after 2003

As can be seen in figures 4 and 5, there has been an evident and considerable rise in the number of SMEs since 2003 when the association was created. Before that moment, only 6 companies could be found; since 2003 up to nowadays, 52 new businesses have been set up that cater for all the tourists' needs thus ranging from small rural hotels to small restaurants, hairdressers, crafts, housing estates, etc. And even more importantly, all the new SMEs have assumed their key role as disseminators and promoters of the Celtiberian heritage as well as the local traditions.

Such considerable economic development made residents feel that their way of living was finally stable and therefore, encouraged them to participate in all the actions brought about by the non-for-profit Association. As a result, residents have brought back to life the traditional craft and artistic skills of the Celtiberians developing products with a large added value on the one hand; and on the other, the Celtiberian cuisine by organizing gastronomic days which attract an important number of tourists who wish a first-hand experience of the heritage history and also, those who are willing to enjoy gastronomic and wine tourism (it is worth noting that one of the most important Spanish wine denomination of origin areas is in this region, i.e. Ribera del Duero). These initiatives have proven crucial as they have encouraged an increase in the number of overnights, thus contributing to the wealth of the small rural hotels and restaurants spread throughout the village; but most importantly, revenues are being reinvested in preserving the site, continuing with the archaeological excavations, and opening up new public premises to unfold the history of the ancient site.

Thanks to the relevant increase in the number of visitors already mentioned, there has been also a rise in revenues from the visits to the site and to the many exhibitions that have been carried out in the village and also, in the whole province. Therefore, and bearing in mind that this year the 2150th commemoration of the Celtiberian-Roman war episodes will take place, the positive visitor rates encouraged the members of the Association as well as the residents to initiate a series of actions towards this celebration as long as two years ago. The outcome has been the creation of a Commission composed of the Spanish Ministry of Culture, the regional government and the village Town Hall (Spanish Ministry of Education, Culture and Sports, 2017); more importantly, the king Felipe VI has accepted to become the Honorary president of this working group. Moreover, from the cultural events and cultural tourism plan of the Secretariat of Culture, a decision has been made to establish fiscal benefits to promote events regarding the above-mentioned commemoration. Since this has been declared as an exceptional event of public interest by the Minister of Culture himself, even up to 90% of tax benefits will be granted out of the total expenditure in order to foster private involvement.

Hence, the Spanish government is adhering to the actions revolving around the European Year of Cultural Heritage 2018.

So far, significant budget items have been allocated towards the preservation of the Celtiberian heritage of *Numantia* in the Finance Law 3/2017 of 27 June (BOE, 2017), i.e. €18,150 for the next archaeological campaign in the site; €30,000 for the reconstruction of a Celtiberian house (and utensils) in the site; €59,000 to improve access to the site; and €15,000 ERDF (European Regional Development) funds to signpost Roman camps in the area surrounding the site. Here it is worth mentioning that all this could not have been possible if a reduced number of young villagers, who were proud of their roots and aware of their rich heritage, would not have decided to start reconstructing their history 20 years ago; thus setting up an Association to involve residents and preserve it; thus increasing the number of visitors to the village (and consequently, revenues and employment); and thus having the right support to draw the attention of both the regional and national governments to contribute towards the cultural heritage of *Numantia*. Therefore, it can not be denied that tourism can contribute greatly to cultural heritage although this would be a difficult target to achieve without an active involvement of the residents.

Through the implementation of all the cultural events (which are free, except for the visit to the archaeological site), there has been a full and active involvement of the residents in the development of their own homeland and the preservation of their heritage site and traditions. Having the privilege of belonging to a rich cultural heritage led locals to innovate and become creative, since the remains had always been there, but it is only the human factor that can make the most of them. However, such a success could not have been possible without the collaboration at a certain stage of public and private bodies and the regional government together with the village Town Hall towards the benefit of the cultural heritage.

3. Conclusions

The beauty and value of a cultural heritage can never be denied. Nevertheless, a heritage is worth nothing if residents do not consider it as part of their own history and also, if local and regional authorities do not learn how to really appreciate it and thus, respect and protect it. Increasing tourism revenues more and more every year can, and should, not be the measurement scale of tourism success anymore. Instead, a focus should be placed further on the destination itself (particularly important in the case of heritage sites) and especially, on the residents. If residents are satisfied with tourism, travellers will be highly satisfied with the experience. And this is what the 21st century tourist wants to enjoy, i.e. a true experience.

Furthermore, governments should not keep on overlooking the situation of rural areas, particularly in countries with major destinations where the focus is always placed on the honeypots thus adding to the demographic rural depopulation. A country can not survive without its rural environment, not only because it can be a source of goods to cater the country's inhabitants but because it is where their roots usually lie and in many occasions, valuable heritage too.

This paper has illustrated how tourism, heritage and small rural communities can go hand in hand to achieve the three successful pillars of a tourism experience: resident's satisfaction, tourist's satisfaction, and revenues to meet the needs of the local governments, the residents and businesses, and the heritage itself. As described, depopulation is not a danger anymore in the case of analysis here but rather, migration has been reverted and the village does not typify and ageing population anymore. Besides, there has been an increase in the number of small businesses and as a result, a rise in job creation and employment; in particular, for segments at risk of labour exclusion such as women and young people, thus contributing to

the SDGs (Sustainable Development Goals), precisely those calling for inclusion and gender equality. This all has led to an increase in income through revenues and taxes deriving from the tourism experience, which, in turn, has favoured a surge in the resident's self-esteem and social cohesion among the village members. And very importantly, the crucial outcome here has been a breach in seasonality, since the various actions and events are developed throughout the year, and consequently, we can observe a sustainable tourism experience, which should always be the main goal to be achieved. In addition, this achieved sustainability has been – and is being – contributing to the protection of the archaeological site, to the preservation of that cultural heritage, and also, to the local traditions.

Notwithstanding the above, it is worth pointing out that overtourism is always a key issue for the aforementioned non-for-profit Association and so far, it has been avoided by limiting the number of visitors in the site itself (always with guides) and also, in the historic recreations and similar activities which are performed in front of an audience: entrance is free of charge and for this reason, the adequate number of visitors has been established so that the village can cater for their needs on the one hand, and on the other, the resident does not feel overwhelmed by the tourist experience.

The involvement of the local community has played a crucial role: by including the local people and the local businesses and town hall they all have ended up truly believing in, and working for, *Numantia*, their heritage, with the clear objective of protecting their territory, the archaeological site, and their traditions and way of life. The initiative has prompted a sustainable tourism, a sustainable economy, and a sustainable environment (both natural and concerning the heritage site), thus leading to a superb tourist experience.

In sum, the case presented here has already complied with the guidelines of the European Year of Cultural Heritage whereby especial emphasis should be placed on four basic issues: 1. the value of cultural heritage to society; 2. its contribution to economy; 3. its role in European cultural diplomacy; and 4. the importance to safeguard it for the enjoyment of future generations. Hopefully, this Spanish case won't be an isolated sample in Europe in the short term.

REFERENCES

- ACC Tierraquemada (Cultural Celtiberian Association Tierraquemada). (2018). *Annual Report 2017*.
- Aznar, M. (2018, forthcoming). 1st Century Tourism: Threats and Opportunities. In: *Innovation Management and Education in Tourism & Hospitality*. Coleção Politécnico da Guarda – Observatório de Turismo da Serra da Estrela.
- Aznar, M. & Hoefnagels, H. (2018). Empowering small rural communities through heritage tourism. In *Proceedings of t-Forum 2018 Global Conference (UNWTO)*. Palma de Mallorca, Spain.
- Aznar, M. (2016). Developing small rural communities through cultural heritage: A Spanish case. *CIET (Contemporary Issues on Economy & Technology) Conference Proceedings*. Split, Croatia. ISBN: 978-953-7220-15-0.
- Aznar, M. (2015). Challenging hard economic times. In: *Innovation Management and Education in Tourism & Hospitality*. Coleção Politécnico da Guarda – Observatório de Turismo da Serra da Estrela.
- BOE (Official Gazette of the Spanish Government). (2017). Finance Law 3/2017 of 27 June. Retrieved May 8, 2018, from https://www.boe.es/diario_boe/txt.php?id=BOE-A-2017-7387.
- Boissevain, J. (ed.). (1996). *Coping with tourists: European reactions to mass tourism*. Providence, Oxford: Berghen Books.
- Bowitz, E., & Ibenholt, K. (2009). Economic impacts of cultural heritage – Research and perspectives. *Journal of Cultural Heritage*, 10 (1), 1-8.

- Di Pietro, L., Guglielmetti, R., & Renzi, M. F. (2018). Heritage and identity: technology, values and visitor experiences. *Journal of Heritage Tourism*, 13 (2), 97-103.
- Di Pietro, L., Guglielmetti, R., Mattia, G., & Renzi, M. F. (2015). Cultural heritage and consumer behavior: A survey on Italian cultural visitors. *Journal of Cultural Heritage Management and Sustainable Development*, 5 (1), 61-81.
- European Commission. (2018). Cultural heritage_Strategic framework. Retrieved January 13, 2018, from <https://ec.europa.eu/culture/>.
- Euromonitor International (Blog). (2018). Barcelona and Spain and their battle with overtourism. Retrieved February 20, 2018, from <https://blog.euromonitor.com/2018/02/barcelona-overtourism.html>.
- Farid, S. M. (2015). Tourism management in World Heritage Sites and its impact on economic development in Mali and Ethiopia. *Procedia – Social and Behavioral Sciences*, 211, 595-604.
- Francis, J. (2018). Overtourism solutions. *Responsible Travel*. Retrieved February 14, 2018, from <https://www.responsibletravel.com/copy/overtourism-solutions>.
- General Sub-Directorate of Statistics and Studies of the Technical Office (Spanish Ministry of Education, Culture and Sports). (2018). *Yearbook of Cultural Statistics 2017*. Retrieved February 13, 2018, from <https://www.mecd.gob.es/servicios-al-ciudadano/estadisticas/cultura/mc/naec/portada.html>.
- Goodwin, H. (2017). The challenges of overtourism. *Responsible Tourism Partnership Working Paper 4*. Retrieved February 20, 2018, from haroldgoodwin.info/pubs/RTP'WP4Overtourism01'2017.pdf.
- Ismagilova, G., et al. (2015). Using historical heritage as a factor in tourism development. *Procedia – Social and Behavioral Sciences*, 188, 157-162.
- Lee, W., & Chhabra, D. (2015). Heritage hotels and historic lodging: Perspectives on experiential marketing and sustainable culture. *Journal of Heritage Tourism*, 10 (2), 103-110.
- Long, L. M. (2014). Culinary tourism. In: P. B. Thompson & D. M. Kaplan (eds.), *Encyclopedia of food and agricultural ethics*, 452-458. Dordrecht: Springer.
- Montevago, J. (2017). European destinations cope with overtourism. *Travelmarket Report*. Retrieved February 14, 2018, from <http://www.travelmarketreport.com/articles/European-Destinations-Cope-with-Overtourism>.
- National Statistics Institute (NSI). (2018). *Municipal Register of Inhabitants 2017*. Retrieved January 18, 2018, from <https://www.ine.es>.
- Responsible tourism partnership. (2018). Overtourism: Can we have too many tourists? Retrieved February 20, 2018, from <http://responsibletourismpartnership.org/overtourism>.
- Spanish Ministry of Culture. (2017). Press Release 7 April 2017. Retrieved May 10, 2018, from <http://www.mecd.gob.es/prensa-mecd/actualidad/2017/04/20170407-numancia.html>.
- Taylor, E., & Kneafsey, M. (2016). The place of urban cultural heritage festivals: The case of London's Notting Hill Carnival. In: K. Borowiecki, N. Forbes, & A. Fresa (eds.), *Cultural Heritage in a changing world*, 181-196. Cham: Springer.
- Timothy, D. J. & Boyd, S. W. (2003). *Heritage Tourism*. Harlow: Prentice Hall.
- Tourtellot, J. (2017). "Overtourism" plagues great destinations. In *Changing Planet, Blog National Geographic*. Retrieved February 21, 2018, from <https://blog.nationalgeographic.org/2017/10/29/overtourism-plagues-great-destinations-heres-why/#>.
- TripAdvisor. (2017). *Travel trends for the Silk Road 2017*. Guide prepared for the UNWTO Silk Road Programme 2017. Retrieved March 15, 2017, from http://cf.cdn.unwto.org/sites/all/files/pdf/unwto_silk_road_2017_for_print_pf.pdf.
- UNWTO. (2018a). Press Release 18021. 7 March.
- UNWTO. (2018b). *Tourism and Culture Synergies*. Madrid: UNWTO. DOI: <https://doi.org/10.18/11/9789284418978>.
- UNWTO. (2018c, forthcoming). *The 21st Century Maritime Silk Road: Tourism Opportunities and Impacts*. Madrid: UNWTO.

Corporate Social Responsibility and Sustainable Development in China

Andrei Maxim

Faculty of Economics and Business Administration,
“Alexandru Ioan Cuza” University of Iasi, Romania
andrei.maxim@feaa.uaic.ro

Laura Diaconu (Maxim)

Faculty of Economics and Business Administration,
“Alexandru Ioan Cuza” University of Iasi, Romania
lauradiaconu_07@yahoo.com

Abstract. The field corporate social responsibility (CSR) is extensively discussed in the specialized literature. However, the focus is generally on the developed countries, even if the need of CSR is more pronounced in the developing ones, due to the gaps in social, economic and environmental aspects. CSR is founded on the idea that corporations are in close relationship with the economic, environmental cultural and social systems, because business activities influence and are influenced by them. The purpose of this paper is to analyse the CSR activities developed by companies present in China (domestic and foreign) in close connection with the main challenges to the sustainable development of this country. To achieve this objective, the research methods used consisted in an investigation of the specialized literature and in an analysis of secondary data. The results show that the CSR activities in China have grown steadily over the past decade, the government’s measures being a key driver. In this context, most of the state-owned companies have embraced CSR practices. However, environmental performance, labour practices, transparency and ethical behaviour are viewed as the most pressing CSR issues for businesses in China over the next decade. Therefore, CSR implementation needs both the managers’ ethical awareness and the change of institutional framework. Meanwhile, to respond to the sustainable development issues, the companies would also need to embrace the so-called *CSR Innovation*, through which they could take the social, economic and environmental problems as a source for innovating new businesses.

Key words: *CSR, sustainable development, China, foreign companies, domestic firms*

1. Introduction

Even though the economic growth has usually been considered a prerequisite for the development of a country, several non-economic dimensions, such as human capital, good governance, adequate public institutions, or strong social and cultural values, may also be taken into account for a functioning market economy (Rosling *et al.*, 2006). Moreover, all these elements play an important role in fostering the social cohesion, the long term economic growth and the environmental awareness. As the increasing concern about sustainable development focused on the activity of the companies, it was argued that corporations need to develop by taking into account the preservation of the environment and the natural resources (Kuhn and Deetz, 2008) and the maintenance of desirable social values (Fergus and Rowney, 2005).

Therefore, the sustainable development concept was related to the social responsibilities of the companies, Frederick (2006) considering that the corporations have the obligation to work for 'social betterment'.

The most commonly used definitions of corporate social responsibility (CSR) refer to the fact that the companies integrate the social and environmental concerns in their business operations, on a voluntary basis. A more detailed explanation of CSR is offered by Dahlsrud, who considers that it is "*the commitment of business to contribute to sustainable economic development, working with employees, their families, the local community and society at large to improve their quality of life*" (Dahlsrud, 2008, p. 7). Analysing the definitions of the CSR, we may notice that the CSR notion refers to a long list of corporate practices, such as environmental management systems, eco-friendly and safe products, labour protection measures, corporate philanthropy and community development projects (Carroll, 2008).

Even though there are numerous studies focused on CSR issues, the specialized literature has paid more attention to the social responsibility in the developed countries than in the developing ones. However, the need of CSR is more pronounced in the later states, due to the gaps in social, economic and environmental aspects (Baughn, Bodie and McIntosh, 2007).

China has enjoyed a remarkable economic growth since the 1980s, but it is well known that this growth comes with social and environmental costs. Neither the multinational corporations that invested in this country, nor did the Chinese companies develop a sense of responsibility in their pursuit of achieving profit. Meanwhile, the competition for foreign investments among the Chinese local governments also enhanced the culture of corporate irresponsibility. The Chinese authorities usually offered the investors regulatory exemption and privileges which negatively affected the quality of working conditions and the protection of the environment. However, the awareness of environmental and social problems, including pollution, labour abuses and lack of food safety, has recently increased (Kolk, Hong and van Dolen, 2010), being linked to the official governmental objective of achieving a 'harmonious society' (See, 2007).

2. Aim and Research Methodology

The purpose of this paper is to analyse the CSR activities developed by the companies present in China (domestic and foreign) in close connection with the main challenges for the sustainable development of the country, such as labour conditions, food safety and environmental protection. In order to achieve the aim of the paper, the research methods used consisted in an investigation of the specialized literature and in an analysis based on secondary data available in different reports and databases.

The literature review helped us identify the major challenges to the sustainable development of China. Moreover, based on the investigation of the existing literature, we analysed the CSR practices developed by the companies present in this country (state-owned, private Chinese firms or foreign funded corporations), in the context of legislative improvements and the implementation of various other government measures.

The analysis of the statistical data helped us formulate several conclusions about the impact of the CSR activities of the companies present in China on the sustainable development of the country.

3. Major Challenges to the Sustainable Development of China

It is well-known that since the 1980's, corporations have been the engine of the economic growth in China. Meanwhile, they are the sources of many social problems in the country, such as labour conditions, environmental pollution and food safety. In the context of the increasing number of foreign investors, the labour conditions in China started to worsen, being considered as a 'race to the bottom' (Chan and Ross, 2003). Despite the remarkable economic boom from the last 30 years, millions of workers, especially migrants from rural areas and less developed provinces, have not benefited from this economic growth. They are still confronting with low wages, long working hours and harsh treatment at the work place (Chan, 2001; Thorborg, 2006).

At the global level, the ethical and social dimensions of the corporations' business practices have become a centre of debate and controversy. Large companies, such as Nike, Reebok, Mattel and Gap, have been criticized for encouraging improper working conditions in China (Yu, 2008). In 2004, the employees of Wal-Mart China entered into a dispute regarding the founding of a labour union. After a long process of negotiation and state intervention, Wal-Mart, known for its anti-union position, accepted the 'officially sanctioned unions' (McGregor, 2004). Another scandal that reached global dimensions started in 2007, when news media and human rights organizations raised serious concerns about the use of 'slave labour' in central China. It was found that thousands of under-aged workers were exploited in illegal brick kilns, coal and iron mines (Barboza, 2008). The child-labour abuses in China became more obvious in the context of the Beijing Olympic Games, when twelve years old children were hired to produce Olympic merchandise by firms in Guangdong Province (Taylor, 2007).

Between 1998 and 2008, the number of the cases received by the Labour Dispute Arbitration committees increased from about 90,000 to about 500,000 (Lin, 2010). The worsening labour conditions in China reflect a low level of CSR. According to the *Nike Corporate Social Responsibility Reports* for 2007, 2008 and 2009, more than 20% of Nike's original equipment manufacturers have asked their employees to work sixty hours or more per week (Nike Inc., 2010). A representative of another multinational company said that, in China, as well as in other developing countries, the law is an 'aspirational standard' and not the minimum level as in the developed economies (Welford, 2007). This statement has to be considered in relation with the fact that increasing the wages and improving the labour conditions may change the position of China as a low-cost producing country and, consequently, would discourage many investors (Kolk and Van Tulder, 2002).

China's double-digit economic growth is accompanied not only by labour issues, but also by severe environmental damages (Kahn and Yardley, 2007a). The significant economic growth registered by China during the last fifteen years has been achieved at the expense of the energy and resource consumption. In 2014, China was ranked the world's second largest energy consumer after the United States (Zhang and Liu, 2014). Meanwhile, since June 2007, it has overtaken the US as the biggest carbon dioxide (CO₂) emitter, one of the most abundant greenhouse gases (Auffhammer and Carson, 2008). Despite the efforts to improve the energy efficiency and to reduce the CO₂ emissions, 75% of China's energy production is still dependent on coal, according to the study published in 2008 by Auffhammer and Carson.

In this context, the pollution represents a serious problem in China. Five of the world's ten most polluted cities are located in China. The groundwater is contaminated in nine out of ten cities and approximately 300 million people do not have access to clean drinking water (Tang and Li, 2009). According to a special report released by the State Environmental Protection

Administration and the World Bank in 2007, only 1% of China's total 560 million urban residents breathed air of a quality that satisfied current European Union safety standards and about 47 billion cubic meters of water below quality standards was supplied to households, industry and agriculture (SEPA and World Bank, 2007).

Kahn and Yardley (2007b) estimated that the outdoor air pollution causes 350,000 to 400,000 premature deaths a year, while the indoor pollution kills another 300,000 people per year. In 2010, the number of the premature deaths due to the outdoor air pollution increased to 1.2 million people, almost 40% of the global level (Nair *et al.*, 2010).

To mitigate the environmental degradation, the Chinese government has established several environmental laws and policies, but because of the lack of enforcement, they have not significantly improved the situation (Zang and Liu, 2014). Moreover, the level of the fines represents just a small proportion of the corporate gains, so profits generated from polluting activities counterbalance the costs.

In China, the pollution did not only cause serious harm to public health, but also led to massive economic losses. In 2006, the State Environmental Protection Administration and the State Statistics Bureau published a Green GDP report stating that, in 2004, the environmental pollution cost China approximately 64 billion US dollars, the equivalent to 3.05% of the GDP of that year (Feng, 2006). However, these statistics did not include the cost of natural resource depletion and the damage of the ecological system (Reuters, 2007).

Apart from the labour and environmental problems, China is also confronting with food safety issues. There were many debates related to the fact that many foreign multinational companies produce in China unsafe goods or have dangerous production processes. Some of these scandals referred to Hiagen-Dazs' unsanitary kitchens, Kentucky Fried Chicken's illegal use of red dye in food and Nestle's unsafe iodine in infant formula (Park and Vanhonacker, 2007). Another issue is that of the wide use of Cadmium, a toxic heavy metal that is strictly regulated in Western countries (Shanghai Daily, 2008). All these problems have been related to the fact that China is a developing country and the supervision of food and drugs started relatively late and, consequently, the progresses are weak (Dyer, 2007).

The Research Centre on Transnational Corporations of the Ministry of Commerce has released a series of reports related to the CSR performance of foreign companies in China. According to these reports, many of the analysed companies engaged in irresponsible behaviour in China, including tax evasion, bribery, monopoly, poor labour protection, environmental pollution and lack of food safety (Wang, 2010).

Considering all these issues that have a strong impact on China's sustainable development, the past three decades of economic boom are often viewed as a period of moral crisis (Tammey and Chiang, 2002).

4. CSR Activities in China

4.1 First steps towards a social responsible behaviour

China's history is shaped to a large extent by Confucian values, which emphasize the importance of building harmony. Therefore, in the Chinese context, the concept of CSR is closely related to the Confucian virtue of *Yi*, which means righteousness: using the principles or norms to obtain and distribute benefits (Lu, 1997). Therefore, this Chinese ancient philosophy of CSR can be

interpreted as being ethical in doing businesses. However, adopting CSR as a company philosophy in China seems a challenging task.

Even though at the global level the multinational firms have been introducing CSR reports since the 1990s, the large Chinese state-owned enterprises did not begin publishing annual CSR reports until 2006 (Tang and Li, 2009).

In 1994, the Chinese government released the Company Law, which pointed out only some aspects of CSR, especially those regarding the rights of employees in a company (Huo, 1995). However, in the 1994 Company Law, the term ‘social responsibility’ was absent. Due to the critics addressed to this law, referring to its inability to cope with the changing economic environment in China, a revision process of the company law began in 2004. One of the main issues explicitly recognized in the new 2006 Company Law was CSR.

However, despite the fact that the government’s pressure on companies to publish the environmental information had increased, the environmental reports were still uncommon in China in 2005 (Welford, 2005). Actually, between 1999 and 2005, only 22 CSR reports had been published (Baskin, 2006). In a study conducted by Baskin (2006) on 19 multinational companies based in China, it was found out that this country is characterised by ‘especially low take up’ of CSR. Another survey which investigated 890 companies in China, state-owned, private and multinational, found that most of them had mistaken ideas about CSR (Qingfen, 2006).

The *Southern Weekend* Chinese newspaper ranked the CSR performance of Chinese companies and the world’s top 500 international companies operating in China in 2006. According to the 2006 report, the large global companies were far from meeting their social responsibilities, mainly because they had very low environmental, labour and ethical standards (China Scope, 2006). Meanwhile, the state-owned companies were also criticized for their questionable environmental practices. According to the report, the most social responsible companies seem to be the privately owned Chinese firms.

Considering all these aspects, we may argue that the state has significantly influenced the development of CSR in China. Before 2006, the state opposed to the western notion of CSR and considered that it had the ultimate authority to define CSR. It argued that the implementation of the western CSR standards was an intervention in China’s internal affairs (Chan, 2005). Therefore, CSR in China has always been the ideological and political work of the government (Zhang, 2014).

4.2 Enforcement of the CSR Implementation

The turning point in the CSR approach of the Chinese government was on 1st of January 2006, when the Chinese Corporate Law was revised and it formally included the concept of CSR. This led to the obligation, especially for the large state-owned enterprises, to issue their first CSR reports. These changes took place in order to facilitate the integration and brand-building of Chinese companies on the global market (Godfrey and Hatch, 2007).

In October 2006, the Sixth General Meeting of the Sixteenth Central Commission of the Chinese Communist Party (Xinhuanet, 2006) stated that ‘building a harmonious society’ is the long-term goal of the Chinese socialism. According to the declaration, the social harmony may be affected by the inequality in regional development, demographical pressure, environmental pollution, unemployment, poor health care services and social security issues. Therefore, the government had the biggest role in shaping the CSR practices in China. This is why the state-owned companies, more scrutinized by the government, were more likely to embrace the CSR activities.

However, even though the declared objective of supporting CSR activities was to reach a harmonious integration into the broader global market, China wanted to create its own CSR guidelines, particularized on its unique economic, cultural and social situation. In this view, the 17th Central Committee of Chinese Communist Party underlined the importance of ‘energy, resources, ecological and environmental conservation’ and the necessity to ‘put people first’ in order to achieve a ‘balanced and sustainable development’ (Hu, 2007). The conclusions of this meeting led to the implementation of the *Labour Contract Law*, in 2007, and to a legal framework of the environmental practices for both domestic and global companies.

More progress was made in 2008, when the State-owned Assets Supervision and Administration Commission of the State Council of China issued a policy directive on *Guidelines to the State-owned Enterprises Directly Managed under the Central Government on Fulfilling Corporate Social Responsibilities*, all the state-owned companies being forced to publish their first CSR reports by the end of 2012.

All these major changes regarding the CSR approach of the Chinese government, led to an increase in the CSR reports. Between 2006 and 2009, 1,600 such documents have been published in China (Mullich, 2011). A number of 582 CSR reports were released by Chinese companies just in 2009. However, the ones published by the Chinese firms were criticized for their low quality (China WTO Tribune, 2009). As mentioned by China WTO Tribune (2009), while half the reports contained only limited information on specific CSR activities, only 6.1% of the companies consulted third-party opinions for the documents they released.

Apart from the involvement of the Chinese government in creating the legal framework of CSR, the implementation of this concept was determined by the catastrophic Great Sichuan Earthquake of 2008. The natural disaster required solidarity from the society, the companies, no matter their size, making donations. It is believed that this disaster has created the seeds of a philanthropic CSR culture, which later has evolved into educational and poverty alleviation projects, implemented by firms (Zhang, Rezaee and Zhu, 2010).

5. CSR and Sustainable Development

Even though China still registers economic growth, the growth rate has considerably diminished during the last decade. As we can see from Table 1, the GDP growth rate between 2007 and 2016 has diminished by more than 7 percentage points.

Table 1 Annual GDP growth rate in China

Year	GDP growth rate (%)
2007	14.2%
2008	9.7%
2009	9.4%
2010	10.6%
2011	9.5%
2012	7.9%
2013	7.8%
2014	7.3%
2015	6.9%
2016	6.7%

Source: adapted from World Bank (2018), *GDP growth (annual %) – China*, <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG>

Confronted with the slowing down of the economy, China is looking for new ways to ensure the economic prosperity. The authorities might have understood that China cannot continue to infinitely grow by polluting, because this would undermine the future of its citizens and the country's position in the world. This is proven by the recent massive investments in renewable energy and clean technology, in order to solve China's pollution problem (Koty, 2017). In fact, nowadays, China has more wind power capacity than the EU (Lam, Branstetter & Azevedo, 2017) and it is becoming the major exporter of cheap green technologies (Mathews & Tan, 2017).

Meanwhile, the emergence of the middle-class, comprised of citizens that are more aware of their societal position, increased the demand for better living conditions, safer products and a healthier environment, and led to changes in corporate behaviour. Wigley (2008) argues that communicating CSR practices to consumers fosters positive attitudes in the purchase process. This motivated the Chinese companies to signal their social and environmental awareness to customers and stakeholders, both in China and outside China (Tan-Mullins & Hofman, 2014). Therefore, CSR is no longer only an ethical imperative, but it also has an economic value.

Since 2008, the State Environmental Protection Administration started to implement a series of measures regarding the corporate environmental reporting. Among these, a regulation according to which the environmental agencies and heavy-polluting companies have to disclose certain environmental information to the public has been adopted (Gozun, Laplante & Wang, 2011).

Moreover, the Chinese government started to use financial channels to improve corporate environmental performance. In 2007 it initiated the green credit policy (Aizawa, 2011). The aim of this policy was to reduce pollution, by encouraging the companies to favour energy conservation and emissions reduction. However, the results of a study conducted in 2011 reveal that the green credit policy was not fully implemented. The major problems of its implementation consisted in the wide-ranging impact on heavily polluting and highly energy-consuming industries, unclear implementation standards and lack of environmental information.

Another initiative aimed to protect the environment has been initiated by the Chinese government in 2009, when it announced that it will spend billions on tree planting and reforestation (Wenfa, Guangcui & Sheng, 2010). In turn, many companies have launched tree-planting initiatives in China, as part of their CSR efforts.

In order to monitor the way in which the companies respond to the sustainable development goals, the Chinese Academy of Social Sciences has created a CSR Development Index, which assesses the managerial, economic, social and environmental responsibilities of state-owned, private Chinese firms and foreign-funded corporations, each year (Chen *et al.*, 2015). Moreover, it analyses phase-specific characteristics of CSR development in China. Based on this Index, a *GoldenBee Research on Corporate Social Responsibility Reporting in China* has been published each year since 2009. According to these studies, between 2009 and 2017, the level of CSR reporting in China has significantly improved (MOFCOM, 2017), as shown in Figure 1. This improvement is mainly due to the fact that, nowadays, enterprises pay more attention to the disclosure of business strategy and CSR plan than they did eight years ago. The studies conducted by the Ministry of Commerce of the People's Republic of China (MOFCOM, 2017) reveal the fact that the number of enterprises disclosing the CSR plan rises by more than 14% each year. This shows that more and more companies start to consider the strategic significance of the CSR activities.

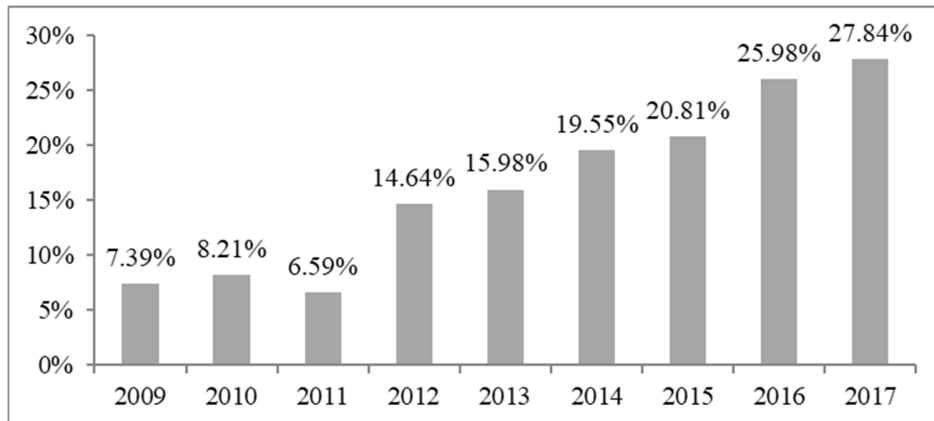


Figure 1 Ratio of reports rated above “good”, between 2009 and 2017

Source: adapted from MOFCOM (2017), *GoldenBee Research on CSR Reporting in China 2017*, <http://csr2.mofcom.gov.cn/article/ckts/sr/201712/20171202687223.shtml>

Analysing the quality of the published reports by taking into account the types of property of the companies, it is noticeable that the state-controlled enterprises and foreign funded firms registered the biggest improvements, during the past eight years (MOFCOM, 2017). The smaller progresses were found in the case of the private Chinese enterprises. These facts indicate that although all the Chinese firms seem to follow the government’s signals regarding CSR, not all of them are doing this in a substantive way (Marquis and Qian, 2014).

The results of a study published in 2012 by Kuo, Yeh and Yu indicate that environmentally sensitive industries and state-owned enterprises are significantly more committed to environmental information disclosure. Meanwhile, these companies are the major investors in the development of new methods that would save energy and reduce the carbon emission (Kuo, Yeh & Yu, 2012).

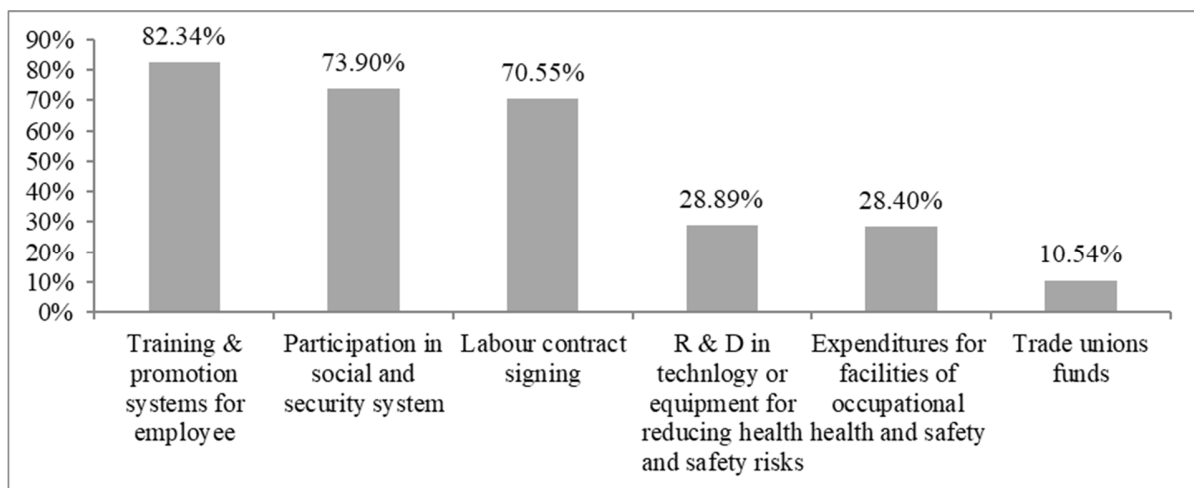


Figure 2 Labour conditions and practices in the companies present in China, in 2017

Source: adapted from MOFCOM (2017), *GoldenBee Research on CSR Reporting in China 2017*, <http://csr2.mofcom.gov.cn/article/ckts/sr/201712/20171202687223.shtml>

From the point of view of the improvements in labour conditions and practices, training and promotion systems for employees have gained ground among the companies present in China. As shown in Figure 2, 82.34% of the companies that have published the CSR reports in 2017 offer training and promotion systems for their employees, while only 28.4% of these firms have invested in facilities for occupational health and safety.

Unlike labour and environmental issues, the food safety aspects have not been included in the studies published by the Ministry of Commerce of the People's Republic of China, between 2009 and 2017. This is probably due to the fact that the companies did not include the food safety issues in their CSR reports.

6. Conclusions

The major conclusion of this paper is that, nowadays, the sustainable development concept is closely related to the social responsibilities of the companies. This is supported by the example of China, which enjoyed a remarkable economic growth since 1980s, but with major social and environmental costs. The corporations, which were the engine of this growth, have been the sources of many social problems, such as poor labour conditions, environmental degradation and low levels of food safety. Moreover, the environmental degradation has also led to massive economic losses.

During the past decade, confronted with the slowing down of the economic growth, the Chinese authorities have been looking for new ways to ensure the economic prosperity. A first step was made when the Chinese Corporate Law was revised and it formally included the concept of CSR. Moreover, the State Environmental Protection Administration started to implement a series of measures regarding the corporate environmental reporting. In order to improve the corporate environmental performance, the Chinese government has also used financial channels, such as the green credit policy.

As secondary data indicates, the level of CSR reporting in China has significantly improved during the last years. This was mainly due to the fact that enterprises started to pay more attention to the disclosure of business strategy and CSR plan.

Considering all these aspects, we may conclude that the implementation of the CSR practices in China needs not only changes in the institutional framework, but also managerial ethical awareness. Moreover, we do consider that, in order to respond to the sustainable development issues, the companies present in China (Chinese private or state-owned firms and foreign funded corporations) would also need to embrace the so-called *CSR Innovation*, through which they could take the social, economic and environmental problems as a source of innovating new businesses.

REFERENCES

- Aizawa, M. (2011). China's Green Credit Policy: Building Sustainability in the Financial Sector. *China Environment Forum*. Retrieved March 22, 2018, from <https://www.wilsoncenter.org/sites/default/files/Motoko%20Aizawa.pdf>
- Carroll, A.B. (2008). A History of Corporate Social Responsibility. In Crane, A., McWilliams, A., Matten, D., Moon, J., & Siegel, D. (Eds.), *The oxford handbook of corporate social responsibility*. Oxford University Press.
- Auffhammer, M., & Carson, R.T. (2008). Forecasting the path of China's CO2 emissions using province-level information. *Journal of Environmental Economics and Management*, 55, 229–247.

- Barboza, D. (2008). *In Chinese factories, lost fingers and low pay*. Retrieved January 25, 2018, from <http://www.nytimes.com/2008/01/05/business/worldbusiness/05sweatshop.html? r=1&oref=slogin>
- Baskin, J. (2006). Corporate responsibility in emerging markets. *Journal of Corporate Citizenship*, 24, 29-47.
- Baughn, C.C., Bodie, N.L.D., & McIntosh, J.C. (2007). Corporate social and environmental responsibility in Asian countries and other geographical regions. *Corporate Social Responsibility and Environmental Management*, 14(4), 189-205.
- Chan, A. (2001). *China's workers under assault: The exploitation of labor in a globalizing economy*. M.E. Sharpe Press.
- Chan, A. (2005). China says "no" to developed countries' corporate social responsibility. *Asian Analysis*. Retrieved January 14, 2018, from <http://www.aseanfocus.com/asiananalysis/article.cfm?articleID=816>
- Chan, A., & Ross, R. J. S. (2003). Racing to the bottom: International trade without a social clause. *Third World Quarterly*, 24(6), 1011-1028.
- Chen, J., Huang, Q., Peng, H., & Zhong, H. (2015). *Research Report on Corporate Social Responsibility of China*. Springer International Publishing AG.
- China Scope. (2006). *Chinese Media Ranks the Performances of Foreign-Owned Companies*. Retrieved March 14, 2018, from <http://chinascope.org/main/content/view/337/26/1/0/>
- China WTO Tribune. (2009). *Four discoveries of the research on CSR reports in China from 2001 to 2009*. Retrieved March 23, 2018, from www.wtoguide.net/Html/tbgz/06122515571068955091271
- Dahlsrud, A. (2008). How Corporate Social Responsibility Is Defined: An Analysis of 37 Definitions. *Corporate Social Responsibility and Environmental Management*, 15(1), 1-13.
- Dyer, G. (2007). China executes ex-chief of food and drug watchdog for bribery. *Financial Times*. Retrieved September 14, 2011, from www.ft.co
- Feng, C. (2006). Pollution costs China 511.8b yuan in 2004. *XINHUA*. Retrieved December 12, 2016, from http://www.gov.cn/english/2006-09/07/content_381756.htm
- Fergus, A. H. T., & Rowney, J. I. A. (2005). Sustainable development: Lost meaning and opportunity? *Journal of Business Ethics*, 60, 17-27.
- Frederick, W. C. (2006). *Corporation be good! The story of corporate social responsibility*. Indianapolis, IN: Dogear Publishing.
- Godfrey, P. C., & Hatch, N.W. (2007). Researching corporate social responsibility: An agenda for the 21st century. *Journal of Business Ethics*, 70(1), 87-98.
- Gozun, E.G., Laplante, B., & Wang, H. (2011). Design and Implementation of Environmental Performance Rating and Public Disclosure Programs. A Summary of Issues and Recommendations Based on Experiences in East Asian Countries. *The World Bank Development Research Group Environment and Energy Team*. Retrieved April 1, 2018, from <http://documents.worldbank.org/curated/en/559241468247854450/pdf/WPS5551.pdf>
- Hu, J. (2007). *Report to the Seventeenth National Congress of the Communist Party of China*. Retrieved March 29, 2018, from <https://fas.org/sgp/crs/row/RS22767.pdf>.
- Huo, S. (1995). The Company Law of the People's Republic of China. *Pacific Basin Law Journal*, 13(2), 1-18.
- Kahn, J., & Yardley, J. (2007b). As China Roars, Pollution Reaches Deadly Extremes. *New York Times*.
- Kahn, J., & Yardley, J. (2007a). Chocking on Growth: Part I: As China Roars, Pollution Reaches Deadly Extremes. *New York Times*.
- Kolk, A., Hong, P., & van Dolen, W. (2010). Corporate social responsibility in China: an analysis of domestic and foreign retailers' sustainability dimensions. *Business Strategy and the Environment*, 19(5), 289-303.

- Kolk, A., & Van Tulder, R. (2002). The effectiveness of self-regulation: corporate codes of conduct and child labour. *European Management Journal*, 20(3), 260-271.
- Koty, A.C. (2017). Investing in China's Green Industries. *China Briefing*. Retrieved March 26, 2018, from <http://www.china-briefing.com/news/2017/06/07/chinas-climate-leadership-opportunities-foreign-investment.html>
- Kuhn, T., & Deetz, S. (2008). Critical theory and corporate social responsibility. In A. Crane, A. McWilliams, D. Matten, J. Moon, & D. S. Siegel (Eds.), *The Oxford handbook of corporate social responsibility*. Oxford, UK: Oxford University Press.
- Kuo, L., Yeh, C.C., & Yu, H.C. (2012). Disclosure of Corporate Social Responsibility and Environmental Management: Evidence from China. *Corporate Social Responsibility and Environmental Management*, 19(5), 273-287.
- Lam, L.T., Branstetter, L., & Azevedo, I.M.L. (2017). China's wind industry: Leading in deployment, lagging in innovation. *Energy Policy*, 106, 588-599.
- Wang, L. (Ed.) (2010). Annual report of Transnational Corporations in China 2006 to 2010. *Beijing New-century Academy on Transnational Corporations*. Retrieved March 25, 2018, from http://www.chinacsrmap.org/Org_Show_EN.asp?ID=754
- Lin, L.W. (2010). Corporate Social Responsibility in China: Window Dressing or Structural Change? *Berkeley Journal of International Law*, 28(1), 64-100.
- Lu, X. (1997). Business ethics in China. *Journal of Business Ethics*, 16, 1509–1518.
- Marquis, C., & Qian, C. (2014). Corporate Social Responsibility Reporting in China: Symbol or Substance? *Organization Science*, 25(1), 127–148.
- Mathews, J., & Tan, H. (2017). China's new Silk Road: is it black or green?. *Energy Post*. Retrieved March 25, 2018, from <http://energypost.eu/chinas-new-silk-road-will-it-contribute-to-export-of-the-black-fossil-fueled-economy/>
- McGregor, R. (2004). Wal-Mart Gives in to China's Union Federation. *The Financial Times*. Retrieved September 25, 2011, from www.ft.co
- MOFCOM. (2017). *GoldenBee Research on CSR Reporting in China 2017*. Retrieved March 5, 2018, from <http://csr2.mofcom.gov.cn/article/ckts/sr/201712/20171202687223.shtml>
- Mullich, J. (2011). Corporate Social Responsibility Emerges in China. *The Wall Street Journal*. Retrieved March 5, 2018, from <http://online.wsj.com/ad/article/chinaenergy-responsibility>
- Nair, H., Nokes, D.J., Gessner, B.D., & Dherani, M. (2010). Global burden of acute lower respiratory infections due to respiratory syncytial virus in young children: A systematic review and meta-analysis. *Lancet*, 375, 1545–1555.
- Nike, Inc. (2010). *Corporate Responsibility Report FY 07, 08, 09, 2010*. Retrieved April 3, 2018, from <http://www.fibre2fashion.com/sustainability/pdf/NikeSustainabilityReport.pdf>
- Qingfen, D. (2006). Survey reveals CSR not fully understood. *China Daily*. Retrieved April 3, 2018, from http://www.chinadaily.com.cn/cndy/2006-10/27/content_718091.htm
- Reuters. (2007). *Green GDP gets black mark from China stats office*. Retrieved February 1, 2018, from <http://www.reuters.com/article/environmentNews/idUSPEK17562920070323>
- Rosling, H., Lindstrand, A., Bergström, S., Rubenson, B., & Stenson, B. (2006). *Global Health. An Introductory Textbook*. Studentlitteratur: Lund.
- See, G.K.H. (2007). 'Harmonious society' and CSR: Transforming the business environment?. *CSR Asia Weekly*, 3(38), 8-10.
- SEPA & World Bank. (2007). Cost of pollution in China. *The World Bank Washington, D.C*. Retrieved February 17, 2018, from

https://siteresources.worldbank.org/INTEAPREGTOPENVIRONMENT/Resources/China_Cost_of_Pollution.pdf

SEPA. (2008). The Third Environmental Economic Policy is Up, Environmental Disclosure System for Listed Companies Will be Established in 2008. *Press Release of the Ministry of Environmental Protection of People's Republic of China*. Retrieved September 25, 2011, from http://www.mep.gov.cn/xcyj/zwhb/200802/t20080225_118588.htm

Park, S.H., & Vanhonacker, W.R. (2007). Kuaguo Gongsi Yinhe Shiqu Zunjing: Jiang Zhongguo Dangzuo Shiyanshi? [Why Multinational Companies Lose Respect? Treating China as a Laboratory?]. *People Daily Online*. Retrieved November 17, 2017, from <http://mnc.people.com.cn/GB/6562449.html>

Shanghai Daily. (2008). *Call for Crackdown on Deadly Cadmium Poison*. Retrieved November 19, 2017, from <http://www.china.org.cn/english/health/237983.htm>

Tammey, J. B., & Chiang, L. H.-L. (2002). *Modernization, globalization, and confucianism*. Westport, CT: Praeger.

Tang, L., & Li, H. (2009). Corporate social responsibility communication of Chinese and global corporations in China. *Public Relations Review*, 35, 199–212.

Tan-Mullins, M., & Hofman, P.S. (2014). The Shaping of Chinese Corporate Social Responsibility. *Journal of Current Chinese Affairs*, 43(4), 3–18.

Taylor, A. (2007). *China: Child Labor Caution for China Olympics*. Retrieved November 19, 2017, from <http://www.corpwatch.org/article.php?id=14513>

Xinhuanet. (2006). *Zhonggong Zhongyang guanyu Goujian Shehui Zhuyi Hexie Shehui Ruogan Zhongda Wenti de Jueding [Several Important Resolutions on the Construction of Socialist Harmonious Society by the Central Commission of the Chinese Communist Party]*. The Sixth General Meeting of the Sixteenth Central Commission of the Chinese Communist Party. Retrieved February 22, 2018, from http://news.xinhuanet.com/politics/2006-10/18/content_5218639.htm.

Thorborg, M. (2006). Chinese workers and labor conditions from state industry to globalized factories: How to stop the race to the bottom. *Annals of the New York Academy of Sciences*, 1076, 893–910.

Welford, R. (Ed.). (2005). *Corporate environmental reporting and disclosure in China*. Hong Kong: CSR Asia.

Welford, R. (2007). The stories behind the Mattel recall. *CSR Asia Weekly*, 3(32), 1-3.

Wenfa, X., Guangcui, D., & Sheng, Z. (2010). China's strategy and financing for forestry sustainable development. *United Nations Forum on Forests*. Retrieved February 20, 2018, from http://www.un.org/esa/forests/pdf/aheg/aheg1/China_case_study.pdf

Wigley, S. (2008). Gauging consumers' responses to CSR activities: Does increased awareness make cents? *Public Relations Review*, 34, 306–308.

World Bank. (2018). *GDP growth (annual %) – China*. Retrieved February 17, 2018, from <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG>

Yu, X. (2008). Impacts of corporate code of conduct on labor standards: A case study of Reebok's athletic footwear supplier factory in China. *Journal of Business Ethics*, 81(3), 513–529.

Zhang, B., & Yang, Y. (2011). Tracking the implementation of green credit policy in China: Top-down perspective and bottom-up reform. *Journal of Environmental Management*, 92(4), 1321-1327.

Zhang, D., Jiang, Q., Ma, X., & Li, B. (2014). Drivers for food risk management and corporate social responsibility; a case of Chinese food companies. *Journal of Cleaner Production*, 66, 520–527.

Zhang, D., Liu, J., & Li, B. (2014). Tackling air pollution in China – what do we learn from the great smog of 1950s in London. *Sustainability*, 6, 5322–5338.

Zhang, R., Rezaee, Z., & Zhu, J. (2010). Corporate Philanthropic Disaster Response and Ownership Type: Evidence from Chinese Firms' Response to the Sichuan Earthquake. *Journal of Business Ethics*, 91(1), 51-57.

Ensuring the Quality Management System in Small and Medium Enterprises - a Way to Increase National Economic Security

Irina Cosnicean

Trade Co-operative University of Moldova, Chişinău, Republic of Moldova
i.cosnicean@mail.ru

Mariana Hîrzob

Trade Co-operative University of Moldova, Chişinău, Republic of Moldova
smolevscaiamariana@gmail.com

Irina Raevskaia

Trade Co-operative University of Moldova, Chişinău, Republic of Moldova
irinaraevskaia@gmail.com

Abstract. In today's dynamic environment, the Republic of Moldova, as a small country, has an emerging economy, facing contradictory processes related to overcoming the recession caused by the incomplete implementation of the proposed new standards. The aim of the study is to identify and substantiate the problems of the quality management systems of small and medium enterprises in the Republic of Moldova, which reduce their potential. The paper presents comparative analysis of international standards ISO 9001: 2008 draft of the new version of ISO 9001: 2015, identifies the advantages and role versions ISO 9001: 2015 in order to improve the competitiveness of small and medium enterprises. In order to increase the competitiveness of the economic units, it is necessary to change the attitude of their superior management towards the quality management system and the observance of the basic principles of labor in the "consumer market" paradigm. Creating a favorable environment for the implementation of this system in small and medium enterprises will contribute to diminishing the threats of national economic security in conditions of economic instability. These processes are aggravated by the global economic crisis. Ensuring the quality management system within the national enterprises will increase the national economic security that will enable us to accelerate the integration of the Republic of Moldova into the European Union.

Key words: *Quality Management System, Small and Medium Enterprises (hereinafter SME), Competitiveness, ISO, National Economic Security.*

1. Introduction

In the current conditions of Small and Medium Enterprises contribute directly to the improvement of the economic situation, stimulates the growth of production, creation of new jobs, contributes to enhancing national economic security.

The significance of the concept of national security and economic environment consists in determining the security environment of a country nationally and internationally, assessment of risks and threats to national security, setting objectives which ensures security, high-priority national interests to be protected by the State and civil society, the delimitation of national economic development, the constitutional order. It explains that the developed nations of the world have designed national security including the economic system through the elaboration and approval of quality management and its implementation in enterprises, including and those small and medium-sized. [6]

Activity of small and medium enterprises in the Republic of Moldova manifests a multitude and diversity of forms, with very different results which is not reflected only in the economic and financial welfare. To the same extent, SMES are associated with technological progress, reducing social inequalities,, an indispensable component of a market economy, act as satellites for large enterprises.

In most developed countries, SMES are in constant growth due to the following factors:

- diversity and individualization, demand flexibility to market requirements;
- Changes in organizational structure of large enterprises,
- Reorienting the economy towards diversity services,
- economic globalization,
- Compliance standards
- State policy of SMC in the field to support SMES.

The quality of the manufactured production is one of the important ways in the competitive struggle of all market participants, including the small and medium enterprises. Quality management is the core of the process of production contributing to high requirements of consumers.

Increase of production quality enterprises are closely linked to the economic stability of the country. The high requirements which are put forward in relation to the quality of production, primarily are dictated by market requirements, indicate the need for changes in organizational management, because their market relations aim at continuously increasing the competitiveness of the products. SMEs have a significant role in the economic development of a country, their share in GDP ranges from 10% to 70%. SMEs contribute directly to the creation of jobs, stimulate competition, contribute to the growth of exports, and foster the creation and implementation of innovations and new technologies. Compared to large enterprises, these enterprises are more flexible, is more responsive to changes in the business environment and the growing demands of the market. SMEs are the most common in businesses all over the world.

2. Methodology

For preparing this study research were used various methods, including as follows: systemic, regulatory, statistics, dynamics, economic analysis; induction and deduction, applied knowledge aspect investigated and other processes, instruments and methods of economic research, such as statistical and economic comparison.

3. Activity of Small and Medium Enterprises in the Republic of Moldova.

World experience of market economy has developed countries shows that the activity of small and medium-sized enterprises is the factor that allows the stabilization of the market and economy all at once has a positive impact on the development of the entire national and industrial complex. The main advantages of micro, small and medium-sized organization may be mentioned: mobility of prompt reaction to changes, the dynamic of market demand and the possibility of easy reorientation to another type of activity. Due to the small structure of the management body, small and medium-sized enterprises manage to maintain a fairly low level of general costs but also ensure the rapid adoption of managerial decisions. Among the reasons for the increase in the number of small and medium-sized enterprises, we can rely on their significant contribution to investment and innovation policy of the country's economy, a positive impact on reducing unemployment in the labour market and social tensions and, as a result, the rate of economic growth as a whole, for which the State must guarantee subsidies and fiscal facilities. SMEs in countries with advanced economy and is actively involved in

the formation of a competitive environment of the market, which is considered to be the main engine of the country.

State support for small and medium-sized enterprises, by organizing various programs lead to increase their competitiveness and attract additional labour to the creation of new jobs. Such measures would contribute to the halting population migration in Moldova.

The development strategy of small and medium enterprises sector in 2012-2020 indicated that, for the development of the SME sector in the Republic of Moldova is of particular importance. During the period of establishment of market relations, the role of SMEs was determined not only by the structure of the national economy, in which the share of high-work, were preferred by small businesses, but also of the existence of human-resources remaining without work, unused machinery, secondary raw materials-that could be used optimally by the small business.

The main indicators of SMEs, the assessment of the potential and contribution of this sector in the economic development of the Republic of Moldova, its evolution, including during the crisis period of the last years, will make it possible to identify the strengths and weaknesses of the Moldovan SMEs in comparison with other European countries, to argue the main directions and state support measures.

The quantitative impact of SMEs on economic growth is estimated by the SME share in GDP ratio. The value of the indicator of the SME share in GDP varies significantly in different countries.

In the EU, the SME sector generates 58.4% of GDP, in the US - 43.4% (in 2009).

In 10 out of 12 countries of the Black Sea Economic Cooperation Organization (BSEC), the share of SMEs in GDP is less than 50%, in 5 countries - less than 30%. The share of Moldovan SMEs in GDP in 2010 was 28.3%. In all countries the contribution of SMEs to GDP is relatively lower than the share of the sector in employment. This reflects a lower level of labor productivity in the SME sector compared to large companies.

SMEs in the Republic of Moldova participate fairly actively in the production of goods and services, satisfying demand, especially on the domestic market. Characteristic for the Republic of Moldova is the lack of cooperation between large enterprises and SMEs that is why SMEs primarily contribute to the saturation of the consumer market.

The Ministry of Economy specifies that the number of SMEs in 2016 constituted 51 thousand 600 enterprises, increasing by one thousand enterprises (or 2 percent) as compared to 2015.

The number of persons working in small and medium enterprises during the year 2016 was over 300 thousand persons, who held 61% of the total number of employees of enterprises in the national economy.

Income from sales of SMEs in this period amounted to 125 mln. lei or 41.5 percent of total sales revenue in the economy and recorded a 4.5 percent increase over the year 2015. [1]

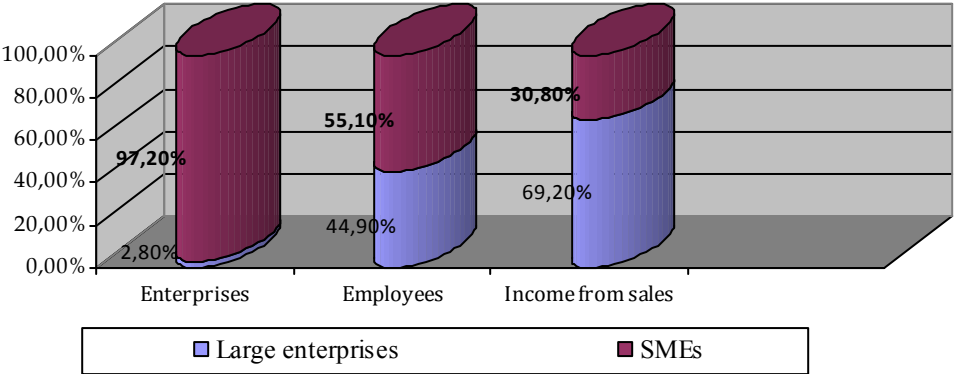


Figure 1. The share of SMEs in the total number of enterprises in the Republic of Moldova (2015). [3]

Most SMEs are active in the field of commerce, accounting for about 20,000 units in 2016, or 40 percent of all small and medium-sized enterprises. They have a major contribution to total sales revenues generated by SMEs, about 49 percent (or 61 million lei).

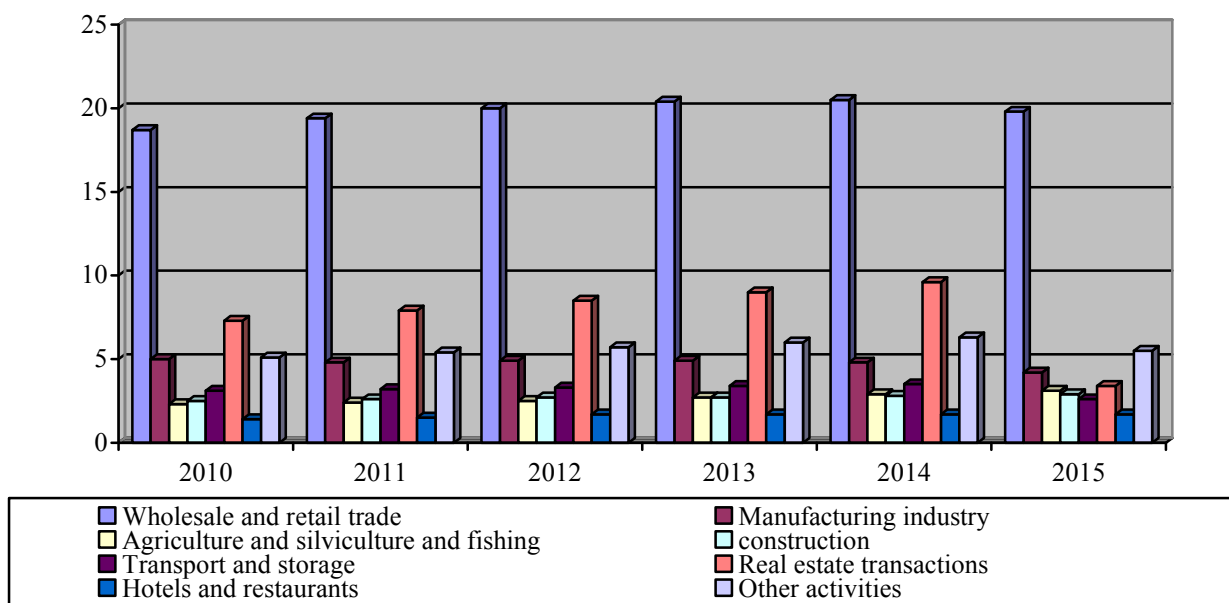


Figure 2. Evolution of the number of SMEs in 2010-2015 by main types of enterprises (thousands of units). [4]

Businesses are followed by manufacturing SMEs, with 4,000 or 8.5 percent of all SMEs (11 percent of total SME sales revenue) , about 14 million lei) and enterprises in the field of professional, scientific and technical activities, which also represent 4 thousand 400 enterprises and which account for 3% of the total sales revenues generated by SMEs (about 4 million lei) .

4. State Support for the Small and Medium Enterprises Sector.

Through the Organization for the Development of the Small and Medium Sized Enterprises Sector (ODIMM), the Ministry of Economy continuously supports small business by implementing business support programs.

Thus, during the whole period of the Program for attracting remittances to the economy, PARE 1 + 1, the investments were financed with the support of the European Union. The total amount of the awarded grants is about 152 mln. and the investments in the economy are around 550 mln. lei. Respectively, each leu granted in the form of a grant generated some 3.6 lei of investments in the economy. Of the total number of beneficiaries, 57 percent invested in agriculture, and 24 percent in services and 19 percent in production.

The entrepreneurs were able to benefit from financial guarantees of about 300 million lei through commercial banks due to Capitalization of the Loan Guarantee Fund (FGC) up to 100 million lei and applying the multiplier in the relations with the partner banks. At the beginning of July of the previous year with FGC support, it was easier to disburse loans worth over 220 million lei and supported the investment projects worth 343 million. lei for 279 SMEs.

All 10 Business Incubators (IA) incubate 144 companies, generating 602 jobs cumulatively. Of which the percentage of women employed is 42 percent and youth jobs 35 percent. The total turnover of the IA residents is over 94 million lei, as compared to December 31, 2016.

Policies promoted in the field of entrepreneurship development in the country have led to a positive development of the number of active enterprises, even if the SME sector continues to

face many financial, legislative, bureaucratic and other difficulties. Over the past five years, the number of SMEs has steadily increased, increasing from 45.6 thousand enterprises in 2010 to 52.3 thousand in 2014, throughout this period a positive attempt has been maintained to increase the number of SMEs. But in 2015, as a result of the banking crisis, there are negative influences on the development of the sector and the number of SMEs decreases by 1% compared to 2014. The impact of the SME sector on the economic development of the country compared to the EU countries is lower today with about 20%. [5]

For these reasons, it is necessary to carry out research to identify the main problems facing small and medium-sized enterprises. During the analysis of the activities of small enterprises in the Republic of Moldova, we can mention that a large number of small and medium-sized enterprises exist in the conditions of constantly increasing production costs due to rising raw material prices and other material resources, more than half of small enterprises the profitability level is below 5%, there is no renewal of the fixed assets and the wear sometimes reaches 80-90%, which significantly reduces the efficiency of the enterprise. Most of the existing methodologies for assessing the effectiveness of these businesses are based on accounting reports that do not fully reflect the reality of the enterprise's state of affairs. The efficiency of small and medium-sized enterprises can only be achieved by assessing the adopters of management decisions by the company's management.

5. Crucial Aspects of the Quality Management System in Small and Medium-Sized Enterprises.

Many organizations face challenges when they start developing a quality management system. In small and medium-sized organizations, these challenges are more serious, due to the limited resources available, of the costs of creating and maintaining a quality management system; difficulties in understanding and applying the standard, especially when conceptualizing concepts such as: the organization's context, the organization's internal knowledge, the process approach, and risk-oriented thinking.

The manager of a small or medium business must consider the time and money spent to implement a quality management system, like any other investment. For the enterprise to be viable, the entrepreneur has to repay the money and efforts, improving the processes of the organization and strengthening the market position of the products or services. The content of the decisions the entrepreneur takes in the shortest time of the implementation / development of the quality management system will be crucial in ensuring the enterprise's competitiveness in its field of activity.

Depending on the size of the enterprise, the quality management system does not have to work out anything that is totally different from how the business has run its business until then. It should be noted that all enterprises already have a kind of quality management system and may already meet some of the requirements of the standard even though they have not yet defined and documented how this is done.

The purpose of the ISO standard is certainly not to impose a completely new management system or to force the owner to modify his already existing management activities. On the contrary, implementing an ISO 9000 quality management system should be understood as a strategic means of controlling the enterprise, monitoring what is happening, and what areas we need to focus on. All requirements of the standard must be applied with perspicacity and dedication. Only then can the enterprise fully benefit from the implementation of the quality management system.

Although there is only one ISO 9001 standard and one set of requirements for the quality management system, there are some differences related to the attributes of SMEs and large enterprises that influence implementation. In the SME group, micro-enterprises and small

businesses require particular attention. That is why these two groups will be analyzed separately.

Medium enterprises. When implementing a SMC (Quality Management System), each member of the enterprise must be aware of the importance of SMC in achieving the business goals and motivated to achieve it. Due to the small number of employees, medium-sized enterprises more easily involve all employees in the implementation of the given system compared to large enterprises. Medium-sized enterprises have a simpler organizational structure, carry out fewer SMC processes and can limit themselves to simpler communication tools. This can result in a significant reduction in system documentation. The above-mentioned enterprises, according to their level of complexity and in terms of number of employees, result (as opposed to micro-enterprises and small ones), a documented management system of the company, which presents the basis of the company's quality management system. [7]

Another aspect that derives from the company's features is customer focus. As the potential of the mid-market market is limited compared to the potential of large corporations or trusts, they can be considered quite dependent on (large, major, presence) customers and suppliers. Thus, medium-sized enterprises are strategically oriented towards establishing long-term relationships with suppliers and customers.

Micro-enterprises and small businesses. Micro/small enterprises have a linear organizational structure and simple and few communication tools. Regarding the lack of documented procedures and processes, SMC documentation should be developed from scratch and require the hiring or training of staff for documentation preparation and implementation of the quality management system. [7]

A difference between micro / small enterprises and medium-sized enterprises consists of a multitude of management processes where all requirements for effective management are consistently applied, including measurable indicators reported within the SMC, which contribute to increasing the economic efficiency of the enterprise.

All international standards are periodically updated to ensure their relevance in the ever-changing market.

The comparative features between ISO 9001: 2008 and ISO 9001: 2015 are as follows:

ISO 9001:2008		ISO 9001:2015
8	The principles of quality management	7
8	Number requirements / main chapters	10
6	Mandatory procedures	4
26	Mandatory records	26

Figure 3. Comparative characteristics between ISO 9001: 2008 and ISO 9001: 2015. [2]

1. According to the old ISO 9000, 8 principles of quality management were defined. Along with changes in management systems, they were reduced to 7 - the principle of "Management approach as a system" was deleted.

2. The general structure of the standard. There are 10 chapters of requirements, compared to 8 in the previous edition. The chapters of requirements will be the same for all Management Systems (environment, information security, etc.), which will greatly facilitate the integration of several standards into a single management system.

3. In the 2008 edition, 6 procedures (document control, control records, internal audit, nonconformities, corrective actions, preventive actions) and the Quality Management System Manual are required. In the new edition 2015, these documents are no longer mandatory. Other documents are required, such as: scope, quality policy, etc.

4. There are new requirements that did not exist in the 2008 edition, but also requirements from the previous edition that are no longer in the new standard.

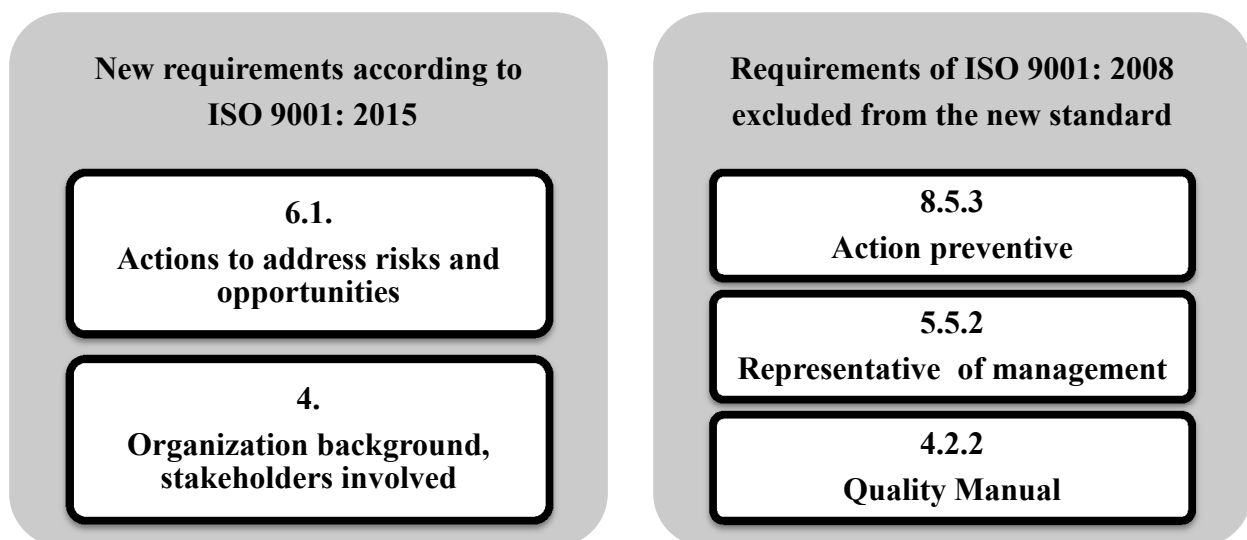


Figure 4. Changes to the ISO 9001 [2]

The implementation of the current version of the ISO 9001: 2015 standard offers a number of **advantages for SMEs**, including:

a. **Improving the performance of the business** as a result of the management system is strictly in line with the organization's business strategies, being used as business management tools, they will improve performance and provide real value by integrating performance indicators from the stages early.

b. **Improving risk management and opportunities.** New aspects of risk management and opportunities within the management system will enable them to be used both as a management tool and as a performance accelerator, while at the same time ensuring the enterprise's ability to identify risks and opportunities more efficiently, thereby improving efficiency operational, reducing duplication and saving both time and financial resources.

c. **Improving the image of the enterprise.** By implementing the new standard, the company sends a clear message to its potential and potential customers that it has an innovative and practical approach to quality management through the management system. Thus, the trust and interest of customers and stakeholders will grow.

d. **Reduced risk related to the transition process.** If the company does not implement the new standard by the end of the transition period, it will have less time to resolve some problematic issues, and it will take longer to start last-minute action. At the

same time, there may be a risk that the organization's certificate of compliance expires before the actual transition to the new standard, endangering the business.

e. **Timely transition to standards reduces costs.** Businesses that go beyond the new updated standards over a longer period must manage a management system that meets the requirements of both old and new versions of standards.

f. **Flexible approach.** Implementing new standards early enables you to benefit sooner from less prescriptive requirements of revised standards, for example - the number of documents will help save time and financial resources.

g. **Enhanced involvement.** It will be much easier for the enterprise to promote the operation of internal changes if they are among the first to implement the new standards, and not those who meet the new requirements at the end of the transition period. Thus, the enterprise will have more time to allocate the necessary resources, and that existing management systems will be managed more efficiently over time.

h. **Improving system integration.** The common structure for all management system standards facilitates the integration of multiple systems within the enterprise without additional time and money.

6. Conclusions

For small and medium enterprises, ISO 9001: 2015 is an ideal version of a quality management system that assumes equal benefits for all participants. Implementing it in a small business will increase profit growth, develop business, save financial resources and, at the same time, meet the needs of more customers.

The quality management system, based on the requirements of ISO 9001: 2015, is the right solution for the development of small and medium-sized enterprises in order to increase national economic security. For SMC structure formation, there are special procedures and processes that meet all requirements and help to ease the business. The implementation of processes and procedures does not require major investments. Despite the fact that the vast majority of small and medium-sized enterprises are not in a hurry to implement this new system. The main reasons can be very diverse, not only external but also internal, caused by development, implementation of the quality management system, certification and maintenance of the company in good working order.

External reasons, in most cases, are the lack of regional quality policy that could directly influence the leadership of small and medium-sized enterprises by encouraging them to implement the new standard.

The activity of small and medium-sized enterprises focuses on the internal market for the following reasons:

- Lack of necessary resources;
- High costs for SMC development, implementation and certification;
- Difficulties in understanding the requirements of the standard and its application.

The process of implementing the ISO 9001: 2015 standard for small and medium-sized enterprises has its own specific features and it is very important to identify them in time, taking into account the successful experience in developing and implementing 9001: 2015 other enterprises.

Following these, we can propose the following steps and procedures that can help small and medium-sized enterprises successfully implement ISO 9001: 2015:

1. **Identify the organization environment.** This new requirement in the standard and therefore requires particular attention, since compliance with it is the foundation of the quality system in its new interpretation.

2. **Registration and keeping track of all stakeholders.** Stakeholders have to share the same processes with the business environment - another absolutely new concept that requires proper attention. Identifying all stakeholders and their expectations will help the enterprise adjust its strategic direction of development.
3. **Review the scope of SMC.** Moving to the new edition of the standard is a good time to carry out a complete audit. of the already formed scope. The reliability of the entire system depends on it.
4. **Demonstration of its leadership position.** In the given field, the requirements for the management of the enterprise are almost the same as in the previous version, the emphasis being placed even more on leadership. It is necessary to demonstrate its leadership skills by focusing on the quality system, providing it with the necessary resources, setting political objectives and quality management.
5. **Matching quality objectives with enterprise strategy.** The Quality Management System should be included in the company's overall strategy. Quality objectives should be directed as well as all other business activities, subordinated to a single strategy. It is necessary to prepare the plan for achieving the objectives - this is the requirement of the new edition of the standard.
6. **Assessing risks and opportunities.** According to ISO 9001: 2015, it is necessary to assess the risks and opportunities. These elements of the system are focused on the issue of achieving the planned system results but are also needed for other aspects of the system, such as the environment of the organization and compliance obligations. Following the risk and opportunity assessment, a plan for risk offsetting and opportunities is developed.
7. **Management of documentary information.** This new concept includes previous procedures and records. Changes in the ISO 9001: 2015 documentation will require not only the document restructuring in terms of the standard paragraphs but also the full improvement of the SMC documentation. Documents on preventive actions are no longer needed (warning actions are included in the risk assessment process), so you have to decide whether or not you want to get rid of the procedure.
8. **Operational management.** The new version requires a new level of process management development, including the description of process stages and the implementation of business process assessment tools.
9. **Analysis of design and development processes.** Design and development require even more detail in the documentation. It is necessary to address the issues of accountability of control mechanisms, input, output, prescriptions, mechanisms for implementing changes in design and development processes, including the need to specify: who analyzes the results of changes, who has the authority to impose changes, it is necessary to know what actions are planned to prevent the negative effects of failures in the design and development process.
10. **Managing external suppliers.** "Acquisition" in the current version of the ISO 9001 standard is now referred to as "Managing process and outsourced product providers." Within the business it is necessary to carry out all the actions that will allow you to maintain firm confidence in the fact that the external supplier offers you exactly the product you want from him.
11. **Evaluation of activities.** It is necessary to determine the subject to be monitored, how and how often it is necessary to pay attention to these monitoring. The purpose of the process is to evaluate the operational activities and the effectiveness of the quality management system. If you are familiar with the concept of "key performance indicators," then the changes in this compartment will be easy to accomplish.

12. Measurement and reporting. The new version of the standard places a strong emphasis on the measurement and reporting processes of their outcomes, especially with regard to the performance assessment of the above mentioned activity. Also, there are amendments to the internal auditing and management analysis requirements that require particular attention. Although the practices to be applied for their implementation remain the same as before, there are key changes in how management is handled by the management, as were the requirements for internal audit objects.

The prospect of moving to a new version of the standard may be daunting, but we can say with certainty that the whole process can not last for more than a year if you devote several hours a month to the given activity. In addition, the changes that will take place will improve the quality management system. This is a good opportunity to further integrate the system into the enterprise's management strategy. By doing so, small and medium-sized enterprises will be able to compete in the domestic and foreign markets, and will once again contribute to enhancing national economic security.

REFERENCES

- [1] Annex to Government Decision No.685 of September 13, 2012, STRATEGY for the Development of the Small and Medium Enterprises Sector for 2012-2020
- [2] About the new ISO 9001: 2015 standard.
from http://www.calitate-management.ro/articole/newISO9001_2015.htm
- [3] Cerbușca, V. (2016), Financing of Small and Medium Enterprises in the Republic of Moldova: Specifics of Innovation Enterprises. Unpublished doctoral dissertation, Chisinau.
- [4] Evolution of the number of small and medium enterprises in 2010-2015 by main types of business activity. Statistical yearbook of the Republic of Moldova
from http://www.statistica.md/public/files/publicatii_electronice/Anuar_Statistic/2016/AS_2016.pdf
- [5] Report of the Organization for the Development of the Small and Medium Enterprises Sector. Retrospection of Small and Medium Enterprises in the Republic of Moldova.
from <http://odimm.md/files/ro/pdf/Perspectiva%20sectorului%20IMM.pdf>
- [6] Raevskaia, I. (2015) Economic environment national security of Moldova Annals of the Free International University of Moldova (vol.16). 166-176
- [7] Smolevscaia, M. Panuța, S. (2012). Effects of implementing the quality management system in small and medium enterprises. Scientific papers / Agrarian State University of Moldova.: Chișinău. Vol. 31. pp. 193 – 196.
- [8] Quality management systems -- Fundamentals and vocabulary. ISO 9000:2015.
from <https://www.iso.org/standard/45481.html>

Attributes That Define Store Image – A Comparative Perspective

Claudia Stoian (Bobâlcă)

Alexandru Ioan Cuza University of Iași, Faculty of Economics and Business Administration
Iași, Romania
iuliana.bobalca@uaic.ro

Andreea Lupu

Alexandru Ioan Cuza University of Iași, Faculty of Economics and Business Administration
Iași, Romania
andreealupu1994@gmail.com

Oana Țugulea

Alexandru Ioan Cuza University of Iași, Faculty of Economics and Business Administration
Iași, Romania
ciobanu.oana@uaic.ro

Abstract. The purpose of the research is to evaluate the image of a store using the attributes that define this image. The present study investigates a hypermarket from Iași, Romania. The study has three main objectives: (1) to evaluate the perceived importance of the attributes that define the image of the store for the customers; (2) to evaluate the image of the store based on the attributes that define it; (3) to compare the perceived image of the store among different groups of customers (men and women, loyal customers and occasional customers). As a research method, we used the quantitative survey based on a questionnaire. The sample is represented by 213 persons, men and women, ages between 18-65 years, who are customers of one specific store. Eight main attributes were identified as being related to a store image: products (diversity, quality and visibility), location (place, access), store design (exterior design, colors), price (products prices, sales promotions), serving time (schedule, waiting time), general atmosphere (music, smell, light), staff (attitude regarding customers, uniforms) and auxiliary services (parking, payment options). The results indicate that the most important elements for choosing a store are represented by the products sold by the hypermarket, the location and the prices.

Key words: *brand image; the dimensions of store image; store location, loyal customers*

1. Introduction

The increasing competition in the retail market determines the companies to invest in analyzing buyer behavior and developing effective marketing strategies.

Consumer behavior studies have shown that once customer needs have developed the store image became a decision-making element in choosing a specific store, because buying decision is influenced by both economic factors as well as affective and symbolic factors. The image they are forming about the store is important in the purchasing process (Zimmer & Golden, 1988). Tauber was the first to discover that many of the customer buying reasons are not related directly to the product in the store; customers choose different stores because their purchasing needs are different. Customers' perceptions regarding the stores are mainly determined by their intangible characteristics, such as distance from home, shop atmosphere, sales persons or ambience.

The purpose of our research is to evaluate the image of a store using the attributes that define this image. The present study investigates a hypermarket from Iasi.

The study has three main objectives:

Objective 1. To evaluate the importance of the attributes that define the image of the store for the customers.

Objective 2. To evaluate the image of the store based on the attributes that define it.

Objective 3. To compare the perceived image of the store among different groups of customers (men and women, loyal customers and occasional customers).

2. Store Image

Many studies were developed over the years for studying store image multidimensional construct (Bloemer & De Ruyter, 1998; Osman, 1993). Martineau (1958, p. 47) explained the concept of store image as "...the way the store is defined in the mind of the consumers, both through functional characteristics and an aura of psychological attributes" while Oxenfeldt (1974, p. 9) refers to this concept as "a complex of attributes that consumers feel about the store". Aron (1960, p.2) defines store image as "a complex of meanings and relationships serving to characterize the store for people". Store image has been also seen as "an overall attitude of a consumer to the store" (Yoo & Chang, 2005, p.24).

The researchers support the idea that the definition of store image represents more than the features of a store and that includes also the interactions between the characteristics (Amirani & Gates, 1993). The study of Du Preez et al. (2008) presents a proposed model of store image with four concentric circles indicating the interactions between the main eight dimensions and their subdimensions. The store image dimensions identified in this research are: service, atmosphere, convenience, facilities, institutional, merchandise, promotion and sales personnel. In order to measure store image, the research of Saraswat et al. (2010) focused on the following dimensions: sales persons, store ambience, service, customer convenience, sensory appeal and customer presence. The research of Chang and Luan (2010) investigates the perception of Chinese consumers on store image, using six dimensions defining this construct: store atmosphere, service personnel, merchandise, convenience, service and reputation.

The store brands' image is transferred to retailer brand image on two aspects: price (price level, value for money) and value (including environmental issues or the interest in sustainability) (Kremer and Viot, 2012).

The research of Yoo and Chang (2005, p. 37) investigated the relation between store image attributes (price, advertisement, assortment, brand, store atmosphere, facilities, credit service, convenience of shopping, location, promotion, sales personnel service, and product quality) and customer loyalty, on the example of department stores and discount stores. While store atmosphere and easy access of location have the largest influence on customers' loyalty for the department stores, in the case of discount stores the most important variable determining loyalty are the quality of the products and advertisement.

3. Research Methodology

As a research method we used the quantitative survey based on a questionnaire. Previously a qualitative research was conducted in order to identify the attributes of store image, as they are seen by people from target market. Three focus groups were conducted with the customers of the specific supermarket, ages between 18-65 years. The groups were organized in three categories: 18-25 years, 26-45 years and 46-65 years. The focus groups were conducted in a classroom at the Alexandru Ioan Cuza of Iasi, Romania. The qualitative research was

organized in March, 2017. The instrument used for collecting the data was the focus group guide, containing open-ended questions about the motivations and the buying behavior from the supermarket and the image of the store.

The sample is represented by 213 persons, men and women, ages between 18-65 years, who are customers of one specific store. For reasons of confidentiality the name of the store, which was the subject of research, remains anonymous. The structure of the sample is presented in Table 1.

Table 1 Structure of the sample

		Gender		Total
		Male	Female	
Age	18-24 years	29	116	145
	25-35 years	23	26	49
	36-45 years	8	5	13
	46-65 years	2	4	6
Total		62	151	213

Figure 1 presents the structure of respondents' age. The majority of customers (68%) are between 18 and 24 years old, while 23% of them are between 25 and 35 years old.

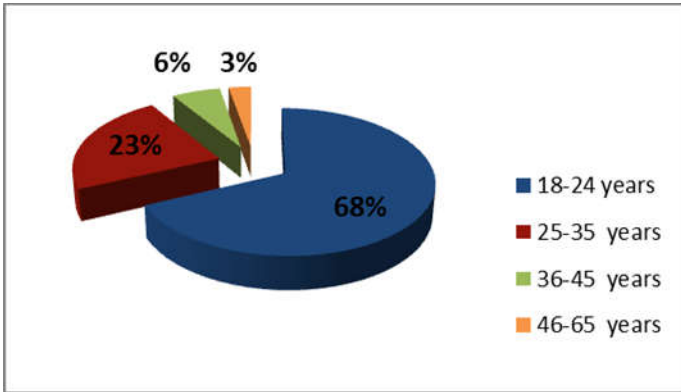


Figure 1 Structure of the sample –respondents' age

As for respondents' gender, most of the investigated customers are women (71%), as Figure 2 indicates.

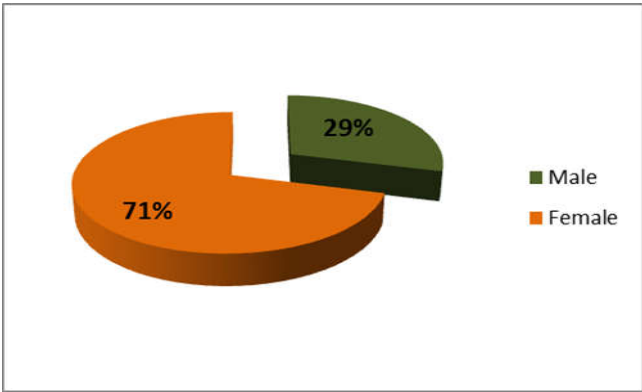


Figure 2 Structure of the sample –respondents' gender

The research instrument, the questionnaire, was built after an exploratory qualitative research in order to identify the main attributes that describe a store image. The items used in the questionnaire are grounded on the data extracted from the qualitative research.

The questionnaire was tested on a sample of 20 persons from the total investigated population and corrections have been made.

4. Research Results

The first objective was to evaluate the importance of the attributes that define the image of the store for the customers. From the previous qualitative research 8 main attributes were identified as being related to a store image: products (diversity, quality, visibility), location (place, access), store design (exterior design, colors), price (products prices, sales promotions), serving time (schedule, waiting time), general atmosphere (music, smell, light), sales persons (attitude regarding customers, uniforms) and auxiliary services (parking, payment options). The customers were asked to rate the importance of each attribute when they go to a hypermarket for shopping using a scale from 1 (Not important at all) to 5 (Very important).

Table 2 presents the results for each attribute.

Table 2 The importance of the attributes defining store image

Attribute	Mean value
Products	4.27
Location	4.11
Price	4.04
Serving time	3.60
Auxiliary services	3.46
Sales persons	3.41
General atmosphere	3.41
Store design	3.25

Analyzing the results, we noticed that the most important element for choosing a store is represented by the products sold by the hypermarket (4.27). Two more important attributes are location (4.11) and prices (4.04). Less significant is the design of the store (3.25).

The second objective of this research was to evaluate the image of the store based on the attributes that define it. We identified 8 main attributes explained by 36 characteristics. The customers were asked to rate their level of satisfaction regarding each of the 36 characteristics for store image, using a scale from 1 (Not satisfied at all) to 5 (Very satisfied).

A mean for each characteristic was computed and based on these values, a mean for each attribute was also computed. The results are presented in Table 3. The general mean for the store image evaluation is 3.97, indicating a good level of appreciation made by the customers.

Table 3 Mean values for attributes and components of store image

Attributes	Components	Mean	Attribute mean
LOCATION	Place of the hypermarket	4.32	4.19
	Easy access to the store	4.05	
PRODUCTS	Diversity of products portfolio	4.29	4.09
	Easy to find the products	3.97	
	Variety of the products from the same category	4.05	
	Quality of the products	4.15	
	Availability of the products in the store	4.10	
	Merchandising of the products	4.08	
	Quality of the store brand products (private label)	4.00	

AUXILIARY SERVICES	Paying options	4.32	3.95
	Ease of returning the products	3.70	
	Availability of parking places	3.84	
GENERAL ATMOSPHERE	Music from the store	3.83	3.95
	Smell in the store	3.82	
	Temperature in the store	3.93	
	Ventilation	3.72	
	Lights in the store	4.17	
	Cleaning in the store	3.93	
	Feeling of space	4.25	
STORE DESIGN	External design	4.09	3.92
	Decoration	3.87	
	Advertising in the store	3.87	
	Colors in the store	3.93	
	Visibility of the products	4.05	
	Products design	3.87	
	Decoration from special days	3.77	
PRICE	Prices	3.94	3.92
	Promotions	3.9	
SERVING TIME	Opening hours of the store	4.33	3.69
	Waiting time for cash registers	3.74	
	Quickness in serving the customer	3.0	
SALES PERSONS	Quickness in solving the requests of the customers	3.83	3.84
	Availability of hypermarket sales persons for customers	3.78	
	Appearances of sales representatives	3.92	
	Attitude of sales representatives	3.79	
	Information offered by sales representatives	3.88	

The most appreciated attribute that define store image was the *location* (4.19); customers are very satisfied by the position of the store in a central area (4.32).

The products of the store are also a reason for the customers to be satisfied (4.09) and improve the image of the hypermarket. More specific, customers appreciate the diversity of products portfolio (4.29), the quality of the products (4.15) and the fact that they find many products available on the shelf (4.10).

Analyzing the components of the image attributes, we notice that a reason for good satisfaction is the opening hours of the store (4.33). Other positive characteristics are paying options (4.32) and the diversity of products portfolio (4.29).

The sales persons of the hypermarket (3.84) and serving time (3.69) represent the less appreciated attributes that define store image, as Table 3 describes. In order to improve its image, the managers of the store should work on serving time (3.69), the appearances and the behavior of sales representatives (3.84), the prices (3.92) and store design (3.92).

The third objective of this research was to compare the perceived image of the store among different groups of customers (loyal customers and occasional customers, men and women). The perceived image of the store was evaluated based on the attributes presented at the first objective: products, location, store design, price, serving time, general atmosphere, sales persons and auxiliary services. We wanted to check if there are significant differences

between loyal customers and occasional customers, regarding their perception of store image. In the same manner, men and women perceptions were compared.

We grouped the respondents in loyal and occasional customers using three variables: the buying frequency, the intention to buy from the same store in the future and if they recommended or not the hypermarket to others. All the respondents mentioned they intended to buy from the same hypermarket in the future and they recommended at least once the store to other persons. We grouped the customers who usually go shopping in that particular store more than once a month in the category called loyal customers (71%). The customers who usually go shopping in that particular store once a month or less often were included in the category called occasional customers (29%).

As each attribute is explained by some characteristics, we used the means for each one of the total attributes. In order to test if there are significant differences between loyal and occasional customers regarding the way they perceive store image, we used Independent Sample T Test. The main results are presented in Table 4.

Table 4 Store image attributes - loyal and occasional customers

Attribute	Customers	Mean
Products	Loyal customers	4.142
	Occasional customers	4.010
Location	Loyal customers	4.262
	Occasional customers	3.932
Prices	Loyal customers	3.993
	Occasional customers	3.671
Serving time	Loyal customers	3.908
	Occasional customers	3.886
Auxiliary services	Loyal customers	4.030
	Occasional customers	3.712
Sales persons	Loyal customers	3.949
	Occasional customers	3.677
General atmosphere	Loyal customers	4.074
	Occasional customers	3.830
Store design	Loyal customers	4.008
	Occasional customers	3.669

For the first attribute, the products sold in the store, the Independent Sample T test indicated that there are no significant differences ($Sig=0.26 > 0.05$) between the mean values of loyal customers (4.142) and occasional customers (4.010). Although this attribute is the most important for the customers, they do not rate it differently according to their level of loyalty. One reason might be that similar brands are sold by different stores and the frequency of buying from a specific hypermarket is not due to the products.

Regarding store location, the Independent Sample T test indicated that there are significant differences ($Sig=0.01 < 0.05$) between the mean values of loyal customers (4.262) and occasional customers (3.932). Both values are high, indicating that location is perceived as a good one, but loyal customers appreciate it more than the others.

For the third attribute, the prices, the Independent Sample T test indicated that there are significant differences ($Sig=0.03 < 0.05$) between the mean values of loyal customers (3.993)

and occasional customers (3.671). The first category of customers is more satisfied with the prices than the second category.

Regarding Serving time attribute evaluation, there is not any significant difference between the mean values of loyal customers (3.908) and occasional customers (3.886) (Sig=0.88 > 0.05), indicating that this attribute doesn't make the difference in the preference for the store, between the two groups.

The quality of auxiliary services is perceived differently by the loyal customers who are more satisfied by these services (4.030) than the occasional customers (3,712) (Sig=0.01 < 0.05).

For the Sales persons attribute, the Independent Sample T test indicated that there are significant differences (Sig=0.03 < 0.05) between the mean values of loyal customers (3.949) and occasional customers (3.677). The first category of customers is more satisfied with the store employees than the second category.

Regarding general atmosphere, there wasn't any significant difference between the mean values of loyal customers (4.074) and occasional customers (3.830) (Sig=0.07 > 0.05).

For the last attribute, store design, the Independent Sample T test indicated that there are significant differences (Sig=0.007 < 0.05) between the mean values of loyal customers (4.008) and occasional customers (3.669). The loyal customers of the hypermarket appreciate more its general design than the occasional buyers.

As a conclusion, loyal customers' perception on store image is significantly better compared with occasional customers, especially regarding store location, prices, the quality of auxiliary services, sales persons and store design.

We also evaluate the store image as it is perceived by women (71% of the sample population) and men (29% of the sample population). The results of the analysis are presented in Table 5.

Table 5 Store image attributes– male and female customers

Attribute	Customers	Mean
Products	Female customers	4.127
	Male customers	4.073
Location	Female customers	4.228
	Male customers	4.082
Prices	Female customers	3.884
	Male customers	4.000
Serving time	Female customers	3.831
	Male customers	4.079
Auxiliary services	Female customers	3.891
	Male customers	4.115
Sales persons	Female customers	3.876
	Male customers	3.909
General atmosphere	Female customers	4.039
	Male customers	3.964
Store design	Female customers	3.930
	Male customers	3.927

For the first attribute, the products sold in the store, the Independent Sample T test indicated that there are no significant differences (Sig=0.61 > 0.05) between the mean values of female

(4.127) customers and male customers (4.073). Also, there are no significant differences between the two groups regarding the appreciation of the Location (Sig=0.30 > 0.05), the satisfaction level regarding Price policy (Sig=0.39 > 0.05), Serving time (Sig=0.09 > 0.05) or the quality of Auxiliary Services (Sig=0.08 > 0.05). According to the Independent Sample T test there are no significant differences (Sig=0.80 > 0.05) between the mean values for the level of satisfaction regarding the Sales persons. It seems that no matter if they are men (3.909) or women (3.876), the customers appreciate the same component of store image and they are satisfied with the employees with whom they interact in the store, during shopping. Customers also appreciate the general atmosphere in the store, both men and women customers (Sig=0.57 > 0.05). The Independent Sample T Test indicated no significant difference between the mean value for Store design attribute, for female customers (3.930) and male customers (3.927) (Sig=0.98 > 0.05). As a conclusion, the customers' gender has no influence on the perception regarding store image, for the example of our research.

5. Conclusions

The purpose of the research was to evaluate the image of a store through the attributes that define it. The first step was to evaluate the importance of the attributes that define the image of the store from the customers' perspective. Following this objective, the conclusion was that the most important perceived attributes of store image are: the products sold by the hypermarket (4.27), location (4.11) and prices (4.04). Less significant attribute is the design of the store (3.25).

In order to evaluate the global image of the store, we identified 36 characteristics that describe the eight attributes perceived as being relevant for the customers. Regarding the characteristics, the most appreciated by the customers are: the opening hours of the store (4.33), the place of the hypermarket (4.32), paying options (4.32), the diversity of products portfolio (4.29) and the feeling of space (4.25). The less appreciated characteristics of the store are represented by the waiting time for cash registers (3.74), the air ventilation (3.72), the ease of returning the products (3.70) and the quickness in serving customer (3.63).

Analyzing the general attributes defining store image, the results indicate that the most appreciated attribute which defines store image is the location (4.19) while the sales persons of the hypermarket represents the less appreciated attribute that defines store image (3.84).

Comparing the perceived image of the store among different groups of customers, the research results indicate that loyal customers' perception on store image is significantly better compared with occasional customers, especially regarding store location, prices, the quality of auxiliary services, sales persons and store design. Also, the customers' gender has no influence on this perception.

Research limitations. The research investigates the image of one single store, meaning that the attributes and the characteristics identified in the study cannot be generalized for other stores. Although the research methodology can be used for investigating store image, other studies have to be conducted in order to develop a scale to measure store image. In addition, the sample size must be improved, especially for the group of buyers older than 36 years.

Future research directions. The research can be expanded on a larger sample that includes all the customers' segments. Also, a scale that measures brand image can be developed in the future.

Managerial implications. The research results can be used by the store managers who want to investigate the image of the store and also to identify strategies for improving the actual perceived image from their customers' point of view. In this particular case, the managers of the store should work on the appearances and the behavior of sales representatives, on reducing serving time, adjusting the prices and improving store design.

REFERENCES

- Aron, L. (1960). Does television viewing store image and shopping frequency. *Journal of Retailing*, 37 (3), 1-13.
- Amirani, S. & Gates, R. (1993). An Attribute-Anchored Conjoint Approach to Measuring Store Image. *International Journal of Retail & Distribution Management*, 21 (5), 30-39.
- Chang, E., & Luan, B. (2010). Chinese consumers' perception of hypermarket store image. *Asia Pacific Journal of Marketing and Logistics*, 22 (4), 512 – 527.
- Du Preez, R., Visser, E., & Noordwyk, H. (2008). Store Image: Toward a Conceptual Model Part 1. *SA Journal of Industrial Psychology*, 34 (2), 50-58.
- Bloemer, J., & Ruyter, K. (1998). On the relationship between store image, store satisfaction and store loyalty. *European Journal of Marketing*, 32 (5/6), 499-513.
- Kremer, F., & Viot, C. (2012). How store brands build retailer brand image. *International Journal of Retail & Distribution Management*, 40 (7), 528 – 543.
- Martineau, P. (1958). The personality of the retail store. *Harvard Business Review*, 36 (1), 47-55.
- Osman, M.Z. (1993). A conceptual model of retail image influences on loyalty patronage behaviour. *The International Review of Retail, Distribution and Consumer Research*, 3(2), 133-148.
- Oxenfeldt, A. R. (1974). Developing a Favorable Price-Quality Image. *Journal of Retailing*, 50, 8-14.
- Saraswat, A., Mammen, T., Aagja, J. P., & Tewari, R. (2010). Building store brands using store image differentiation. *Journal of Indian Business Research*, 2(3), 166 – 180.
- Zimmer, M.R. & Golden, L.L. (1988). Impressions of Retail Stores: a content analysis of consumer images. *Journal of Retailing*, 64(3), 265-293.
- Yoo, S., & Chang, Y. (2005). An Exploratory Research on the Store. Image Attributes Affecting Its Store Loyalty. *Seoul Journal of Business Volume*, 11 (1), 19-41.

Legal Protection of Trade Secrets

Ivan Akrap, senior lecturer

University Department of Professional Studies, University of Split, Split, Croatia
iakrap@oss.unist.hr

Slavko Buotić, student

University Department of Professional Studies, University of Split, Split, Croatia
buoticslavko@gmail.com

Abstract. Legal protection of trade secret in the Republic of Croatia is stipulated with the Trade Act as well as with the Labour Act. On the 8th June 2016, European Parliament has enacted Directive 2016/943 on the protection of undisclosed know-how and business information (trade secrets) against their unlawful acquisition, use and disclosure which member states will have to transpose into their national laws by the 9th June 2018. This paper deals with current state of legal protection of trade secret in the Croatian legal system estimating the legislative changes that will have to be done in order to comply with the Directive.

Key words: trade secret protection, compensation of damage, provisional measures

1. Introduction

Valuable know-how, experience and business information, that is undisclosed and intended to remain confidential, is referred to as a trade secret.¹ Businesses value trade secrets as much as patents and other forms of intellectual property right. They use confidentiality as a business competitiveness tool. Trade secrets allow creators and innovators to derive profit from their creation or innovation by protecting such a wide range of know-how, experience and business information, therefore being particularly important for business competitiveness.²

Innovative businesses are increasingly exposed to dishonest practices aimed at misappropriating trade secrets, such as theft, unauthorised copying, economic espionage or the breach of confidentiality requirements, whether from within or from outside of the Union. The unlawful acquisition, use or disclosure of a trade secret compromises legitimate trade secret holders' ability to obtain first-mover returns from their innovation-related efforts.³

There are important differences in the member states' legislation as regards the protection of trade secrets against their unlawful acquisition, use or disclosure by other persons. These differences lead to the fragmentation of the internal market in this area and the weakening of the general deterrent effect of relevant rules, thus interfering with the proper functioning of the internal market.⁴

To ensure a sufficient and consistent level of legal protection within the framework of civil law in the internal market on 8th June 2016 the European Union adopted the Directive (EU)

¹ Item 1 Introductory statement of the Directive (EU) 2016/943 of the European Parliament and of the Council of 8th June 2016 on the protection of undisclosed know-how and business information (trade secrets) against their unlawful acquisition, use and disclosure, *SL L 157, 15.6.2016., str. 1–18, further in the text referred to as: Trade secret Directive.*

² Item 2 Trade Secret Directive Introductory Statements

³ Item 4 Trade Secret Directive Introductory Statements

⁴ Item 6 Trade Secret Directive Introductory Statements

2016/943 on the protection of undisclosed know-how and business information (trade secrets) against their unlawful acquisition, use and disclosure, and member states are obliged to implement it by 9th June 2018.

The Directive, which establishes common measures against the unlawful acquisition, use and disclosure of trade secrets, is intended to ensure the smooth functioning of the internal market.

2. The Scope of the Directive and the Definition of Trade Secret

The Trade Secret Directive minimally complies with the member states' rules on trade secrets, which means that member states may, in compliance with the provisions of the Treaty on the Functioning of the European Union (hereinafter referred to as: TFEU), provide for more far-reaching protection against the unlawful acquisition, use or disclosure of trade secrets.⁵

This Directive does not affect the exercise of the right to freedom of expression and information. This Directive provides for measures and remedies which can consist of preventing the disclosure of information in order to protect the confidentiality of trade secrets. Still, it is essential that the exercise of the right to freedom of expression and information which encompasses media freedom and pluralism, as reflected in Article 11 of the Charter of Fundamental Rights of the European Union (hereinafter referred to as: the Charter), not be restricted, in particular with regard to investigative journalism and the protection of journalistic sources.⁶

In the interest of innovation and the strengthening of market competition, the provisions of this Directive should not establish any exclusive right to knowledge and experience or to information protected as a trade secret. Thus, independent discovery of the same knowledge and experience or information should continue to be possible.

Item 38. of the Introductory Statements asserts that Directive should not affect the application of competition law rules, in particular Articles 101 and 102 of the Treaty on the Functioning of the European Union. However, the measures, procedures and remedies provided for in this Directive should not be used to restrict unduly competition in a manner contrary to the TFEU.⁷ Item 39 states that the Directive should not affect the application of any other relevant law in other areas, including intellectual property rights and the law of contract. In paragraphs 1-3 the introductory statements explain the relationship of this Directive with regards to intellectual property. Participants may derogate from the provisions of the Trade Secret Directive by agreement. Where the scope of application of Directive 2004/48/EC of the European Parliament and of the Council on the implementation of intellectual property rights and the scope of this Directive overlap, this Directive takes precedence as *lex specialis*.⁸

The Directive was to establish a homogenous definition of a trade secret without restricting the subject matter to be protected against misappropriation. The definition was therefore constructed so as to cover know-how, experience, business information and technological information where there is both a legitimate interest in keeping them confidential and a legitimate expectation that such confidentiality will be preserved. Furthermore, such know-how or information should have a commercial value, whether actual or potential. Such know-how, experience or information should be considered to have a commercial value, for example, where its unlawful acquisition, use or disclosure is likely to harm the interests of the person lawfully controlling it, in that it undermines that person's scientific and technical potential, business or financial interests, strategic positions or ability to compete.⁹

⁵ Art. 1, Item 1 Trade Secret Directive

⁶ Item 19 Trade Secret Directive Introductory Statements

⁷ Item 38 Trade Secret Directive Introductory Statements

⁸ Item 39 Trade Secret Directive Introductory Statements

⁹ Item 14 Trade Secret Directive Introductory Statements

Ch. 1 Art. 2 of the Directive states that trade secret means information which meets all of the following requirements:

- a) it is secret in the sense that it is not, as a body or in the precise configuration and assembly of its components, generally known among or readily accessible to persons within the circles that normally deal with the kind of information in question;
- b) it has commercial value because it is secret;
- c) it has been subject to reasonable steps under the circumstances, by the person lawfully in control of the information, to keep it secret.¹⁰

Consequently, the terms are that they are secret business information which has commercial value because they are secret, and that reasonable measures have been taken to preserve the secrecy.

The Directive defines that the ‘trade secret holder’ is any natural or legal person lawfully controlling a trade secret¹¹. The Directive specifically lists companies and non-commercial research institutions which use trade secrets for innovation-related activities, including cooperation with research or production partners, related production and later cross-border trade, outsourcing or investment in other member states.

An ‘infringer’ is any natural or legal person who has unlawfully acquired, used or disclosed a trade secret. If a third party unlawfully acquires, uses, or discloses a trade secret, this could have devastating consequences for the legitimate trade secret holder, because once it is publicly disclosed, its holder can no longer restore the condition that existed before the loss of a trade secret.¹²

‘Infringing goods’ are goods, the design, characteristics, functioning, production process or marketing of which significantly benefits from trade secrets unlawfully acquired, used or disclosed. A trade secret could be used illegally to design, manufacture or place on the market the goods or parts which could be expanded in the internal market, thus affecting the commercial interests of the trade secret holder and the functioning of the internal market.¹³

3. Lawful Acquisition, Use and Disclosure of Trade Secrets

According to art. 3. item 1. the acquisition of a trade secret shall be considered lawful when the trade secret is obtained by any of the following means:

- a) independent discovery or creation;
- b) observation, study, disassembly or testing of a product or object that has been made available to the public or that is lawfully in the possession of the acquirer of the information who is free from any legally valid duty to limit the acquisition of the trade secret;
- c) exercise of the right of workers or workers' representatives to information and consultation in accordance with Union law and national laws and practices;
- d) any other practice which, under the circumstances, is in conformity with honest commercial practices.¹⁴

The use or disclosure of a trade secret shall be considered unlawful whenever carried out, without the consent of the trade secret holder, by a person who is found to meet any of the following conditions:

- a) having acquired the trade secret unlawfully;

¹⁰ Art. 2, Item 1 Trade Secret Directive

¹¹ Art. 2, Item 2 Trade Secret Directive

¹² Art. 2, Item 3 Trade Secret Directive

¹³ Art. 2, Item 4 Trade Secret Directive

¹⁴ Art. 3, Item 1 Trade Secret Directive

- b) being in breach of a confidentiality agreement or any other duty not to disclose the trade secret;
- c) being in breach of a contractual or any other duty to limit the use of the trade secret.¹⁵

The acquisition, use or disclosure of a trade secret shall also be considered unlawful whenever a person, at the time of the acquisition, use or disclosure, knew or ought, under the circumstances, to have known that the trade secret had been obtained directly or indirectly from another person who was using or disclosing the trade secret unlawfully.¹⁶

The production, offering or placing on the market of infringing goods, or the importation, export or storage of infringing goods for those purposes, shall also be considered an unlawful use of a trade secret where the person carrying out such activities knew, or ought, under the circumstances, to have known that the trade secret was used unlawfully.¹⁷

4. Legal Remedies for the Protection of Trade Secret

Member states shall provide for the measures, procedures and remedies necessary to ensure the availability of civil redress against the unlawful acquisition, use and disclosure of trade secrets.¹⁸

The measures, procedures and remedies must be fair and equitable, must not be unnecessarily complicated or costly, and must be effective.¹⁹

4.1. Provisional and precautionary measures

Member states shall ensure that the competent judicial authorities may, at the request of the trade secret holder, order any of the following provisional and precautionary measures against the alleged infringer:

- a) the cessation of or, as the case may be, the prohibition of the use or disclosure of the trade secret on a provisional basis;
- b) the prohibition of the production, offering, placing on the market or use of infringing goods, or the importation, export or storage of infringing goods for those purposes;
- c) the seizure or delivery up of the suspected infringing goods, including imported goods, so as to prevent their entry into, or circulation on, the market.²⁰

Member states shall ensure that the judicial authorities may, as an alternative to the measures, make the continuation of the alleged unlawful use of a trade secret subject to the lodging of guarantees intended to ensure the compensation of the trade secret holder. Disclosure of a trade secret in return for the lodging of guarantees shall not be allowed.²¹

4.2. Right to compensation for damages

In order to avoid a person who knowingly, or with reasonable grounds for knowing, unlawfully acquires, uses or discloses a trade secret being able to benefit from such conduct, and to ensure that the injured trade secret holder, to the extent possible, is placed in the position in which he, she or it would have been had that conduct not taken place, it is necessary to provide for adequate compensation for the prejudice suffered as a result of that unlawful conduct.²²

Member states ensure that the competent judicial authorities can, upon the request of the injured party, order an infringer who knew or ought to have known that he, she or it was

¹⁵ Art. 4, Item 3 Trade Secret Directive

¹⁶ Art. 4, Item 4 Trade Secret Directive

¹⁷ Art. 4, Item 5 Trade Secret Directive

¹⁸ Art. 6, Item 1 Trade Secret Directive

¹⁹ Art. 6, Item 2 Trade Secret Directive

²⁰ Art. 10, Item 1 Trade Secret Directive

²¹ Art. 10, Item 2 Trade Secret Directive

²² Item 30 Trade Secret Directive Introductory Statements

engaging in unlawful acquisition, use or disclosure of a trade secret, to pay the trade secret holder damages appropriate to the actual prejudice suffered as a result of the unlawful acquisition, use or disclosure of the trade secret.²³

When setting the damages, the competent judicial authorities shall take into account all appropriate factors, such as the negative economic consequences, including lost profits, which the injured party has suffered, any unfair profits made by the infringer.

Alternatively, the competent judicial authorities may, in appropriate cases, set the damages as a lump sum on the basis of elements such as, at a minimum, the amount of royalties or fees which would have been due had the infringer requested authorisation to use the trade secret in question.²⁴

5. Legal Regulation of Trade Secrets in the Republic of Croatia and Possibilities of Implementation of the Directive

Lipton (2011) citing Merges, Menell and Lemley (2007) defines trade secret law as protection against the misuse of confidential commercial or technical information by unfair or unreasonable means. Protection of trade secrets in the Republic of Croatia is regulated by the Trade Act²⁵ (hereinafter referred to as: TA) at the institute unfair trading and by the Criminal Code²⁶ (hereinafter referred to as: CC) as a criminal offense of giving and unauthorized access to trade secrets. Unfair trading are those actions of traders by which they violate good trades for the purpose of market competitiveness.²⁷ The act of trade secret violation is considered to be an act of unfair trading, and according to art. 64. item 10. the act is defined as an unlawful acquisition of a trade secret of another trader or unlawful exploitation of trusted trade secrets of another trader.

According to the CC anyone who communicates, submits, or otherwise makes unauthorized access to information which is a trade secret, as well as who obtains such information in order to forward it to an unauthorized person shall be punished by imprisonment for a term not exceeding three years.²⁸

The TA as well as the CC do not contain a definition of a trade secret, however it can be found in the Labour Act²⁹ (hereinafter referred to as: LA) and in the Data Secrecy Act³⁰ (hereinafter referred to as: DSA). According to art. 159 para. 2 of the LA and art. 19 of the DSA a trade secret is considered to be information which is classified as trade secret by law, other regulation or general act of a company, institution or other legal entity, and which represents a production secret, results of research or construction work, and other information which if communicated to an unauthorized person would result in harmful consequences to its economic interests.

Therefore, regulated conditions define it as information which is classified as trade secret by law, other regulation or general act of legal person, and which if communicated to an unauthorized person would result in harmful consequences to its economic interests. The term information specifically entails a production secret and results of research or construction work, but the list is not closed.

²³ Art. 14, Item 1 Trade Secret Directive

²⁴ Art. 14, Item 2 Trade Secret Directive

²⁵ Official Gazette, No. 87/08, 96/08, 116/08, 76/09, 114/11, 68/13, 30/14

²⁶ Official Gazette, No. 125/11, 144/12, 56/15, 61/15, 101/17

²⁷ Art. 63 of the TA

²⁸ Art. 262, para. 1 of the CC

²⁹ Official Gazette, No. 93/14, 127/17

³⁰ Official Gazette, No. 108/96

The violation of trade secrecy is prohibited.³¹ TA prescribes the right to compensation for damages caused by prohibited acts of unfair trade which is to be realized in court proceedings.³² A plaintiff can be the trader who suffered the damage as well as the chambers of commerce and trade associations. The time limit for submitting such a claim is also prescribed, which is one year from the day when the claimant finds out about the offense and the perpetrator, and no later than three years from the day of the commission of the offense.³³

The Directive came into force in July 2016, and states are obliged to implement it in their legislation by 9th June 2018. It will not be possible to implement it into existing special laws currently in force which so far contained provisions on trade secrets, like the TA and the Labour Act, because the TA only regulates trading activity. According to art. 63. item 1. unfair trading implies all trading activities which violate good trading customs for the sake of market competition,³⁴ but the Directive applies to all activities.

Therefore, it will be necessary to adopt a special law for regulating this matter, which will cover all activities and will contain detailed implementing regulations.

At the time of writing this paper the Government of the Republic of Croatia presented the final proposal of the Law on protection of know-how and trade secrets, which establishes and regulates the protection prescriptions and the rules of procedure for protection against unlawful acquisition, use or disclosure of trade secrets or unpublished information which have market (commercial) value.

This proposal of law introduces the provisions of the Directive into our legislation and calls for the appropriate enforcement of the general regulations governing mandatory relationships, litigation and the insurance procedure. It is to be under the exclusive jurisdiction of commercial courts, what is understandable considering that within the commercial courts' jurisdiction are also the protection of industrial property, copyright and related rights and other intellectual property rights.

Also, the range of persons authorized to request protection has been extended, besides the trade secret holders to holders of exclusive license, and the damage compensation has been regulated in more detail. In addition to actual damage, the beneficiary is also entitled to the loss of profit and intangible damage. In addition to claims for damages, the beneficiary may claim for compensation through lawsuit under the rules of unjust enrichment, thereby extending the possibility of a positive answer to the claim.

Art. 22 of the final Proposal of the Law on protection of know-how and trade secrets, as these proceedings are urgent an amendment of the Civil Procedure Act is necessary which is to specify the proceedings regarding unlawful acquisition, use or disclosure of trade secrets as urgent.

6. Conclusion

Business secrets play an important role in protecting the exchange of knowledge between companies, especially in small and medium-sized enterprises. The knowledge, innovation and information that they possess give them competitive advantages.

There is a large difference between member states in the system and the definition of dealing with trade secrets and their protection. The Directive will provide legal clarity and equal game rules for all European companies. It will also contribute to increasing their interest in the development of research and innovation activities.

³¹ Art. 63, para. 2 of the TA

³² Art. 65, para. 1 of the TA

³³ Art. 65, para. 3 of the TA

³⁴ Art. 63 of the TA

The Directive came into force on 5th July 2016, and member states are obliged to implement it in their legislation by 9th June 2018, so the deadline for implementation is quite near.

We consider that by the final proposal of the Law on protection of know-how and trade secrets the beneficiaries of civil law protection against unlawful acquisition, use or disclosure of trade secrets are well protected. For full compliance with the Directive, minor changes to laws, which regulate civil and mortgage enforcement proceedings are necessary.

REFERENCES

1. Charter of Fundamental Rights of the European Union, Retrieved March 15, 2018 from <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:12012P/TXT>
2. Criminal Code (Official Gazette, No. 125/11, 144/12, 56/15, 61/15, 101/17)
3. Data Secrecy Act (Official Gazette, No. 108/96)
4. Directive (EU) 2016/943 of the European Parliament and of the Council of 8th June 2016 on the protection of undisclosed know-how and business information (trade secrets) against their unlawful acquisition, use and disclosure, *SL L 157, 15.6.2016*.
5. Labour Act (Official Gazette, No. 93/14, 127/17)
6. Lipton, B. (2011) Trade Secret Law and the Changing Role of Judge and Jury, *The Yale Law Journal*, 955-965
7. Proposal of the Law on protection of know-how and trade secrets, Retrieved March 21, 2018 from <https://vlada.gov.hr/UserDocsImages//Sjednice/2017/11%20studeni/65%20sjednica%20Vlade%20Republike%20Hrvatske//65%20-%202.pdf>
8. Trade Act (Official Gazette, No. 87/08, 116/08, 76/09, 114/11, 68/13, 30/14)
9. Treaty on the Functioning of the European Union, Retrieved March 21, 2018 from <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:12012E/TXT>

Cultural Heritage Tourism as a Factor in the Production of Economic and Social Capital

Rossella Del Prete

University of Sannio, Benevento, Italy
delprete@unisannio.it

Abstract. One of the objectives of my research was to encourage local policy stakeholders to develop an innovative model of governance for a better management of cultural heritage, thus promoting the use of cultural activities as a tool to enhance and promote cultural heritage sites and, more generally, as a tool for a sustainable development of the territory fostering intercultural dialogue and enacting strategies to protect and promote the same cultural assets. This theme - at a time of dramatic cuts to the funding for the cultural sector at large- is highly topical, as it rises from the need to give an answer to questions, hesitations and challenges that institutions and cultural operators constantly experience while trying to enhance cultural heritage. In order to define new strategies and new methods in terms of both governance and management of cultural sites, my project has relied on a comparative analysis that has involved all the project's partners, the representatives of the institutions and of the academic and business communities, along with economic and cultural operators. Each of them was involved in "participatory" working out of a governance plan, meant to outline innovative strategies and efficient management models on the basis of the different existing systems in the project partner countries. This was also geared towards finding a possible integration across the different policies of local development.

Keywords: *Cultural Heritage, Tourism, Public History, CCIs*

1. Introduction

The cultural and cultural cognitive tourism is currently a type of tourism, focusing on the cultural environment. This in turn may include cultural and historical sights of a destination or cultural-historical heritage, value and lifestyle of the local population, arts, crafts, traditions and customs of the local population. Furthermore, cultural and cognitive routes may include a visit or participation in cultural activities and events, including museums, concerts, exhibitions, galleries, etc. (ICOMOS – International Council on Monuments and Sites).

Cultural tourism is defined as "trips". Its main or concomitant goal is visiting those sites and events that thanks to their cultural and historical value have become part of the cultural heritage of a community.

The concept of **cultural heritage** includes intangible and tangible, movable and immovable heritage as "a set of cultural values that are carriers of historical memory, national identity and have scientific or cultural value".

Some categories of Cultural Tourism are: Heritage tourism, Art tourism, Creative tourism, Urban cultural tourism, Rural cultural tourism, Local cultural tourism, Contemporary cultural tourism.

Public History is seen, heard, read, and interpreted by a popular audience. Therefore, public historians expand on the methods of academic history by emphasizing non-traditional evidence and presentation formats, reframing questions, and creating a distinctive historical practice in the process.

Public history, as its name suggests, belongs to the public. By emphasizing the public context of scholarship, public history trains historians to transform their research to better reach audiences. It began in the United States in the late 19th century; in the 20th century-professionalization and standardization; in the mid-1970s – the first program at the University of California, Santa Barbara. Today it is in a wide variety of fields, especially preservation and document management, policy advice, legal consultation, documentary filmmaking, media programming, archeology and historical sites, website designer, communication, Museum and Cultural tourism [Bertella Farnetti P., 2017].

Therefore, Public History takes many forms: museum presentations, television documentaries, historic preservation projects, collection and recording projects, re-translation of traditional historical knowledge into modern, micro-computer-based formats.

As an academic discipline, it also focuses on the efficient and ethical management of our nation's historical heritage and collective memories. It is based on the understanding that history is not taught solely in the classroom, but it is learned in a variety of places and ways.

Thus, Culture, Heritage, Environment and Tourism are interconnected and the economic contribution on heritage resources is one of the main means to achieve sustainable tourism development. A better understanding of heritage tourist behavior in terms of heritage service aspects and tourist preferences is important: *Natural* (Landforms - Rural Scenery - Flora and Fauna), *Cultural* (Festivals - Arts/crafts - Traditional practices/products), *Built* (Historical Building - Monuments- Industrial sites).

Historical, cultural and artistic heritage pertains to tangible as well as intangible aspects.

Cultural heritage is identified as the origin of all forms of arts and the soul of cultural and creative industries. It brings together cultural aspects from the historical, anthropological, ethnic, aesthetic and societal viewpoints; it also influences creativity and is the origin of a number of heritage goods and services as well as cultural activities. Associated with heritage is the concept of “traditional knowledge and cultural expressions” embedded in the creation of arts and crafts, as well as in folklore and traditional cultural festivities [UN Creative Economy Report, 2008].

Artistic heritage pertains to historic artwork. This group includes visual arts such as paintings, sculptures, photography and antiques; and performing arts such as live music, theatre, dance, opera etc. The social benefits of the arts on individual and community development have been argued by the Community Arts Movement since the 1960s. However, although there was a significant body of evidence to support this argument, most of it was anecdotal and there were significant gaps in the documents available. The low priority given to the issue of impact measurement within the political and policy agendas of the time, coupled with the lack of a systematic evidence-basis, meant that the case for the arts having a wider societal impact was never sufficiently robust to convince policymakers to release substantial funds for its further investigation. Myerscough (1988) demonstrated, through the use of a multiplier, that direct spending on the arts led to spending in other economic sectors, which in turn enhanced wealth and job creation, and made cities appear more attractive to citizens and companies alike. The study had a far-reaching impact on the cultural sector and strengthened its argument for the *economic* impact of the arts as a powerful justification for continued public funding. The Report set the stage for a generation of impact studies and other analyses commissioned by local authorities and other public funding agencies, which sought to document and argue the case for the role of the arts and creative industries as important agents for economic development and urban renewal, and begin to measure this impact in quantitative terms.

As Pratt (1997) notes: 'much attention has been paid to developing analyses of the *indirect impact* of the arts and cultural industries. Urban managers in the US and latterly the UK have

developed economic impact studies that have sought to explore the extra economic activity generated by arts and culture; predominantly via participation figures, and secondary impacts via proximity on shopping and tourism, as well as transport and accommodation. Such studies have effectively re-legitimized arts investment (that is not-for-profit art activity) within a new state regime.'

Focusing on the conditions and requirements allowing for a sustainable conservation and enhancement of cultural heritage seems to be indispensable. Indeed, these will lead to suggest actions likely to result in virtuous solutions to take a challenge at the same time economic, political and civic in nature. An acceptable system for involving economic operators in the policies regulating use and enjoyment of cultural heritage should be devised by defining economies of scale and reference parameters in a self-government oriented approach.

In this perspective, on the basis of the framework governing this sector, the present research effort has focused on the need for changes and innovation in the management of cultural heritage with a “consistent contextuality” approach where the formal quality of the administrative organization is an important, albeit not the only, element that defines new governance models. The entire system of actors and of their internal and external relations are expected to be innovated as well. Experience has already taught us that managing cultural heritage with a corporate approach does not always result in expected outcome. By its own nature, each heritage site is characterized by an intense exchange with its own users, with cultural operators, with the local community and its representatives both inside and outside its own borders. From a time perspective, this exchange also benefits future generations.

The above comparative analysis has taken place by means of an International Conference organized by my spin-off unisannio Kinetès, on March 2012 in Benevento. During the Conference representatives of major institutions, of academic and business communities, and cultural operators have analyzed policies, tools and best practices.

The first point of discussion is devoted to a comparative analysis of the legal frameworks and regulations in force at local, regional and national levels in the regions covered in each one of the project member countries. Particular attention is paid to the “jurisdictions” of the individual institutions, as well as to public-private partnerships in terms of cultural heritage protection, management and enhancement actions, in order to compare the different national legislations, Constitutional Charters included, and the different regional policies for a clear identification of differences in terms of local governments’ competences in matters related to cultural heritage. On the basis of these differences, and always with a comparative approach, an attempt has been made to try and understand the meaning attributed to the term “cultural asset” and whether this latter is regulated at a national, regional and local level in the project member countries.

This analysis highlighted a patchy landscape: not all the countries involved granting legislative powers to regional governments in terms of cultural heritage, with clear differences also in terms of best practices and legislative constraints at all levels of government in countries under study.

The second point examines the central topic of this research: the economics of culture. It contains a synthesis of the presentations delivered by the protagonists of the Conference who, from different perspectives, tackled the themes of culture as a factor of social capital production, cultural assets management and organizational systems with a special focus on the regulatory, economic and financial aspects resulting from the choice of a given governance model.

All the cultural actors invited to the Conference have identified some key points, including a general consensus on the need to:

- put in place a networking effort across institutions and communities involving private actors and the third sector;
- expand the systems for an integrated and community-based enhancement of cultural heritage;
- improve communication in cultural sites by a better knowledge of visitors based on advanced survey systems and scientific studies on the identity traits of the users of Cultural Assets;
- improve the visit experience also from an emotional point of view, focusing on merchandising efforts and on *high-sensing* methods, so that it is not only an economic or knowledge-driven experience, but a memory, an emotion to take back home;
- go beyond the logic of public funds as the only source of funding actions meant to protect and enhance cultural heritage.

A proposal has been put forward to give a central stage to creative and cultural businesses within territorial animation and enhancement actions. However, this should be done only after a business training program addressed to cultural operators has been started and new boundaries have been established for the participation of private actors in the cultural sector. This would allow to overcome present constraints to private participation in the management of heritage ancillary services.

In addition to that, most interestingly, the proposal of setting up an ethical fund has been made for a new and more efficient modality for funding cultural heritage, cultural and creative businesses, together with the proposal of granting access to network agreements.

The third point focuses on the analysis of one of the key issues of cultural heritage management, perhaps the most neglected public institutions: communication as a tool of development. Indeed our research effort has highlighted the importance of communicating culture bearing in mind its possibility to serve as the real economic engine of the entire economic sector and of regional development as shown by the revitalization of the cultural assets covered by the best practices presented.

The fourth point of discussion illustrates the aims and objectives, as well as the issues and outcomes obtained in the experimentation phase put in place within the Project of a Cultural Heritage Governance. Outcomes have been measured on the basis of the data related to the network of the sites of historical artistic interest created by the project, as well as on the basis of the participation and sharing methodologies enforced by all the partners. The study ends by putting forward proposals and recommendations for the development of the cultural sector through a new and more efficient governance plan able to take on a challenge on the economic, political and civic levels.

2. Culture As a Factor of Social Capital Production

The last few years have been marked by a policy of steady economic retrenchment in terms of funding for the cultural sector in all of its aspects. The objective budget difficulties of the central government, of the regional governments and of the other local governments cannot by themselves alone account for a trend that relegates culture to a non-productive, non-economic status.

These policies clash against evidence that proper investments in culture generate a remarkable economic return, strengthen the tourist sector together with all of its ancillary industries, and improve both employment and the overall quality of citizens' lives. It is just in this setting of fewer public funds made available to culture that both the economic and financial sectors are likely to play a key role and support the cultural sector in identifying efficient and sustainable development models.

Associating economics and culture is not as illogical as it might seem. Over the last few years, economists have tended to associate economics to philosophy, ethics, culture. They have studied the market from the perspective of interpersonal relations where psychology, commonsense and feelings matter more than price. A “new humanism” is developing in economics.

The present financial crisis had its origins first of all in a lack of ethics and long-term perspectives. Financial gain (resulting from market operations) is an immediate gain calculated on the basis of months, quarters. Whereas real entrepreneurs and business leaders take a long view when it comes to their profits, the “gain” of a society is based on the future generations.

The economic crisis - and the financial meltdown that caused it - call for a definite discontinuity in our way of understanding economics, in the way we understand the relationship between ethics and economics, in the way we are entrepreneurs as well as in our development model. A sustainable model should be proposed and pursued in social and environmental terms and in terms of cultural growth. According to the European Union, the economic crisis has mainly hit the social capital, this latter being meant as that set of relations, of relationships among individuals, of identities, traditions, in one word “culture” that connects the individuals one another. If there is a wealth of social capital, there is also economic development: social capital underpins the development of an advanced economy and of forms of innovation [Santagata, 2009].

Economic development is not only based on the availability of material resources, but also on the availability of immaterial capital which is referred to as “cultural capital” and made up of well-established traditions, identities, behaviors and on the availability of a non-formal institution that we call mutual trust. A healthy economics is therefore based on formal institutions (laws, democracy, governmental institutions), and on informal ones based on a sense of belonging, mutual trust and proper information exchange [Mato, 2009].

Cultural and creative businesses have by now been recognized also by the European Commission to be at the basis of social capital because of their capacity to generate creativity and enhance those “informal” factors for a new economic renaissance. Nevertheless, creativity, obviously, is not an accounting item of balance sheets as it accounts for an immaterial asset. Market itself is not able to define the worth of that fundamental business asset that we call creativity. This is one of the key issues: banks lack both capacity and tools to assess an asset that is made of immaterial skills and of the social capital cultural-creative businesses are endowed with. This social capital is accounted for by the cultural environment, traditions, identity, history, human relations, by trust and ability to communicate with each other. The asset “Culture” must be interpreted also as the ability of individuals to think critically: an individual able to assess and evaluate the external world has got a wealth of culture, of knowledge, and is, therefore, a free individual. The freer and more creative a person/one is, the better he/she is at producing innovation. [Valentino, 2013]

On the basis of this evidence, it is possible to claim that culture and cultural and creative companies (CCIs) are not only immaterial assets able to produce well-being and happiness, quite the contrary: they also represent a factor of economic development in view of the social capital they are able to produce. According to the European Commission report dated 2006, the Cultural and Creative industries are: the “Heart of the arts”; “Cultural Industry”; “Industrial and creative activities” and “Connected industries”. Culture has the ability to combine an economic need with a moral need and an ethical need with a productive one. The emergence of creative enterprises is one of the fastest growing sectors in the world [Del Prete, 2018].

According to a 2013 United Nations Report on The Creative Economy: «World trade (in the creative sector) more than doubled from 2002 to 2011; the average annual growth rate during that period was 8.8 percent [...] growth in developing-country exports of creative goods was even stronger, averaging 12.1 percent annually over the same period».

Despite the rapidly emerging creative sector, many artists get little if any training in business or entrepreneurship or how to start a creative enterprise. While many universities are trying to make up for this situation by merging the arts broadly defined with their business school, the market for new creative and cultural enterprises is just being more seriously discovered. Part of the reason is a lack of understanding of how large or important the creative and cultural sector is or can be. Partly it is because launching such enterprises requires tenacity, temperament and the skill set of the entrepreneur. Creative and cultural entrepreneurs drive global change, create economic value and promote cultural preservation and innovation. They enrich their communities and the world. They generate self-determination and self-reliance.

Creativity and cultural businesses, as sources of creativity, must be placed on the same standing as public assets, i.e. assets made available to the entire community. Public assets do not pass through the market since they need support from the public sphere. If only central governments and local governments could realize that culture is the very basis of development, they would modify their economic policies allotting most of their spending and investments to culture. The new horizon of the European Union planning period 2014-2020 envisages big investments in culture, creativity, but above all in innovations, and knowledge-based economy.

This derives from a by now raised awareness of competitiveness as a factor that comes from innovation and, in its turn, innovation is the result of capacity in terms of research efforts and advancing new ideas [Cicerchia, 2013].

The 2014-2020 financial framework identifies a wide and complex project to fund research and innovation in order to implement European Parliament Resolution of May 12, 2011. The European Union decided to allocate 87,740.00 m € to three main priorities:

1. Setting new horizons for innovation and supporting young talents to create scientific poles of excellence;
2. Allocating funds to support the European industrial sector to make it internationally competitive;
3. As much as 60% of the total amount is to be allocated for the so-called “Society Challenges”, that is problems connected with social integration, education and increase in cultural sensitivity. Europe bets on innovation and poles of excellence as a support to social capital, but more investments are needed in the environment and cultural heritage sectors. The latter indeed accounts for a tangible testimony of civilization with a clear identity-related value and economic value, two values that do exist only when they are both recognized. Heritage is a tool of dialogue and a symbol.

It has been estimated that in the next few years the creative industry will become the real industry. Culture has got a multiplier factor by far stronger than that of other sectors as it is able to stimulate other industrial sectors: tourism, craftsmanship, catering, accommodation, leisure, fashion and design. Our art, knowledge, historical and archeological wealth do not merely lie in cultural heritage, but even in a great source of economic income.

The problem is that the potentiality of this source is not exploited at its most. There is a lack of public intervention even in the field of human capital training for the management of this wealth and in the field of strategies in the whole sector of CCIs, despite the fact that it is estimated to account for 5% of the European GDP and 3.8% of employment.

Cultural tourism amounts to 30% of the total revenue for this sector and in 2011 it has grown by 9.6%. Museums, theatres, music and cinemas produce 40 bln worth in Italy (2.6% of the Italian GDP and as much as 13% if cultural tourism is added). Despite these returns, the Italian State spent as little as 0.19% of GDP (very little if compared to 1% of France) on culture. In total, 1.5 bln euros were spent by the state and 4.8 bln if the expenditure of Regions and other public institutions is added.

The Keynesian multiplier effect of investment on culture is the biggest in a modern economy, even bigger than that on housing or other manufacturing sectors. Therefore, the level of interdependence between this sector and the rest of the economy is very high. In dynamic terms, the added value of cultural firms has increased over the past year by more than 3% while the whole economy decreased by 3%. Investing in culture is the only way to overcome the crisis.

Culture is not only a sign of welfare, but also a cause for it. In spite of this, cultural and creative businesses, on the grounds of the inability on the part of banks to consider social capital as one of their “Assets”, and because of their frequently very small size, are not able to be financially sustainable. For this limit to be faced and overcome, networking is mandatory. Network economics is spreading within academic communities and also legislations have started to support this new type of economics: business networks should be thought of as tools to overcome the diseconomies of scale resulting from a fabric all too often made of micro businesses.

In addition to being tools to transfer and share innovations, these networks are aggregation tools, as well as knowledge-transfer and knowledge-sharing tools. They do represent chains of values: they can have either a horizontal (sectoral) structure, or vertical structure that covers the entire production chain (from the heritage site, to restaurants, to farmers producing typical produce). These synergisms should be considered from both a horizontal and vertical perspective. If we fail to do this, individual business are doomed to be losers. The way cultural businesses are structured and organized is one of the reasons why tourism is losing ground in terms of competitiveness: operators are usually poorly aggregated and work in isolation.

Three kinds of synergies should be put in place: across institutions, between the public and private sectors, across private initiatives. All these forms of collaboration need a number of incentives. A network agreement has been envisaged by the legislation which must be meant as a contract «whereby some entrepreneurs pursue the objective of increasing and improving, both individually and collectively, their innovative capacity and their competitiveness on the market. To this end, on the basis of a common network program, they undertake to collaborate in pre-established forms and contexts within the fields of their businesses by exchanging information or industrial, commercial, technical or technological processes and operations in a view to delivering shared operations always within the field of operations of their businesses».

This is a tool that can be benefited from both small-sized and medium-sized enterprises (SMEs), that, by means of cooperation and wealth integration efforts are likely to reach a greater level of development compared to that they would be able to reach on their own, a level comparable to that of large corporations: through aggregation, businesses specializing in different fields can benefit from a certain level of network synergisms to strengthen their core business or develop new ones taking advantage of the *expertise* of the other network businesses and operating in an international context.

In some cases the “common” activity might be a research effort with no immediate economic impact at all. What is important, when it comes to enforce network agreements, is that the implementation of a common program allows for a growth in innovative capacity and

competitiveness on the market of the businesses that participate in the network not only “individually”, but also “collectively”. Moreover, participation in a network agreement entitles businesses to tax breaks. Under the present legislation network agreements are allowed only to private businesses, but if properly amended, the laws could also extend this kind of agreements to public institutions.

Network agreements could account for a tool allowing for shaping collaboration between private and public stakeholders: as a public asset culture needs to be supported by the State. Unfortunately, though, the enormous number of regulations and the Pantagrueian proportion of State bureaucracy result in huge inefficiencies that can only be overcome with the help of private stakeholders inasmuch as these latter are entitled to produce profits for their businesses.

But profits are to be meant as a compensation for businesses that innovate, organize and risk their capital, a kind of reward in exchange for a deep sense of responsibility *vis à vis* society and a sort of efficiency benchmark. Cultural businesses are expected to produce profits because these latter account for a parameter of efficiency. Making profits also means that the resources made available by the State and the European Community have been used in the best way. However, a difficulty still remains in identifying appropriate funding tools for cultural and creative industries. Donations and public and/or private sponsorship, self-funding and access to credit lines account for the funding systems that have been experimented so far. Access to credit accounts for a common form of funding that unfortunately is less and less resorted to as it is becoming more and more difficult to get access to a line of credit in the absence of securities.

As a matter of fact, banks cannot evaluate risks because of gaps in both mutual trust and legislation. The main problems connected with access to finance for CCIs are the following: insufficient skills in analyzing risks and opportunities; difficulties in assessing the value of intellectual property assets; insufficient information on growth potential; dependence on public support.

Therefore, the social capital made up of information exchange, mutual trust, relationships, ideas and proper communication of cultural initiatives should be strengthened. Within this context, it is difficult to offer to the creative and cultural industries a choice between different ways of financing and capitalization. The commonly available alternatives are the following: grants and public or private sponsorship; self-financing; access to credit lines. Occasional solutions are the following: private equity (venture capital, mezzanine finance, business angels); guarantee funds; revolving funds; hedge funds; project financing [Bocci, Cacciatore, 2017].

Our proposal is the introduction of ethical funds for culture. Given the peculiarities of creative and cultural activities, setting up ethical funds for culture could represent the best option of financial support to the businesses of this sector.

Present ethical funds are financial instruments (like private equity or venture capital funds) enabling investors to combine the aims of their investments with aims of solidarity and social responsibility. By purchasing shares, investors become able to fund social initiatives or no-profit organizations, thus guaranteeing a careful selection of the investments. Culture and the safeguard of artistic heritage and CCIs are to be introduced in the aims of ethical funds. It is possible to widen the idea of ethicality and extend it to cultural assets, these latter being able to produce public profits and social capital mainly when supported by public policies that envisage incentives (e.g. tax breaks) for those ethical funds investing in culture. In conclusion, in order to overcome the present world crisis, it is necessary to adopt two significant factors: ethics (as rules and moral behaviors mainly in finance) with the basic aim

to allocate resources at best for sustainable growth; and esthetics as beauty to be improved in all aspects (natural, artistic, creativity etc.) [Del Prete, 2018].

A number of prerequisites are to be met: investing in human capital, research and knowledge.

3. Public and Private Stakeholders

The relationship between public and private sector is sensitive and critical; it is all too often addressed only from a legal perspective by resorting to some legal entities, including foundations, and complex statutes.

This approach has resulted in apparently perfect legal tools which unfortunately have not improved the quality of the services provided.

The few successful cases are not characterized by the fact that they have set up public-private foundations, but rather by the fact that they have been able to build an entirely self-managed system revolving around a public-private collaboration, thus creating an organizational model able to confer contents and quality the services provided. Many private organizations are committed to providing cultural services. Unfortunately, 90% of the concessions in Italy are in the hands of only eight companies. Under these circumstances, we certainly cannot speak of an economy of culture. It is all too obvious that these sectors need legislative and financial adjustments in order to open the sector to the market and attract new private investments.

The issue of PPPs is difficult to be framed: there is no univocal definition even at European level. The term public-private partnership (“PPP”) is not defined at Community level. In general, the term refers to forms of cooperation between public authorities and the world of business which aim to ensure the funding, construction, renovation, management or maintenance of an infrastructure or the provision of a service.

Many are the implications of the public-private relationship on cultural projects, including the following: investments; design; renovation; management; funding; execution; exploitation; distribution of risks. All interactions among partners imply an impact on balance sheet and cash flow like cooperation in revenues generation, resources sharing, investments sharing, knowledge sharing and costs sharing.

The main instances of collaboration of the private sector in the management of cultural assets are concessions and foundations. Economists believe that the partial failure of the ancillary services managed by private businesses through the mechanism of concessions is ascribable to failure in the integration of services: one individual service within a small museum will never be profitable to anyone. For this to be put in place we need to define i) the services private businesses should be entitled to manage, and ii) the role of public authorities and of private businesses within a proposed management model. Moreover, we should understand how this impacts cooperative work, profits and resource sharing.

A managing approach based on a project financing model can account for a tool to acknowledge a public role to private businesses. For example, in cases of cultural assets and unused spaces owned by a public authority, private businesses might be asked to put forward proposals with the public “side” being responsible for selecting the most appropriate proposal, defining and regulating private businesses responsibility and making sure that the quality of services is in line with the expected standards.

4. The Cultural Challenge: Citizens’ Education in Art and Culture

The economic impact of the entire culture production chain, meant as: research and education, including undergraduate courses, professional training and updating, Academies,

music conservatories; typical agricultural produce, food and non-food shop retailing system dealing with cultural industry products; tourist operations, including booking, hosting, restaurants and catering, tourist assistance and tourist guide services; transport systems for both goods and passengers; building sector operations, including the construction of public works and the rehabilitation of the historical-architectural heritage; any other activities including research and experimental development in social sciences and the humanities; regulation of the organizations that produce and provide recreational, cultural activities and social services; activities realized by non-profit organizations.

About 25% of the Italian businesses operate within the culture production chain producing an added value of 211.5 billion Euros and employing 18% of the Italian workforce. According to some studies, each Euro produced by the cultural productive system, narrowly speaking, yields 1.6 Euros to the entire culture production chain. More than thirty thousand new jobs were made available in the cultural sector in 2012 accounting for 5.4% of the national wealth in the same year thus confirming the enormous potential of our cultural heritage in terms of employment. In spite of this remarkable performance, and in spite of other favorable factors, including: a) the good economic performance of all the sectors linked to the cultural industry; b) the competitive advantage “inherited” from the large number of art cities that punctuate the national territory, and c) the extraordinary and widespread level of creativity, Italy fares very poorly and is not even included sometimes in the main rankings of the cities that stand out for their investments in Culture and creative businesses to foster and support their growth process.

Quite the contrary, public administration is more and more required to put in place more innovative cultural policies and cultural heritage governance at all levels (from central to local governments) by defining the following: governance systems strongly linked to the political inheritance of the cities and of their territory [as a matter of fact, by means of an appropriate strategic-cultural plan, cities are able to create synergisms and complementary elements crucial to their growth and development (Bilbao, Barcelona, Lyon...)]; cultural policies as an integral part of a broader strategy able to create both tangible and intangible urban networks through a strong internal cohesion resulting from a joint effort of Society and Public Institutions ready to take on the same challenge; a State-City relationship in a perspective of cooperation also at a territorial level; a better public-private relationship by streamlining administrative and tax procedures for businesses that invest in Culture to obtain better results in terms of image and visibility.

The foundation of a basic synergism required to improve territorial cohesion is the creation of a quality planning that combines identity and innovation. This is why a model of governance should be adopted which involves the entire social fabric from the different levels of public administration to schools, universities, to citizens' associations for a widened and as participatory as possible sharing of the strategies to be pursued. The studies that have measured the impact of cultural events organized so far in the Cities of Art and Culture have shown that the absence of cross-cutting integrated policies and the absence of a planning perspective account for the real weakest link in the process of development of a culture-based economy.

What is more, an additional constraint seems to be poor attention to both development and upgrading of the so-called cultural audiences, this being reflected by the too low levels of cultural participation and engagement observed across Europe. For a culture-based development, cities of art and culture are not enough, citizens of art and culture are also needed. This is the real challenge to be taken on at a time of “mass smartness”. For this challenge to be successfully faced, important resources should be allocated by the State to citizens' education and training, by experimenting with and expanding art universities. [Del Prete, 2018]

5. History for New Tourist Cultural Products

That history can play a role in cultural tourism is a fact from many decades. Not to go too far, you can remember - for the Italian case - the widespread use of ethnographic museums in the Seventies, that almost always had as reference the intangible heritage of historical knowledge.

The transformations that have characterized the tourist industry in recent decades and which for simplicity, here, we summarize in the concepts of post-modern tourism and experience tourism, created a very favorable context of the use of history in the design of tourism experiences. Essentially tourism has become one of the information channels for the historical knowledge and this course has opened a long series of problems, which in the literature had partly already been addressed by reasoning on the relationship between cultural heritage and tourism.

However, the most interesting aspect is that historical research has become one of the components of the innovative process of tourism products themselves. In fact, the need to constantly renew their tourist proposal, has urged several destinations to design and continuously introduce new experiences for their tourists and visitors. History has been able to present itself as one of the cultural sources through which invent new experiences and new products. If we imagine an innovative process that begins with research, continues with product development and finally comes to its large-scale production, we can easily understand the crucial role that historians can play in each of these phases.

The paper compares various examples of the use of historical research for the design and development of new tourism experiences in order to answer two important questions:

1) what are the risks of dissemination of historical knowledge through the tourism channel?

2) What is the contribution that historical research can make to the process of innovation in the tourism sector?

A trip to a museum or a Unesco site, already 'wrapped' in a tourist itinerary, cannot exhaust the pleasure of sharing the results of historical investigation that will continue in the streets, squares, abandoned factories, in the gardens, along with the paths of transhumance or lumberjacks. A city or a landscape can be paths, even several times, guided by images of an art collection, to discover places portraits by artists who, after seeing them, handed them over to the history and memory of all, or the literary evocation of life stories, individual or collective. In order to facilitate, enrich and renew this curious and endless journey in time, it is necessary that the story comes out of hiding places and combines tourism and culture in the best way possible. The promotion of cultural heritage for economic purposes, such as those in the tourism sector, inevitably passes through the knowledge of tangible and intangible resources in the area. Without historical research, the *storytelling* is a fraud, a hoax!

6. Conclusions

A whole group of activities is related to the stabilization of the cultural system: equipping cultural institutions and associations, changing the relationships among the entities of a cultural system; maximizing the use of resources, initiating new programmes and projects, as well as creating new cultural subjects. Among the activities that are expected to contribute to the development of basic cultural activities, there are openings of bookstores and antique shops; strengthening and expansion of the existing publishing houses and promotion of new ones. In order to fill the present gaps in terms of book offer a broader project could be started based on old town revitalization. As a part of the revitalization project, the old part of town should offer favorable economic conditions for the opening of bookstores, antique

shops, editorial publishing companies, and new residential facilities for literary creators, as well as for the development of other cultural offers. The project should be worked out and included in national and cross-border cultural development projects.

For the implementation of this cultural strategy, it is essential to provide an incentive to historical, cultural and literary-historical lines of research and to studies focused on the evaluation of cultural heritage and intangible culture. Another essential step is mediation i.e., familiarizing citizens – through specialized programmes – with cultural heritage, as well as through the cooperation with educational institutions. Raising the awareness of cultural heritage value is a long-term objective essential for preservation purposes.

However, to make heritage fully accessible it is necessary to find a governance model that is economically sustainable, and provides access to cultural heritage to everyone: citizens, travelers and tourists. The implementation of the present model represents one of the biggest challenges of this cultural strategy. A project based on such principles and strategies is devised for a small City that is presently developing a model of service management and event organization that can be readily taken as an example in developing all cultural activities.

The relationship between culture and tourism is not always a happy one, even if this relation often accounts for a benefit for both. Cultural policies are based on a relationship between citizens and cultural production. Cultural institutions belong to citizens with these latter also being responsible for them.

Now, networking accounts for a strategy combining a series of activities intended to link the cultural entities. The first step is to detect an individual, an institution, a “subject” able to carry out this networking job.

REFERENCES

- Bertella Farnetti P. (2017), *Public History: una presentazione*, in Bertella Farnetti P., Bertucelli L., Botti A., *Public History. Discussioni e pratiche*, (pp. 37-56), Milano, Mimesis Edizioni.
- Bocci C. & Cacciatore S. (2017). Le nuove sfide dell'Impresa Culturale, *Il Giornale di Kinetès*, 1(1) . https://www.kinetes.com/uploads/6/8/7/0/68706149/ilgiornaledikinet%C3%A8s_n1-2017.pdf
- Cicerchia A. (2013). Europa: dalla cultura alla creatività e ritorno. Proposte e dilemmi politici. *Economia della Cultura*, 3(XXIII).
- Del Prete, R. (2018). *Le imprese culturali e creative in Italia: un settore produttivo in crescita, tra occupazione e sistemi di governance*, in M. Vetis Zaganelli – L. Síveres- M. C. da Silva Gonçalves-R. Del Prete (Ed), *GESTÃO PÚBLICA: responsabilidades e desafios contemporâneos - estudos interdisciplinares*, (pp. 22-47), Paracatu, CENBEC-FINOM.
- Eurobarometer, *European Cultural Values, The European Commission*, 2007
- Mato, D. (2009). All Industries Are Cultural, *Cultural Studies*, 1(23), pp. 70-87.
- Myerscough J. (1988), *The economic importance of the arts in Britain*, London , Policy Studies Institute.
- Pratt, Andy C. (1997) *The cultural industries sector: its definition and character from secondary sources on employment and trade, Britain 1984-91*, London, London School of Economics and Political Science.
- Santagata W. (2009), *Libro bianco sulla creatività: per un modello italiano di sviluppo*, Milano, Università Bocconi.
- Valentino P. (2013). L'impresa culturale e creativa: verso una definizione condivisa, *Economia della Cultura*, 3(XXIII).
- UN (2008), *Creative Economy Report. The challenge of assessing the creative economy: towards informed policy-making* , Nation Unies.

CIET | **Split**
2018 | **Track 3**

**Electrical Engineering,
Information Technology and
Mechanical Engineering**

Analysis of Voltage Drops and Protection Range When Connecting a Large Consumer to the Electrical Grid

Ivan Andrić

HEP Distribution system operator d.o.o., Split, Croatia
ivan.andric@hep.hr

Roko Miše

HEP Distribution system operator d.o.o., Split, Croatia
roko.mise@hep.hr

Eduard Škec

HEP Distribution system operator d.o.o., Split, Croatia
eduard.skec@hep.hr

Abstract. This paper contains an analysis of the voltage drops and the protection range when there is a three-phase consumer connected to the electrical grid with load of 45 kW at the electrical grid. When there are many customers that are connected at the end of a radial feeder in low-voltage network it significantly damages voltage conditions as well as the proper functioning of protection range. In order to accomplish the criteria for permitted voltage deviation of $\pm 10\%$ and different proper criteria functioning of protection range it is necessary to analyze the low-voltage network and intervene in the construction or reconstruction of the low voltage network to function properly after connecting a new consumer. This paper analyzes the connection of the above mentioned consumer at the electrical grid from the substation 20(10)/0.4 kV "Vrsine 5" at the area of Elektrodalmatija Split.

Key words: *Voltage drops, low voltage network, scope of protection, line length, peak load*

1. Introduction

The importance of the low voltage distribution network is primarily due to the fact that a large number of consumers are supplied by low voltage of 0,4 kV. In addition, construction, maintenance of low voltage network and substations 20(10)/0,4 kV give the number in one power system and it represents the most significant part of distribution activity.

Figure 1 shows the low voltage distribution network which is supplied from a substation 20(10)/0,4 kV. Usually transformers are grounded on low voltage side, and the low voltage side provides consumers with electrical energy.

Low voltage network can be designed as:

- Overhead live wires
- Overhead isolated wires
- Underground network (cable network)

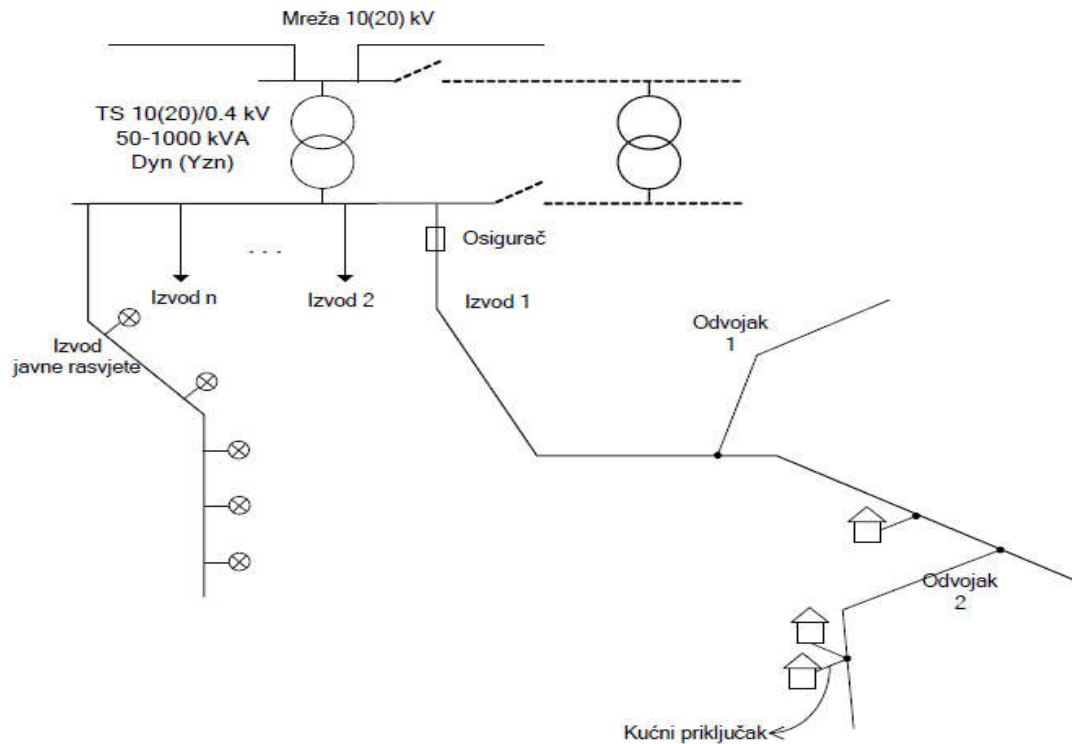


Figure 1 Structure of low voltage network

Low voltage overhead network is the simplest and most economical design especially in non-urban areas where some outgoing network feeders are very long and branched. The problem on long radial overhead lines appears when the load increases, then problems occur with voltage drops at the end of the network feeder. Protection devices in such drive state often do not meet the defined requirements, or it can react wrong when a short circuit or overload occurs at the network feeder so it can react too late in case of single pole or three phase short circuit.

At the end of the long radial network feeder voltage drops depend on three parameters:

- Connection power at the end of the network feeder,
- Overall length and cross section of a conductor,
- Type of overhead line conductor material.

Voltage drop is assumed to be within $\pm 10\%$ of its normal value according to the norm HRN EN 50160. If the voltage drop is greater than $\pm 10\%$ then the network feeder does not meet the prescribed values.

Voltage drop is determined by the following expression:

$$u_{\%} = \frac{\sum P \cdot l}{U^2} (r + x \cdot \operatorname{tg} \varphi) \cdot 100\%$$

Where:

P – power (kW)

l – length (m)

U – line voltage

φ - phase angle

r,x – conductor constants

The overcurrent protection in the substation that protects the entire outgoing network feeder must fulfil four criteria:

- Peak load of the outgoing network feeder must be less than the nominal current of the fuse,
- The nominal current of the fuse must be less than the nominal current of the line on which it is located,
- Criteria of thermal strength,
- Criteria of protection range.

Based on the input data the situation of the low voltage network, and their inclusion in the WinDis program package, it is possible to perform a high and efficient analysis of voltage drops and protection range of low voltage networks. The software program performs all of the above mentioned calculations except for calculating the peak load of a single household and a group of households that can be calculated analytically (Ruscova formula) or by tables.

When a consumer with high power demand is connected to the electrical grid voltage conditions can be disrupted, as well as the protection range of the outgoing network feeder. The energy situation in the place Poljica is described further.

2. The Current State of Electricity Supply

The place of Poljica is located in the area of Marina Municipality, extending over a surface area of 67 000 m². Residents of the place are mostly engaged in tourism activities, so during the tourist season there is an enormous increase in the number of inhabitants. State Road D8 passes through the entire area and divides it into two units. Poor infrastructure of local roads, lack of urban plans and poor connectivity of the area also had a major impact on the energy development of medium and low voltage network as well as power plant facilities.

The area of Poljica are covered by three substations: SS 10(20)/0,4 KV Vrsine 2 (Poljica), SS 10(20)/0,4 kV Vrsine 3 (Kotorine) i SS 10(20)/0,4 kV Vrsine 5. The substations are supplied by an old transmission line of 10 kV with conductors type Al/Fe 35 mm² over wooden pillars. The low voltage network in the observed area is mostly performed with underground cables type XP00-A, PP41-A 4x150 mm², and partially with overhead lines type X00/0-A, and AlFe conductors.

2.1 Analysis of the Low Voltage Network of the Existing State

In the WinDis program package, all parameters which are crucial for performing an analysis of low voltage network must be entered. WinDis program has three basic modes by clicking on the corresponding button in the upper left corner of the window:

Drawing mode:



Data entry mode:



Analysis mode:



Each of these modes has appropriate “sub-modes” which allow the use of certain program functions.

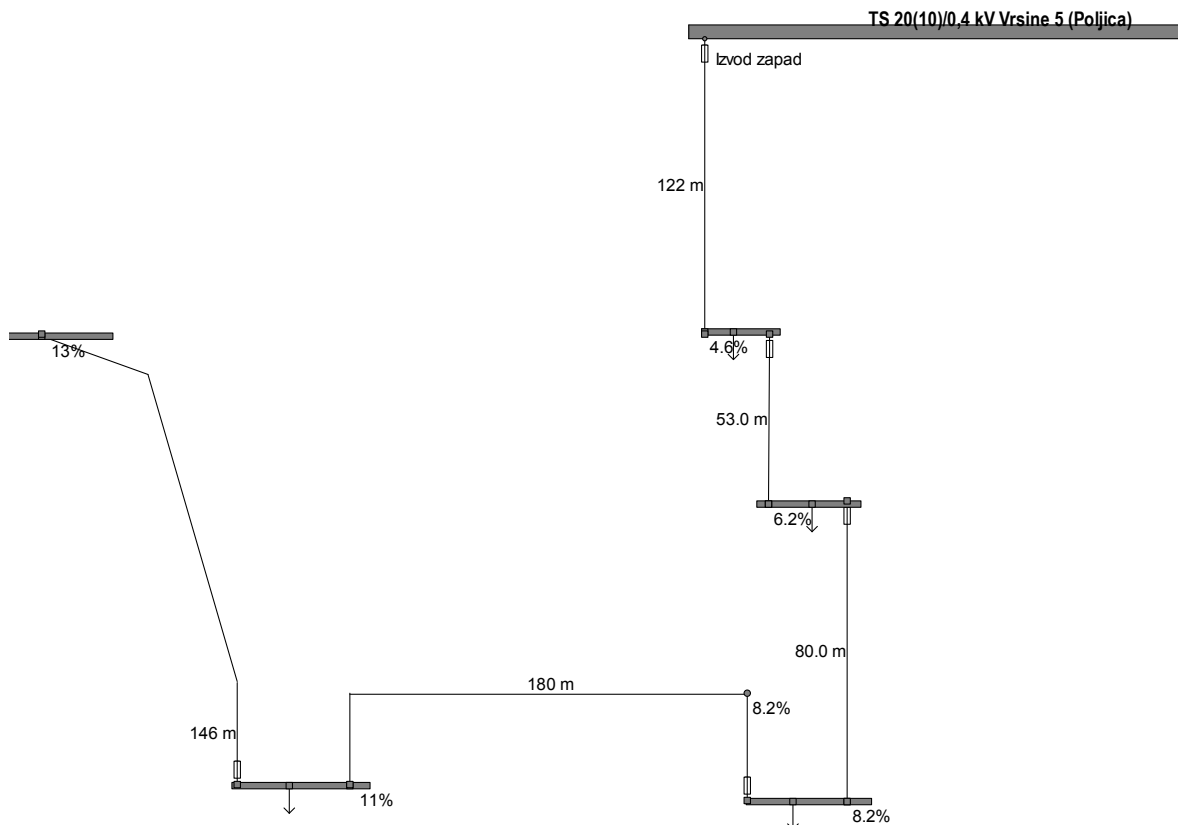


Figure 2 Equivalent of low voltage network schematic diagram with voltage drop analysis in WinDis software package

Figure 2 shows the low voltage schematic diagram with performed analysis to check the voltage drops in case when the new consumer is connected on the existing outgoing network feeder. The scheme shows that the voltage drop at the end of the outgoing network feeder is 13 % and it exceeds the permitted voltage drop. In this case the outgoing network feeder “west” is overloaded and the fuse would blow since the peak current is greater than the nominal current of the cable, so the solution of connecting the new consumer at the existing outgoing network feeder has been rejected. Since the criteria for permitted voltage drops does not meet the necessary conditions for the correct operation of the electrical network, the criteria for protection range has not been performed. The criteria for protection range will be performed after certain interventions in the low voltage network and after bringing the voltage drop within permissible limits of $\pm 10\%$.

2.2 Possibilities of Connecting the New Consumer to a Low Voltage Network with Higher Power Demand

The process of checking the possibility to connect a new consumer on a low voltage network applies to all requirements of connecting a building to a low voltage network, but is primarily intended for connection of buildings with the need for higher power demand and/or more distant from the existing low voltage network and it is implemented in three steps:

Step 1 – connection on the existing outgoing network feeder

- a) Connecting a new consumer to a low voltage network with the existing SS 20(10)/0,4 kV Vrsine 2 (Poljica 1) is only possible with the replacement of the existing transformer and low voltage network. The existing SS 20(10)/0,4 kV Vrsine 2 (Poljica 1) is constructed of a type “turret” and it is equipped with a transformer of 630 kVA. Considering the construction of the object it is not possible to increase the capacities of the existing transformer and replace it with a new transformer with rated power of 1000 kVA. It would be necessary to replace the whole substation with a new prefabricated concrete substation (MTS) with a new transformer of 1000 kVA and new equipment, including a new low voltage panel and middle voltage block. The existing low voltage network is made with double overhead lines on concrete pylons, and it is necessary to cable the complete low voltage network feeders across the State Road D8. Considering the infrastructure works cannot be carried out as mentioned above so new solutions will have to be found.
- b) The calculation has shown that the connection to the existing outgoing network feeder of the SS 20(10)/0,4 kV Vrsine 5 is not a good solution since in this scenario the outgoing network feeder itself is overloaded and the voltage drops are greater than 10 %.

Step 2 – connection with the creation of technical conditions in the network by building or reconstruction in the medium voltage network

A better quality solution, as well as a considerably more costly solution is the interpolation of a new substation 20(10)/0,4 kV with renewed medium voltage and low voltage lines to provide a durable energy solution in this area and to achieve better voltage conditions. This solution would make it possible to connect further more consumers.

The new substation would be carried out as a MTS with a transformer of 1000 kVA and it would be supplied from the existing SS 20(10)/0,4 kV Vrsine 2 (Poljica 1) with cable type XHE 49-A 3x(1x185mm²), 24 kV. Then from the new built substation a new outgoing network feeder would be built so that the existing network would be interpolated from the existing SS 20(10)/0,4 kV Vrsine 2 (Poljica 1) and SS 20(10)/0,4 kV Vrsine 5 (Poljica 3). This procedure would greatly contribute to the relieving of these transformers, but given the lengthy process of making and getting all necessary documentation at this time a new solution should be found. However, such a development plan should not be neglected and completely abandoned considering the large increase in construction (houses, hotels, etc.).

Step 3 – connection with the creation of technical conditions in the network by building or reconstruction in the low voltage network

In order to connect the new consumer, it is necessary to make a simpler and more economical solution. Given the length of the procedure, and according to the Law of Construction and Construction Conditions the consumer must be connected to the electrical grid in order to acquire conditions for obtaining the “use license” and immediately have started carrying out tourist activity. However, it is important to consider how to meet the voltage drop criteria at the end of the radial outgoing voltage network feeder, and at the same time ensure quality of the new consumer’s power

supply without jeopardizing existing consumers. In order to meet all of the above mentioned criteria, it is necessary to build a new outgoing network feeder from the neighboring SS 20(10)/0,4 kV Vrsine 5 (Poljica 3) with cable type XP00-A 4x150 mm² which is 510 meters away from the new consumer.

2.3 Analysis of the Low Voltage Network and Protection Range After Building a New Outgoing Network Feeder from The Ss 20(10)/0,4 Kv Vrsine 5

Connection of the new consumer will be done by forming a new outgoing network feeder from the SS 20(10)/0,4 kV Vrsine 5 (Poljica 3).

New outgoing network feeder from the SS 20(10)/0,4 kV Vrsine 5

- Underground cable type XP00-A 4x150 mm² in length of 510 m, lay west until the new KRO (cable splitter box)
- From the new built KRO lay an underground cable type XP00 4x50 mm² and connect it to the measuring box

Figure 3 shows an equivalent network diagram after withdrawal of the new 510 m length outgoing network feeder which is directly connected to the new consumer. From figure 3 it is apparent that the maximum voltage drop at the site of a new consumer is 3,1 %. It is also noticed that the voltage conditions are not disturbed. By fulfilling the technical criteria of voltage drop at the end of the outgoing network feeder, it remains to analyze protection range of the low voltage network.

Using 10 kW electrical normative for unit loads of households and with a permissible voltage drop of ± 10 %, at the end of the outgoing network feeder.

The new projected low voltage outgoing network feeder satisfies all the consumers and provides a reserve for future consumption in the area of Poljica.

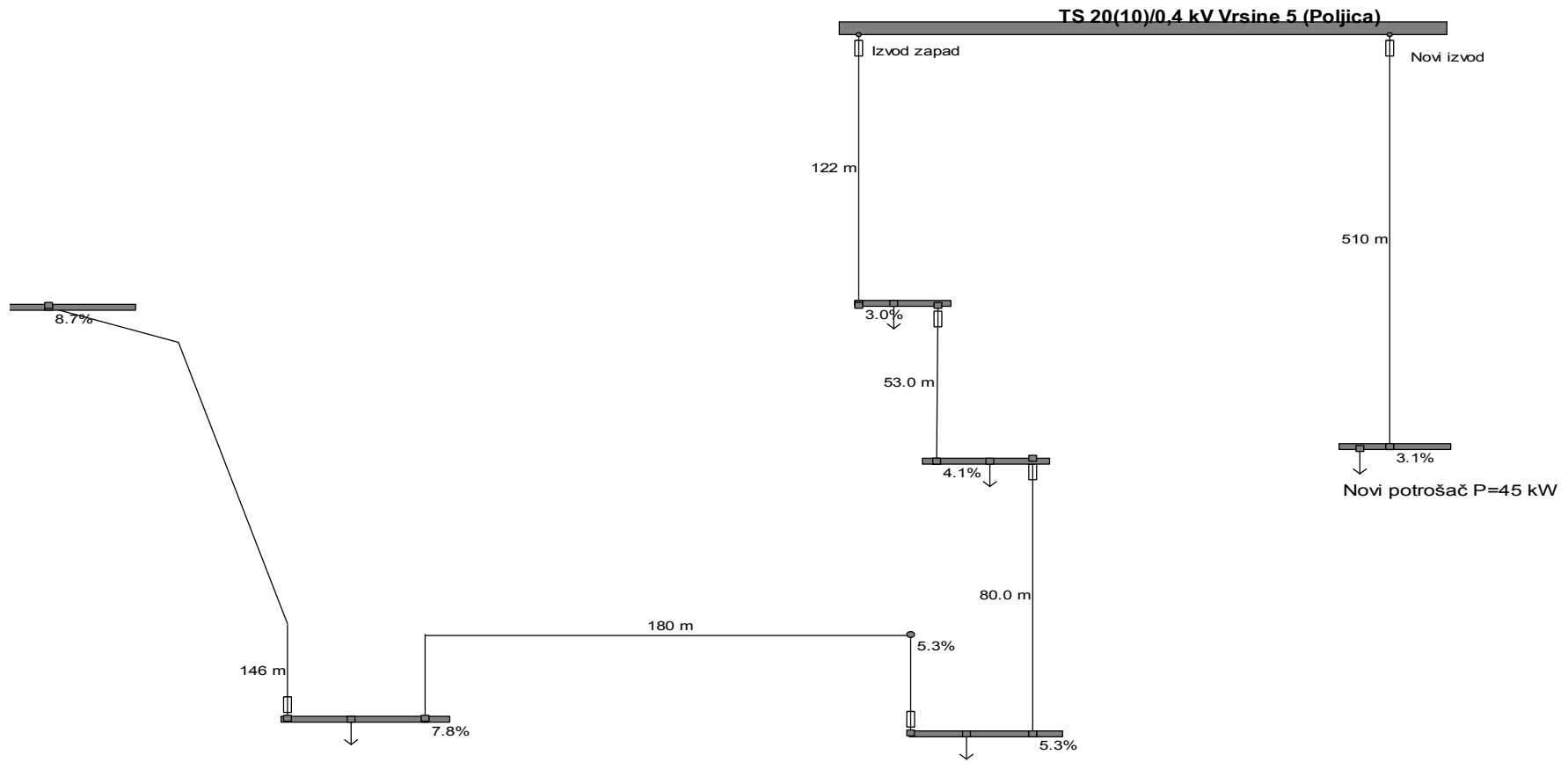


Figure 3 Equivalent of low voltage network schematic diagram after building a new outgoing network feeder

3. Fuse Rating Criteria and Proper Functional Protection

Each fuse set up in the low voltage network must meet the defined criteria in order for the protection to function properly and selectively:

- Criteria of permanent and peak current of the line,
- Criteria of the thermal strength with considering a three phase short circuit I_{k3} ,
- Criteria of protection range considering a minimum single pole short circuit I_{k1} ,
- Criteria of the duration of the minimum single pole short circuit I_{k1} .

The first criteria is related to the fuse which is placed in the substation on low voltage panel and it protects the entire outgoing network feeder. The nominal current for the fuse must be one row larger than the calculated peak current of the entire outgoing network feeder.

$I_n(\text{fuse}) > I_y$.

For example, if the calculations show that the current of the entire outgoing network feeder is 138 A, it is necessary to set a fuse of 160.

Criteria of permanent load of the line warn that a fuse of a higher rated current than the nominal current of the line cannot be set.

The secondary of a distribution transformer is star connected, and the secondary side is directly grounded which allows a single pole short circuit in the network, also this fault is the most common malfunction in the distribution network. Such short circuits are often followed by much lower currents than in the case of intermediate short circuits. Therefore, special care must be taken to select fuses with rated current that will safely and selectively shut down the fault. The biggest problem with the fulfillment of this criteria is that often the values of the maximum operation current and the minimum current of a single pole short circuit (WinDis program automatically calculates this value based on the drawn network scheme) are very close or overwhelming, which results in improper functioning of the protection. To prevent this problem along the circuit, line fuse is set to provide selective and timely earth fault estimation. The maximum allowed single pole short circuit in the low voltage network is 5 seconds. In this case, in the example shown below, the low voltage network in figure 3, in order for the fuse rating criteria to be fulfilled and for the protection to function properly and selectively, it is necessary to set a fuse with rated current of 125 A at the beginning of the outgoing network feeder specifically on the low voltage panel. Fuses that are located in the KRO provide selectivity and protection for further distribution of electricity.

Od:	Cpt
Do:	C1
Izvod:	
Tip kabela/voda:	PP41A 4*150
Smještaj:	Zemlja
Ck:	1
In:	275 A
Duljina:	510 m

P = 41.2kW Q = 13.6kvar
I(rst) = 62.6 A I%(rst) = 23%
ΔP = 1.27kW
ΔQ = 0.48kvar

Tip Osigurača : Končar 2NVO 00[125A]
In : 125 A
k : 2.5
Izvod :
nivo : 1

tmax(Ik1) : 1.24 s

Kriteriji valjanosti odabranog osigurača

Provjera prema vršnom opterećenju

In(osigurač) : 125 A
Iv : 62.6 A
In(osigurač) > Iv ⇒ ZADOVOLJAVA
Rezerva: 50%

Provjera prema trajno dopuštenom opterećenju

In(osigurač) : 125 A
In(kab/vod) : 275 A
In(osigurač) < In(kab/vod) ⇒ ZADOVOLJAVA
Rezerva: 55%

Provjera termičke čvrstoće s obzirom na Ik3

Ik3: 22.9kA
t(osigurač) = t(Ik3): 46.7ms topl
t(dop.) = (Ik3x1sek/Ik3)^2: 46.6 s
t(osigurač) < t(dop.) ⇒ ZADOVOLJAVA
Rezerva: 100%

Provjera dosega zaštite (minimalni Ik1)

Ios(faz) = Ik1min + Ip * 30%: 893 A
Ios(nul) = : 705 A
k * In(osigurač) : 312 A
Ios > k * In(osigurač) ⇒ ZADOVOLJAVA
Rezerva: 65%

Provjera trajanja Ik1min

t(osigurač) = t(Ik1): 1.24 s topl
TN mreža t(dop.): 5.00 s
t(osigurač) < t(dop.) ⇒ ZADOVOLJAVA
Rezerva: 75%

4. Conclusion

The paper analyzes the voltage drop and the functionality of the protection in the WinDis software package when connecting power consumers $P = 45$ kW. On the long and branched (overhead/cable) lines when the load is increased problems with voltage drops occur at the end of the network feeder. In the first situation, an analysis was carried out of the case when a new consumer with high power demand would be connected on the existing outgoing network feeder which is supplied from the SS 20(10)/0,4 kV Vrsine 5. The calculation showed that the voltage drop at the end of the network feeder was 13 % deviating from the standard by which the voltage drops must be within $\pm 10\%$. In order to connect the consumer, it was necessary to make a simple and economical solution. The fastest and simplest solution was to intervene in the construction of a new outgoing network feeder, so the analysis has shown that the voltage

drop at the end of the network feeder resulted with 3,1 % and the voltage conditions were not disturbed for other consumers.

The problem of permissible current loads and protection range due to the occurrence of a single-pole short circuit is also solved by analysis in the WinDis program package by setting fuses in the low voltage network at certain points of the network in order to protect the function properly and selectively protect the low voltage circuit due to the occurrence of current overload or short-circuit currents.

REFERENCES

- [1] R. Goić, D. Jakus, I. Penović, "Distribucija električne energije", Fakultet elektrotehnike, strojarstva i brodogradnje Split, Split
- [2] R. Goić, „WinDis 1.22 upute za programski paket za analizu niskonaponskih distributivnih mreža“, Split 2015
- [3] Naponske karakteristike električne energije iz javnih distribucijskih mreža (EN 50160:2010)

Net Efficiency of a Parabolic Dish Concentrator

Mateo Hrgović

University Department of Professional Studies, University of Split, Split, Croatia
mateo.hrga@gmail.com

Ivan Vrljičak

University Department of Professional Studies, University of Split, Split, Croatia
vrljicak@oss.unist.hr

Igor Gabrić

University Department of Professional Studies, University of Split, Split, Croatia
igabric@oss.unist.hr

Zlatko Jankoski

University Department of Professional Studies, University of Split, Split, Croatia
zlatko.jankoski@oss.unist.hr

Abstract. The article gives the overview of an in-house made parabolic dish concentrator. A system for continuous tracking of the sun throughout the day was based on a dual axis tracker, where a linear actuator for vertical tracking and a pair of gears for horizontal tracking were applied. The tracking system was equipped with DC electric motors, operated by microprocessor-based control system. Position of the concentrator was periodically and automatically adjusted to direct sunlight, based on the amount of light delivered to four photo sensitive diodes. The sun's solar energy, reflected from the surface of the dish to the receiver and transferred to recirculating water, was finally stored into the heat storage tank. In order to investigate the operational parameters and to determine the net efficiency of receiver of parabolic dish concentrator, initial measurements of the main working parameters were performed, and the results presented and elaborated.

Key words: *concentrated solar power, parabolic dish concentrator, net efficiency*

1. Introduction

In general, the energy needs are in constant rise. According to IEA, during the last 45 years the world's total primary energy supply has doubled, while the electricity generation has increased for almost four times [1]. Although fossil fuels still hold the biggest share, the utilisation of renewable energy sources is in rise due to their lower impact on environment and climate. For example, from 2005 to 2015 the world's electricity production from wind has increased from 104 TWh to 838 TWh [1], while the production from solar photovoltaic systems has increased from 4 TWh to 247 TWh [1].

Among the different types of renewable energy sources, the solar energy is the most interesting. The existing solar technologies are continuously improving, while new solar technologies for electricity and heat production are developing. Taking into account advantages and disadvantages of different solar technologies, nowadays Concentrating Solar Power (CSP) technologies have developed to a viable commercial level. According to Eurobserv'er publication [2], since 2014 the European Union concentrated solar power capacity trend has stopped at 2.313,7 MW, where almost whole capacity (2.303,9 MW) has been installed in Spain only. The installations in Spain showed to be reliable, producing in

average some 5 TWh of electricity per year [2]. In the EU the CSP plants in operation are mainly based on “Parabolic Through” technology. Although having higher efficiencies and concentration ratios, “Parabolic Dish Concentrators” are still lacking commercial application within the EU. Some of the reasons include higher investments, question of reliability of heat engines in case of large-scale power plants, etc. However, a number of experimental and testing facilities are installed, generating valuable experience [3, 4].

2. Parabolic Dish Concentrator

A parabolic dish solar concentrator was designed and constructed (Figure 1) [5], where the old satellite dish has been appropriately rearranged into concentrator (Figure 2). In order to attain the reflectivity of the concentrator, a self-adhesive foil with mirror effect has been applied to the surface of the dish. Due to slightly elliptical shape of the dish, the length of two axis was defined, 1005 mm (major axis) and 970 mm (minor axis), resulting in the concentrator projected area of 0,765 m². Since during the operation the receiver and its holder have created a shadow on the concentrator, the effective projected area of concentrator was recalculated to 0,7207 m². Based on the dish geometry, the focal length has been defined as 710 mm.

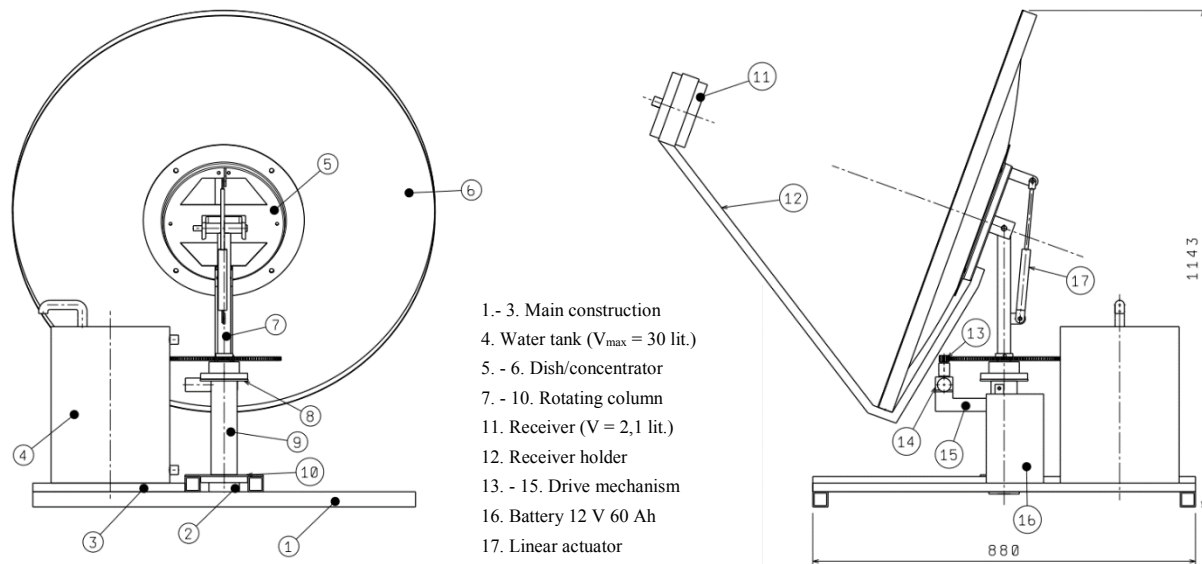


Figure 1 Parabolic dish concentrator – design phase [5]

Although the parabolic dish concentrators commonly use Stirling engine as a receiver, at this phase a small water container was selected instead. Initially it was not intention to generate the electricity, but to use the concentrated solar power for warming up the water stored in a heat storage tank. The volume of the water container/receiver was selected as 2,1 dm³. The receiver volume was divided in two smaller volumes (chambers) by the partition surface with the overflow hole placed at the top region. The volume of the primary chamber (inlet flow, front side of the receiver) was around 1/3 of the receiver’s total volume. The intention was to reduce the effective volume of water being heated by the concentrated solar power, and to separate inlet flow from outlet flow which was leaving the receiver from secondary chamber (back side of the receiver). The material used for the receiver was SAE 304 stainless steel, except the front focal surface which has been made of technically clean copper (99,5%; DIN SE-Cu 2.070). The focal surface was painted by heat-resistant black mat paint, which can withstand the temperature levels of up to 800°C (Figure 3). Finally, the receiver was insulated with 20 mm thick layer of rock mineral wool ($\lambda = 0,039$ W/(m·K) @ 50°C), and bounded with the self-adhesive aluminium foil.



Figure 2 View of parabolic dish concentrator



Figure 3 View of receiver

Since the designed concept has required heat storage, an atmospheric water tank of some 30 litres has been built (Figure 2). The water tank had two connections, one at the bottom for radial water outlet from the tank to the receiver, and one at the top for radial water inlet to the tank (from the receiver). The water tank as a heat storage tank was made of SAE 304 stainless steel, and was insulated with 19 mm thick plates of closed-cell foam insulation ($\lambda = 0,033 \text{ W}/(\text{m}\cdot\text{K}) @ 0^\circ\text{C}$).

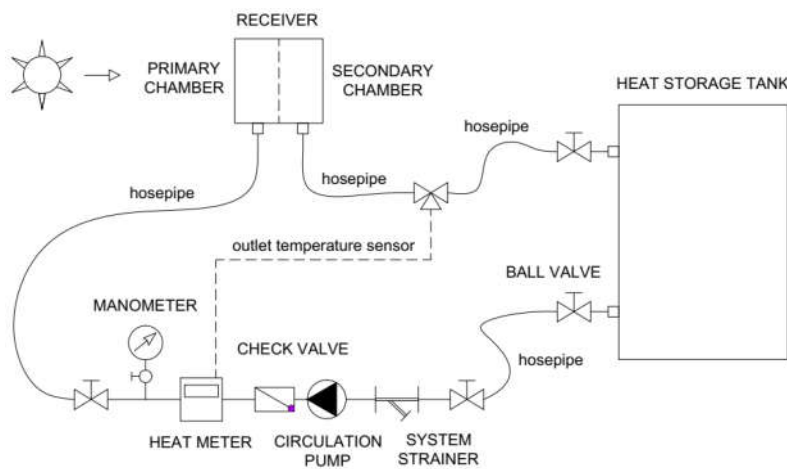


Figure 4 Schematic view of hydraulic system



Figure 5 View of dual axis mechanism

In order to maintain the controllable circulation of water, the hydraulic system was equipped with the circulation pump with integrated electronic power control and a high-precise ultrasonic heat meter (Figure 4). The piping also included standard elements of water circulating systems, such as system strainer, ball valves with swivel nut, check valve, etc. Receiver and heat storage tank were connected to the hydraulic system with hosepipes reinforced with an internal web of fibres. Whole hydraulic system, including hosepipes, was insulated with 19 mm thick closed-cell foam insulation for tubes ($\lambda = 0,033 \text{ W}/(\text{m}\cdot\text{K}) @ 0^\circ\text{C}$). The measurement of volume flow, inlet and outlet temperatures, and system power were conducted with the ultrasonic heat meter Kamstrup Multical 401.

The parabolic dish solar concentrator was equipped with a system for continuous tracking of the sun throughout the day in order to maintain the position of the concentrator perpendicular to the sun. The system was based on a dual axis tracker (Figure 5), where a linear actuator for

vertical tracking (elevation) and a pair of gears for horizontal tracking (azimuth) were applied. The tracking system was equipped with 12 V DC electric motors, which were operated by microprocessor-based control system. Position of the concentrator was periodically and automatically adjusted to direct sunlight, based on the amount of light delivered to four photo sensitive diodes until their illumination becomes equal and balanced. In order to improve the precision of positioning, a shading device was used for controlling the illumination of electro-optical sensors. Additionally, further adjustments could be achieved by manual adjustment of the level of sensitivity of optical sensors. The electric energy, necessary for operation of DC electric motors, control system and circulation pump, was supplied by AGM battery of 12 V and 60 Ah.

3. Experimental Results

The measurement of operational parameters took place on April 2018, from 9:15 to 14:30, at the location 43°31'21" N and 16°27'01" E. During the measurement the sky was largely clear (Figure 10). The measurement included the values of irradiance at the optimal angle, the temperatures of water inlet and outlet of the receiver, the power of the receiver, and the volume flow of circulating water.

A calibrated Hukseflux pyranometer was used for irradiance measurement at the optimal angle. The collected data were logged by sensor readout unit. Since the performance of solar concentrator depends only on direct component of solar irradiance, while pyranometer measures global irradiance, the measured data were recalculated. For this purpose online free solar energy calculator PVGIS [6] was used, where the ratios of global and diffuse irradiance for the specific location, month and hour have been calculated. The ratios obtained from PVGIS were applied in order to estimate the values of direct irradiance during the period of measurement, as shown in Figure 6. As a result, during the measurement the direct irradiance has varied from 764 to some 864 W/m², while based on the effective area, the power of concentrator (Q_c) has varied from 550 to 623 W.

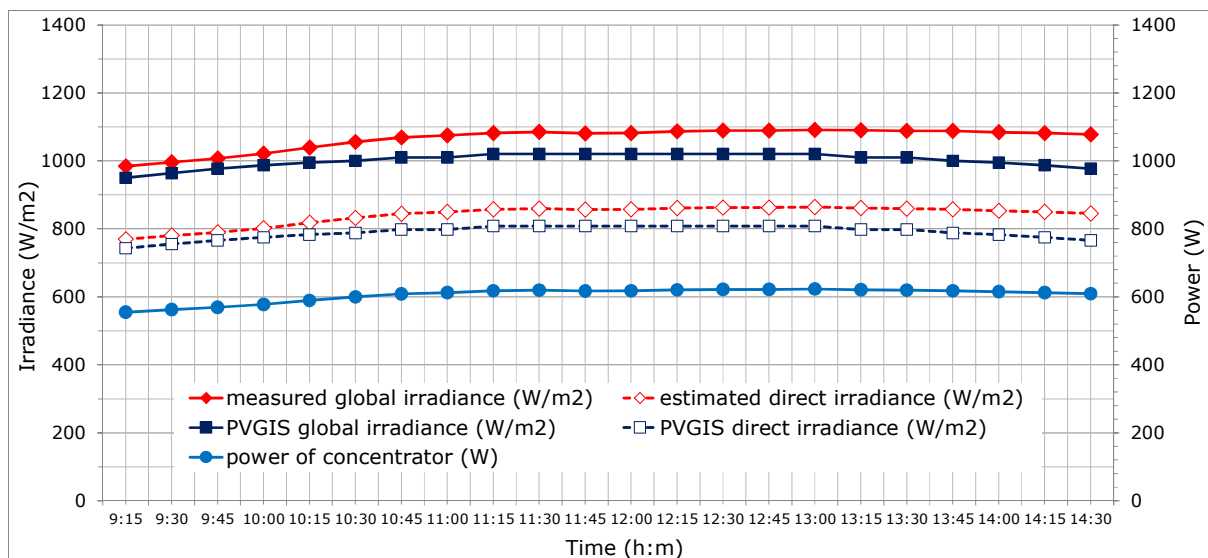


Figure 6 Solar irradiance and the power of concentrator

At the beginning of the measurement, the temperatures of circulation water at inflow and at outflow of the receiver were 20,90°C and 23,37°C, respectively (Figure 7). By the end of measuring time (315 minutes), the outflow temperature from the receiver has reached 74,79°C, resulting in temperature increase of 51,42°C. The temperature difference of circulation water at the receiver have varied around 2,5°C (Figure 9). During the measurement the outdoor temperature was around 20°C. As already stated, the power of

concentrator has varied from 550 to 623 W. The corresponding power of receiver was measured by the ultrasonic heat meter. Due to the limitation of heat meter in displaying the value of power in basic units (W instead of kW), the power of the receiver (Q_R) was calculated. The calculations involved the measured values of temperature difference (ΔT), the values of volume flow (V), and density (ρ) and heat capacity (c_p) of circulating water. The variation of density and heat capacity as a function of temperature was taken into account.

$$Q_R = \rho \cdot \dot{V} \cdot c_p \cdot \Delta T \text{ (W)} \tag{1}$$

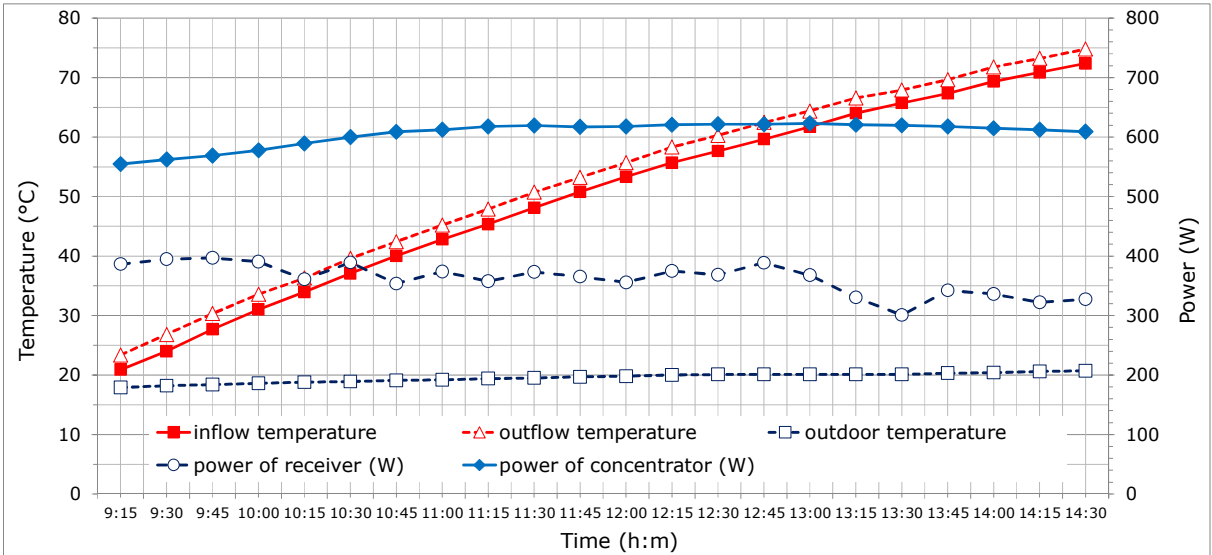


Figure 7 The variation of water temperature; the power of concentrator and receiver

Based on the measurements and calculations, the power of receiver has varied from 300 W to 397 W (Figure 7). It was noticed that the power of concentrator (Q_C) was reducing as the temperature of circulation water was increasing. A net sun to water efficiency was also a function of the temperature increase. This was in correlation with Jamil and Ali (2016) [4], where the temperature dependence of net efficiency curve was established. As seen from Figure 8, the net sun to water efficiency on the receiver was maximal at 70%, while the temperature level of outflowing water was at the lowest. As the water temperature increased, the efficiency has decreased to some 53%. The average net sun to water efficiency on the receiver could be defined as 59,86%.

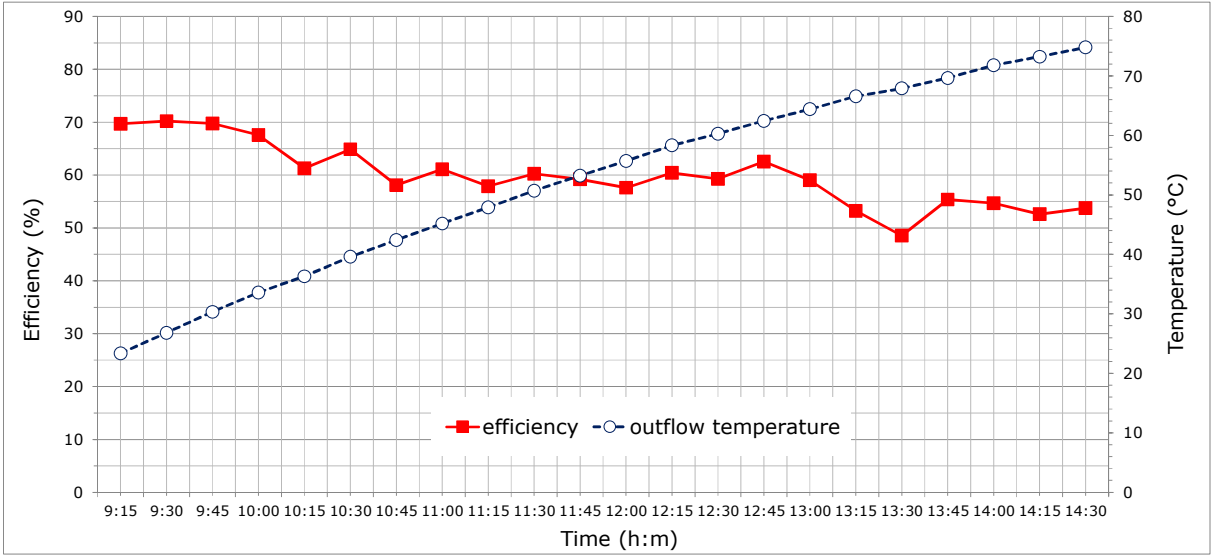


Figure 8 Net sun to water efficiency (on the receiver)

The efficiencies of the receiver of around 90% have been reported in the literature [4], while the record has achieved a 97% conversion of sunlight into steam [7]. Thus, the following work should embrace improvements in lowering heat losses of the receiver and the optimisation of the receiver geometry.

$$\eta_{\text{net}} = \eta_{\text{optical}} \cdot \eta_{\text{thermal}} = \frac{Q_R}{Q_C} \cdot 100 \text{ (\%)} \quad (2)$$

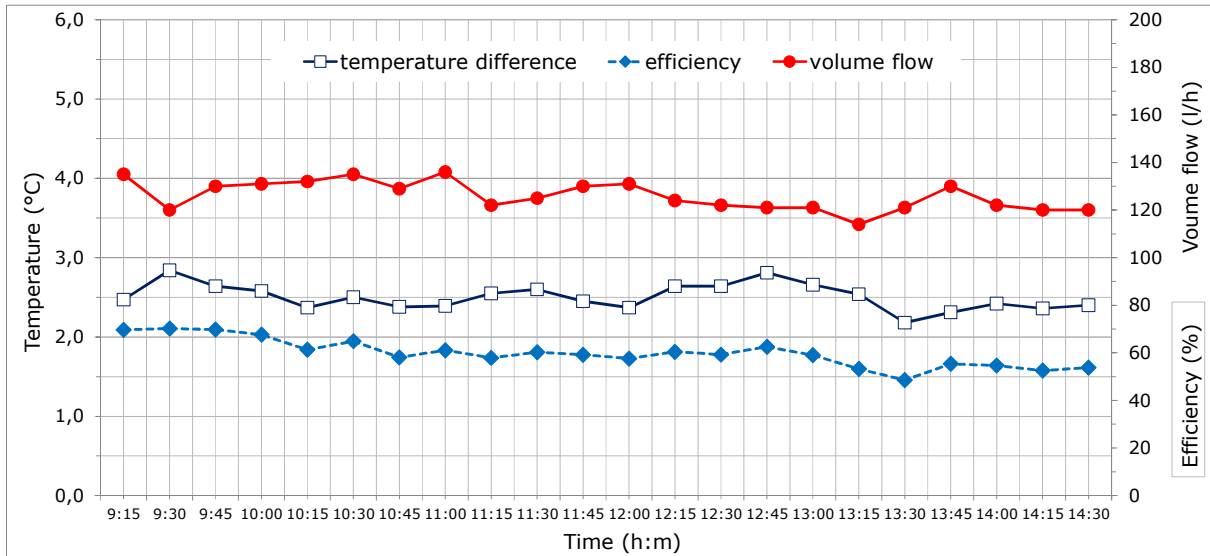


Figure 9 The variation of temperature difference and volume flow during the measurement

The circulation pump with integrated electronic power control was regulated to constant speed, which gave the variation of volume flow of circulation water from 120 to 135 l/h (Figure 9). This resulted with a value of volume flow from 2 to 2,25 l/min, which has been initially selected based on the experience gained from conventional solar thermal systems. However, the volume flow should be optimised based on the amount of direct irradiance delivered on the concentrator surface.



Figure 10 Parabolic dish concentrator in operation

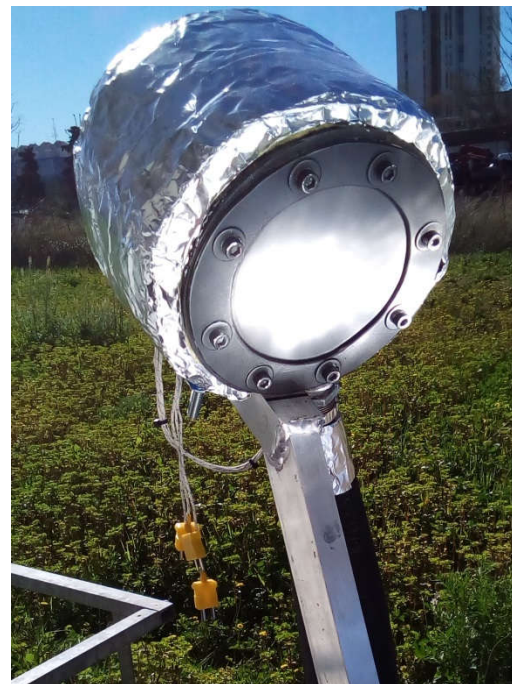


Figure 11 The receiver aperture

For the purpose of initial measurements, the volume of water in the heat storage tank was 20 litres. As it was already mentioned, the tank was insulated with 19 mm thick plates of closed-cell foam insulation, and it was built as atmospheric tank. Although the net sun to water efficiency was in average some 59,86%, the overall efficiency of the process of heating the water in the heat storage tank showed to be around 38,59%. This could be explained by significant heat losses through the walls of the storage tank into the surrounding environment with the outdoor temperature of some 20°C. Furthermore, since the storage tank was partially filled with water, hot water was evaporated and condensed at the top surface of the tank, which added to overall heat losses.

During the operation of dish concentrator, the temperature of outdoor air close to focal surface has been measured with K type thermocouple probe, with recorded values of up to 670°C. The measurement of the receiver aperture (Figure 11) and optical efficiency of the concentrator was out of the scope of this paper.

4. Conclusions

The results presented in this paper have provided preliminary data on functionality of the dish concentrator concept and on some of the operational parameters as well. The initial tests have demonstrated the values of net sun to water efficiency, the temperature dependence of the efficiency, the temperature level at the focal surface, the importance of optimising the volume flow of the water for maximising the power of receiver, etc.

In order to improve the performance of parabolic dish concentrator, several topics have to be addressed such as: (1) the optimisation of the receiver's geometry and shape, (2) the measurement of optical efficiency of the concentrator, (3) the measurement of the size of the receiver aperture using for example burn plate test, (4) the optimisation and control of the volume flow in order to maximise the power of receiver, and (5) the reduce of heat losses of the system in whole.

REFERENCES

- [1] International Energy Agency (IEA), 2017 Key World Energy Statistics
- [2] Solar Thermal and Concentrated Solar Power Barometers – Eurobserv'er – June 2017
- [3] Gholamalizadeh, E. and Dong Chung, J. (2017). Exergy Analysis of a Pilot Parabolic Solar Dish-Stirling System. *Entropy* 2017, 19(10), 509. Retrieved March 18, 2018, from www.mdpi.com/1099-4300/19/10/509/pdf
- [4] Jamil, U. and Ali, W. (2015). Performance Tests and Efficiency Analysis of Solar Invictus 53S – A Parabolic Dish Solar Collector for Direct Steam Generation. *AIP Conference Proceedings*, Volume 1734, Issue 1, 2017. Retrieved March 18, 2018, from <https://aip.scitation.org/doi/pdf/10.1063/1.4949165>
- [5] Hrgović, M. (2017). Concave Parabolic Solar Concentrator. *Final Thesis*. University Department of Professional Studies, University of Split, Split, Croatia
- [6] Photovoltaic Geographical Information System PVGIS © European Communities (2001-2012). <http://re.jrc.ec.europa.eu/pvgis/>
- [7] Pye, J., Hughes, G., Abbasi, E., Asselineau, C.A., Burgess, G., Coventry, J., Logie, W., Venn, F. and Zapata, J. (2016). Development of a higher-efficiency tubular cavity receiver for direct steam generation on a dish concentrator. *AIP Conference Proceedings*, Volume 1734, Issue 1, 2016. Retrieved March 18, 2018, from <https://aip.scitation.org/doi/abs/10.1063/1.4949081>

Modification of the CEMEX Cement Plant Control System

Dean Dereani

University Department of Professional Studies, Split, Croatia
dean.dereani@cemex.com

Mikela Jozić

University Department of Professional Studies, Split, Croatia
mk333@protonmail.com

Abstract. This article describes implementation of control system replacement in Cemex Hrvatska d.d. cement plants based on the application of good engineering practice recognized in the cycles of investment in the control systems for the period 2000 - 2015 and implementation of project control standards. The organization is integrated into the ISO 9001 quality system in the form of procedures and operating instructions. Most of the Cemex cement plant's technological processes were built from 1968 till 1979, with associated control systems. In 1968, the Sv.Kajo cement plant, cement and clinker production control technology refers to relays from the central control room with buttons and switches, and visualization of the process through the light indication on graphic panel of process. In 1979, the cement plant Sv.Juraj, the cement and clinker production control technology is managed by TTL transistor logic cards from the central control room with buttons and switches, and visualization of the process through the light indication on graphic panel of process. During the last 15 years, parts of the manufacturing process in both factories have been modernized, which resulted in introduction of PLC / SCADA technology for the control of different manufacturers and design solutions. By adopting the experience of maintaining, modifying and detecting failures on these systems and having in mind the upcoming introduction of the control systems which had to be replaced, it was decided to create internal standards and procedures to unify solutions and equipment.

Key words: control system, improvement, standards

1 Introduction

To ultimately have a high availability of equipment and installations, we need to provide the most robust solution and equipment that will not be destroyed in the working environment of the industry process (see Figure 1), and in the event of a failure fault detection and fault rectification is important to be as soon as possible. For the selection of robust solutions and equipment, it is important not only to select high-quality components and to properly dimension them, install them, supply them, provide working conditions (air conditioning, ventilation, water, dust etc.) but also satisfying legal legislation. To quickly detect errors and eliminate failures, it is desirable to unify the layout and content of the documentation, the name and form of symbols, the unified functions and the functional connectivity both on the electric & instrumentation design level and at the communication and program level, the unification of programming and communication tools and the availability of spare parts. If equipment is more unified, demand for investment in software, communication tools and spare parts is smaller. For quick detection and elimination of failures, it cannot be ignored the availability of human resources that is easier to assure at a higher level of standardization of embedded equipment and technical solutions.

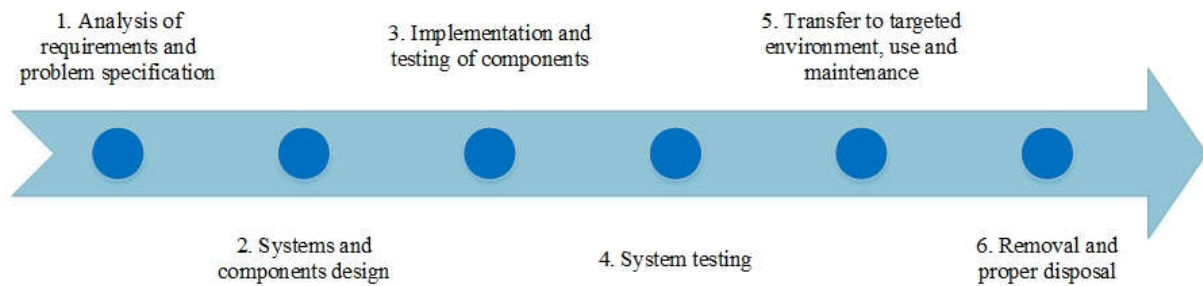


Figure 1 Time period of system modification

2 Analysis of Requirements and Problem Specification

The project task includes:

- scope of project
- Inputs (raw materials, consumables, energy, water, air, spare parts)
- Outputs (production capacity, storage, waste).

It is processed through specifications in the project task, but in the case of replacing the old control system with new one, no major changes are made. The first step in the specification refers to the specification with the user requirements. This specification refers to any function, constraint, features, reliability or other property which customer requires. Second step are requests for designing and programming. This requests follows after all specifications are made by user (project assignments, attachment).

3 Systems and Components Design

It is necessary to specify internal standards in the project assignment (if any exist) for designing systems and components (EPLAN, NEPLAN, PLCs, local management, SIL2, AI, MCC, PLC algorithms, etc.). For the design of systems and components it is necessary to own Unit & Loop diagrams (project assignments, electrical documentation, motor lists, cable lists, instructions for creating tags, block scheme, signal types (I/O), MCC motor list, list of interlocks), drafts of electrical cabinet (EC) and algorithm code (PLC/SCADA).

4 Implementation and Testing of Components

During the process of the implementation and testing of the components it is necessary to respect the standards: “HRN EN 62337:2008 Commissioning of electrical, instrumentation and control systems in the process industry -- Specific phases and milestones (IEC 62337:2006; EN 62337:2007)” (see Figure 2) and “HRN EN 62381:2008 Automation systems in the process industry -- Factory acceptance test (FAT), site acceptance test (SAT) and site integration test (SIT) (IEC 62381:2006; EN 62381:2007)“.

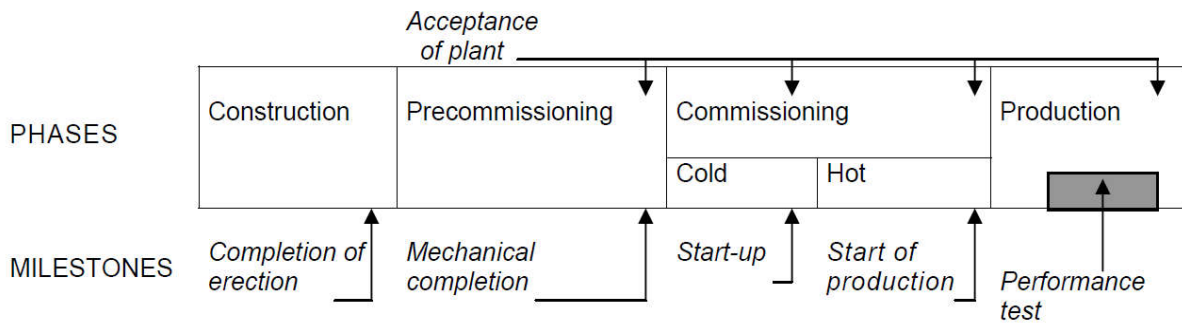


Figure 2 Phase criteria and milestone for system modification

For implementation and testing of components it is necessary to order the equipment, then follows the production (project assignments). After the production follows FAT (Factory Acceptance Test) which will be explained in following chapters. For execution of FAT is mandatory to use working instructions. After successful FAT follows the installation and downloading the program (project assignments). Using GAMP (Good Automated Manufacturing Practice) in Figure 3 shows classification of primary responsibility for the specifications and testing between user and contractor.

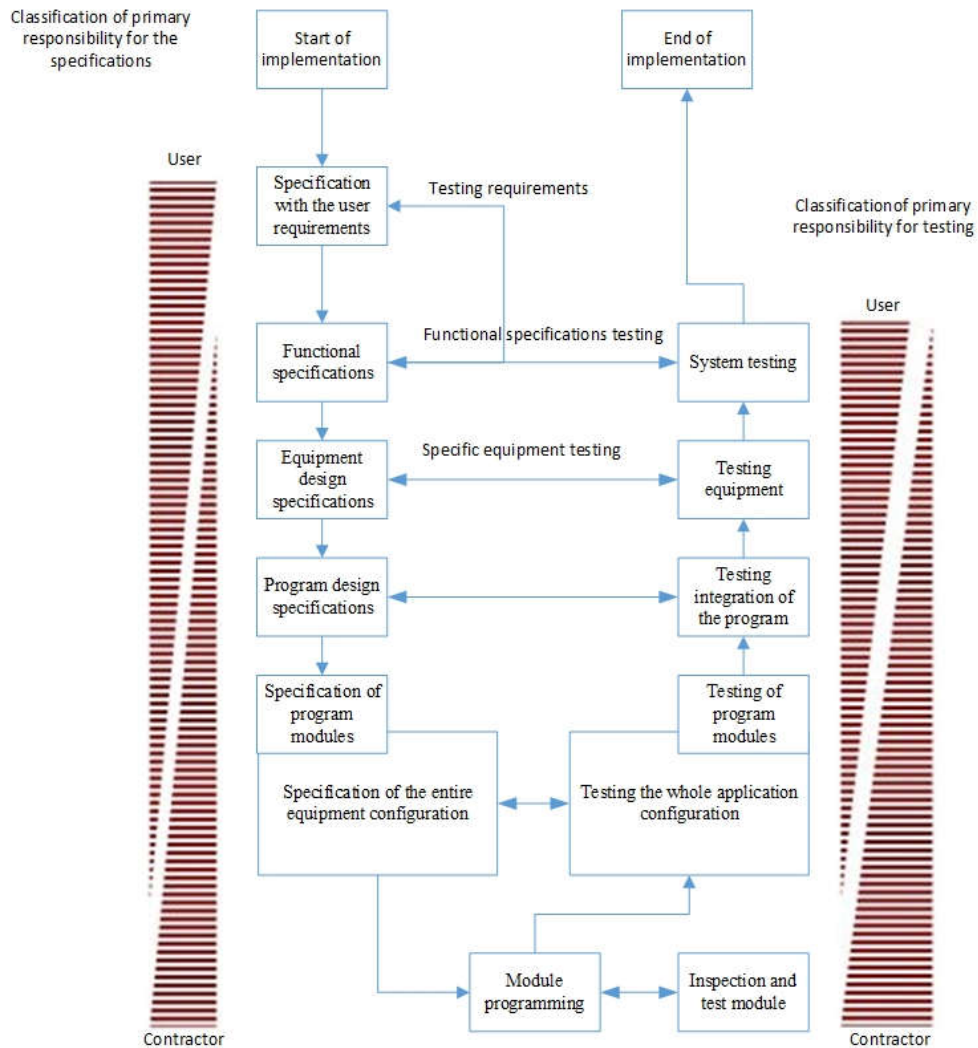


Figure 3 Responsibility according to GAMP

CEMEX		LISTA NE-KRITIČNIH NESUKLADNOSTI							
Ugovor ozn.:		Tvornica:		Tip provjere:	FAT	SAT	C	CM	PM*
Projekt:		Pogon:		Objekt provjere:					
Izvođači:									
Lista br.:									
Br.	Nesukladnost	Stroj/Elek	Odgovoran	Datum	Prioritet	Otklonjeno	Provjereno		
GORE NAVEDENE NESUKLADNOSTI SU OTKLONJENE NA PRIHVATLJIV NAČIN									
Za Izvođača		Za stručni nadzor			Za CEMEX				
Potpis	Datum	Potpis	Datum	Potpis	Datum				

Figure 5 Non-critical inconsistency

4.3 Testing algorithm

Table 1 shows the procedure for testing the algorithm of Unimotor function block. The section in Table 1 relates to the testing of the algorithm that is under the SCADA column where it is seen the “faceplate” status, the signaling lights and the achieved status.

Table 1 Testing algorithm

Korak	LOK PREK	ISKLOPNI UREĐAJI	Faceplate	Lampice	SCADA
					Status
1	O	MCC prekidač ON			mot grupa spremna
2	LOK				lokalno upravljanje
3			Lokalno		lokalna dozvola
4	LOK Start Imp				start lokalno
5	O				lokalno isklop
6	LOK Start Imp				start lokalno
7		potezni ON			sigurnosna blokada
8			Potvrda alarma		
9		potezni OFF			mot grupa spremna
10	LOK Start Imp				start lokalno
11		MCC prekidač OFF			mot grupa nije spremna
12			Potvrda alarma		
13		MCC prekidač ON			mot grupa spremna
14	LOK Start Imp				start lokalno
15		gljiva skupine ON			sigurnosna blokada
16			Potvrda alarma		
17		gljiva skupine OFF			mot grupa spremna
18	LOK Start Imp				start lokalno
19			Rucno		lokalni prek nije na daljinski
20	REMOTE				lokalni prek na daljinski
21			Start		rucno start
22			Stop		rucno stop
23			Start		rucno start
24		potezni ON			sigurnosna blokada
25			Potvrda alarma		
26		potezni OFF			mot grupa spremna
27			Start		rucno start
28		MCC prekidač OFF			mot grupa nije spremna
29			Potvrda alarma		
30		MCC prekidač ON			mot grupa spremna
31			Start		rucno start
32		gljiva skupine ON			sigurnosna blokada
33			Potvrda alarma		
34		gljiva skupine OFF			mot grupa spremna
35			Start		rucno start
36	O				lokalno isklop

5 System Testing

System testing takes place according to Croatian standard “HRN EN 62381:2008 Automation systems in the process industry -- Factory acceptance test (FAT), site acceptance test (SAT) and site integration test (SIT) (IEC 62381:2006; EN 62381:2007)“.

5.1 Site Acceptance and Integration Test (SAT and SIT)

5.1.1 Electrical testing

The MCC drawers should be locked for the electrical test while being controlled by the trial commissioning team. The user staff composed of members of the cement operations is responsible for performing the inspection and recording of the deficiencies, and with the contractors eliminating the deficiencies. The project user should verify the documents (checklists) proving the completion of the work.

Critical requirements that must be completed to confirm completion of the works:


- a) Supports and cable shelves are installed in the correct manner
- b) VN / SN Blocks, MCC cabinets, general consumption cabinet, compensation and UPS distribution board installed in the right way
- c) All equipment connected to a common grounding system
- d) All connectors, all power and control-instrumentation cables are labeled
- e) Implemented the examination of insulation (where is possible)
- f) Completed test sheets for electrical and instrumentation equipment
- g) Implemented the examination of continuity of all cables and connections
- h) Implemented the examination of insulation resistance and symmetry of the phase motor resistance with the cable.

The MCC unit should be in the test position (or power unit unconnected, and the control voltage supplied from the external UPS source etc.) at the instrumental test and supervised by the commissioning team. Fuses for individual control circuits are plugged when needed. The user staff is responsible for testing the signal with the support of PLC programmers. Documents (checklists) proving the completion of the works should be verified by the project user.

Critical requirements that must be completed to confirm completion of the works:

- a) Signal testing (from plant to I/O unit, i.e. SCADA)
- b) Parameterization and calibration of instrumentation
- c) Calibration/test of the signals recorded in the test sheets
- d) Emergency shutdown activation check (E-Stop)
- e) Limits of protection/VSD parameters checked
- f) Installed and tested horns and/or flashes warning which warns about the start of the plant
- g) Start/Stop test of motor groups in the test position (PLC remote/Manual and local control)
- h) Checking the motor rotation direction (respecting relevant locks).

After performing electrical and instrumental tests (without any critical faults), a Blue card as shown in Figure 6 may be placed on the MCC unit indicating that the motor is ready for cold testing.


CEMEX
 HRVATSKA
**DOVRŠENO ELEKTRO
 ISPITIVANJE**

TEHN. OZNAKA: _____

OPIS OPREME

PROVERENI SU SVI DIGITALNI I ANALOGNI SIGNALI
 KOJI PRIPADAJU POGONU ALI BEZ PRISUSTVA
 ENERGIJE. POGON JE SPREMAN ZA POJEDINAČNI
 START UZ UVJET DA JE POTPISANA KARTICA
 "SPREMNOST POGONA ZA POKRETANJE".

LISTA SIGNALA SA ISPUKJENIM PODACIMA NALAZI
 SE U DOKUMENTACIJI PROVJERA POGONA
 PRIPADAJUĆEG ELEKTROPOSTROJENJA.

VOĐITELJ PROVJERE: _____

DATUM: _____

KOMENTARI: _____

Figure 6 Completed electrical test

5.1.2 Plant readiness for start (mechanical)

The MCC units should be locked while being controlled by the commissioning team. The user staff composed of members of the cement operations is responsible for performing the inspection and recording of the deficiencies and with the project contractors eliminating the deficiencies. Documents (checklists) proving the completion of the works should be verified by the project user.

Critical requirements that must be completed to confirm completion of the works:

- a) Equipment properly mounted (tensile and precision)
- b) Mount all parts required for correct operation - couplings, belts, chains, etc.
- c) All data on mechanical equipment is collected.
- d) Lubrication - the user staff must obtain lubricants and lubricate.
- e) Installed equipment must fulfill safety regulations.
- f) All mechanical protective parts must be mounted.

After checking the plant readiness for start (without any critical faults), a Brown card as shown in Figure 7 may be placed on the MCC unit indicating that the plant is ready for a cold test.

◊
CEMEX
HRVATSKA

**SPREMNOST POGONA ZA
POKRETANJE**

TEHN. OZNAKA: _____

OPIS OPREME

PROVJERENA JE INSTALACIJA SVIH STROJARSkih I
ELEKTRO KOMPONENTI POGONA KOJE
OMOGUĆAVAJU POKRETANJE POGONA NA SIGURAN
NAČIN. POGON JE SPREMAN ZA POJEDINAČNI START
UZ UVJET DA JE POTPISANA KARTICA
"DOVRŠENO ELEKTRIČNO ISPITIVANJE".

VOOITELJ PROVJERE: _____

DATUM: _____

KOMENTARI: _____

Figure 7 Plant readiness for start (mechanical)

Figure 8 shows an example of marking and locking MCC unit.



Figure 8 Example of marking and locking MCC drawer

5.1.3 Cold test

Cold tests should include prior checking, marking and set isolation system, unlocked MCC unit and under supervision of the commissioning team. The user staff composed of members of the cement operations is responsible for conducting cold tests. Critical requirements to be completed for cold test verification:

- a) Plant readiness for start label and completed electrical test (Brown and Blue Card)
- b) Installed and tested horns and/or flashes warning which warns about the start of the plant
- c) Long running time without material
- d) Checking - engine current, vibration and operating temperature, monitoring and safety devices

- e) After a successful cold test (without any critical defects), a Green Card as shown in Figure 9 may be used to indicate that the plant is ready to test the sequence.

◊
CEMEX
HRVATSKA

**DOVRŠENA HLADNA
PROBA**

TEHN. OZNAKA: _____

OPIS OPREME

PRIKUPLJENI SU SVI PODACI O HLADNOJ PROBI
TUEKOM PROVJERE UPRAVLJANJA I NAPAJANJA
ENERGIJOM POGOŃA U PRAZŃOM HODU,
PROVJERENO JE LOKALNO/DALJINSKO UPRAVLJANJE,
POJEDINAČŃI UKLOP/ISKLOP I SIGURNOSNE
BLOKADE. POGŃŃN JE SPREMAN ZA ISPITIVANJE U
SEKVENČAMA.

OBRAZAC SA ISPUŃENIM PODACIMA SE NALAZI U
DOKUMENTACIJI PROVJERA POGOŃA
PRIPADAJUĆEG ELEKTROPOSTROJENJA.

VOĐITELJ PROVJERE: _____

DATUM _____

KOMENTARI: _____

Figure 9 Cold test completed

After a cold test has been completed, according to the Croatian standard HR EN 62337, there is a turning point in the so-called “start-up” that marks the end of cold commissioning. After the cold commissioning is complete, the system test is followed. Testing the system involves the hot commissioning phase during which the contents are related to the testing and operation of the equipment using the proper process. After the hot commissioning phase, a turning point marks the end of the hot commissioning and the start of production. This is the turning point after which the production plant starts. After the performance test follows the turning point of the plant acceptance. This is a milestone in which user of the project formally accepts the plant from the contractor. The contractor is relieved of any responsibility, and the user accepts full responsibility for the maintenance and start-up of the plant. After the milestone of plant acceptance, project implementation has been completed. The whole process is shown in Figure 10.

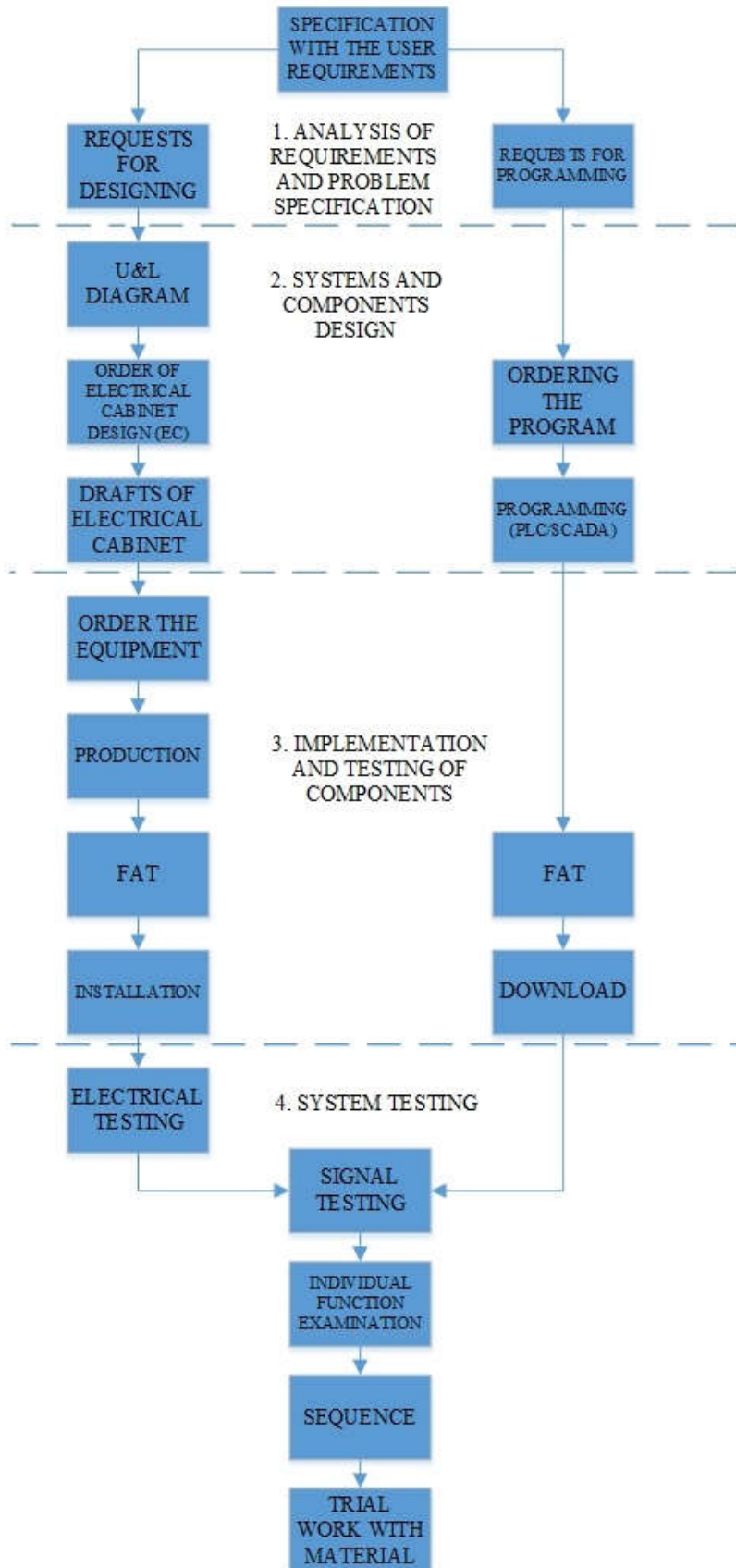


Figure 10 Scheme of the process

6 Transfer to Targeted Environment, Use and Maintenance

Maintenance activities management methodology:

- Build a register of property
- Determine the risk matrix according to the risk criterion
- Define maintenance strategies based on the risk criterion
- Define maintenance tasks and their frequency (optimization of existing maintenance plans)
- Create optimal packages of maintenance activity that lead to maintenance plans

7 Removal and Proper Disposal

Cemex Hrvatska d.d. has environmental protection policy in which they commit to continuously improve the management of the environment, with clear goals, responsibilities with appropriate resources. Their obligation is to plan and manage their manufacturing processes to prevent contamination and preserve natural resources, including biodiversity, water and energy, reducing dust and noise emissions, using alternative fuels, fuels and energy efficiency, in accordance with legal regulations, the requirements of CEMEX and in cooperation with the local community. The company wants to improve their products and services by reducing the impact on the environment lifespan, exploitation, production and efficient use until final recovery or disposal. Constantly improving the quality of the living community by participating in their development, connecting with the relevant stakeholders, reassuring their concerns, while simultaneously achieving business goals.

REFERENCES

- [1] HZN, "Preuzimanje električkih sustava, instrumentacijskih sustava i sustava za vođenje u procesnoj industriji"
- [2] HZN, "Sustavi automatizacije u procesnoj industriji FAT, SAT i SIT"
- [3] CEMEX, "Sustav nadzora i upravljanja procesom proizvodnje u rudniku tvornice cementa Sv.Juraj"
- [4] CEMEX, "X23_01_1_MCC_A05_02"
- [5] CEMEX, "Upute za puštanje pogona u rad"
- [6] CEMEX, "Kako ubrzati probno puštanje u rad"
- [7] CEMEX, "Protokol hladne probe Unimotor"

Industry 4.0: Unleashing Its Future Smart Services

Igor Jurčić

HT ERONET, Mostar and University of Mostar, B&H
ijurcic77@gmail.com

Krishnan Umachandran

General Manager (Org. Dev), Nelcast Ltd., India

Valentina Della Corte

Associate Professor, Department of Economics,
Management, Institution, Federico II University of Naples

Giovanna Del Gaudio

Department of Economics, Management, Institution,
Federico II University of Naples

Vasudeva Rao Aravind

Associate Professor, Department of Chemistry, Mathematics, and Physics
Clarion University, Clarion, PA 16214, USA

Debra Ferdinand-James

Educational Technologist (Lecturer Level), School of Education, St. Augustine Campus
The University of the West Indies, Trinidad

Abstract. The drive to develop towards Industry 4.0 requires appropriate infrastructure in order to harness the full potential of its smart services in the future. Such infrastructure include the following: planning and technical development segments; materials and procurement process; production and manufacturing; and finally, warehousing and logistics. The latter should be transformed from the traditional labor-machine-intensive setup to one that is a completely digital. Progressively, there should be a moving towards a socio-technical-digital ecosystem, in which physical, virtual dimensions are increasingly intertwined for providing smart services. This emerging ecosystem should have more interactions between people, machines, and digital technologies to better serve the needs of society and very interesting benefits can be generated for both local and global economy. Industry 4.0 is interlinked with technologies such as Industrial Internet of Things; Data Sciences; Cloud Computing; Internet of Things; Smart Manufacturing, Advanced Robotics and Artificial Intelligence; 3D Printing, Virtual and Augmented Reality and Data analytics. The shelf-life of modern technologies is changing rapidly to more advance offerings. Organizations should embrace the unleashing of Industry 4.0 and its future smart services. Operations will depend on direct data obtained from the process of planning the necessary resources and optimizing facilities to function online with inbuilt autonomous maintenance. A critical and interesting challenge is also to study how such tools are used and inserted into the organization and its main functions. This paper is organized towards the key design concepts integrating tools and embeds to design industry 4.0 for smart services and innovations.

Keywords: *Industry 4.0, Internet of Things (IoT), Artificial Intelligence (AI), Digital Ecosystem, Mobile Internet.*

1. Introduction

The following period, period that has been already recognized as Fourth Industrial Revolution or Industry 4.0, will bring many big changes in all business segments which will have enormous impacts on people and their lives. Companies from ICT business segment will have crucial roles in this new period but as the first they will have to change and adjust themselves and it is up to them how much they will earn money and how they will use this new period. According to some approximations this new market will worth up to 3.000 billion US\$ by 2020 year and there will be several key industrial players in this new ecosystem.

This previous mentioned amount indicates that many existing and well established but also new companies will try to find positions for themselves. Many new companies but also the famous and well established global ones will try to spread their roles in this new business ecosystem – there are more than 3.000 billion reasons for it. It is important to recognize that in this new environment or better say in this new ecosystem, mobile telecom operators will have to reorganize and reshape themselves and become ICT (mobile) operators but also all companies in all business segments will have to reshape themselves and change/adjust their business activities, organization, products, services... This article will try to give some answers of these changes and potential new services in this new age and how they will change business environment and people lives.

2. Mobile telecom operators in Industry 4.0 era

Telecommunication market will be definitely dramatically changed in following years. Mobile telecom operators will be most exposed to these changes. Industry 4.0 era will be based on Vision 2020 in ICT segment and Vision 2020 defines usage of 5G mobile networks, Internet of Things, Industrial Internet of Things, Over The Top (OTT) Applications, Artificial Intelligence (AI), Cloud Services and many other items. These changes will bring to new approaches for creating of telecommunication products and services. This means that customers will be able to use completely new types and new kinds of products and services on the telecommunication market. And (mobile) telecom operators have been preparing themselves for this new era for several last years.

Key managers in (mobile) telecom operators have been already recognized these opportunities and chances for developing business in new ways and for earning extra money or better say for new income. Here will be mentioned some surveys and analysis which show this assertion. According to survey which was conducted in Q2/2017 and was published in European Communications magazine top managers and key business people in (mobile) telecom operators have seen opportunity in business opportunities based on the Internet of Things (IoT). One of survey question was “are you convinced that operators can provide more than just connectivity services to the IoT”. And 69% of survey participants answered “Yes” and 31% answered “No”. Another question was regarding revenue stream – “are you convinced the IoT can be a significant revenue stream for operators over the next five years”. And 63% of survey participants answered “Yes” (37% of survey participants did not agree with this assertion). From these two questions and related answers can be seen that key people in (mobile) telecom operators recognized opportunities of IoT market a year ago.

When survey participants were asked to tell more about segments for new opportunities (“which market do you think will offer the biggest IoT revenue opportunity for operators between 2017 and 2020”) 73% of them answered “B2B (Business to Business) market” and 27% answered “B2C (Business to Customer) market”. These answers show that key managers in (mobile) telecom operators, as usually when new products and services should be offered to market, will

try to start offering products and services in B2B market because of better ROI and lower initial input costs.

There was one another very indicative question in this previously mentioned survey and very interested answers. The question was “do you agree with the following statement – operators will have to acquire companies to succeed in the IoT space”. And 69% of survey participants answered – “Yes”. So, people who make decisions in (mobile) telecom operators have clear vision – they will have to acquire new companies form ICT segment if they want to make business in IoT space.

In this article will not be analysed all questions and related answers from this survey but it will be mentioned and briefly analysed another question and related answers of survey participants. The question “what do you regard as the biggest challenge to the success of your IoT business” and related answers were:

- Developing the right business models: 32,5%,
- Creating new services: 25%
- Developing the right partnerships: 17,5%,
- Security: 10%,
- Personal issues / lack of skills: 5%,
- Technology issue: 5%,
- Lack of scale: 2,5%,
- Other: 2,5%.

Briefly analysis of these answers shows that key managers were mostly concerned of business models and developing new services (57,5%). If the third answer “developing new partnerships” with 17,5% would be added to the first and second one, the result will be 75% (three quarters). If these answers would be analysed form the top and from their meanings, it is clear that 75% of survey participants were concerned of issues regarding developing new products and services ie. how, which type of products and services, business cases of these new products and services and with whom to develop new products and services.

Another survey form European Communications magazine from Q1/2017 gave some answers of digital transformation. The survey participants answered on 7 questions and the first one was “how long is your digital transformation project expected to last”. The answers were distributed as following:

- 1 year: 2,13%,
- 2 years: 21,28%,
- 3 years: 27,66%,
- 4 years: 6,38%
- 5 years: 31,91%,
- 6 years: 2,13%,
- 7 years: 0%
- 8 years: 2,13%,
- 9 years: 0%,
- 10 years+: 6,38%.

When answers were analysed, it was clear that almost 90% of survey participants believe that digital transformation will be finished in five years ie. until 2022. year. Or it can be seen that more that 50% of survey participants believe that digital transformation in their companies will be over by 2020. year.

According to the same survey, the main aims of digital transformation project will be following issues (survey participants could give more than one answer): improve customer experience (85,42%), reduce complexity (72,92%), automated/realtime processes (70,83%), reduce OPEX (66,67%) and new products/services (62,50%). But also (from the same survey) it is clear that “the biggest challenges” will be big and complex projects, lack of strategy and lack of quality staff (skills inhouse). So, key managers believe that digital transformation is required, but on other hand, they think/know this process will be very complex and it will take a lot of time for finishing it.

In the same magazine in Q3/2017 edition, key managers from (mobile) telecom operators defined the biggest challenges to the success of operators’ digital content strategies and they are: creating differentiation from competitors cost of licensing content, understanding what customers want and complexity of relationship with partners. They also detected the main competitors in content space and according to this survey they are: Netflix, Google, Amazon and Facebook.

In Q1/2018 edition of European Communications magazine there was survey similar as survey from Q12017 (that was briefly analysed in previous part of the article). According to this new survey, key managers still see that “improve customer experience” will be the main aim of digital transformation (85,5%). The aim “reduce OPEX” is on the second place with similar percentage one year later (56,5%) but key managers were less concerned of “automated/realtime processes” (54,8%), of “reduce complexity” (54,8%) and of “creating new products/services” (50%).

These, previous mentioned issues, still concerns key managers in mobile telecom operators but less that year before. And from this very simple analysis it can be clear that key managers and employees more believe in digital transformation in their companies than a year ago – the new products and services and new business models will be required as soon as possible, on the first place, because of improving of customer experience and differentiating from competitors.

The key aim in Industry 4.0 will be creating new products and services, defining new business models in companies and differentiating from competitors. And from these issues will be pointed out another one – “improving of customer experience” What type of products and services will be crucial for “improving of customer experience” and for “differentiating from competitors”? There are many analysis and articles from this field and here will be mentioned several of them and draw some conclusions about potential services and the role of mobile telecoms operators in them.

There are many opportunities for mobile telecom operators in Industry 4.0 era. These fields of potential business lie in different segments such as Internet of Things (IoT), Industrial Internet of Things (IIoT), Over The Top applications (OTT), Artificial Intelligence (AI), Cloud Services, and many others. Here will be noted IoT and IIoT areas. Of course, as it was noted in analysis of surveys that had been previously mentioned in this article, digital transformation was crucial issue for mobile telecom operators. And in Industry 4.0 era, mobile telecom operators will be more mobile ICT operators than mobile telecom operators.

In his analysis that was presented three years ago, professor Ahmed Banafa presented potential business segments for implementation of IoT/IIoT. These segments are shown on following figure.

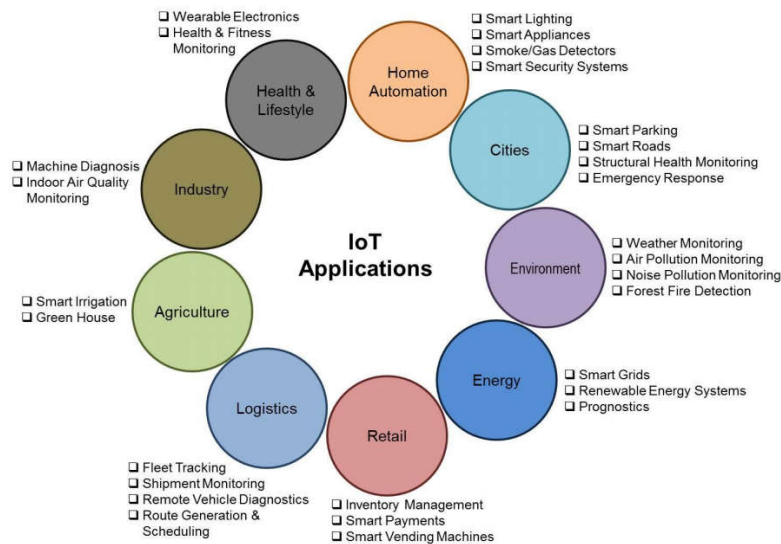


Figure 1. Business segments for IoT/IIoT implementation
 (Source: Ahmed Banafa: „What is next for IoT and IIoT”,
 Enterprise Mobility Summit, Australia 2015)

After brief analysis of Figure 1, it is clear – (almost) all business segments will be exposed to IoT/IIoT influence and they will be changed in following years ie. in Industry 4.0 era. According to previous surveys that were analyzed in this article it is clear that B2B segment or IIoT will be bearers and leaders of these changes. But in three, five or even ten years all business segments will be exposed to these changes and private lives and business environment for people will be dramatically changed. Why is so important for mobile telecom operators to carry out a digital transformation and become a mobile ICT operator? One of the answers is shown on following figure (Figure 2.).

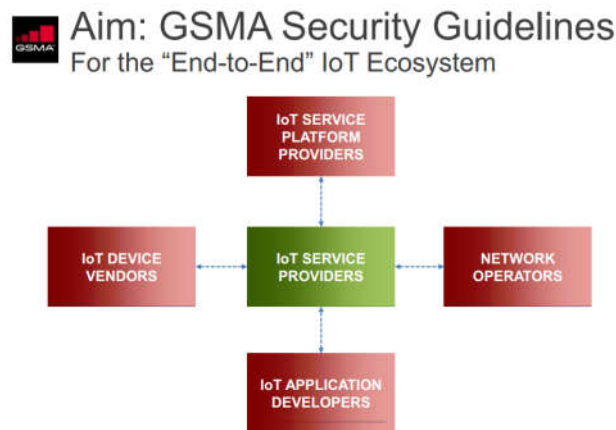


Figure 2. End to end IoT ecosystem
 (FierceLive webinar: Securing the Future of the IoT, 2.2.2016.)

According to some assumptions, IoT/IIoT business potential will be between 2,5 and 3 trillion US dollars. And that money lies in five previous shown segments. Mobile telecom operators can earn only one, small part of new income or they can change their business models, get into another areas of IoT ecosystem and get new income and profit higher than they would be able to earn only in one of these segments.

At the end of this part it will be mentioned only that mobile telecom operators have huge chance and opportunity to change their business models. The main business segments for mobile telecom operators are Industry, Smart cities, Smart homes, Agriculture (Ahmed Banafa: „What is next for IoT and IIoT”, Enterprise Mobility Summit, Australia 2015) and definitely Tourism (Jurčić, I, Jurčić, D:”New products and services in tourism based on new technologies”, CIET 2016, Split, Croatia). But before anything else, mobile telecom operators must carry out their own digital transformation and change their business models. One of directions for mobile telecom operators should be analysis that is in process of developing and creating - “Eight Key Field (EKF) Analysis”. This analysis was mentioned first time in article published on SoftCOM 2016 in Split, Croatia (Jurčić, I., Gotovac, S: “New approach in mobile telecom operators analysis – Analysis of Eight Key Fields”, SoftCOM 2016, Split, Croatia). Intention of this analysis is to give mobile operators answers about their existing position on the market but also what, which, when, where and how they have to do/invest/create/approach, for better results in following years ie. Industry 4.0 era.

3. Industry 4.0 era - System Preparedness

Progress toward Industry 4.0 necessitates a movement in the direction of connecting the prospective future service, which the manufacturing organizations envisage, with adept infrastructure. Industry 4.0; innovative and smart services add value towards appreciating development, resource efficient production and logistics, convergent supply infrastructures, and integration of smart components. These components’ ability to communicate with computerized methods and tools is essential for improving the process and the usage of the product systems in combining the information flow with the real material flow and considerably leaner planning (Judith Binzer, 2016).

A vital link for the manufacturing market is the seamless data collection that permits the rapid feed of manufacturing data and information to management for effective decision-making; and reducing lead times for innovations, to this end, China pushes *internet plus* that emphasises strengthening of the manufacturing value chains on demand, data, and digitally affected product life-cycle management. Such emphasis is becoming increasingly universal, multidisciplinary, modernized, customer-initiated, and fast-tracked service innovation (Lidong Wang, Guanghui Wang, 2016). Industry 4.0 has started to diminish the distinction between the digital and physical worlds; in the following ways: by arranging clusters of remote servers and networks of manufacturing organizations; permitting online access and resources to these clusters with data analytics, visualization and monitoring; through cloud computing simulations of various stakeholders to use effectively (I. Singh, N. Al-Mutawaly, T. Wanyama, 2015).

The coordination of science, industry and society is crucial to effectively shift concepts into economically viable innovations of mammoth communal use. If done effectively, this coordination allows for €f transnational knowledge-value creation with scientific prosperity increased through research institutions and university cooperation among international partners (Johanna Wanka, 2016).

While Industry 4.0 holds much promise for the future, firms must have their systems prepared in order to reap its benefits. The software system connects the entire company’s business logic and information access as a module and built as a highly integrated and flexible functionality in an efficient and completely promising system (Andreas Moeller, Bernd Page, Martin Schreiber, 2008). In effect, Industry 4.0 is the amalgamation of tangible outputs supported by the information technology integrated systemic processes; and frequent interdisciplinary manufacturing facilitations directed by seamless tie-ups. Thus, the business environment performance increasingly impacts the management of energy and natural resources, but may risk the long-term value and future of a business if wastage occurs.

The Internet has revolutionized the way we live, do business and communicate. Building a business in the host country's market as quickly as possible is at ease with e-commerce and well received by the business community and consumers. The global connectivity creates business avenues that cannot be matched by traditional commercial channels but some preparation is necessary. Market knowledge for local operating capability and intensive distribution is an enabling condition in recognising local regulatory requirements, business practices, negotiating styles, and cultural norms for the development of the business. As such, multinational companies have invested substantial sums in developing their own distribution network required for doing business in any country. They have also been flexible to accommodate e-business portals and customizing their own to be linked with it as synergic coexistence for enhanced marketing flow (Shaista E. Khilji , Mary B. Teagarden , Daing Nasir Ibrahim, Tan Teck Meng , Zafar U. Ahmed (2007).

4. Managing Manufacturing Marketing Flow

Manufacturing flow determines the obligatory infrastructure to accomplish the customers' needs with accommodation for the marketing functions, logistics, core process and its interfaces as explained in Figure 1. The innovator develops key elements of the value chain such as customer demand management information through the following processes: forecasting, synchronizing and managing service management; and by reevaluating, reorganizing and reengineering the process as continuous options with no disruptions in the product flow (Keely L. Croxton, Sebastián J. García-Dastugue, Douglas M. Lambert, Dale S. Rogers, 2001).

This infrastructure would include planning and technical development segments; materials and procurement process; production and manufacturing; and finally, warehousing and logistics. Progressively, there should be a movement towards a socio-technical-digital ecosystem, in which physical, virtual dimensions are increasingly intertwined for providing smart services. Unlike traditional development, short and long-term innovation processes impact the full value chain through extensive changes in their core processes, products, new technologies and services on society (Judith Binzer, 2016)

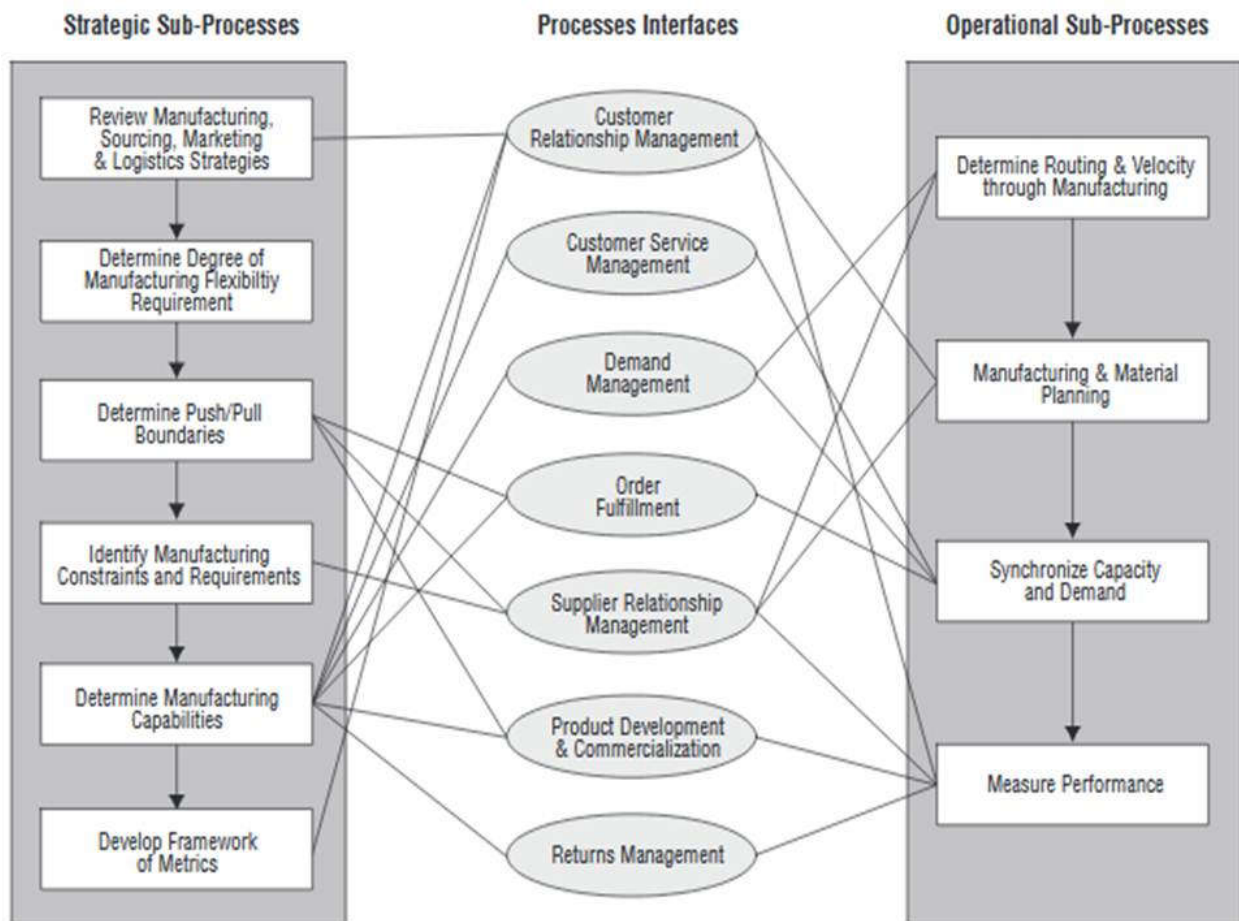


Figure 3 – Manufacturing Flow Management
 (Source - Keely L. Croxton et al., (2001))

The transformation from the traditional labor-machine-intensive setup to one that is a completely digital will be informed by imminent and specialized needs to industry-specific and individualized-market solutions. Practical training required for Industry 4.0 setting include the following: Intelligent production facilities; Industrial processes networked with ICT production process; uninterrupted performance enhancement; changing and improving practices compulsory to the work, and motivational approaches. European countries with key enabling technologies and digital economy will have many jobs being radically changed with increase in automation of routine jobs;. This automation can affect more employees at high and medium risk, leading to their jobs disappearing or tasks transformed meaningfully. Therefore, in anticipating skill-needs of Industry 4.0, it is necessary to re-skill and up-skill human resources in the global race of talent. This talent will be the key factor influencing future investment and modernization which would positively correlate with labour productivity (André Richie, 2017).

5. Industry 4.0 Ecosystem

The Industry 4.0 ecosystem will have more interactions between people, machines, and digital technologies in serving the needs of society, local and global economy, and improving the quality of lives through meaningful experiences in the emerging environment. IoT Cloud infrastructure supports IoT applications in becoming a common practice in industry. As such, interoperability supplements the determination of IIoT solutions springing from Industry 4.0 and evolving into a complete ecosystem. Cloud computing consequently earns prime position

in computing analogous descriptions and smart features to enhance the convention of computing resources. IIoT for Manufacturing will support the changeover to self-managed manufacturing competencies which influence extreme alterations for synergy and flexibility toward progressive development (Martin Serrano, Danh Le-Phuoc, Maciej Zaremba, Alex Galis, Sami Bhiri, Manfred Hauswirth (2013)).

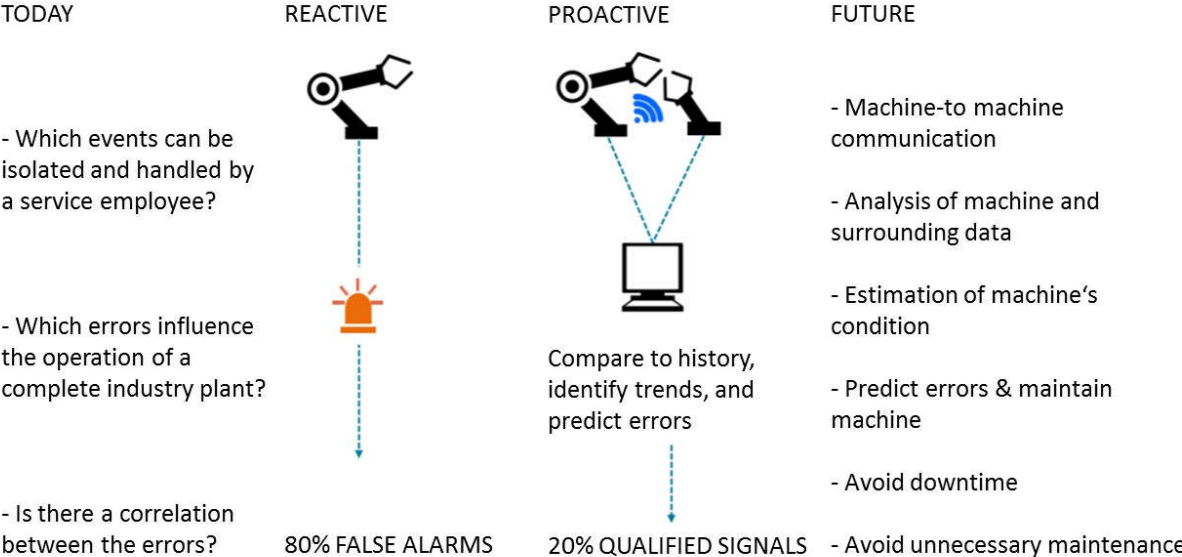


Figure 4 - Smart Ecosystems: An Enabler for Future Innovations
(Source - Dieter Rombach., (2015).)

Industry 4.0 is interlinked with data and communication technologies that uses data collected from physical things of IIoT through Cloud Computing and data analytics to build smart products in a factory Internet of Things are therefore used to create cyber-physical systems, which influence smart manufacturing using advanced robotics and artificial intelligence. With a combination of technologies in data and manufacturing, an interdisciplinary machine is being built that exploits various techniques such as 3D Printing, and Virtual and Augmented Reality, providing customization and need satisfactions for customers in the market. This information process impacts on the manufacturing process and helps to build smarter products, which are not off-the-shelf products. Rather they are built on technology that uses cyber physical systems, representing an evolution of the fusion of advanced digital technology and AI with both people and machines. Information provided through real-time insight, that inform products and their structures assist in good sales and increased financial turnover. In so doing, the manufacturing organization signals a change of gear in its operations according to the market demand verified by comparing data from multiple sensors in the IoT. Thus value addition in the chain involves the systematic partitioning of tacit information that increases efficiency within the firm or across firms in different geographic regions when combined with others exchanging information as shown in Figure 2. As a result, both outsourcing and offshoring are possible through the use of modular type of GVC linkages (Timothy J. Sturgeon, Torbjörn Fredriksson, Diana Korke, 2017). The shelf-life of modern technologies is rapidly decreasing in light of more advance offerings. A perilous encounter in manufacturing operations is that it is subject to on undeviating data from the planning process, resources optimizing facilities and roll out online with integral self-directed upkeep of its function. Thus, organizations should embrace

the unleashing of Industry 4.0 and its future smart services, affording conceivable occasions for interoperability in gaining competitive advantage in the global contest.

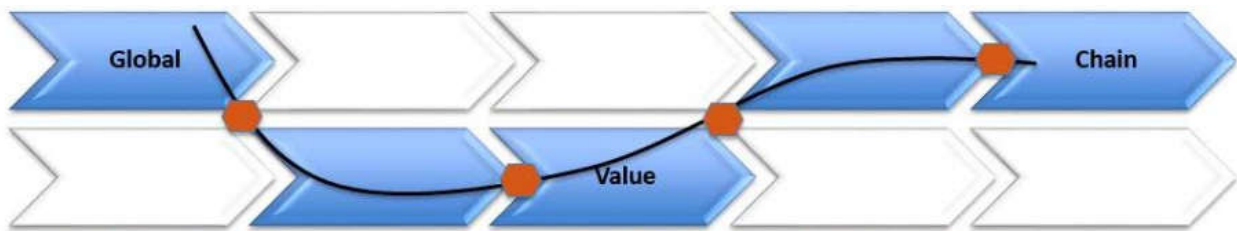


Figure 5. Global Value Chain cross border linkages and flow by value chain modularity

(Source - Timothy J. Sturgeon et al., (2017).)

6. Conclusion

In this article were shown brief analysis of unleashing of new smart services in Industry 4.0 era and mobile telecom operators roles in this new age. Mobile telecom operators will have one of the main role in this new period and key managers in mobile telecom operators have already recognized these new opportunities. Changes in them were already started and the main activities in mobile telecom operators will be how to use this new era for new business opportunities. The main conclusion is that all employees in mobile telecom operators must have „shift in mindset“ and they have to know how to use this new period and get better results. Or on the other hand, some other, existing but also new companies, will take their market. Mobile telecom operator sin this new era will be more and more ICT (mobile) operators.

Industry 4.0 will bring changes in all business segments. People will feel all these changes in their private lives but also in their businesses. These changes will touch all segments in human's lives and they will bring even more changes in private lives and businesses than any industrial revolution before. This article briefly tries to explain some of these changes and how to use this new age for the common progress of the human species.

REFERENCES

Published proceedings:

Andreas Moeller, Bernd Page, Martin Schreiber (2008), Environmental Informatics and Industrial Ecology, 22nd International Conference on Informatics for Environmental Protection Proceedings of the 22nd International Conference Environmental Informatics –Informatics for environmental protection, sustainable development and risk management, September 10 – 12, 2008, Leuphana University Lueneburg, Germany, Shaker Verlag Aachen, pp. 643.

Judith Binzer (2016), Industrie 4.0 Research at German Research Institutes – An Overview“, VDMA Industrie 4.0 Forum, <http://www.bollettinoadapt.it/wp-content/uploads/2016/10/study-i40-research-vdma.pdf>.

Shaista E. Khilji , Mary B. Teagarden , Daing Nasir Ibrahim , Tan Teck Meng , Zafar U. Ahmed (2007), Advances in Global Business Research Vol. 4, No. 1, ISSN:1549-9332. pp. 981. 4. Lidong Wang, Guanghui Wang (2016), Big Data in Cyber-Physical Systems, Digital Manufacturing and Industry 4.0, I.J.Engineering and Manufacturing,2016, 4, 1-8)DOI: 10.5815/ijem.2016.04.01.

I. Singh, N. Al-Mutawaly, and T. Wanyama (2015). Teaching network technologies that support Industry 4.0. Proc. 2015 Canadian Engineering Education Association (CEEAA15) Conf., CEEAA15; Paper 119, McMaster University; May 31-June 3, 1-5.

Keely L. Croxton, Sebastián J. García-Dastugue and Douglas M. Lambert, Dale S. Rogers (2001), The Supply Chain Management Processes, The International Journal of Logistics Management, pp. 13-36.

André Richie, (2017), Professional Higher Education 4.0: A Change for Universities of Applied Sciences, European Commission - Directorate General for Internal Market, Industry, Entrepreneurship and SMEs, Le Havre, France, 30-31 March 2017. Pp. 100. https://www.eurashe.eu/library/mission-phe/EURASHE_AC_LeHavre_170330-31_proceedings.pdf.

Johanna Wanka (2016), Federal Report on Research and Innovation 2016, Federal Ministry of education and research, Germany, pp. 164. http://www.bundesbericht-forschung-innovation.de/files/Bufi_2016_Short_Version_eng.pdf.

Martin Serrano, Danh Le-Phuoc, Maciej Zaremba, Alex Galis, Sami Bhiri, Manfred Hauswirth (2013), Resource Optimisation in IoT Cloud Systems by Using Matchmaking and Self-management Principles, https://link.springer.com/content/pdf/10.1007/978-3-642-38082-2_11.pdf.

Timothy J. Sturgeon, Torbjörn Fredriksson, Diana Korka (2017), The 'New' Digital Economy and Development, UNCTAD, Division of Technology and logistics Science, Technology and ICT, Branch ICT policy, Section Technical Note No. 8 Unedited, TN/UNCTAD/ICT4D/08 October 2017. pp. 41.

Dieter Rombach., (2015), Smart Ecosystems: An Enabler for Future Innovations, SEC Special Seminar: Software Engineering and Business Innovation at the Era of IoT Tokyo, February 20, 2015, Fraunhofer IESE Kaiserslautern, Germany, pp.44.

Ahmed Banafa: „What is next for IoT and IIoT”, Enterprise Mobility Summit, Australia 2015

Jurčić, I., Jurčić, D. (2016):” The potential for the development of new products and services in the tourism industry based on new ICT technologies, ” CIET 2016, Split, Croatia

Jurčić, I., Gotovac, S.(2016):” New approach in mobile telecom operators analysis - Analysis of Eight Key Fields” SoftCOM 2016, Split, Croatia

Gotovac, S., Jurčić, I., Radoš, I.:” Services in tourism based on Vision 2020 – a chance for telecom operators”, Splitech 2016, Split, Croatia

Journal article:

European communications, magazine, Q1, 2016, <https://www.eurocomms.com/>,

European communications, magazine, Q2, 2016, <https://www.eurocomms.com/>,

European communications, magazine, Q3, 2016, <https://www.eurocomms.com/>,

European communications, magazine, Q3, 2017, <https://www.eurocomms.com/>,

European communications, magazine, Q1, 2018, <https://www.eurocomms.com/>,

Implementation of Alfresco's document management software into University institution

Siniša Zorica

University Department of Professional Studies, University of Split, Republic of Croatia
szorica@oss.unist.hr

Lada Reić

University Department of Professional Studies, University of Split, Republic of Croatia
lada@oss.unist.hr

Marinko Lipovac

University Department of Professional Studies, University of Split, Republic of Croatia
lipovac@oss.unist.hr

Sandra Antunović Terzić

University Department of Professional Studies, University of Split, Republic of Croatia
santunov@oss.unist.hr

Abstract. Nowadays the amount of information and documents in business is exponentially increasing and productivity depends significantly on the availability of the right information at the right time. The traditional way of doing business prevent systematic access and manipulation of information. Documents are often lost, employees spend too much time to get information and there is no easy way to manage security and access rights to documents and information. The solution lies in use of a content management system. Alfresco ECM (Enterprise Content Management) is the leading open source document management system. It offers document management, digital content management, record management, web content management, collaboration portal, business process management and more. The open source architecture allows a design of custom solutions and simple integration with other systems or office applications such as Microsoft Office or OpenOffice tools. Introduction to Alfresco and its functionalities suitable for implementation into University institution are given, including proposition of appropriate architecture.

Key words: *Alfresco, document management software, increase of productivity*

1. Introduction

Enterprise Content Management is the collection of strategies, methods, and tools used to capture, manage, store, preserve, and deliver content and documents related to organizational processes [1], [2]. ECM systems use a repository, a number of different applications, and application development platforms to enable this control, access, and delivery of content. Content can be any unstructured information, such as documents, Web pages, images, video, records, or simple files [3]. The ECM system manages the content and its lifecycle the way a database management system manages data in a database. An ECM system manages the actual digital binary of the content, the metadata that describes its context, associations with other content, its place and classification in the repository, and the indexes for finding and accessing the content [4]. Just as important, the ECM system manages the processes and lifecycles of the content to ensure that this information is correct. The ECM system manages the workflows for capturing, storing, and distributing content, as well as the lifecycle for how

long content will be retained and what happens after that retention period. By managing content in an ECM system, organizations are generally able to reduce costs of manual processing, increase the accuracy of information, and aid the search and discovery of important documents and information.

Alfresco is an open source Enterprise Content Management (ECM) system that manages all the content within enterprise: documents, images, photos, Web pages, records, XML documents, or any other unstructured or semi-structured file [5].

For end users, Alfresco appears as a suite of applications or extensions to their existing tools that manages their content. Alfresco exposes itself as though it were a shared drive to replace networked shared disk drives that have no organizational, search, or control mechanisms in place. Alfresco can replace networked shared drives with a store that organizes and controls information and provides a portal interface for searching and browsing content. By emulating the SharePoint protocol, Alfresco also helps users manage their office documents from within Microsoft Office by using the tools in the Office Suite designed to be used for Microsoft SharePoint. More importantly, Alfresco provides an out-of-the-box suite of applications to browse, search, manage, and collaborate on content in the repository. These applications include document management, Web content management, content collaboration, records management, and email integration. These applications can supplement and can be supplemented by new applications developed on the Alfresco platform.

For the business, Alfresco is designed to support the content requirements of a number of business critical processes and uses. The document management tools, applications, and interfaces support general office work, search, and discovery. The workflow management capabilities support numerous business processes, including case management and review and approval. The collaboration applications and services support the collaborative development of information and knowledge in the creation and refinement of content and documents. The scalable Web content management services support the delivery and deployment of content from the enterprise to its customers. The records management capability provides an affordable means to capture and preserve records based upon government-approved standards. The standards-based platform also provides access to applications that use these standards, such as publishing, image, and email management.

For the developer, Alfresco provides a full-featured, scalable repository and content management platform to simplify the development of the content-centric applications. Based on content management and Internet standards, Alfresco exposes the content management capabilities as services that can be accessed from REST-based or SOAP-based Web services, the new OASIS Content Management Interoperability Services (CMIS) standard Web-based services, or the PHP programming language. It can also be incorporated directly into a Java-based application with core Java services. In addition, Alfresco incorporates lightweight scripting languages that can access these services and provide a light weight programming model when speed of development is important. These services provide patterns similar to those used with databases, repositories, or user interface components, but have been extended for the unique challenges of content-centric applications (such as full text search and hierarchical content structures). Being open source, the platform is transparent, and the developer can peer into the internal repository patterns. Alfresco also provides a framework application that delivers much of what end users need, but can be extended by the developer for unique application logic and a customized user interface through Surf, CMIS, Web scripts, and Core Services.

At the heart of the Alfresco system is the Content Application Server, which manages and maintains the Content Repository. The binary streams of content are stored in the repository and the associated full-text indexes are maintained by the Lucene indexes. Alfresco

applications are built upon the Content Application Server and rely on the Content Application Server to persist, access, query, and manage content. The Alfresco applications exist to provide the basic capabilities that most users need to manage content. The two main applications are Alfresco Share and Alfresco Explorer.

The Alfresco system is available in two basic versions: Alfresco Enterprise Edition (Alfresco Content Services) and Alfresco Community Edition. Alfresco Community is completely free to use, but comes without any support from Alfresco. There are no service packs and hot fixes for this version, and there is no possibility of using advanced architectures such as high availability. The set of supported databases and application servers is significantly more limited than the Enterprise version. As with the Enterprise version, there is no explicit limit on the number of named users or simultaneous users. The Alfresco Community used in this paper also includes a Records Management Module required for advanced administration capabilities, defining metadata and security policies.

2. Administrative Office of the Department of Professional Studies

Administrative office responsibilities include receiving and reviewing documents, sorting, scheduling and enrolling documents, submission of documents, administrative and technical processing of documents, dispatch of documents, archiving and storing documents. Document and mail admission is done through the department's administrative office and the staff member of the office has the authority to open all mail. Any irregularities established during the opening of the shipment should be described briefly (e.g. damaged shipment, number of documents marked on the envelope does not correspond to the received number of documents, sender information is not noted, etc.).

Upon completion of the examination, the staff member must imprint stamp on each received document. In this imprint, staff member needs to write the date of receipt, the classification code, the registry book number, the total number of received documents, the total amount of money or other values attached to the document.

Information about received and distributed documents is entered in the registry book. The registry book is based on the system of classification marks and registry book numbers. The classification mark is determined when registering the first document establishing the case, and the registry book number during the recording of a specific document. Registry book contains: a classification code, a brief description of the subject or a specific document, the name and the address of the sender, the registry book number of the document, the date of receipt of the document, the date of creation of the document, the mark of the internal organizational unit. The registry book is divided into nine units, according to the organizational units of the Department. Each unit is further divided according to the document type. The same structure of the registry book is listed below.

Registry book number consists of four parts:

2181 - 193	-	01 - 03	/	08	-	1
city and organisation mark		organisation unit and document type mark		year of creation		document ordinary number

Classification mark consists of four parts:

602 - 04	/	08	-	04	-	5468
classification by content		year of creation		classification by form		ordinary number or student ID

By analysing business processes, it was decided that the most appropriate solution would be to apply the organizational structure of the folders so that each of the organizational units represents the main folder within which subfolders are created depending on the type of documents. Such a solution is actually a copy of how the organization is currently working through a registry book that is implemented in a way that individual Excel workbooks represent organizational units and worksheets within an Excel workbook represent a certain document group.

In the same way, user groups could be defined, and each group (organizational unit) would have the appropriate access rights to their own part of the structure. In addition, a group of management members and persons with special roles in the organization could be created to provide insight into all documents of all organizational units.

3. Installation and Implementation of the Alfresco ECM

The Alfresco Community Edition software is available for download from the developer site www.alfresco.com. Alfresco offers two different content management user interfaces: Alfresco Explorer (<http://mysite/alfresco>) and Alfresco Share (<http://mysite/share>).

Alfresco Explorer is the core of a content management system. Explorer lets you browse the repository, set up rules and actions, and manage content and its metadata, associations, and classifications. Alfresco Explorer was built using Java Server Faces and is integrated into the content application server. It also has extensive capabilities for managing the repository as a system administrator tool.

Alfresco Share is a separate remote application which provides content management capabilities with simple user interfaces, tools to search and browse the repository, content such as thumbnails and associated metadata, previews using Flash renditions of content, and a set of collaboration tools such as Wikis, Discussions, and Blogs. Unlike Alfresco Explorer that is integrated into the Alfresco instance, Share can be installed on a remote computer and connect to a remote Alfresco repository. It is recommended that end users use the Share Interface, and the Explorer interface is more intended for system administrators. The interface is shown in Fig. 1.

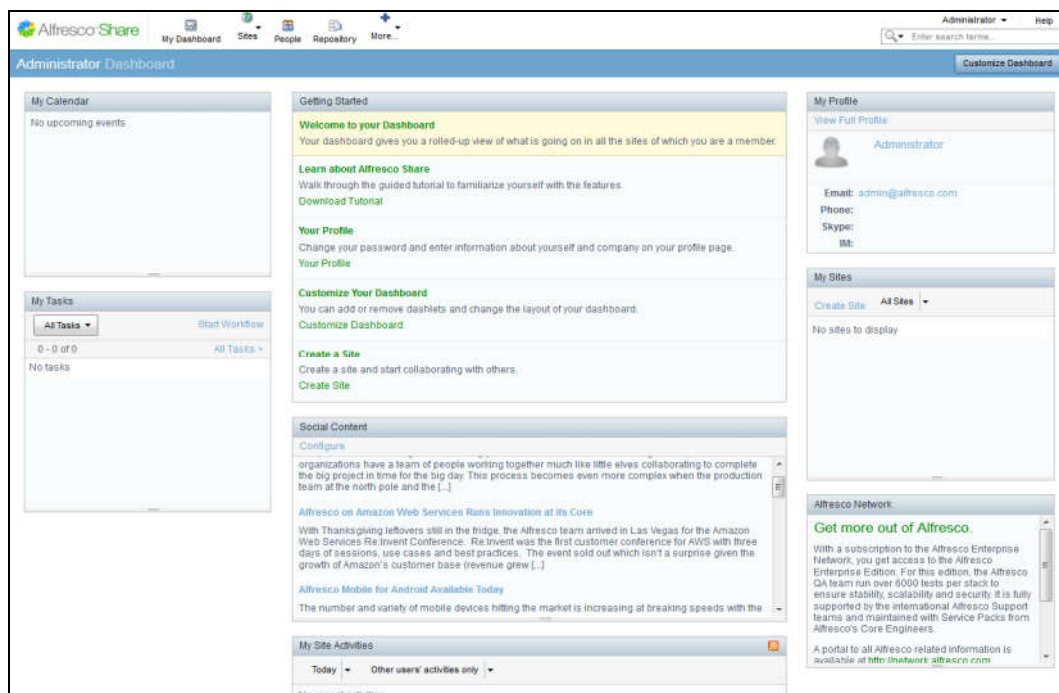


Figure 1 Alfresco administrator interface

By clicking the Customise dashboard button we can edit the interface layout, shown in Fig. 2.

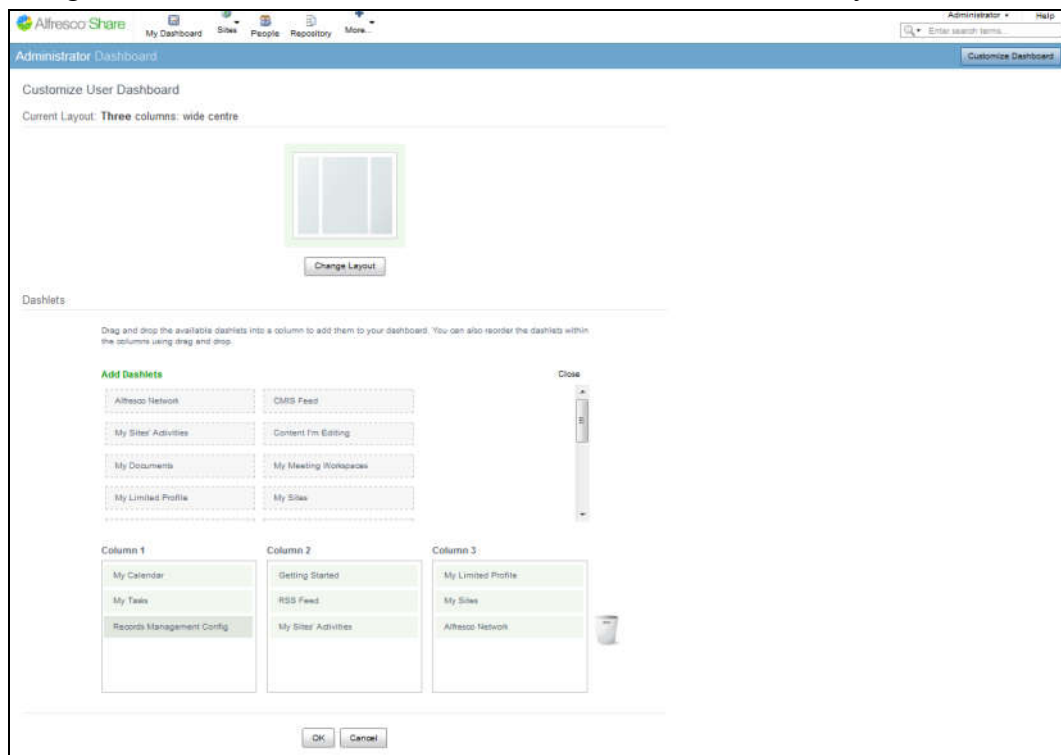


Figure 2 Changing the interface layout

Dashlets are Alfresco tools. Records Management Config dashlet needs to be enabled in order to manage records. The easiest way to manage user groups is via Share interface, as shown in Fig. 3. It is possible to add new users and groups or manage existing. In addition to the input of basic data, it is possible to limit available disk space available for the user.

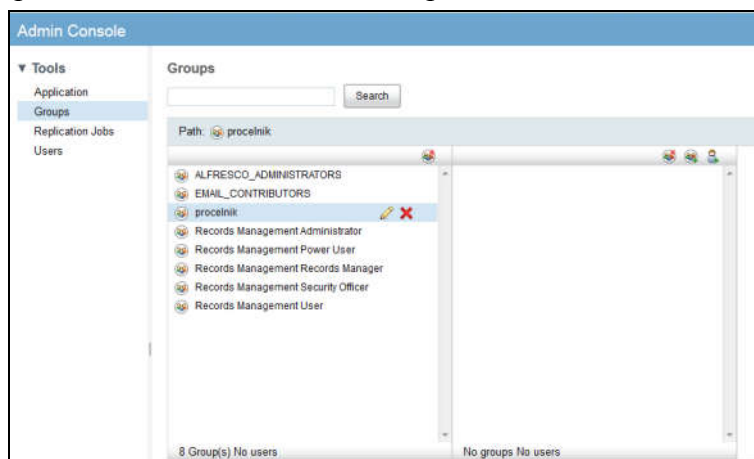


Figure 3 Creating users and groups

Sites are created within the repository and represent a virtual space for collaboration and resource sharing between users working on the same project or within the same organizational unit. The Site can be imagined as one folder of the repository in which page components are represented by different elements (wikis, blogs, documents, calendars, discussions, etc.). Site is created by selecting Sites -> Create Site on the My dashboard.

Figure 4 Creating site

After the page is created, the created page control panel opens and the address in the web browser changes to <http://127.0.0.1:8080/share/page/site/procelnik/dashboard>, as shown in Fig. 5.

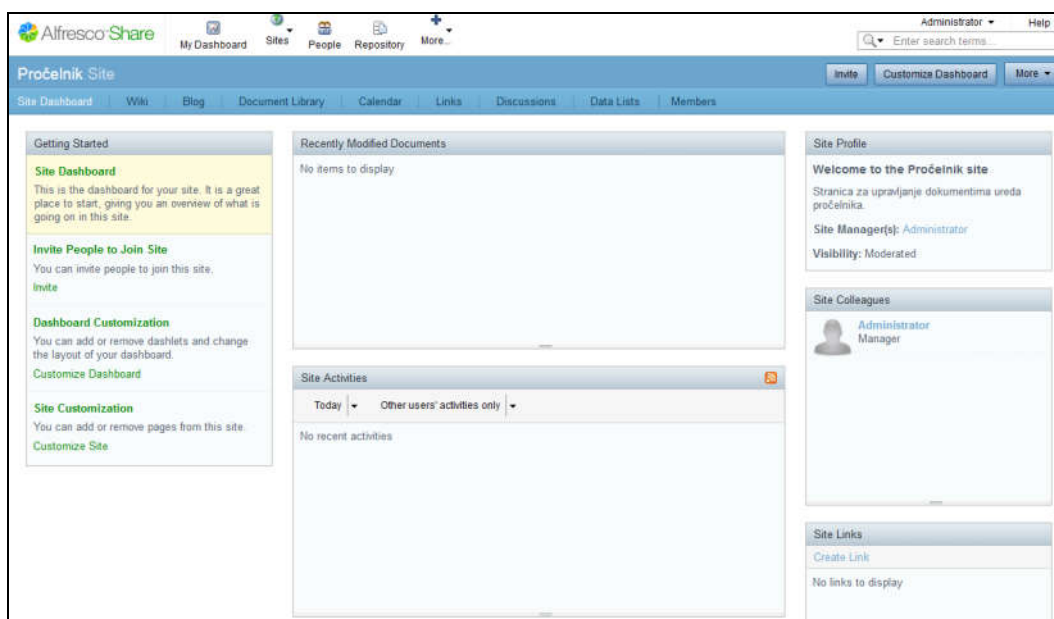


Figure 5 Site Control panel

User can customize the site interface, add participants, or transfer documents and content for collaboration. It is possible to send an invitation to the group or particular users, and select their role: Manager (full permissions), Collaborator (permission to add and edit), Contributor (permission to add), Consumer (read only). Users can request to join or leave the Site.

Document Library is the space within the page repositories where the hierarchy of document storage folders is placed, as shown in Fig. 6.

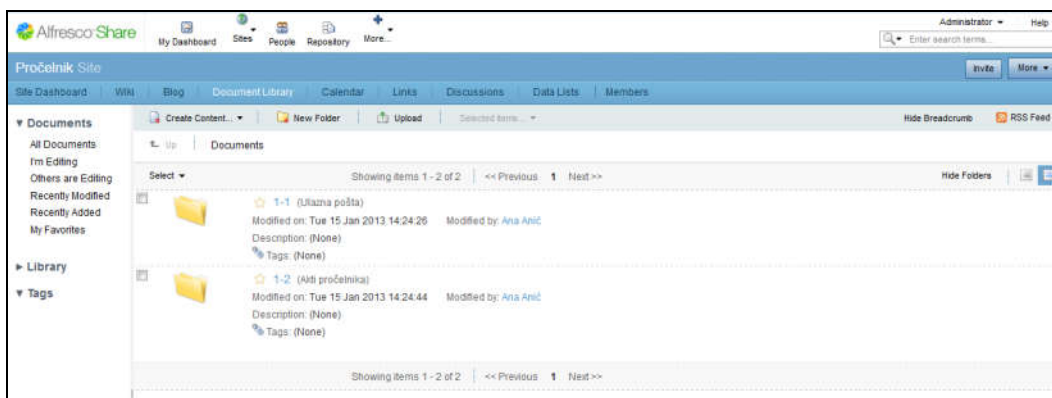


Figure 6 Document Library

At the level of each folder/file there are various administration options shown in Figs. 7. and 8.

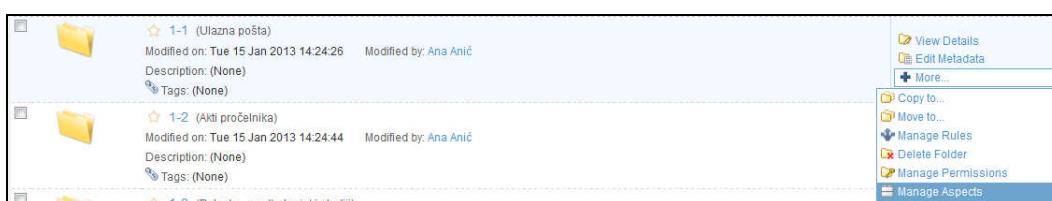


Figure 7 Folder administration options

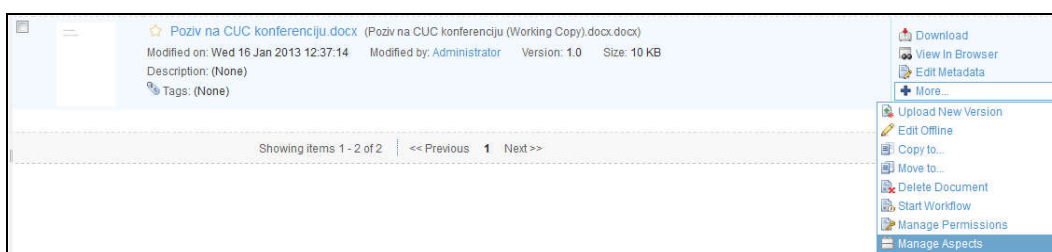


Figure 8 File administration options

Clicking on the document name displays all the properties of the selected document, available actions, versions, rights, workflows and comments, as well as a preview of the document itself, as shown in Fig. 9.

Site members with sufficient levels of rights can collaborate and work on the same documents as the system monitors all document events and automatically creates different versions of that document. User can see all versions of the document, with an option to download or revert to the desired version.

Another available option is using the workflow feature depicted in Fig. 10., to assign the document to another user for review. The first step is to select the Workflow type from the drop-down menu, then enter a message, possibly specify the date and priority of the task, and select the person for whom the task is intended.

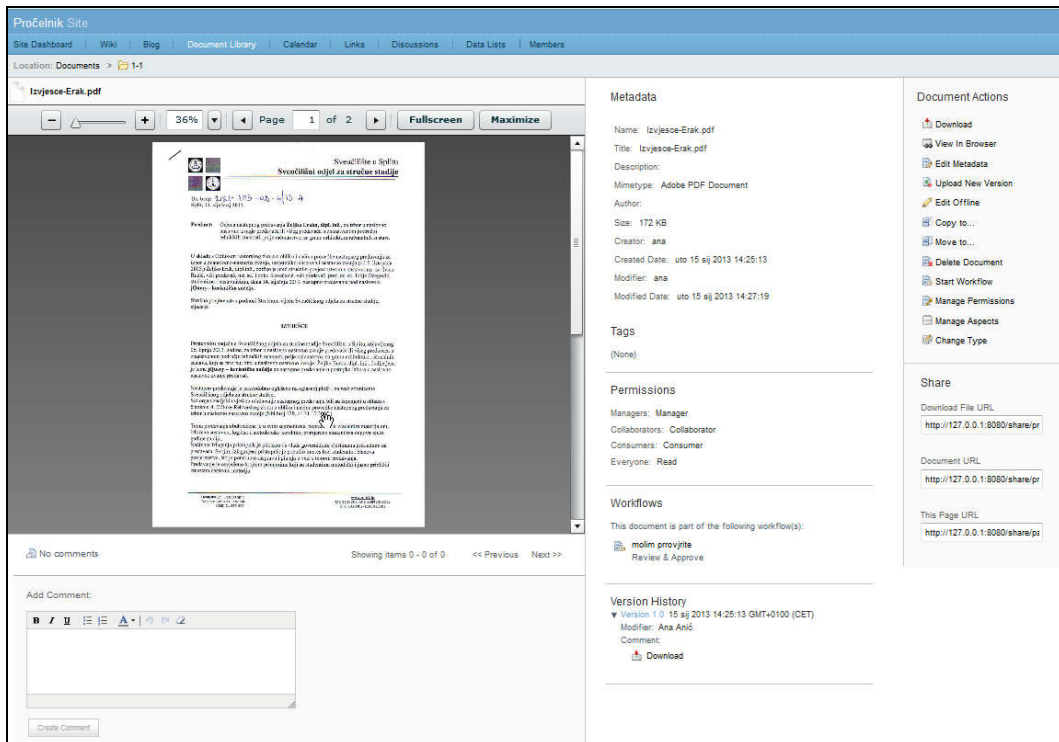


Figure 9 Document preview and options

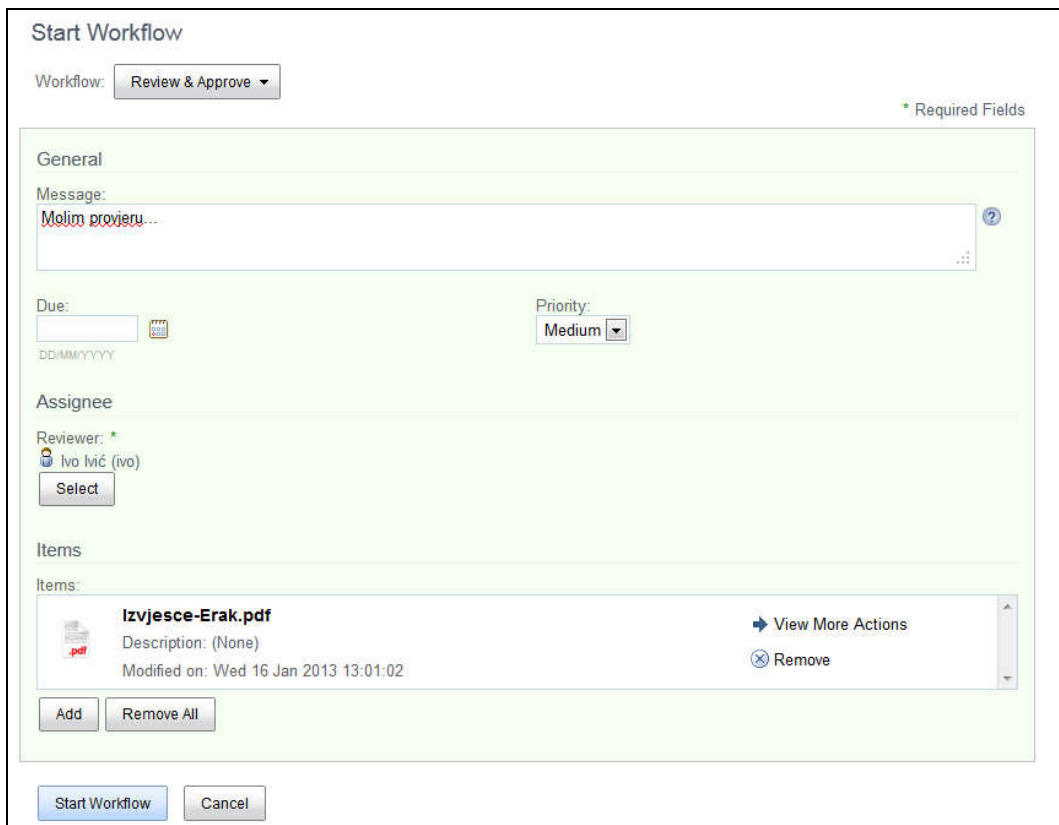


Figure 10 Workflow window

When the specified user logs in to the system, this task will be located among his tasks (My Tasks), as shown in Fig. 11.

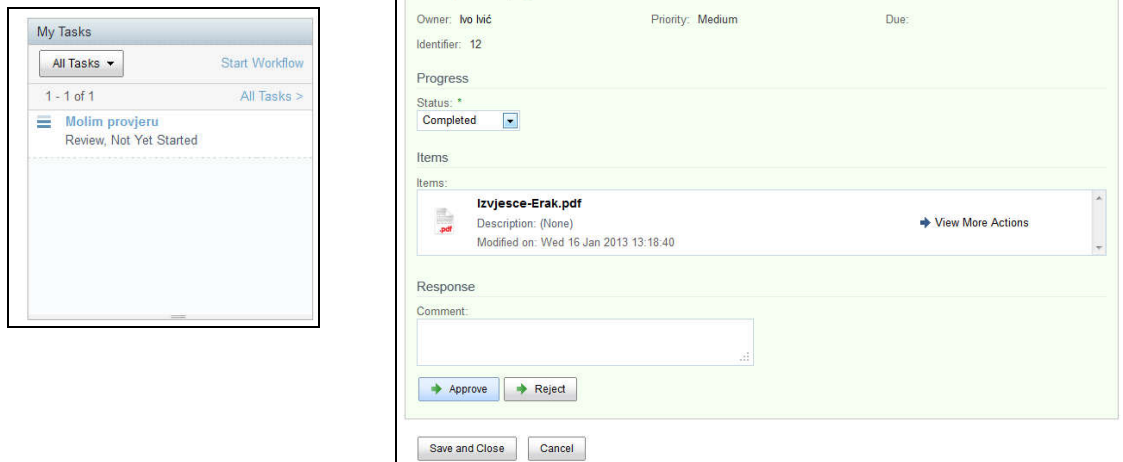


Figure 11 My Tasks

4. Record Management

The concept of record management does not only prescribe the procedures of recording and classifying the file, but should, according to the definition of the 1989 American Records Management Association (ARMA), "... systematic supervision of all files, starting with their creation or receipt, through processing, distribution, storage and search, to the decision about their ultimate destiny ". The records management module depicted in Fig. 12., is accessed through the Records Management tool that needs to be enabled in My Dashboard. Records Management consists of a tool, i.e. dashlet, which, like the other sites in the Share environment, can track different activities on the page. What this page differs from is the menu below the page title that, instead of various collaboration and document management tools, offers File Plan options, Records Search, and Members review.

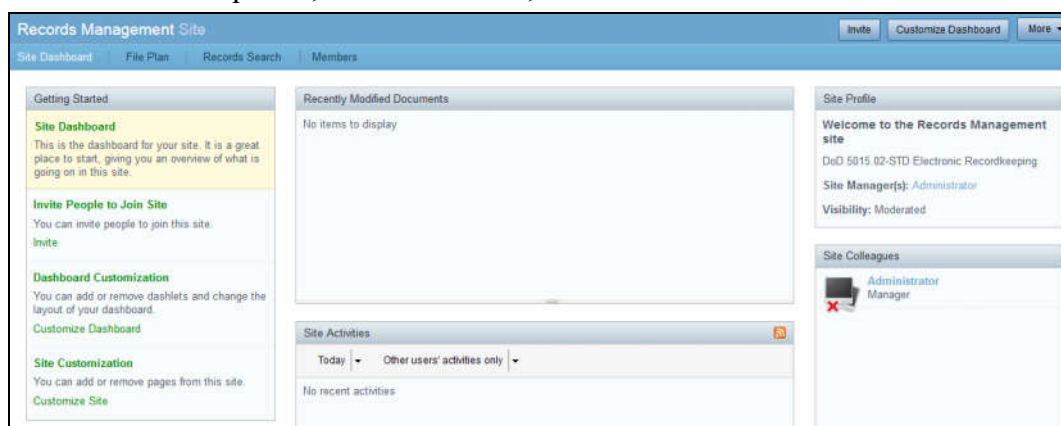


Figure 12 Records Management Site

File plan depicted in Fig. 13., represents the hierarchy of the records folder and is adapted to the DoD 5015.2 standard. First level maps are Series, second level folders represent Categories, and third level represents Folders in which records are stored. Records cannot be stored in any part of this hierarchy except in Folders.

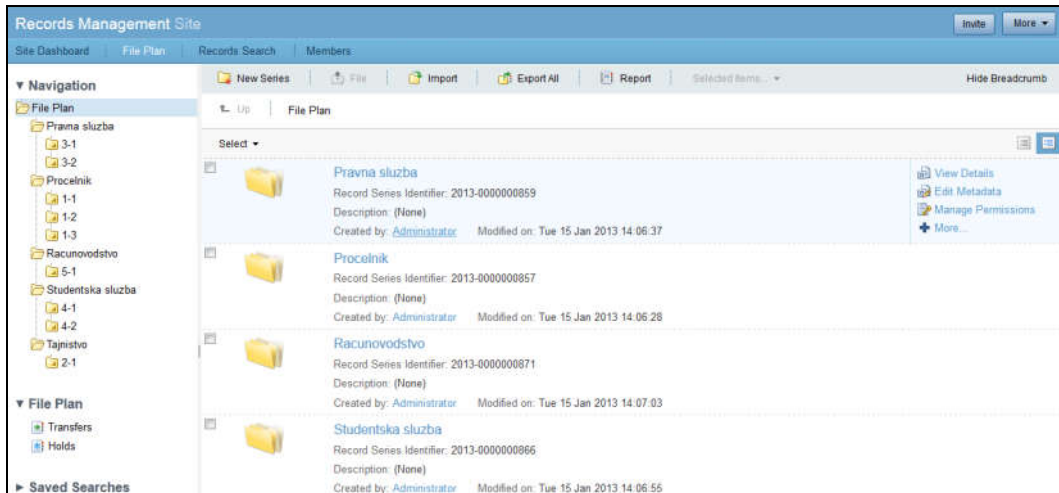


Figure 13 Records Management Site File Plan

Each of these series, categories, and folders has its own unique identifier, and it is also possible to define schedules and rules of disposition for the records they contain. When adding file to folder, system differs electronic or non-electronic record.

For an electronic record, it is necessary to select the type of record (default, scanned, pdf, image, and web) and upload the file. To load non-electronic records, it is necessary to enter metadata describing the physical location on which the record is located. After uploading the file, it is displayed in the folder but is still marked as an undeclared record until the necessary metadata is described.

Choosing the Records Search depicted in Fig 14., option from the menu below the page title, the window for entering the search conditions is open. From the drop-down menu, the metadata for which records will be searched need to be chosen.

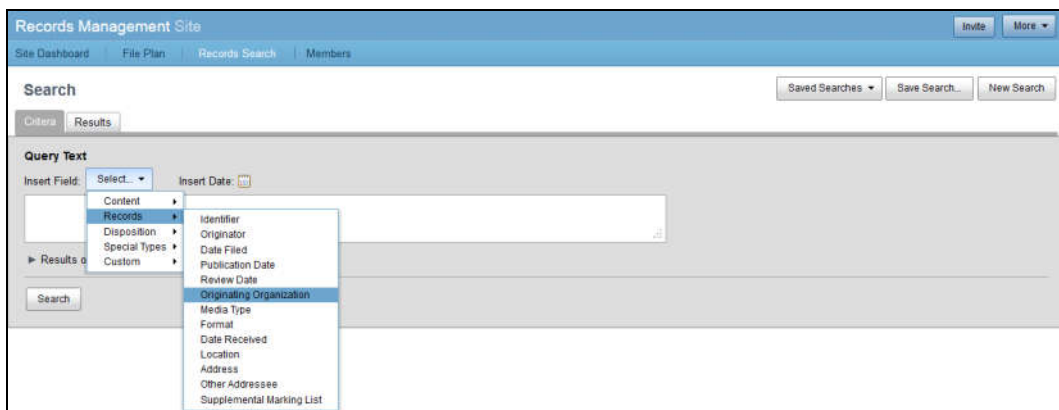


Figure 14 Searching Records

It is important to know that when a document is under the control of the EDRM system, the document can be changed and modified by authorized users, whereas a record cannot be changed or modified at all. A document becomes a record when that particular document is archived.

5. Conclusion

The growing volume, complexity and variety of digital content makes use of ECM application important element of University business. Alfresco is an open source content management system that helps in boosting document sharing, collaboration and more in an effective and efficient way. Alfresco supports document sharing, storage, workflows, and collaboration and

it is used as a publishing platform. Use of Alfresco ensures that every person knows what is to be expected and where a person concerned requires the input. Moreover, in a business, each of the employees is responsible for different tasks, and they usually end up carrying information in their heads or under a bundle of emails. By using Alfresco, such a problem is mitigated by ensuring that the information with each employee is stored in an accessible repository.

REFERENCES

- [1] Alalwan J.A., Weistroffer H.R. Enterprise content management research: a comprehensive review. *Journal of Enterprise Information Management* 2012;25:441–61. doi:10.1108/17410391211265133.
- [2] Tyrväinen P., Päivärinta T., Salminen A., Iivari J. Characterizing the evolving research on enterprise content management. *European Journal of Information Systems* 2006;15:627–34. doi:10.1057/palgrave.ejis.3000648.
- [3] Laumer S., Beimborn D., Maier C., Weinert C. Enterprise Content Management. *Business & Information Systems Engineering* 2013;5:449–52. doi:10.1007/s12599-013-0291-3.
- [4] Roszkiewicz R. Enterprise metadata management: How consolidation simplifies control. *Journal of Digital Asset Management* 2010;6:291–7. doi:10.1057/dam.2010.32.
- [5] Caruana D., editor. *Professional Alfresco: practical solutions for enterprise content management*. Indianapolis, IN: Wiley Pub; 2010.

Computer Customization and Protection in a Computer Classroom Using the Features of an Operating System

Marinko Lipovac

University of Split, University Department of Professional Studies, Split, Croatia
lipovac@oss.unist.hr

Siniša Zorica

University of Split, University Department of Professional Studies, Split, Croatia
szorica@oss.unist.hr

Lada Reić

University of Split, University Department of Professional Studies, Split, Croatia
lada@oss.unist.hr

Sandra Antunović Terzić

University of Split, University Department of Professional Studies, Split, Croatia
santunov@oss.unist.hr

Abstract. Computer protection issue in computer classrooms is very significant for the quality of teaching. It is necessary for the computers to perform well and be properly customized. Besides common hardware and software failures, computers can be vulnerable because of the large number of users, who, either on purpose or accidentally, delete system files, install unwanted software, visit websites infected with malwares etc.

There is certain commercial software that can remove this problem; the drawbacks are the lack of options for overall protection and computer customization as well as price (the price of the software proportionally grows with the number of computers in a classroom).

Microsoft had offered a free software for computer protection, called Windows Steady State; however, this software was not compatible with Windows 7 or later operating systems.

Even so, it is possible to protect and customize your computer if you know and understand well the Microsoft operating systems; you'll do that by customizing user profiles, customizing the settings of the operating system by using the console and defining the access rights to folders and files.

This approach enables the computers to look the same and to perform in the same way, which might be of a great help for the teacher himself/herself.

This paper aims at describing the way in which the computers at the University Department of Professional Studies have been customized and protected by using the operating system features, taking into consideration faults and problems that may occur during this process.

Key words: computer customization, access limitation, operating system features

1. Introduction

A computer is ready for use after certain steps had been taken: installing the operating system, customizing drivers, installing adequate programmes for performing exercises in a specified course. However, all these steps are not enough when we speak about multi-user systems where within a day a large number of users interchange. In order to have all computers with installed programmes customized in the same way for each user, it is necessary to do some

additional customizing. In this paper it will be explained how to perform the customization of a computer based on the properties of the operating system. The first part of the paper will be dealing with file and folder permissions in order to protect them from being deleted, accidentally or deliberately.

In the second part it will be discussed how to create new user accounts focusing on permissions and their capability of performing.

Mandatory user profiles will be explained in the third part of this paper. The purpose of these profiles is to customize computer back to default settings so that each new user can start working with the same profile.

As last, MMC (The Microsoft Management Console) as a system administration program that can act as a host application for a variety of tools will be rendered.

2. File and Folder Permissions

Permissions can be broken down into Access Control Lists with users and their corresponding rights. Here is an example with the user list at the top and the rights at the bottom (Figure 1):

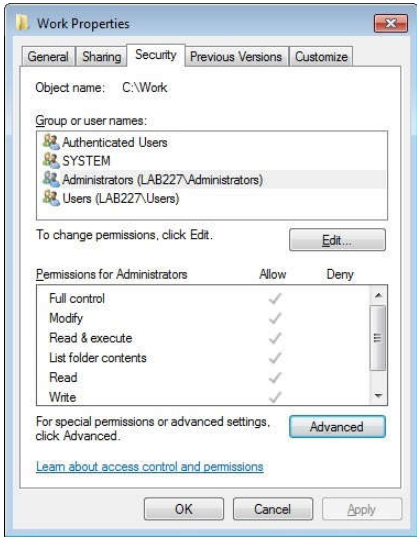


Figure 1 Working with basic permissions

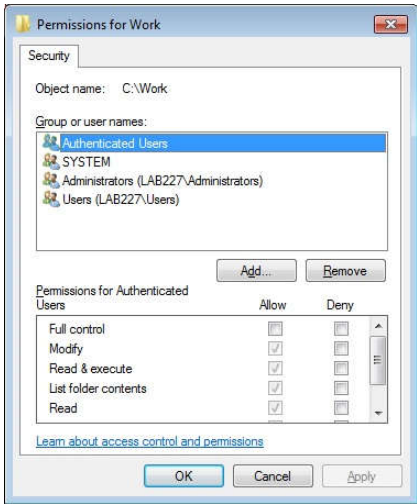


Figure 2 Setting individual basic permissions

Permissions are also either inherited or not. Normally in Windows every file or folder gets their permissions from the parent folder. This hierarchy keeps going all the way up to the root of the hard drive. The simplest permissions have at least three users: SYSTEM, currently logged in user account and the Administrators group [3, 4].

Note that if the permissions are greyed out, like in the example above, the permissions are being inherited from the containing folder.

2.1 Permission Types

There are basically six types of permissions in Windows: Full Control, Modify, Read & Execute, List Folder Contents, Read, and Write. List Folder Contents is the only permission that is exclusive to folders. There are more advanced attributes, but you'll never need to worry about those.

Table 1 Basic permission for files and folders

Permission	Meaning for Folders	Meaning for Files
Read	Permits viewing and listing of files and subfolders	Permit viewing or accessing of file's contents
Write	Permits adding of files and subfolders	Permit writing to file
Read & Execute	Permits viewing and listing of files and subfolders as well as executing of files; inherited by files and folders	Permits viewing and accessing of the file's contents as well as executing of the file
List Folder Content	Permits viewing and listing of files and subfolders as well as executing of files; inherited by folders only	N/A
Modify	Permits reading and writing of files and subfolders; allows deletion of the folder	Permits reading and writing of the file; allows deletion of the file
Full Control	Permits reading, writing, changing, and deleting of files and subfolders	Permits reading, writing, changing and deleting of the file

2.2 Viewing and modifying existing basic permissions

You can view or modify a file or folder's existing basic permissions by completing the following steps:

1. In Windows Explorer, right-click the file or folder you want to work with and then select Properties.
2. In the Properties dialog box, select the Security tab. As shown in Figure 1, the "Group or user names" list shows all users and groups with basic permissions for the selected file or folder. If you select a user or a group in this list, the assigned permissions are displayed in the "Permissions for Users" or "Permissions for Groups" list.
3. Before you can change or remove permissions, you must click Edit. This opens an editable view of the Security tab in a new dialog box (Figure 2).
4. Click the existing user or group whose permissions you want to modify.
5. To modify existing permissions, use the Allow and Deny columns in the "Permissions for Users" list. Select checkboxes in the Allow column to add permissions, and clear checkboxes to remove permissions.
6. To prevent a user or a group from using a permission, select the appropriate checkbox in the Deny column. Denied permissions have precedence over other permissions.
7. Click OK to save your changes.

2.3 Adding new basic permissions

You can add new basic permissions to a file or folder by completing the following steps:

1. In Windows Explorer, right-click the file or folder you want to work with and then select Properties.
2. In the Properties dialog box, select the Security tab. The "Group or user names" list shows all users and groups with basic permissions for the selected file or folder.
3. If a user or group whose permissions you want to assign isn't already listed, click Edit. This opens an editable view of the Security tab in a new dialog box.
4. Click Add to display the Select Users or Groups dialog box, shown in Figure 3.
5. Type the name of a user or a group account. Click Check Names and then do one of the following:

- If a single match is found for each entry, the dialog box is automatically updated as appropriate and the entry is underlined.
 - If multiple matches are found, you'll see an additional dialog box that allows you to select the name or names you want to use, and then click OK.
 - If no matches are found, you've probably entered an incorrect name. Modify the name in the Name Not Found dialog box and then click Check Names again.
6. Configure permissions for each user and group you added by selecting an account name and then allowing or denying access permissions as appropriate.
 7. Click OK to save your settings.

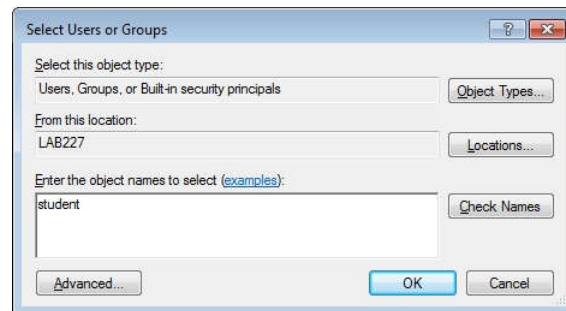


Figure 3 Select Users or Groups dialog box

2.4 Removing basic permissions

You can remove a user or group's basic permissions by following these steps:

1. In Windows Explorer, right-click the file or folder you want to work with and then select Properties.
2. In the Properties dialog box, select the Security tab. The "Group or user names" list shows all users and groups with basic permissions for the selected file or folder.
3. Click Edit to open an editable view of the Security tab in a new dialog box.
4. Click the existing user or group whose permissions you want to remove, and then click Remove.
5. Click OK to save your changes.

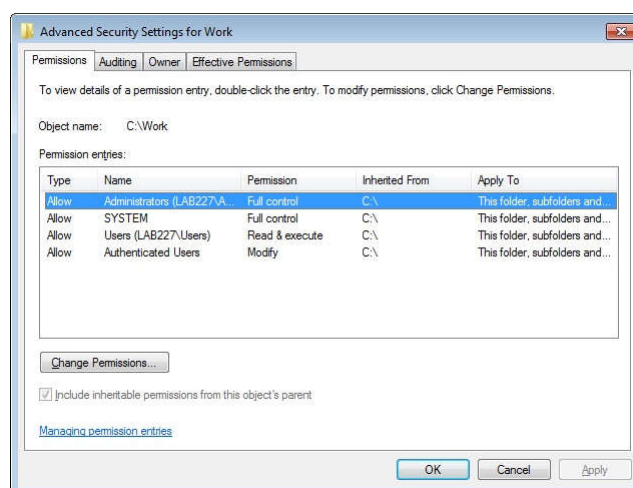


Figure 4 Select Users or Groups dialog box

2.5 Special Permissions

Each basic permission is actually a set of special permissions. Because of this, whenever you allow or deny a basic permission, Windows 7 works behind the scenes to manage the related special permissions for you.

In the Properties dialog box, select the Security tab and then click Advanced. In the "Advanced Security Settings for" dialog box, the permissions are presented much as they are on the Security tab. The key difference is that you now have additional advanced options (Figure 4).

3. User Accounts

The two main types of user accounts in Windows 7 are Standard User and Administrator [5].

3.1 Standard User Accounts

The default type of user account in Windows 7 is a standard user account. This account is designed to provide basic permissions for completing common daily tasks. It allows users to launch applications, create new documents, and modify basic system configuration settings. In general, these operations affect only the user who is logged on to Windows 7. They do not include system wide changes such as the installation of new software.

3.2 Administrator User Accounts

Accounts that have Administrator permissions have the capability of performing any operation or task on the system. This includes all of the permissions that are granted to a standard user account plus the ability to make major operating system changes, install new software, and create and modify other user accounts. Administrator accounts also have the ability to set permissions for other users on the system.

Windows 7 creates a default account called Administrator during the installation process. This account has full permissions on the system and is generally not designed for regular use. For this reason, the default Administrator account is disabled on new installations. For in-place upgrade installations of Windows 7, the setup process disables the built-in Administrator account only if there are other active Administrator accounts on the system. If there aren't any, the account remains enabled.

3.3 The Guest Account

A third type of account that is created with default Windows 7 installations is the Guest account. This account is designed for users who require temporary access to a computer and don't need to store their user-specific profile settings permanently. For example, if a friend is visiting your home and just needs to launch a Web browser to check her/his e-mail, you can allow her/him to use the Guest account. Users who log on as a guest have a very limited set of permissions. For example, they cannot access other users' files or perform systemwide tasks such as installing software or hardware.

For security reasons, the built-in Guest account is disabled by default. This prevents users from having an option to log on to the system as Guest.

3.4 Configuring Standard User Accounts

Your computer can, and probably should, have multiple user accounts configured as administrators. However, not everyone who logs on to your computer should be configured with an administrator account. Remember, anyone with administrator privileges can read any file on your computer and make changes to your computer's configuration. If you're in doubt as to whether a person needs an administrator account, create that account as a standard user account first. When he or she is trying to perform tasks that require administrator privileges and cannot, you should encourage the user to ask you for help. You can then type in your username and password to allow him or her to perform the task, or explain to the user why he or she shouldn't be trying to perform this type of task on your computer [7].

Before other people can log on to your computer, you'll need to create a user account for them. You can create a local user account on a computer by following these steps:

1. Click Start, Control Panel, User Accounts and Family Safety then Add or Remove Users Accounts.
2. On the "Choose the account you would like to change" page, you'll see a list of existing accounts on the computer. If an account has a password, it is listed as being password-protected. If an account is disabled, it is listed as being off.
3. Click "Create a new account." This displays the Create New Account page shown in Figure 5.
4. Type the name of the local account. This name is displayed on the Welcome screen and Start menu.
5. Set the type of account as either Standard user or Administrator.
6. Click Create Account.

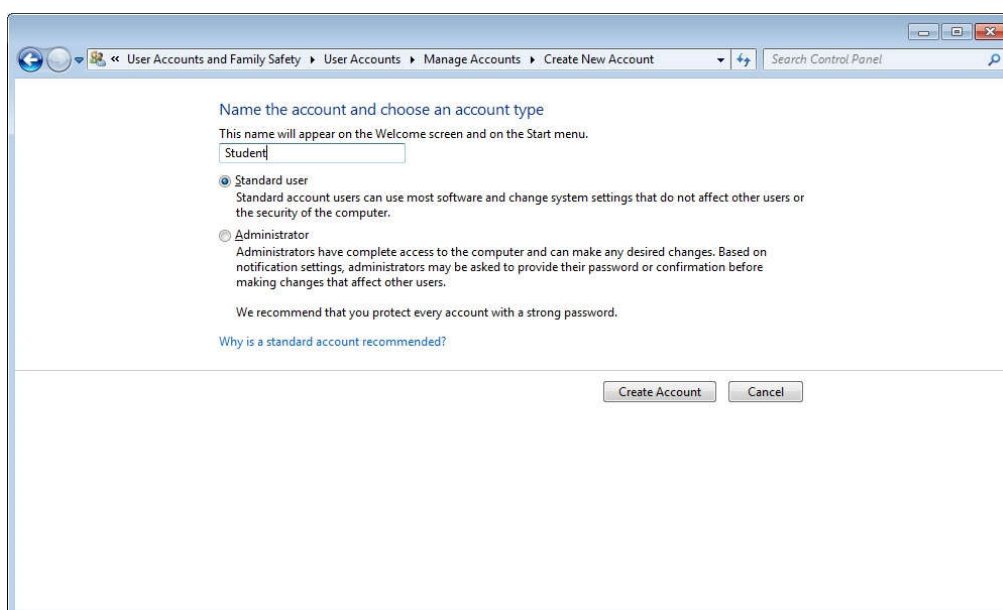


Figure 5 Select Users or Groups dialog box

Windows 7 will create a user profile and personal desktop for this user the first time he or she logs on to your computer.

4. Mandatory User Profiles

A mandatory user profile is a roaming user profile that has been pre-configured by an administrator to specify settings for users. Settings commonly defined in a mandatory profile include (but are not limited to): icons that appear on the desktop, desktop backgrounds, user preferences in Control Panel, printer selections, and more. Configuration changes made during a user's session that are normally saved to a roaming user profile are not saved when a mandatory user profile is assigned [2].

Mandatory user profiles are useful when standardization is important, such as on a kiosk device or in educational settings. Only system administrators can make changes to mandatory user profiles.

When the server that stores the mandatory profile is unavailable, such as when the user is not connected to the corporate network, users with mandatory profiles can sign in with the locally cached copy of the mandatory profile, if one exists. Otherwise, the user will be signed in with a temporary profile.

User profiles become mandatory profiles when the administrator renames the NTuser.dat file (the registry hive) of each user's profile in the file system of the profile server from NTuser.dat to NTuser.man. The .man extension causes the user profile to be a read-only profile.

4.1 Profile extension for each Windows version

The name of the folder in which you store the mandatory profile must use the correct extension for the operating system it will be applied to. The following table lists (Table 2) the correct extension for each operating system version.

Table 2 Correct extension for each operating system version

Client operating system version	Server operating system version	Profile extension
Windows XP	Windows Server 2003 Windows Server 2003 R2	none
Windows Vista Windows 7	Windows Server 2008 Windows Server 2008 R2	v2
Windows 8	Windows Server 2012	v3
Windows 8.1	Windows Server 2012 R2	v4
Windows 10, versions 1507 and 1511	N/A	v5
Windows 10, version 1607 (Anniversary Update) and version 1703 (Creators Update)	Windows Server 2016	v6

4.2 Creating a Mandatory User Profile

The first step to creating a mandatory user profile is to create a default user profile. The section titled Configuring Standard User Accounts describes how to create a default user profile. You must create a folder for the mandatory user profile and configure its permissions so that everyone can access it. Then you copy the default user profile to the mandatory user profile folder [6].

Windows 7 recognizes a mandatory user profile that is based on the name of the registry hive file. Each user profile contains a registry hive file named Ntuser.dat, which contains the user's registry settings. Renaming it to Ntuser.man causes Windows 7 to make the user profile mandatory.

To create a mandatory user profile

1. Copy the default user profile that you created in Configuring Standard User Accounts to C:\Users on the shared computer.
2. Rename the folder Mandatory.v2. (The root part of the file name can be anything you like, but the folder name must end with ".v2" to identify it as a Windows 7 user profile folder.)
3. Use the following procedure to rename Ntuser.dat to Ntuser.man:
 - Open C:\Users\Mandatory.v2 in Windows Explorer.
 - In Windows Explorer, click Organize, and then click Folder and search options.
 - On the View tab, select the Show hidden files and folders check box, clear the Hide protected operating system files check box, click Yes to confirm that you want to show operating system files, and then click OK to save your changes.
 - Rename Ntuser.dat to Ntuser.man. Figure 6 shows what this should look like in Windows Explorer with hidden files showing.

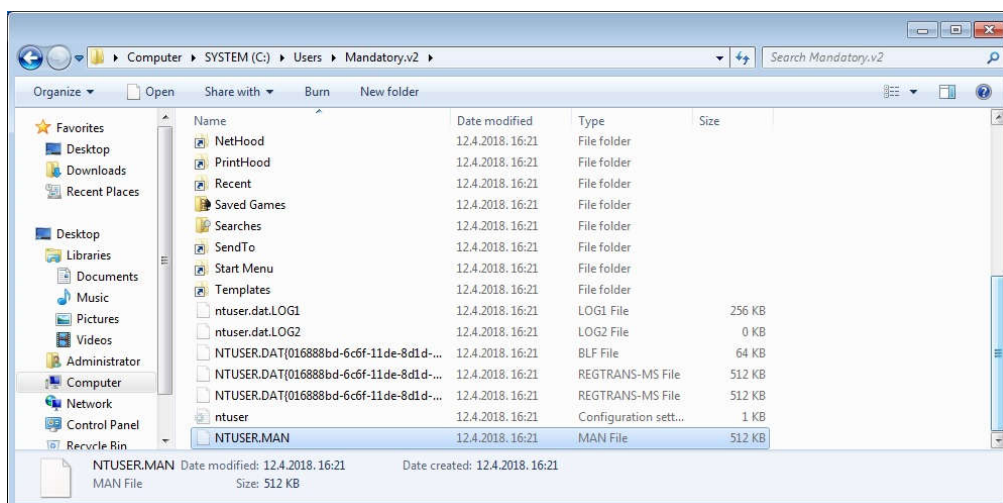


Figure 6 Preparing a mandatory user profile

5. Microsoft Management Console (MMC)

The Microsoft Management Console (MMC) is a system administration program that can act as a host application for a variety of tools. The advantage of MMC is that it displays each tool as a console, a two-pane view that has a tree-like hierarchy in the left pane (this is called the tree pane) and a taskpad in the right pane that shows the contents of each branch (this is called the results pane). This gives each tool a similar interface, which makes it easier to use the tools. You can also customize the console view in a number of ways, create custom taskpad views and save a particular set of tools to reuse later. These tools are called snap-ins because you can "snap them in" (that is, attach them) as nodes to the console root [1, 2].

5.1 Reviewing the Windows 7 Snap-Ins

When you work with the MMC interface, what you're really doing is editing a Microsoft Common Console Document, a .msc file that stores one or more snap-ins, the console view and the taskpad view used by each snap-in branch. You learn how to create custom MSC files in this section, but you should know that Windows 7 comes with a large number of predefined MSC snap-ins, and I've summarized them in the table below.

5.2 Launching the MMC

To get the MMC onscreen, you have two choices:

- To start with a blank console, select Start, type mmc, and then press Enter.
- To start with an existing snap-in, select Start, type the name of the .msc file you want to load (see table 3), and then press Enter.

Table 3 Default Windows 7 Snap-Ins

Snap-In	File	Description
Active X Control	N/A	Launches the Insert ActiveX Control Wizard, which enables you to choose an ActiveX control to display as a node. I haven't been able to find a good use for this one yet!
Authorization Manager	azman.msc	Used by developers to set permissions on applications.
Certificates	certmgr.msc	Enables you to browse the security certificates on your system.
Component Services	comexp.msc	Enables you to view and work with Component Object Model (COM) services.

Snap-In	File	Description
Computer Management	compmgmt.msc	Contains a number of snap-ins for managing various aspects of Windows 7. You can examine hidden and visible shared folders, set group policies, access Device Manager, manage hard disks, and much more.
Device Manager	devmgmt.msc	Enables you to add and manage your system hardware.
Disk Management	diskmgmt.msc	Enables you to view and manage all the disk drives on your system.
Event Viewer	eventvwr.msc	Enables you to view the Windows 7 event logs.
Folder	N/A	Enables you to add a folder node to the root to help you organize your nodes.
Group Policy Object Editor	gpedit.msc	Enables you to work with group policies.
IP Security Monitor	N/A	Enables you to monitor Internet Protocol (IP) security settings.
IP Security Policy Management	N/A	Enables you to create IP Security (IPSec) policies.
Link to Web Address	N/A	Adds a node that displays the contents of a specified web page.
Local Users and Groups	lusrmgr.msc	Enables you to add, modify, and delete user accounts.
NAP Client Configuration	napclcfg.msc	Enables you to configure Network Access Protection (NAP) for a computer.
Performance Monitor	perfmon.msc	Enables you to monitor one or more performance counters.
Print Management	printmanagement.msc	Enables you to view and manage either local printers or network print servers.
Resultant Set of Policy	rsop.msc	Shows the applied group policies for the current user.
Security Configuration and Analysis	N/A	Enables you to open an existing security database, or build a new security database based on a security template you create using the Security Templates snap-in.
Security Templates	N/A	Enables you to create a security template where you enable and configure one or more security-related policies.
Services	services.msc	Enables you to start, stop, enable, and disable services.
Shared Folders	fsmgmt.msc	Enables you to monitor activity on your shared folders.
Task Scheduler	taskschd.msc	Enables you to schedule programs, scripts, and other items to run on a schedule.
TPM Management	tpm.msc	Enables you to configure a work with Trusted Platform Module (TPM) security devices.
Windows Firewall with Advanced Security	wf.msc	Presents an advanced Windows Firewall interface.
WMI Control	wmimgmt.msc	Enables you to configure properties related to Windows Management Instrumentation.

5.3 Adding a Snap-In

You start building your console file by adding one or more snap-ins to the console root, which is the top-level MMC container. (Even if you loaded the MMC by launching an existing snap-in, you can still add more snap-ins to the console.) Here are the steps to follow:

1. Select File, Add/Remove Snap-In (or press Ctrl+M). The MMC displays the Add or Remove Snap-ins dialog box.
2. In the Available Snap-ins list, select the snap-in you want to use.
3. Click Add.
4. If the snap-in can work with remote computers, you see a dialog box. To have the snap-in manage a remote machine, select Another Computer, type the computer name in the text box, and then click Finish.

To use a snap-in with a remote computer, that machine must have remote administration enabled.

5. Repeat steps 2 to 4 to add other snap-ins to the console.
6. Click OK.

Figure 7 shows the MMC with a custom console consisting of several snap-ins and subfolders.

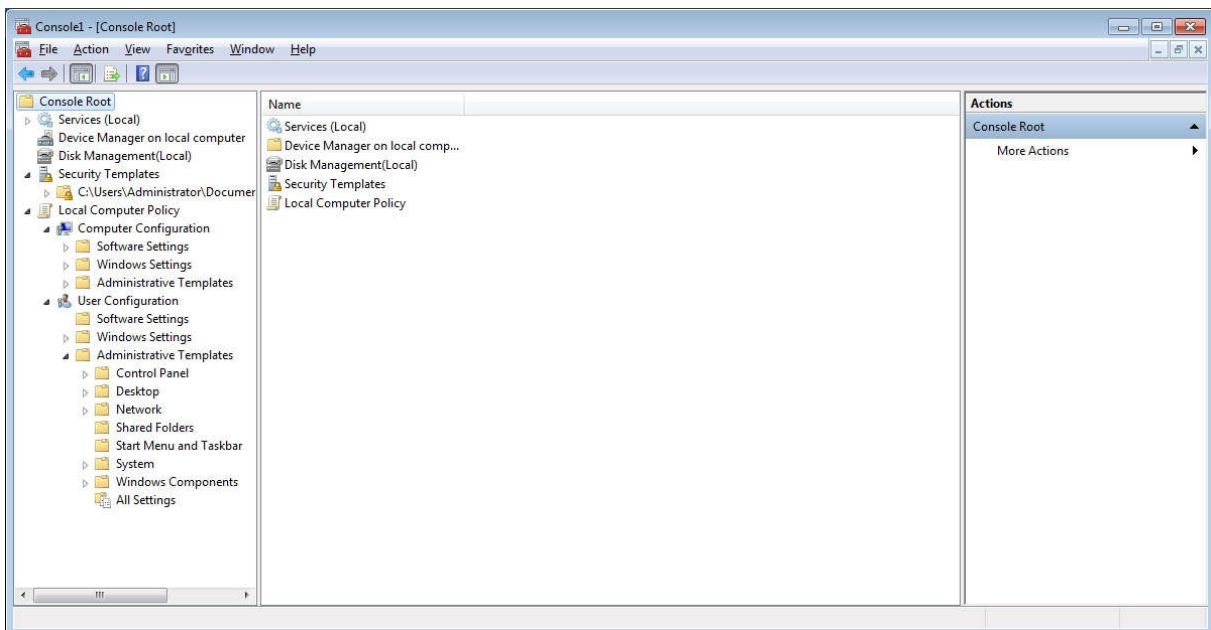


Figure 7 The MMC with a custom console

5.4 Saving a Console

If you think you want to reuse your custom console later on, you should save it to a .msc file. Here are the steps to follow:

1. Select File, Save (or press Ctrl+S) to open the Save As dialog box.
2. Type a filename for the console.
3. Select a location for the console file.
4. Click Save.

5.5 Creating a Custom Taskpad View

A taskpad view is a custom configuration of the MMC results (right) pane for a given snap-in. By default, the results pane shows a list of the snap-in's contents - for example, the list of categories and devices in the Device Manager snap-in and the list of installed services in the Services snap-in. However, you can customize this view with one or more tasks that run

commands defined by the snap-in, or any program or script that you specify. You can also control the size of the list, whether the list is displayed horizontally or vertically in the results pane, and more.

6. Skipping the Welcome Screen

If there are multiple user accounts, a welcome screen is shown at start-up of Windows, but sometimes it is practical if one of the user accounts is logged on automatically (without showing the welcome screen). Especially when the other user accounts are barely used, this can be very useful. To accomplish the automatic logon, start the Command Prompt (Start menu, All programs, Accessories, right click the shortcut and select Run as administrator) enter the command `control userpasswords2`, tab Users and deactivate the option Users must enter a user name and password to use this computer. In the next windows, specify the user account name and the password of the account to be logged on automatically.

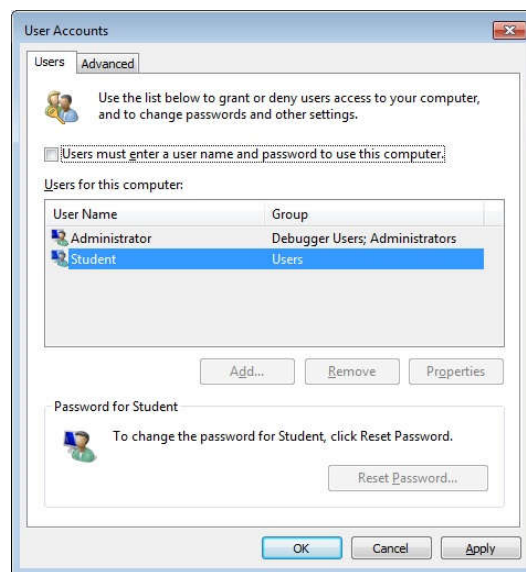


Figure 6 User Accounts

7. Conclusion

In laboratories with a large number of computers being used by many different users it is very important to maintain the stability of operating systems and softwares.

Nowadays, there are numerous commercial programs for that purpose. The problem is that it is a large investment for Universities. Fortunately, with some knowledge the user can protect a computer using Windows built in features.

The aim of this paper was to present the procedures for customizing and protecting computers based on the properties of the operating system. The experience in the last fifteen years has proved these procedures, primarily implemented on Windows 2000, Windows XP and Windows 7, to be very effective.

REFERENCES

- [1] Preppernau, Joan, and Joyce Cox. *Windows 7*. Microsoft Press, 2010.
- [2] Stanek, W. R. (2010). *Windows 7: The definitive guide*. Sebastopol, CA: O'Reilly.
- [3] Gibb, Taylor. "How to Understand Those Confusing Windows 7 File/Share Permissions." *How-To Geek*, How-To Geek, 17 Sept. 2016, www.howtogeek.com/72718/how-to-understand-those-confusing-windows-7-fileshare-permissions/.

- [4] Kishore, Aseem. "How to Set File and Folder Permissions in Windows." *Online Tech Tips*, Online Tech Tips, 13 Nov. 2015, www.online-tech-tips.com/computer-tips/set-file-folder-permissions-windows/.
- [5] Menno Schoone. "User Accounts in Windows 7." *Setting up User Accounts in Windows 7*, www.optimizingpc.com/windows7/windows_7_multiple_useraccounts.html.
- [6] Meyer, Tara, and Aquent LLC. "Creating a Mandatory User Profile." *Microsoft Docs*, [docs.microsoft.com/en-us/previous-versions/windows/it-pro/windows-7/gg241183\(v=ws.10\)](https://docs.microsoft.com/en-us/previous-versions/windows/it-pro/windows-7/gg241183(v=ws.10)).
- [7] Meyer, Tara, and Aquent LLC. "Configuring Standard User Accounts." *Microsoft Docs*, [docs.microsoft.com/en-us/previous-versions/windows/it-pro/windows-7/gg241188\(v=ws.10\)](https://docs.microsoft.com/en-us/previous-versions/windows/it-pro/windows-7/gg241188(v=ws.10)).

Migrating User Data to a New Debian Server

Mirko Lovričević

University of Split, University Department for Professional Studies, Split, Croatia
mirko.lovricevic@oss.unist.hr

Abstract. This paper presents the installation and configuration of a new server with the latest Debian operating system and user data migration from an old server with all functionalities and minimum unavailability of services such as e-mail.

Long-term security and version updates as well as updates of the complete operating system usually bring quite many differences of system and configuration files. The result is a quite large number of obsolete or just unnecessary, not deleted files, as well as unneeded packages. All stated can slow the server down or even present security risks. The solution is an installation of a new server with all the latest needed applications, its configuration, and finally user data migration. The old server is working until the last moment. Finally, the old server is turned off and the new one is put in the production state. This action is measured in minutes so unavailability of critical services such as e-mail is also measured in minutes. After the procedure the users will notice an increase in server speed and the server's fresh installation guarantees error free operation and much lower security risks. At the same time the old files are not deleted which is important in case the old server should, if necessary, be restored to fully functional state.

Keywords: *Debian, user data migration, server, configuration*

1. Introduction

Today it is very hard to imagine the world without web and mail. And majority of those services run on servers with Unix and Unix-like (i.e. Linux) operating systems. According to SecuritySpace, which provides the most comprehensive and detailed Internet Research Reports, in March 2018 46% of public world-wide web servers run Apache [1]. And more than 92% of those run on Linux distributions [2]. The numbers are even more shocking for mail, 98% of mail servers are running mail services originating from Unix and Unix-like operating systems (Exim, Postfix, Sendmail, MailEnable etc) [3].

The distribution which we chose a long time ago is Debian. It is one of the earliest systems based on Linux kernel with the first stable release made in 1996. Debian is known for its manifesto, social contract and policies, which result in open development and free distribution in the spirit of the GNU project [4]. That is why almost 29% of web servers running apache are Debian servers, not counting more than 70 Debian-based distributions [2]. The latest version, version 9 (code name Stretch) was released in June 2017.

Debian version upgrades usually are not too hard to perform because of Debian maintainers' careful planning and in-depth testing. The first Debian version installed on the server was version 3 (code name Woody). The server has been upgraded to all other versions since then with no problems and its hardware is still good for today's services. Big changes were introduced in version 8. For example, the controversial *systemd* became part of Debian and it changed the way the system initializes. Also, new versions of *apache*, *bind*, *php* and *mysql* were

introduced and it was time to choose between another upgrade or fresh installation of the latest Debian. The upgrade would probably work. Configuration files are fine but years old. And unneeded packages, leftover files, broken symlinks and other garbage can clutter the server, slow it down and present security risks. So, the decision was to install a fresh server and move user data.

2. Installation and Configuration of a New Server

The most practical way to install a fresh Debian server is by using network install image (ISO) which can be downloaded via Debian official release channel. It contains minimal amount of software to start the installation and the remaining packages are fetched over the internet. Installation can be started in "classic" (text-mode) or graphical mode. The only difference is the visual appearance (figure 1).



Figure 1 – installation start

The first steps of installation include choosing language, location, setting root password and adding the first user on the system. These are followed partitioning disk(s) and installing the base system. The next option allows the installation of collections of software, including web server, mail server and file server (figure 2).

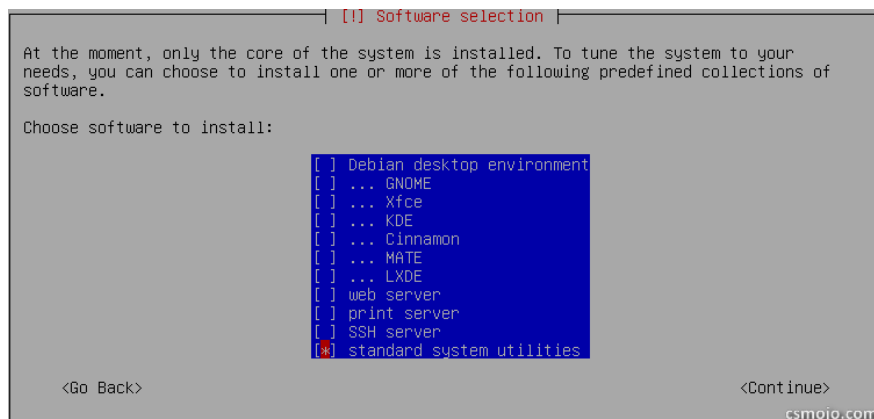


Figure 2 – Software selection in text-mode installation

In our case we chose only web server (*apache*) and ssh server (*openssh*). We did not include mail server because default packages are *exim4* (Mail Transfer Agent), *mutt* (Mail User Agent) and *procmail* (Mail Delivery Agent) which will be replaced with *dovecot* and *postfix*. Desktop environment (GUI) and print server are definitely not needed so they are left out. If needed, other collections of software can be chosen.

Important part of the installation process is setting the FQDN (hostname) of the server and it must be the same as FQDN of the old server. In order to allow mail to work on the old server until the new server is ready to be deployed, the IP address of the new server is different and we will not (re)configure DNS.

What needs to be done, as far as packages are concerned, is configure *apache*, *postfix* and *dovecot* and install and configure *mailman* if needed, as well as *squirrelmail* and *mysql* or some other webmail and/or database package with the proper certificates (this is beyond the scope of this paper).

3. Creating Users On the New Server

After we finish configuring all needed software, it is time to prepare users on the new server. Users on Debian (and Linux, in general) are defined in several files. The first one is */etc/passwd* which contains user account information such as login name, user ID (UID), group ID (GID), user name, home directory and user command interpreter. For example, the entry for user *root* in this file looks like this:

```
root:x:0:0:root:/root:/bin/bash
```

We will copy this information of selected users from the old server to a new one. Bear in mind that we must not copy any users from *passwd* file with UID smaller than 1000 as these are system users. To print out users sorted by UID we can use the following command:

```
sort -n -t ':' -k3 /etc/passwd
```

This way we can easily choose needed users. Selected lines (i.e. users) can be copied into temporary file for inspection. Finished user's lines are then copied to the */etc/passwd* file on the new server.

The next file which needs our attention is */etc/shadow*. It contains encrypted user passwords, date of last password change, minimum and maximum password age, password warning and inactivity period and account expiration date. For a user *root* it can look like this:

```
root:some_encrypted_password:17352:0:99999:7:::
```

Once again, selected users can be copied to temporary file for inspection and editing and, once it is finished, to */etc/shadow* on the new server.

Groups and their members are defined in */etc/group* file and this file can also be sorted for easier managing with a similar command as before:

```
sort -n -t ':' -k3 /etc/group
```

Again, group IDs which are smaller than 1000 are system groups which we must not copy. We will copy only the needed groups to the same file on the new server.

Thus, the preparation of users on the new server is completed.

4. Moving User Data and Testing

User files are by default located in the `/home/` directory and their inbox is located in the `/var/mail/` directory. We must copy all those files to new server and we will use `rsync` command for transferring. `rsync` is a fast and extraordinarily versatile file copying tool which is used to copy locally, to/from another host over any remote shell, or to/from a remote `rsync` daemon. It has the ability to copy files to a remote computer together with ownership of files as well as keeping permissions. It is famous for its delta-transfer algorithm, which reduces the amount of data sent over the network by sending only the differences between the source files and the existing files in the destination [5]. We will use all of these capabilities.

In order to work with `rsync` we must break the rule which says that user `root` cannot connect to the server via `ssh`. This must be done in order to copy all user files with only a few commands as `root`. So, in `/etc/ssh/sshd_config` file we find and change the following line to look like this:

```
PermitRootLogin yes
```

After the change `ssh` daemon must be restarted with the command

```
service sshd restart
```

If there are users or user files we do not want to copy, we will list them in a separate file called `exclude_me`. It contains one directory or file per line with absolute path and can look something like this:

```
/home/user1  
/home/user2/test  
/home/user3/document.pdf
```

Finally, the command to copy user data from `/home` directory looks like this:

```
rsync -avz --delete --progress --exclude-from /root/exclude_me /home/-root@ip_address:/home
```

It must be executed on the old server with the following options meaning:

- `-avz` puts `rsync` in archive mode, compresses file data and increases verbosity
- `--delete` deletes extraneous files from destination directories
- `--progress` shows progress during the transfer
- `--exclude-from` reads `exclude_me` file from `/root` directory and does not copy listed files and directories
- `/home/` directory is what is being copied i.e. transferred
- `root` is user which will connect to remote (new) server – in general, the user must exist
- `@ip_address:/home` is destination path, it implies the new server with an IP address and destination directory

Archive mode implies several options (`-rlptgoD`) and, in short, it copies recursively and preserves permissions, modification times, groups, owners and special files. You can check the man page for details.

The execution of this command can take several hours, depending on the size of the copied `/home` directory.

Same goes for `/var/mail` directory, where user inboxes are located. We will use a different exclude file named `ex_inbox` since these are files (i.e. inboxes) of the users we will not migrate. The command looks like this:


```
rsync -avz --delete --progress --exclude-from /root/ex_inbox /var/mail/ root@ip_address:/var/mail
```

Options are the same, the only changes are source and destination paths and excluded inboxes. Also, if *squirrelmail* webmail is used, we have to copy user preferences and address books. We will use the third exclude file named *exclude_sq*:

```
rsync -avz --delete --progress --exclude-from /root/exclude_sq /var/lib/squirrelmail /  
root@ip_address:/var/lib/squirrelmail
```

The idea is to move all existing files and mails at once and then to repeat the commands several times during the following couple of days. This way we can allow some of the users to test if the mail on the new server works as it should. For instance, they can use webmail service with the new IP address.

The final step is to turn off the old server and deploy the new one. First, we have to stop mails from coming in and going out from the old server. We use the following commands:

```
service postfix stop
```

```
service dovecot stop
```

Then we repeat the commands for copying all user files and inboxes one final time. The commands should not take too long to execute because we copied most of the data on previous occasions.

Since it is very likely that there are some mailing lists configured on the old server, we have to copy *mailman* database and mails:

```
rsync -avz --delete --progress /etc/mailman root@ip_address:/etc
```

```
rsync -avz --delete --progress /var/lib/mailman root@ip_address:/var/lib
```

The exclude directive is missing from both commands since there is nothing to skip. Mail aliases, which are also used for mailing lists, are located in */etc/aliases/* file and should also be copied. After editing the file, we must execute *newaliases* command to initiate the alias database.

MySQL databases can be exported with *mysqldump* command, moved with *rsync* and imported back to new MySQL instance with *mysqldump*. On the old server we issue these two commands:

```
mysqldump -u root -p database_name > /var/backups/backup_database_name.sql
```

```
rsync -avz --delete --progress /var/backups/backup_database_name.sql /  
root@ip_address:/var/backups
```

And on the new server we import the databases by:

```
mysqldump -u root -p database_name < /var/backups/backup_database_name.sql
```

We shut down the old server (or unplug it from the network) and change the IP address on the new server to the one the old server had. As we did not change DNS configuration, this is how mails are routed to the new server. Since all users' data is already on the new server which is fully configured for mail and web service, users should now be able to use it as they did before. We will not start postfix and dovecot services on the old server.

The procedure is done leaving us to tweak the new server. For example, do not forget to set *PermitRootLogin no* option in */etc/ssh/sshd_config*.

The old server can be configured with the new IP address and plugged back on the network so the old files are available if needed. And if some major problems with the new server should emerge, the old server can be put back in production with a simple change of IP address and postfix and dovecot start.

5. Conclusion

Debian is a sturdy operating system which complies with Debian Free Software Guidelines (DFSG) [6]. More than 1200 developers make it run on 10 different architectures with more than 50.000 binary packages available for installation making it the largest software compilation [7; 8; 9]. Debian is proud of its stability and prompt security patches. Thus, it is not surprising that this Linux distribution was the first choice.

Unneeded packages and leftover files can present security risks and slow the server down. After years of upgrading this was not an option. Fresh install of Debian results in a clean, fast and secure server. Although moving user data to a new server may seem complicated, with Linux powerful commands it is quite easy, as are most operations on Linux. With careful planning of mail and web unavailability, the process will be almost completely transparent for users.

REFERENCES

- [1] https://w3techs.com/technologies/overview/operating_system/all (retrieved on 2018-04-10)
- [2] https://secure1.securityspace.com/s_survey/data/man.201803/apacheos.html (retrieved on 2018-04-10)
- [3] http://www.securityspace.com/s_survey/data/man.201803/mxsurvey.html (retrieved on 2018-04-10)
- [4] <https://en.wikipedia.org/wiki/Debian> (retrieved on 2018-03-28)
- [5] manual (man) page of rsync
- [6] <https://www.debian.org/doc/debian-policy> (retrieved on 2018-04-10)
- [7] <https://contributors.debian.org/> (retrieved on 2018-04-10)
- [8] <https://wiki.debian.org/Statistics> (retrieved on 2018-04-10)
- [9] Amor, J. J., Robles, G., Gonzalez-Barahona, J. M., & Carlos, J. (7). Measuring Lenny: the size of Debian 5.0.

Analytical and Numerical Simulations of Cylindrical Cup Deep Drawing for DC06 Sheet Sample

Vedrana Cvitanić, Ivana Dumanić, Maja Kovačić

Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture,
University of Split, Ruđera Boškovića 32, 21 000 Split, Croatia
vcvit@fesb.hr, iduman00@fesb.hr, majkovac@fesb.hr

Mohsen Safaei

XL Systems, National Oilwell Varco, Houston, Texas, USA
matt.safaei@nov.com

Abstract. Generally speaking, all sheet metals demonstrate some degree of anisotropic plastic behavior. In cylindrical cup deep drawing process, this anisotropic behavior results in undesirable appearance on the top cup edge called earing. The optimization of cylindrical cup deep drawing process includes reduction of this undesired effect. For this purpose, numerical and analytical simulations of the cup drawing process can be of great importance. Numerous experimental, numerical and analytical studies indicate that the cup earing profile is closely related to the directional dependence of the plastic strain ratio called Lankford coefficient obtained in the uniaxial tensile testing of the sheet specimens with different orientations to the sheet rolling direction. In this paper, the cylindrical cup deep drawing process of DC06 steel sheet sample is simulated by the simple analytical approach and by the finite element program ADINA. Both adopted approaches utilize the experimentally determined directional dependence of the Lankford coefficient as input data. According to the standards, Lankford coefficient can be considered as a constant or as an incremental value depended on the strain accumulated during tensile test. Based to the available data for the considered material, analytical and numerical simulations are performed using the directional dependence of the constant Lankford coefficients and using the directional dependence of the instantaneous Lankford coefficients corresponding to the certain amount of the equivalent plastic strain. The obtained cup profiles are compared with the experimental data. By comparison, capabilities of the analyzed analytical and numerical models in predicting considered forming process are estimated.

Key words: *sheet metals, deep drawing, constitutive modelling, Lankford coefficient, anisotropy*

1. Introduction

Cup deep drawing is a sheet metal forming process in which an initially flat sheet, usually constrained by a blank-holder, is forced into a die by a punch to form the final cup shape product. This forming process is used for the mass production of cup shape components in various industries such as packaging, automotive and household articles. In cup deep drawing processes, numerous defects might appear such as earing, wrinkling, tearing, thinning, cracking and drawing grooves. In cylindrical cup deep drawing process, in which a cylindrical cup is drawn from a blank sheet, the earing is the most frequent undesirable phenomena. The earing is formation of a wavy edge on the top of drawn cup as presented at Figure 1. This defect requires additional trimming in order to produce a cup with uniform height. In order to reduce production and material costs and to achieve uniformity of mechanical properties of the drawn cup, optimization of the drawing process for earing minimization is required. In optimization of drawing process, analytical and numerical predictions of the process can be of

great importance. For instance, Nadga et al. [1] performed numerical simulations of the cylindrical cup drawing process for the steel sheet sample by considering modified initial blank shapes. Han et al. [2] considered optimization of the process for the aluminum sheet by performing numerical simulations in which force on the blank-holder surface was distributed circumferentially region by region. These numerical studies clearly indicate that earing reduction can be achieved by modification of blank shape or/and by non-uniform distribution of blank-holder force.

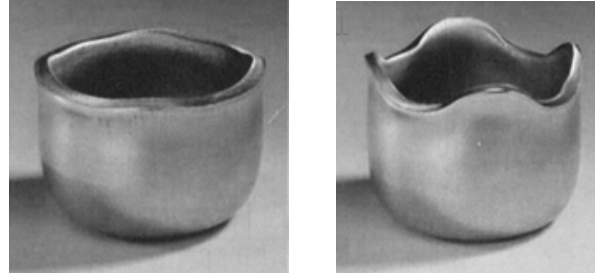


Figure 1 Drawn cylindrical cups with ears

All sheet metals demonstrate a certain initial plastic anisotropy mainly due to the crystallographic texture caused by production rolling steps. Consequently, by uniaxial tensile testing of sheet specimens with different orientations to the rolling direction, directional dependence of plastic mechanical properties such as yield stress and Lankford coefficient can be observed. Lankford coefficient is often utilized as a measure of the sheet anisotropy in plastic flow and it is defined as the ratio of plastic strain increments in specimen's transverse and thickness direction. According to standards it can be calculated as a constant value or as an incremental value depended on the strain accumulated during the tensile test.

Anisotropy is the fundamental reason for earing profile in deep drawn cups. Therefore, analytical/numerical model that is applied in predicting cup deep drawing processes should be based on the reliable anisotropic plasticity constitutive model. Among previously mentioned studies, numerous phenomenological anisotropic plasticity constitutive models have been tested in numerical simulations of cylindrical cup deep drawing processes (for instance [3], [4], [5]). Generally, these models are based on the various settings related to the representation of yield surface and plastic flow and they are calibrated by different numbers of yield stresses and/or constant Lankford coefficients obtained in tensile testing of sheet specimens with different orientations. These numerical studies clearly indicate that the predicted earing profile is strongly correlated to predicted directional dependences of uniaxial yield stresses/Lankford coefficients. In fact, it can be stated that the predicted earing profile (location of peaks and valleys) can be considered as the mirror image of predicted Lankford coefficient trend with respect to the transverse direction, and that the prediction of earing profile amplitude (the maximum difference in cup heights) is correlated to the prediction of yield stress anisotropy amplitude.

In this paper, analytical and numerical simulations of cylindrical cup deep drawing for DC06 sheet steel sample are performed. Based on the available data for the analyzed sample, Lankford coefficient is considered as a constant value and as an instantaneous value depended on the equivalent plastic strain. The simulations of the process are performed using constant or instantaneous values of Lankford coefficient in model calibration and results of simulations are compared to the experimental data. By comparison, influence of Lankford coefficients on the final cup predictions is analyzed. The paper is organized as follows. In Section 2, directional dependences of constant and instantaneous Lankford coefficients are presented. In Section 3, short description of the adopted analytical approach is provided. The basic

preferences of the adopted numerical model and comparison of analytical and numerical predictions with experimental cup profile are presented in Section 4.

2. Lankford Coefficient for DC06 Steel Sheet

Lankford coefficient (plastic strain ratio, r -value) is defined as the ratio of true plastic width strain and true plastic thickness strain in a test specimen subjected to uniaxial tensile test. In the incremental form, r -value can be written as

$$r = \frac{d\varepsilon_w^p}{d\varepsilon_t^p} = -\frac{d\varepsilon_w^p}{d\varepsilon_w^p + d\varepsilon_t^p} \quad (1)$$

where $d\varepsilon_l^p$, $d\varepsilon_w^p$ and $d\varepsilon_t^p$ are true plastic strain increments in specimen's longitudinal, transverse (width) and thickness direction, respectively. In the above equation, the plastic incompressibility condition ($d\varepsilon_l^p + d\varepsilon_w^p + d\varepsilon_t^p = 0$) is applied, since it is easier and more precise to measure changes in length than in thickness specimen direction.

According to standard BS ISO 10113:2006, r -value can be calculated based on the transverse true plastic strain ε_w^p vs. longitudinal true plastic strain ε_l^p diagram obtained in the tensile test by two approaches illustrated in Figure 2. By these standard approaches, r -value is calculated using the slope of the linear regression of the strain diagram $m_r = d\varepsilon_w^p / d\varepsilon_l^p$ in the selected longitudinal strain range

$$r = -\frac{m_r}{1 + m_r} \quad (2)$$

By the first approach, linear regression through the origin (O) is applied to the whole measured longitudinal strain range. Therefore, by this approach r -value is considered as a constant value regardless to the accumulation of plastic strain during tensile test. By the second approach, linear regression through the origin (O) is applied for each longitudinal strain range (A) defined by lower (B) and upper strain limit (C). By this approach, r -value is considered as an incremental value altered by the continuation of deformation in tensile testing.

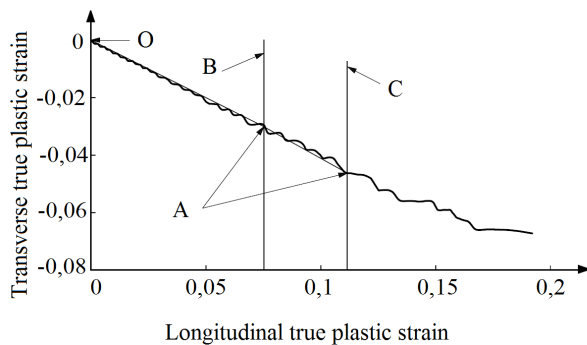


Figure 2 Illustration of standard approaches in calculating Lankford coefficient

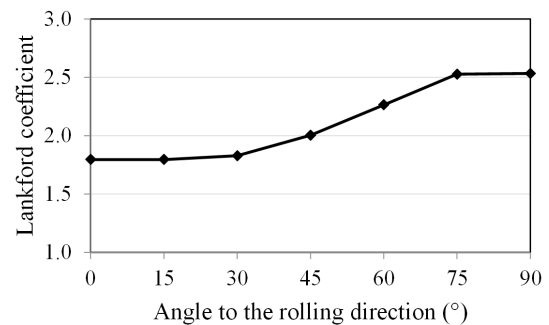


Figure 3 Directional dependence of constant Lankford coefficients

In this paper, constant and instantaneous r -values reported by Safaei et al. [6] for 0.8 mm thick DC06 steel sheet samples with different orientations to the rolling direction are utilized ($\theta = 0^\circ, 15^\circ, 30^\circ, 45^\circ, 60^\circ, 75^\circ, 90^\circ$). For each orientation, the constant r -value is calculated by using the slope of linear fit over the measured longitudinal strain range (0 – 0.3) in tensile

testing. Instantaneous r -values corresponding to the certain longitudinal true plastic strain ε_l^p are calculated using the slope of the 3rd order polynomial fit by which the experimental transverse and longitudinal true plastic strains are approximated. The strains in longitudinal and transverse directions were obtained using Digital Image Correlation (DIC) technique. This technique is suitable for full-field non-contact measurement of 3D deformations and enables reliable determination of r -values. A stochastic pattern of black and white speckles is applied to the tensile specimen's surface by spray painting. Software based on a dedicated image correlation algorithm is used to process the images recorded by two synchronized digital cameras. A considerable advantage of using DIC for deformation measurement as compared to a mechanical extensometer is that data can be extracted beyond the onset of necking. Another advantage is that strain can be calculated at any point or area within a large surface of the specimen during post-processing. Considering the DC06 deep drawing steel, localization of strain or diffuse necking occurs at approximately 0.2 longitudinal strain. The mechanical extensometer is practically inutile beyond this point. However, up to 0.8 longitudinal true strain was measured by DIC. This strain corresponds to failure of the tensile sample. The complete description of the tests and methods that were used in obtaining data utilized in this paper can be found in [6] and [7].

Constant r -values and parameters of the adopted 3rd order polynomial fit of the strain diagram for seven specimen orientations are provided in Table 1.

Table 1 Constant r -values and parameters of polynomial function* for DC06 sheet reported in [6]

θ	const. r -value	a	b	c	d
0°	1.794	-0.6763	0.1343	0.0174	0.0008
15°	1.794	-0.6619	0.0597	0.0941	0.0005
30°	1.827	-0.6606	0.0153	0.1404	0.0008
45°	2.003	-0.6808	0.0249	0.1241	0.0003
60°	2.263	-0.7102	0.0425	0.1070	0.0003
75°	2.526	-0.7309	0.0292	0.1243	0.0005
90°	2.532	-0.7277	0.0088	0.1459	0.0005

* $Poly3(\varepsilon_l^p) = a + b \cdot \varepsilon_l^p + c \cdot (\varepsilon_l^p)^2 + d \cdot (\varepsilon_l^p)^3$

The directional dependence of constant r -values is presented in Figure 3. It can be observed that directional dependence of constant r -values demonstrates one extreme value for the orientation 90°. Using the data presented in Table 1 and the data related to the hardening description for the each specimen presented in [6], following procedure based on the principle of plastic work equivalence, instantaneous r -values corresponding to the specific amount of the equivalent true plastic strain $\bar{\varepsilon}^p$ are calculated. In the adopted approach, longitudinal true plastic strain in the rolling direction ($\theta = 0^\circ$) is utilized as the equivalent true plastic strain. The calculated r -values for each specimen orientation corresponding to the selected equivalent plastic strain values are presented in Figure 4. Significant decrease of the instantaneous r -values with continuation of the straining in tensile test can be observed. Directional dependences of r -values corresponding to the selected equivalent plastic strains are presented in Figure 5. It can be observed that for lower values of equivalent plastic strain directional dependences of instantaneous r -values demonstrate two extreme values for orientations 0° and 75°. For greater values of equivalent plastic strain, similar to constant r -values directional dependence, directional dependences demonstrate one extreme for the orientation 90° but instantaneous r -values are lower than constant r -values.

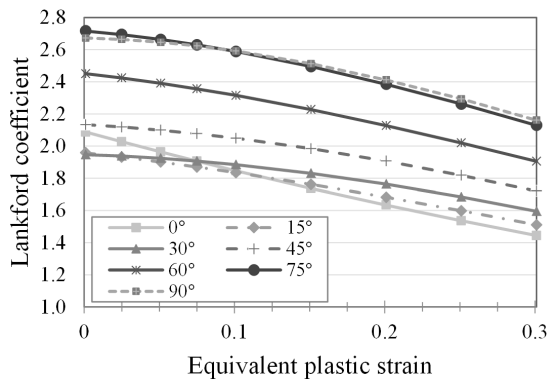


Figure 4 Lankford coefficient with respect to equivalent plastic strain for sheet specimens with different orientations

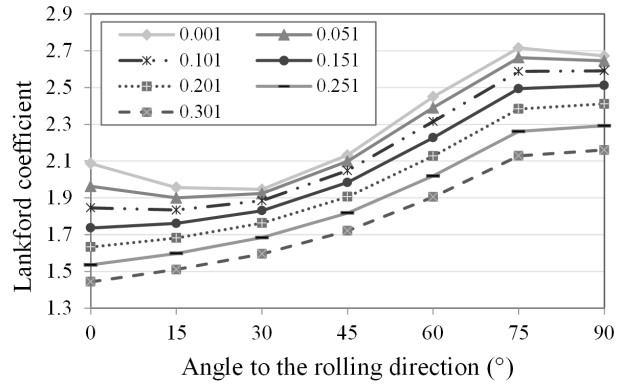


Figure 5 Lankford coefficient directional dependences corresponding to selected values of equivalent plastic strain

3. Analytical Approach to Predict Earing in a Drawn Cup

For the quick assessment of the earing profile, simple analytical approach proposed by Yoon et al. [8] can be utilized. According to their approach, a reasonable approximation of the earing profile can be obtained based only on the major geometry parameters of the process (initial blank and final cup geometry) and the r -value directional dependence. Short description of the adopted analytical approach is as follows.

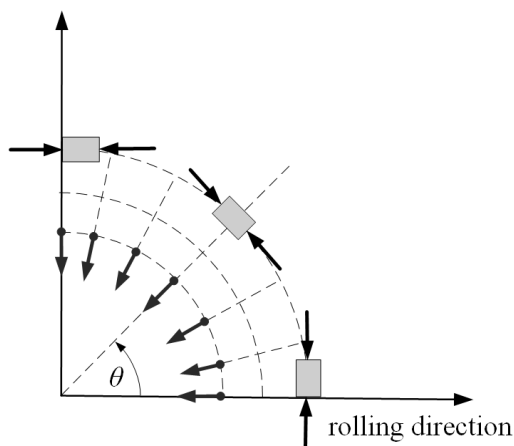


Figure 6 The elements in compression at rim

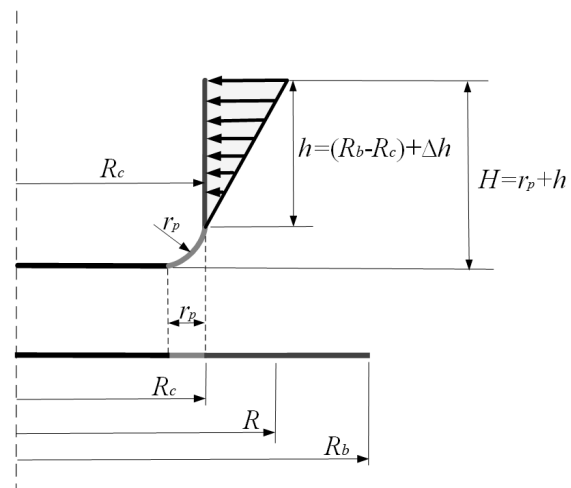


Figure 7 Initial blank and drawn cup

As presented in Figures 6 and 7, during the cup drawing process the part of blank between die and blank-holder can be considered as a ring whose inner edge is drawn into the die cavity. It is assumed that during the drawing process circular blank lines with initial radius R between cup radius R_c and blank radius R_b are continuously compressed to the final cup radius R_c . Considering the selected circular line at the ring it can be concluded that due to the planar anisotropy different radial strains can be generated circumferentially in the considered blank part. For the element at the specific circular line with orientation θ to the rolling direction, the relation between radial ε_r , circumferential ε_θ and thickness strain ε_t can be stated by considering r -value obtained in the compression test in the specimen's transverse direction $\theta + 90^\circ$ as follows

$$r_{\theta+90} = \frac{\varepsilon_r}{\varepsilon_t} = -\frac{\varepsilon_r}{\varepsilon_r + \varepsilon_\theta} \quad (3)$$

In the above equation, the incompressibility condition $\varepsilon_r + \varepsilon_\theta + \varepsilon_t = 0$ is applied and the elastic deformation part is neglected.

For the completely drawn cup, the circumferential strain in the cup wall is defined as

$$\varepsilon_\theta = \ln\left(\frac{R_c}{R}\right) \quad R_c \leq R \leq R_b \quad (4)$$

By using Eqs. (3) and (4), the radial strain of the element with the direction θ at the circular line with initial radius R can be obtained

$$\varepsilon_r|_\theta = -\frac{r_{\theta+90}}{(r_{\theta+90} + 1)} \ln\left(\frac{R_c}{R}\right) \quad (5)$$

Furthermore, it is assumed there is no sheet deformation at the flat punch head and the cup height increase can be calculated by integrating Eq. (5):

$$\Delta h_\theta = \int_{R_c}^{R_b} \varepsilon_r|_\theta dR = \frac{r_{\theta+90}}{(r_{\theta+90} + 1)} \left((R_c - R_b) + R_b \ln\left(\frac{R_b}{R_c}\right) \right) \quad (6)$$

Finally, the total cup height is obtained

$$H_\theta = r_p + (R_b - R_c) + \Delta h_\theta = r_p + (R_b - R_c) + \frac{r_{\theta+90}}{(r_{\theta+90} + 1)} \left((R_c - R_b) + R_b \ln\left(\frac{R_b}{R_c}\right) \right) \quad (7)$$

where r_p is the punch radius. For the further application of Eq. (7) presented in this paper, it is assumed that uniaxial tension and compression tests lead to identical r -value. Furthermore, in calculating cup heights according to Eq. (7) directional dependence of constant r -values and directional dependences of instantaneous r -values corresponding to the different amounts of equivalent plastic strain presented in Section 2 are utilized.

4. Predictions of Cylindrical Cup Deep Drawing for DC06 Steel Sheet

4.1 Parameters of the experimental setup

The experimental cylindrical cup drawing tests for 0.8 mm thick DC06 steel blank with 90 mm in diameter were previously performed [7] and then post-processed by authors. The main geometry parameters of the utilized setup are presented in Figure 8. The tests were performed with blank-holder force of 30 kN and under lubricated conditions.

The material data for the considered sheet material that are required in the numerical simulations are listed in Section 4.2.

The experimental cup heights presented in Figure 10 are the averaged values of the measured data corresponding to three selected test samples.

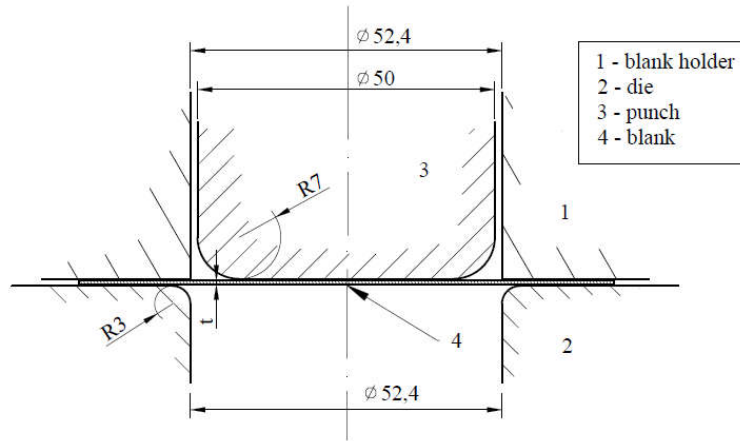


Figure 8 Geometry parameters of cylindrical cup drawing process for DC06 steel sheet

4.2 Basic features of the adopted numerical model

Numerical simulations are performed using finite element code ADINA 8.6. Since orthotropic material symmetry is considered, only a setup quarter is modelled. In the analysis, tool surfaces are considered as rigid while a quarter of the circular sheet is modelled with 369 4-node shell elements. For the frictional contact treatment, the constraint function algorithm, classical Coulomb's friction law and constant friction coefficient of 0.1 are utilized. The blank-holder force is kept constant during simulation and corresponds to the quarter of value applied in experimental tests. The solution of finite element system equilibrium equations was obtained by the automatic time stepping and Newton iterative method using energy and contact force convergence criteria.

The plastic material behaviour is described by the orthotropic elasto-plastic material model available in ADINA 8.6 based on the associated flow rule, isotropic hardening concept and four parametric orthotropic Hill (1948) stress function [9] as the yield function/plastic potential. For plane stress conditions, Hill yield criterion can be written in the following form

$$f_y = \sqrt{\lambda_1 \sigma_{xx}^2 + \lambda_2 \sigma_{yy}^2 - 2\nu \sigma_{xx} \sigma_{yy} + 2\rho \sigma_{xy}^2} = \sigma_y \quad (7)$$

where σ_{xx} , σ_{yy} and σ_{xy} are in-plane stress components where x -axis denotes the original sheet rolling direction while y -axis denotes sheet transverse direction. Dimensionless stress weighting parameters λ_1 , λ_2 , ν and ρ are parameters by which material anisotropy in yielding is described and σ_y is the yield stress for the referent direction. Under associated flow rule, yielding and plastic flow are described by the same function and therefore orthotropic parameters of yield function can be adjusted to the data indicating plastic flow such as r -values. The orthotropic parameters of Hill (1948) stress function adjusted to r -values corresponding to orientations 0° , 45° and 90° (r_0 , r_{45} and r_{90}) read

$$\lambda_1 = 1, \quad \lambda_2 = \frac{1+1/r_{90}}{1+1/r_0}, \quad \nu = \frac{1}{1+1/r_0}, \quad \rho = \frac{(1+2r_{45})(1/r_0 + 1/r_{90})}{2(1+1/r_0)} \quad (8)$$

Capabilities of Hill (1948) stress function in predicting directional dependence of constant and instantaneous r -values corresponding to considered equivalent plastic strain values are presented in Figure 9. It can be observed that Hill (1948) stress function provides good predictions of constant r -values and of instantaneous r -values particularly for greater strain levels.

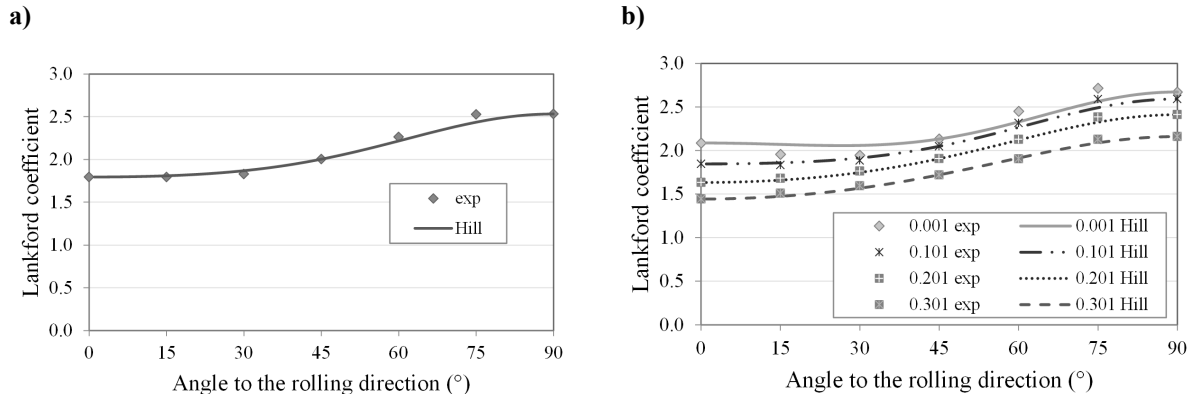


Figure 9 Predictions of: **(a)** constant; **(b)** instantaneous r -values for DC06 steel sheet obtained by Hill (1948) stress function

In performed numerical simulations, the isotropic hardening is governed by Swift hardening curve that corresponds to the experimental hardening curve for the sheet sample with orientation 0° reported in [6]

$$\sigma = 580(0.002 + \varepsilon^p)^{0.285} \text{ MPa} \quad (8)$$

Furthermore, elastic constants, Young's modulus $E = 200 \text{ GPa}$ and Poisson ratio $\nu = 0.3$ are utilized.

4.3 Results and discussion

In Figure 10 analytical and numerical predictions of cup heights obtained using constant r -values are compared with the experimental data. The experimental cup profile demonstrates one pronounced extreme near the orientation 0° and small extreme for the orientation 90° . The presented analytical prediction is obtained using Eq. (7) and constant r -values for all orientations presented in Table 1. The numerical solution is obtained using constant r_0 , r_{45} and r_{90} values in calculating parameters of Hill (1948) stress function. It can be observed that both, analytical and numerical approach, significantly underestimate experimental cup heights. As expected, analytical cup profile can be considered as the mirror image of experimental constant r -values presented at Figure 3, namely it shows only one extreme height for the orientation 0° . On the other hand, the numerical profile cannot be considered as the mirror image of constant r -values predicted by Hill (1948) function presented at Figure 9.a since it demonstrates two extreme heights for orientations 0° and 90° . It can be stated that the numerical approach results in better prediction of earing amplitude.

Analytical predictions obtained using instantaneous r -values corresponding to selected equivalent plastic strains are presented at Figure 11. Again, these cup height predictions can be considered as mirror images of corresponding experimental r -value directional dependences presented in Figure 5. It can be observed that these analytical cup height predictions significantly differ in trend, particularly in predicted cup height for the orientation 90° . For lesser equivalent plastic strain values, analytical predictions demonstrate smaller extreme for the orientation 90° as the experimental profile.

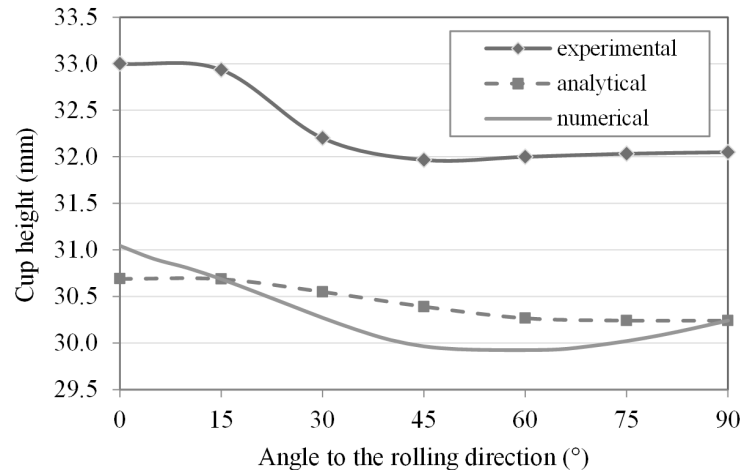


Figure 10 Analytical and numerical predictions of cup heights for DC06 sheet based on constant r -values

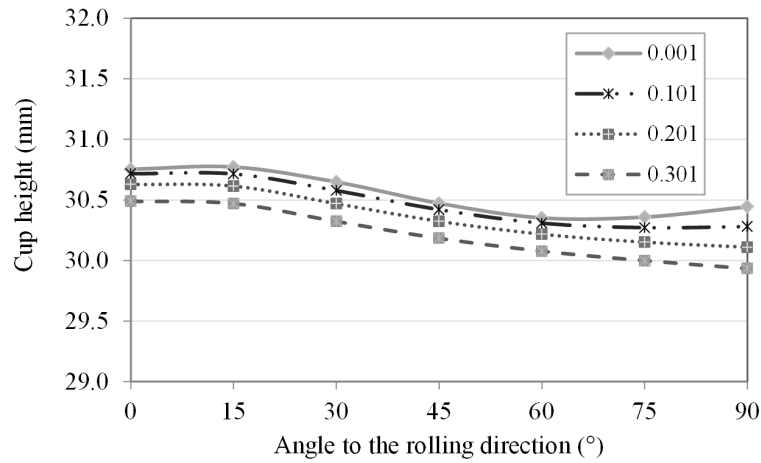


Figure 11 Analytical predictions of cup heights for DC06 sheet based on instantaneous r -values corresponding to selected plastic strain levels

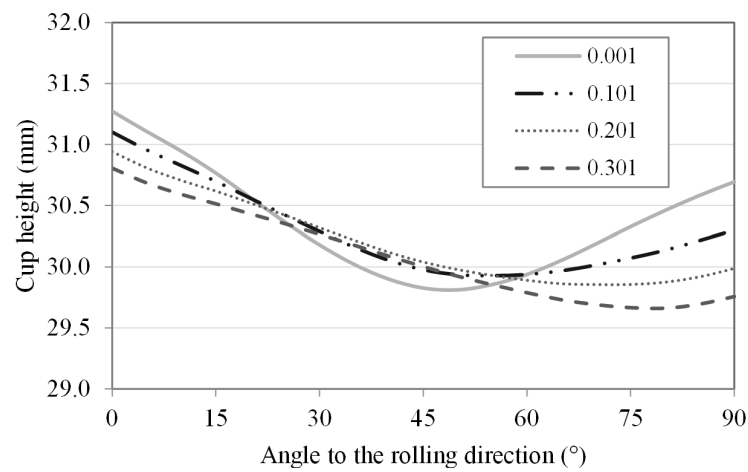


Figure 12 Numerical predictions of cup heights for DC06 sheet based on instantaneous r -values corresponding to selected plastic strain levels

Numerical predictions presented at Figure 12 are obtained using r_0 , r_{45} and r_{90} values corresponding to selected equivalent plastic strains in calculating parameters of Hill (1948) stress function. Similar for constant r -values, these numerical cup height predictions demonstrate two extreme heights. The results demonstrate that numerical cup profiles are significantly affected by utilized r -values.

Finally, based on the presented results it can be stated that analytical and numerical predictions of cylindrical cup drawing for DC06 sheet are strongly influenced by the r -values (constant or instantaneous) utilized in model calibration.

5. Conclusions

In this paper, analytical and numerical simulations of the cylindrical cup deep drawing for DC06 steel sheet sample are performed. The analytical approach is based on main geometry parameters of the process and the r -value directional dependence. The numerical simulations are performed by using finite element program ADINA where elasto-plastic material model based on the orthotropic Hill (1948) stress function, associated flow rule and isotropic hardening is utilized. In calibrating Hill (1948) stress function r -values corresponding to orientations 0° , 45° and 90° are utilized. Both, analytical and numerical simulations are performed using constant r -values and instantaneous r -values corresponding to selected equivalent plastic strain values. It has been observed that predictions are significantly influenced by r -values utilized in model calibration. Since the distribution of equivalent plastic strain in deformed cup is not uniform, the obtained results indicate that improvements in numerical model can be achieved by developing evolutionary anisotropic models in which anisotropy parameters of the yield function/plastic potential are stated as continuous functions of the equivalent plastic strain.

REFERENCES

- [1] Nagda, P.S., Bhatt, P.S., Shah, M.K. (2017). Finite element simulations of Deep Drawing Process to Minimize Earing. *International Journal of Mechanics and Mechatronics Engineering* 11(2), 413-416.
- [2] Han, J., Yamazaki, K., Makino, S., Shirasawa, T. (2013, May). *Optimization of Deep Drawing Process for Circular Cup Forming*. Paper presented at 10th World Congress on Structural and Multidisciplinary Optimization, Orlando, Florida.
- [3] Yoon, J.W., Barlat, F., Dick, R.E., Karabin, M.E. (2006). Prediction of six or eight ears in a drawn cup based on a new anisotropic yield function. *International Journal of Plasticity* 22 (1), 174-193.
- [4] Cvitanić, V., Vlak, F., Lozina, Ž. (2008). A finite element formulation based on non-associated plasticity for sheet metal forming. *International Journal of Plasticity* 24 (4), 646-687.
- [5] Safaei, M., Zang, S.-I., Lee, M.-G., De Waele, W. (2013). Evaluation of anisotropic constitutive models: Mixed anisotropic hardening and non-associated flow rule approach. *International Journal of Mechanical Science* 73, 53-68.
- [6] Safaei, M., Lee, M.-G., Zang S.-I., De Waele, W. (2014). An evolutionary anisotropic model for sheet metals based on non-associated flow rule approach. *Computational Materials Science* 81, 15-29.
- [7] Safaei, M. (2013). *Constitutive modelling of anisotropic sheet metals based on a non-associated flow rule*. Faculty of Engineering and Architecture, Ghent University, Belgium.
- [8] Yoon, J.W., Barlat, F., Dick, R.E., Karabin, M.E. (2006). Prediction of six or eight ears in a drawn cup based on a new anisotropic yield function. *International Journal of Plasticity* 22 (9), 174-193.
- [9] Hill, R. (1948). Theory of yielding and plastic flow of anisotropic metals, *Proc. Roy. Soc. A* 193, 281-297.

Zip Line Structural Analysis

Frane Vlak, Nedjeljko Marušić, Vedrana Cvitanić

University of Split, Faculty of Electrical Engineering, Mechanical Engineering and Naval
Architecture, Split, Croatia
{fvlak, nmarusic, vcvit}@fesb.hr

Ado Matoković

University of Split, University Department of Professional Studies, Split, Croatia
amatokov@oss.unist.hr

Abstract. Zip line Cetina structural analysis is presented in this paper. Each of eight segments of this structure, used for outdoor adventure activity, is consisted of wire rope stretched between anchoring supports. According to pre-tension force, three segments are chosen for static analysis based on elastic catenary equilibrium equations, and dynamic analysis is performed for the shortest one. The results of the analysis are presented and discussed.

Key words: *Zip line, Catenary, Statics, Dynamics*

1. Introduction

Zip line structures (also known as zip wire, flying fox, aerial runway, rope slide, death slide, etc.) are used for a long time all around the world, primarily for transportation of people and goods in mountains to override natural obstacles. Basically, zip line consists of one or two cables secured with anchors on both sides, simple or complex platforms, braking system and trolley that is assembly of pulleys responsible for safely carrying the rider via handlebar, seat or harness due to gravity from one end to the other, Figure 1. From 1970s, zip lines have been more frequently used for entertainment purposes and structural analysis of this type of zip line is subject of this paper. The structure analysed is located above canyon of river Cetina in the vicinity of Split, Croatia. It consists of eight parts (cables) of total length of 2000 metres, Figure 2.



Figure 1 Zip line ride [1]

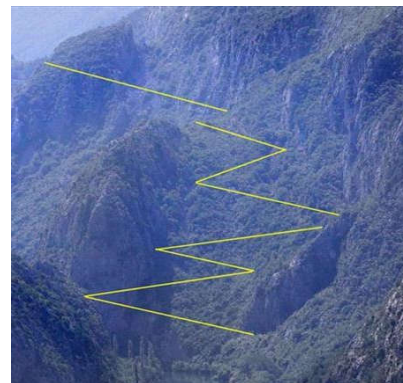


Figure 2 Zipline Croatia [2]

During the ride, riders are exposed to many hazards. Consequently, the safety is of the primary importance and it is the key aspect of design and use of zip lines. Also, all structures of this type should be designed, mounted, used and maintained following appropriate standards [3-5]. Detailed analysis of zip line structures should include: static and dynamic

analysis of cable wire itself, static analysis of anchors with special attention to anchor bolts, analysis of braking system and trolley, and optionally static analysis of platforms. Although static and dynamic analyses of cable structures are subject of numerous papers, there is a limited number of papers dealing with zip lines [6-10]. Alamoreanu & Vasilescu [6] considered a classical static and dynamic theoretical analysis of one particular zip line, while Kožar & Torić Malić [7], and Rukavina & Kožar [8] presented dynamic analysis of mass attached to pendulum sliding along the cable. On the other hand, a more comprehensive analysis can be performed using numerical methods like finite element method (FEM). For example, Ju et al [9] studied structural safety of zip line under dynamic impact loading condition using 3D FEM nonlinear model, while Denoël et al [10] presented design methodology and dynamic model based on specially developed 2D chain-like finite element.

In this paper, classical static analysis of zip line structure with thermal loads included is presented. Also, dynamic analysis for the shortest segment of the considered structure is performed using approach presented in [7, 8]. All results are obtained using in-house code written in MATLAB [11].

2. Static Cable Analysis

Catenary analysis is the subject of interest for a large number of scientists and engineers, for a long time [11]. The expressions for catenary equilibrium configuration subjected to its own weight are well known and can be found in many references, e.g. [12, 13].

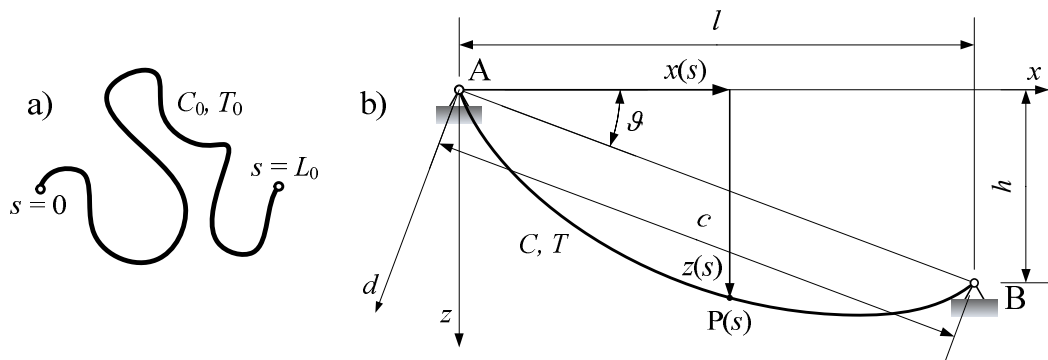


Figure 3 Suspended cable under self-weight: a) unstressed configuration C_0 ; b) equilibrium configuration C

It is assumed that flexural and shear rigidity of elastic cable, with unstressed length L_0 at reference temperature T_0 (Figure 3a), are negligible. Also, normal (tensile) stress and extensional strain of the cable cross section are assumed to be uniformly distributed. For the suspended cable under self-weight, the equilibrium configuration at any temperature T , denoted as C in Figure 3b, is defined by coordinates of point $P(s)$ as follows

$$\begin{aligned} x(s) &= \frac{H}{EA} s + \frac{H}{w} (1 + \alpha \Delta T) \left[\sinh^{-1} \left(\frac{V}{H} \right) - \sinh^{-1} \left(\frac{V - w \cdot s}{H} \right) \right] \\ z(s) &= \frac{s(2V - w \cdot s)}{2EA} + \frac{1}{w} (1 + \alpha \Delta T) \left[\sqrt{H^2 + V^2} - \sqrt{H^2 + (V - w \cdot s)^2} \right] \end{aligned} \quad (1)$$

where H and V are horizontal and vertical components of reaction at left support A, respectively; EA is axial rigidity; s is curvilinear (Lagrange) coordinate of cable; w is cable weight per unit length; α is thermal expansion coefficient; and ΔT is temperature change. Tension force at any point along cable reads

$$N(s) = \sqrt{H^2 + (V - w \cdot s)^2} \quad (2)$$

If the cable is additionally loaded with vertical point force G at particular location s_G , equilibrium configuration is defined separately for two cable segments: $0 \leq s \leq s_G$, and $s_G \leq s \leq L_0$. For $0 \leq s \leq s_G$, equations (1) and (2) remain the same, while for $s_G \leq s \leq L_0$ these equations are modified by preserving static equilibrium at any point within this interval. This solution can be presented in non-dimensional, normalized form [12], by using

$$\tilde{s} = \frac{s}{L_0}, \quad \tilde{x} = \frac{x}{l}, \quad \tilde{z} = \frac{z}{l}, \quad \tilde{H} = \frac{2H}{wL_0}, \quad \tilde{V} = \frac{2V}{wL_0}, \quad \tilde{G} = \frac{2G}{wL_0}, \quad \tilde{N} = \frac{N}{H} \quad (3)$$

where l is cable span, as presented in Figure 3b. Introducing Irvine-Sinclair parameters [12]

$$\rho = \frac{wL_0}{2EA}, \quad \lambda = \frac{L_0}{l} \cos \vartheta \quad (4)$$

where ρ is referred to be cable extensibility (flexibility) factor and λ is cable aspect ratio (with angle of cable inclination ϑ , Figure 3b), equilibrium configuration can be expressed as

$$\begin{aligned} & 0 \leq \tilde{s} \leq \tilde{s}_G \quad (0 \leq s \leq s_G) : \\ & \tilde{x}(\tilde{s}) = \frac{\tilde{H}\lambda}{2 \cos \vartheta} \left\{ 2\rho\tilde{s} + (1 + \alpha\Delta T) \left[\sinh^{-1} \left(\frac{\tilde{V}}{\tilde{H}} \right) - \sinh^{-1} \left(\frac{\tilde{V} - 2\tilde{s}}{\tilde{H}} \right) \right] \right\} \\ & \tilde{z}(\tilde{s}) = \frac{\lambda}{2 \cos \vartheta} \left\{ 2\rho\tilde{s}(\tilde{V} - \tilde{s}) + (1 + \alpha\Delta T) \left[\sqrt{\tilde{H}^2 + \tilde{V}^2} - \sqrt{\tilde{H}^2 + (\tilde{V} - 2\tilde{s})^2} \right] \right\} \\ & \tilde{N}(\tilde{s}) = \sqrt{1 + \left(\frac{\tilde{V} - 2\tilde{s}}{\tilde{H}} \right)^2} \\ & \tilde{s}_G \leq \tilde{s} \leq 1 \quad (s_G \leq s \leq L_0) : \\ & \tilde{x}(\tilde{s}) = \frac{\tilde{H}\lambda}{2 \cos \vartheta} \left\{ 2\rho\tilde{s} + (1 + \alpha\Delta T) \left[\sinh^{-1} \left(\frac{\tilde{V}}{\tilde{H}} \right) - \sinh^{-1} \left(\frac{\tilde{V} - \tilde{G} - 2\tilde{s}}{\tilde{H}} \right) + \right. \right. \\ & \quad \left. \left. \sinh^{-1} \left(\frac{\tilde{V} - \tilde{G} - 2\tilde{s}_G}{\tilde{H}} \right) - \sinh^{-1} \left(\frac{\tilde{V} - 2\tilde{s}_G}{\tilde{H}} \right) \right] \right\} \\ & \tilde{z}(\tilde{s}) = \frac{\lambda}{2 \cos \vartheta} \left\{ 2\rho\tilde{s}(\tilde{V} - \tilde{s}) + (1 + \alpha\Delta T) \left[\sqrt{\tilde{H}^2 + \tilde{V}^2} - \sqrt{\tilde{H}^2 + (\tilde{V} - \tilde{G} - 2\tilde{s})^2} - \right. \right. \\ & \quad \left. \left. 2\rho\tilde{G}(1 - \tilde{s}_G) + \sqrt{\tilde{H}^2 + (\tilde{V} - \tilde{G} - 2\tilde{s}_G)^2} - \sqrt{\tilde{H}^2 + (\tilde{V} - 2\tilde{s}_G)^2} \right] \right\} \\ & \tilde{N}(\tilde{s}) = \sqrt{1 + \left(\frac{\tilde{V} - \tilde{G} - 2\tilde{s}}{\tilde{H}} \right)^2} \end{aligned} \quad (5)$$

Primary unknown variables, normalized reactions \tilde{H} and \tilde{V} , are found using geometry constraints $x(L_0) = l$ and $z(L_0) = h$, where h is defined as vertical distance of the supports, i.e.

$$\tilde{x}(1) = 1, \quad \tilde{z}(1) = \tan \vartheta. \quad (6)$$

The above system of equations is highly nonlinear and has to be solved numerically. The selection of the initial solution appeared to be very important to achieve the convergence of the numerical procedure. The proposal of initial solution values, depending on parameter λ , can be found in [14].

The catenary solution represented with Equations (3)-(6) is implemented in MATLAB code to analyze static response of the cable structure. MATLAB function "fsolve" with its default options is used for the solution of nonlinear equation system (6). According to pre-tension force used during installation, three of eight cable segments of zip line structure are analysed. Data related to these cables, denoted as Cable 1, 2 and 3 (actually 1st, 4th and 3rd cable segment from top of the structure shown in Figure 2) are given in Table 1.

Table 1 Cable data

	Cable 1	Cable 2	Cable 3
Field location	Viseć-Propuv	Kuk-Sipar 1	Stina-Kuk
Span l (m)	682	300	107
Height difference h (m)	70	41	17
Pre-tension force N_0 (kN)	15	10	5

The steel wire rope FSS 619 F-3AY Stahlseil [1, 2] is used for all cables with following properties: diameter $D = 13$ mm, minimum breaking force $F_{MBL} = 158$ kN, modulus of elasticity $E = 93$ GPa, mass per unit length $\bar{m} = 0.88$ kg/m (leading to $w = \bar{m}g$, with $g = 9.81$ m/s²), $\alpha = 12.5 \cdot 10^{-6}$ K⁻¹ and fill factor $C_{fill} = 0.56$ (cross section area is $A = C_{fill} D^2 \pi / 4$). According to [2, 3], factor of safety for this type of structures has to be at least $FS = 5$. For the considered cables, the largest value is obtained for Cable 1 and it amounts $FS = 158/15 = 10.53$ that is twice larger than it is required.

Based on the above mentioned data, in the first step of analysis, the unstressed cable length L_0 due to pre-tension force is determined. The cables are mounted by tensioning at upper support A until desired value, controlled by dynamometer, is acquired. The unstressed length L_0 is calculated by iterative procedure where estimated value of L_0 is varied until desired value of tension force at support A, $N_A = N_0$, is obtained. The solution is determined using Equations (5) and (6) by neglecting thermal strains and additional vertical force i.e. $\Delta T = 0$ and $G = 0$. The obtained results are presented in Table 2, and Figures 4 and 5.

Table 2 Unstressed lengths and sag to chord ratios

	Cable 1	Cable 2	Cable 3
L_0 (m)	688.91	303.25	108.91
d_{max}/c	0.0512	0.0333	0.0235

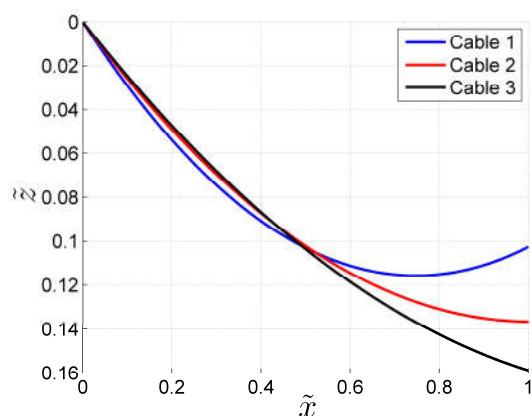


Figure 4 Equilibrium configurations

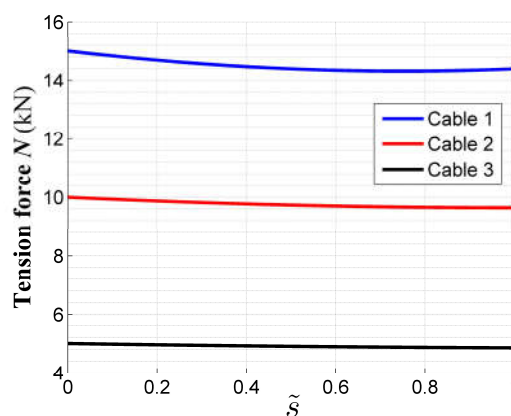


Figure 5 Variation of tension force

Sag to chord ratio d_{\max}/c shown in Table 2 represents ratio between maximal sag d and chord length c (Figure 3). Equilibrium configurations of selected cables are shown in non-dimensional form in Figure 4, while variations of tension forces N with respect to non-dimensional length of cable \tilde{s} are shown in Figure 5. From this figure, it is easy to notice that tension forces at upper support A ($\tilde{s} = 0$) are equal to pre-tension forces, and that they are slightly decreasing while approaching the lower support B ($\tilde{s} = 1$).

Furthermore, influence of the temperature on the equilibrium configuration is investigated. Reference temperature (during installation) is taken to be $T_0 = 20^\circ\text{C}$, and calculations are performed for another five temperatures $T = T_0 + \Delta T$, defined by temperature change ΔT . The results of these calculations are shown in Table 3.

Table 3 Thermal strains analysis data

ΔT	Cable 1				Cable 2			Cable 3	
	$\frac{N_{\Delta T}}{N_0}$	β_B ($^\circ$)	z_{\max} (m)	x_m (m)	$\frac{N_{\Delta T}}{N_0}$	β_B ($^\circ$)	x_m (m)	$\frac{N_{\Delta T}}{N_0}$	β_B ($^\circ$)
-30	1.02310	+5.6354	78.27	514.57	1.05320	-0.5023	300.00	1.11415	-4.1585
-20	1.01524	+5.7286	78.48	513.19	1.03470	-0.3677	300.00	1.07276	-3.9658
-10	1.00754	+5.8215	78.68	511.80	1.01698	-0.2339	300.00	1.03484	-3.7753
0	1.00000	+5.9138	78.89	510.41	1.00000	+0.1010	300.00	1.00000	-3.5872
10	0.99262	+6.0057	79.10	509.03	0.98371	+0.0309	299.39	0.96793	-3.4017
20	0.98538	+6.0972	79.31	507.64	0.96807	+0.1619	296.96	0.93834	-3.2189

In Table 3, $N_{\Delta T}/N_0$ denotes ratio of tension force for given ΔT with respect to tension force for the reference temperature ($\Delta T = 0$) at upper support A (where the largest tension force in cable appears); β_B is cable slope at lower support B (in degrees, +sign for counter clockwise direction); z_{\max} is maximal value of absolute z -coordinate (indicating cable vertex or extreme z -coordinate) with respective x -coordinate denoted as x_m . The slope β_B and z_{\max} position can be used as valuable information about change of tension in cable, but it can be also used to estimate/control speed at the end of the ride. The obtained results clearly indicate that increase of temperature increases length of the cable, and accordingly β_B . Also, z_{\max} position of Cable 1 is moving further from lower support B with temperature increase. According to the obtained results, z_{\max} position for Cables 2 and 3 is constant for all considered temperature regimes. Therefore, z_{\max} that amounts 41 m for Cable 2 and z_{\max} and x_m for Cable 3 in amounts of 17 and 107 m respectively, are not presented in Table 3.

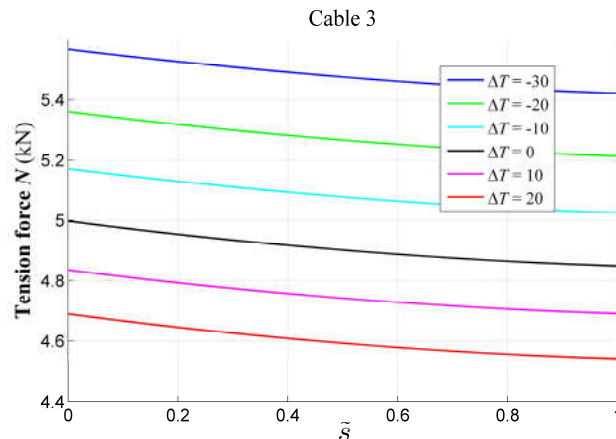


Figure 6 Tension forces for Cable 3 with respect to temperature change

As expected, temperature variation results in variations of tension forces, and these variations are more pronounced for Cable 3 than for other two cables. Figure 6 shows tension force variations for Cable 3 with respect to non-dimensional cable length, for all considered temperature regimes. As it can be seen from Figure 6, the variations of tension force N , for one particular temperature, are very small along the cable length. But, for temperatures below reference temperature ($\Delta T = 0$), tension forces along the cable are higher than 5 kN, that is pre-tension force for this cable.

Finally, the static analysis is also performed for the case when the cable is subjected to vertical force. In this analysis, the influence of the force position on the final solutions is considered. The value of the force is taken to be $G = 1500$ N, which is slightly larger than rider's weight limit according to design requirements [2]. Each cable is divided into 100 equidistant segments, so solutions for 99 point force positions are calculated. The analysis of the obtained solutions indicate that maximum increase of tension forces is obtained for $\tilde{s}_G = 0.5$, i.e. for the vertical force positioned at half of cable length L_0 . For this case, corresponding results for equilibrium configurations and distribution of the tension forces are presented in Figures 7 and 8.

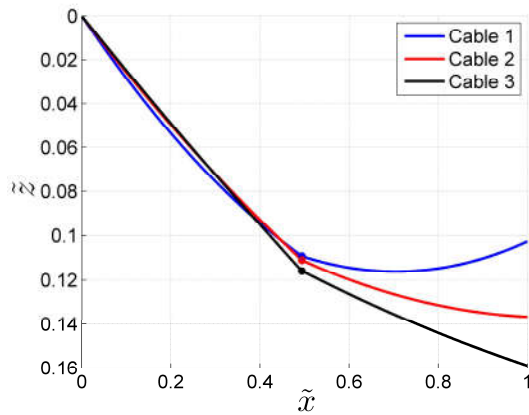


Figure 7 Equilibrium configurations for $s_G = L_0/2$

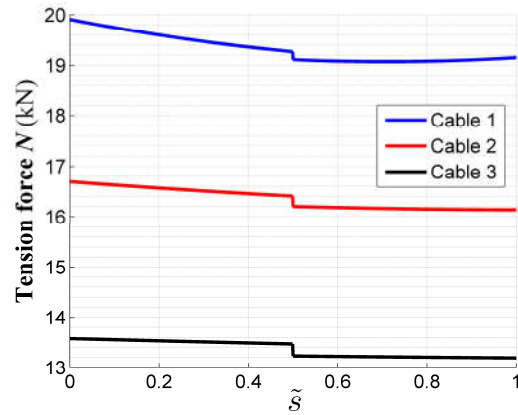


Figure 8 Tension force for $s_G = L_0/2$

According to Equations (5), equilibrium configurations and distributions of tension forces demonstrate different characteristics in the regions in front of and behind the vertical force point as presented at Figures 7 and 8. By comparing these Figures with Figures 4 and 5, the differences in equilibrium forces and tension forces are more pronounced. Additional data related to this analysis are presented in Table 4.

Table 4 Vertical point force analysis data

	G/G_{cab}	N_{max}/N_0	$d_{1,max}/c_1$	$d_{2,max}/c_2$	$(d_{1,max}/c_1)_{\tilde{s}_G=0.5}$	$(d_{2,max}/c_2)_{\tilde{s}_G=0.5}$
Cable 1	0.252	1.32720	0.0499	0.0501	0.0186	0.0196
Cable 2	0.573	1.66978	0.0316	0.0319	0.0096	0.0102
Cable 3	1.595	2.71545	0.0198	0.0204	0.0042	0.0045

In this table, G/G_{cab} represents the ratio between the weight of the rider and the cable weight $G_{cab} = wL_0$. It's easy to notice that, in contrast to Cables 1 and 2, Cable 3 is almost twice lighter than rider. N_{max}/N_0 is the ratio between maximal tension force showed up during these calculations and respective pre-tension force (given in Table 1). According to these results, tension force significantly increases due to vertical point loading. For Cable 3, maximal tension force is 2.715 times larger than pre-tension force. The highest value of

tension force appears in Cable 1, and it amounts 19.908 kN which reduces factor of safety to $FS = 158/19.908 = 7.94$. The ratios d_1/c_1 and d_2/c_2 denote sag to chord ratios for two parts of cable divided by the location of point force: $d_{1,max}$ and c_1 are maximal value of sag and length of the chord of the cable part where $0 \leq s \leq s_G$; while $d_{2,max}$ and c_2 correspond to the other part where $s_G \leq s \leq L_0$. Maximal values of sags are obtained for locations (1st and 99th) of point force that are the closest to supports A and B, respectively. Comparing these ratios (especially those related to location $\tilde{s}_G = 0.5$) with ratios given in Table 2, it is easy to conclude that cables are flattening due to point load. Since this effect is the most pronounced for Cable 3, dynamic analysis is performed for this part of the structure in the following section.

3. Dynamic Cable Analysis

Dynamic analysis, presented in this section, is based on the studies presented in [7, 8] where the pendulum with attached mass is sliding along elastic, stretched cable, Figure 9.

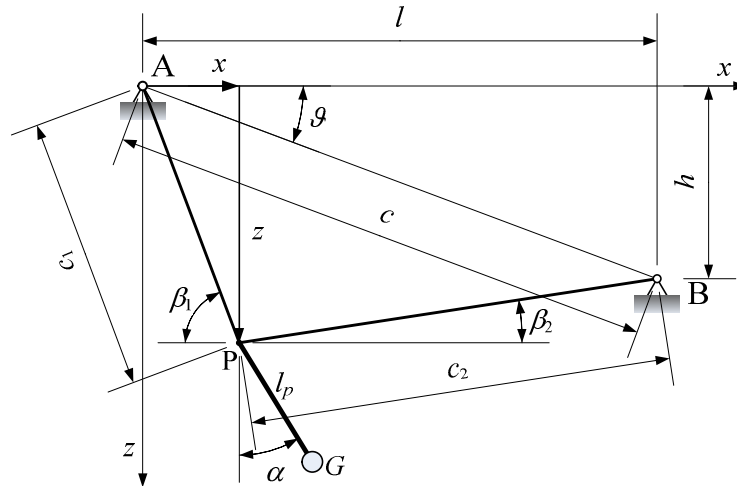


Figure 9 Pendulum sliding along a cable

Based on dynamic equilibrium equations for attached mass $m = G/g$, geometric and trigonometric relations for angles β_1 , β_2 and coordinates x , z of cable point P, the following system of three differential equations is obtained

$$\begin{aligned} \ddot{x} &= \frac{N}{m}(\cos \beta_2 - \cos \beta_1) - l_p (\ddot{\alpha} \cos \alpha - \dot{\alpha}^2 \sin \alpha) - R_x \\ \ddot{z} &= g - \frac{N}{m}(\sin \beta_2 + \sin \beta_1) + l_p (\ddot{\alpha} \sin \alpha + \dot{\alpha}^2 \cos \alpha) - R_z \\ \ddot{\alpha} &= \frac{1}{2l_p}(\ddot{z} \sin \alpha - \ddot{x} \cos \alpha - g \sin \alpha) \end{aligned} \quad (7)$$

where $\ddot{x} = d^2x/dt^2$, $\ddot{z} = d^2z/dt^2$ and $\ddot{\alpha} = d^2\alpha/dt^2$ are respective accelerations; R_x and R_z denote resistance forces in respective directions; l_p is pendulum length; and tension force N is determined using

$$N = EA \left(\frac{c_1 + c_2}{L} - 1 \right). \quad (8)$$

In the above equation, L is cable length and it can be used to define cable pre-tension ($L \leq c$). System of second order differential equations (7) in presented form cannot be solved using MATLAB solver "ode45" (based on an explicit Runge-Kutta (4,5) formula). So, it has to be transformed to equivalent system of first order differential equations. Introduction of three additional unknowns (u , w and ω), leads to system of six first order equations

$$\begin{aligned} u &= \dot{x}, & v &= \dot{z}, & \omega &= \dot{\alpha}, & \dot{u} &= B(1 + \cos^2 \alpha) - D \sin \alpha \cos \alpha, \\ \dot{w} &= D(1 + \sin^2 \alpha) - B \sin \alpha \cos \alpha, & \dot{\omega} &= \frac{1}{2l_p} (\dot{w} \sin \alpha - \dot{u} \cos \alpha - g \sin \alpha) \end{aligned} \quad (9)$$

where

$$\begin{aligned} B &= \frac{EA}{m} \left(\frac{c_1 + c_2}{L} - 1 \right) \left(\frac{l-x}{c_2} - \frac{x}{c_1} \right) + \frac{g}{4} \sin 2\alpha + l_p \omega^2 \sin \alpha - R_x \\ D &= g - \frac{EA}{m} \left(\frac{c_1 + c_2}{L} - 1 \right) \left(\frac{z-h}{c_2} + \frac{z}{c_1} \right) - \frac{g}{2} \sin^2 \alpha + l_p \omega^2 \cos \alpha - R_z \\ c_1 &= \sqrt{x^2 + z^2} \\ c_2 &= \sqrt{(l-x)^2 + (h-z)^2} \end{aligned} \quad (10)$$

In Equations (9), respective velocities are denoted with dot operator ($\dot{f} = \frac{df}{dt}$). Moreover, in order to use "ode45" solver for integration of equation system (9), variables have to be grouped into vector form $\mathbf{v} = [x, z, \alpha, u, w, \omega]$. With x_0 and α_0 chosen arbitrary, the initial conditions are

$$\begin{aligned} x(t=0) &= x_0, & z(t=0) &= z_0, & \alpha(t=0) &= \alpha_0, \\ u(t=0) &= 0, & w(t=0) &= 0, & \varepsilon(t=0) &= 0 \end{aligned} \quad (11)$$

where z_0 is determined by solving static equilibrium equation for z -direction, that reads

$$G - EA \left(\frac{c_1 + c_2}{L} - 1 \right) \left(\frac{z_0 - h}{c_2} + \frac{z_0}{c_1} \right) = 0 \quad (12)$$

Resistance appearing in equations (10) can include a variety of effects like drag, wind, trolley friction, braking, etc. [15]. In this paper, only influence of drag force is included using

$$R_x = \frac{1}{2} \rho_A C_{Dx} A_{Rx} v_{rx}^2, \quad R_z = \frac{1}{2} \rho_A C_{Dz} A_{Rz} v_{rz}^2 \quad (13)$$

where ρ_A is air density; C_{Dx} and C_{Dz} are respective drag coefficients; A_{Rx} and A_{Rz} are areas occupied by rider with respect to x and z axes, respectively; v_{rx} and v_{rz} are relative velocities of the rider defined as

$$v_{rx} = \dot{x}_G - v_{wx}, \quad v_{rz} = \dot{z}_G - v_{wz} \quad (14)$$

Since the influence of the wind forces is neglected in this analysis, wind velocity components are $v_{wx} = v_{wz} = 0$. Velocity of the rider, represented as mass attached at the end of pendulum in Figure 9, is obtained as in [7] by using expressions for mass position

$$x_G = x + l_p \sin \alpha, \quad z_G = z + l_p \cos \alpha \quad (15)$$

and derivation of velocity components is straightforward.

The presented approach is implemented to dynamic analysis of Cable 3. This cable is selected since it is the most tensioned/stretched cable among the cables analysed in previous section. So, it is expected that above described method is closely matching dynamic behaviour of Cable 3. The weight of the mass attached to pendulum of length $l_p = 1$ m is taken to be $G = 1500$ N (as in static analysis). Cable length is calculated using Equation (8) to match cable pre-tension $N_0 = 5$ kN, i.e.

$$L = \frac{c}{N_0/EA+1} = 108.264 \text{ m.} \quad (16)$$

According to equations (11) and (12), assumed initial conditions are

$$x_0 = 5 \text{ m,} \quad z_0 = 1.628 \text{ m,} \quad \alpha_0 = -5^\circ \quad (17)$$

Dry air density is $\rho_A = 1.2041 \text{ kg/m}^3$ (at 20 °C and 101.325 kPa), assumed areas occupied by rider in seating position [15] are $A_{Rx} = 0.5 \text{ m}^2$ and $A_{Rz} = 0.25 \text{ m}^2$, while drag coefficients are taken from [16] to be $C_{Dx} = 0.75$ and $C_{Dz} = 0.2$. The analyses are performed with and without drag force, and the results are presented in the following Table and Figures.

Table 5 Dynamic analysis data

	t_{end} (s)	v_{end} (km/h)	$N_{d,\text{max}}/N_0$
Without drag ($R = 0$)	10.23	63.82	2.95109
With drag	17.40	19.38	3.10131

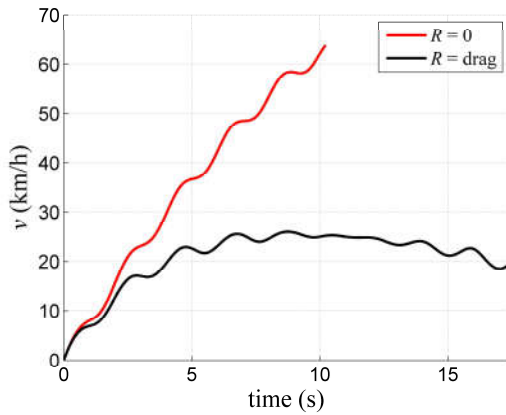


Figure 10 Variation of velocity in time

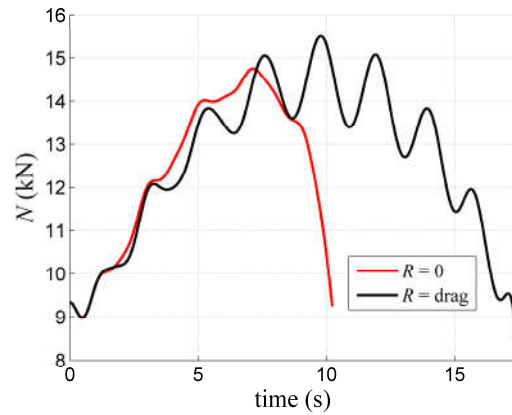


Figure 11 Variation of tension force in time

The value t_{end} , presented in Table 5, is time determined using MATLAB "Event" property for "ode45" solver to stop the simulation. In this case, the analysis is terminated when x -coordinate has reached distance of 3 m from cable span, i.e. using constraint equation $x(t_{\text{end}}) = l - 3$. The difference between solutions with and without drag is obvious, and more observable from Figures 10, 11 and 12. By taking drag into account, t_{end} increases for 7 seconds more with respect to t_{end} calculated without drag. On the other hand, arrival velocity, calculated as $v = \sqrt{\dot{x}^2 + \dot{z}^2}$, decreases more than 3 times. Although not presented in this paper, dominant velocity component is velocity in x -direction. Since the arrival velocity of 19.38 km/h is still high, the simulation of braking will probably give more realistic results. The dynamic model that includes braking is left for future investigations. The value $N_{d,\text{max}}/N_0$ in Table 5 represents the ratio between maximal tension force occurred during dynamic analysis with respect to pre-tension force. Comparing these results with result

presented in Table 4, it can be observed that cable is more tensioned than in the static analysis. Moreover, comparing the maximal values of tension forces calculated without and with drag forces, larger value is obtained in the latter case. Oscillations of the solutions presented in Figures 10 and 11 can be explained with swinging motion of the pendulum that is shown in Figure 12. Analysing the variation of the pendulum angle with drag included, it can be observed that these oscillations are dissipated until some instance of time, and after that time they are increasing. Also, in this analysis the pendulum is oscillating around vertical axis ($\alpha = 0$) during almost the whole simulation, in contrast to analysis without drag included.

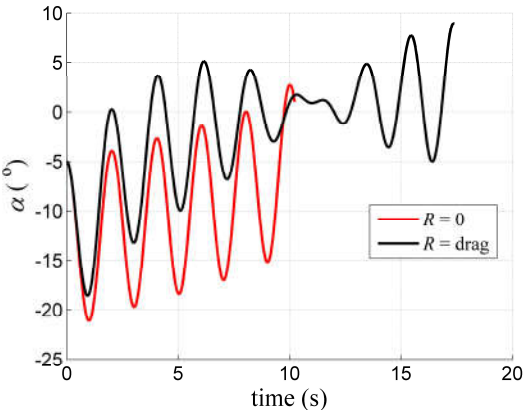


Figure 12 Variation of pendulum angle in time

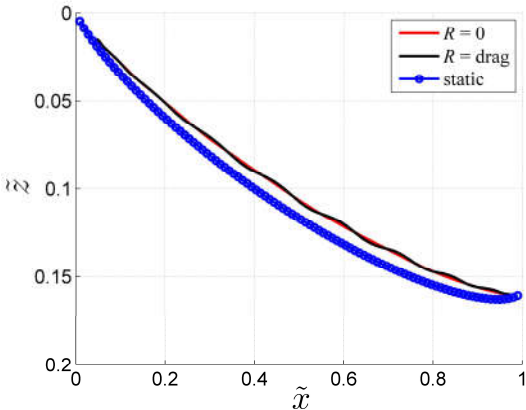


Figure 13 Paths of point P

Finally, Figure 13 shows paths of dynamic solutions for point P defined in Figure 9 compared with solutions obtained by static analysis for vertical point load G acting at various positions along the cable. These results are, again, shown in non-dimensional form. Presented results demonstrate that dynamic solutions are very close to each other. The solution obtained with drag force included shows small oscillations around the solution obtained without drag. On the other hand, static solutions differ from dynamic ones. This can be explained by different assumptions used in both analyses. The static solution is obtained considering weight of the cable and vertical point force while dynamic solution neglects cable effects and includes inertia (and drag) forces. Also, catenary curves in static analysis are different from straight cable segments that are assumed in dynamic analysis.

4. Conclusions

In this paper, the structural analysis of zip line structure Cetina is presented. Well known catenary equilibrium equations are used for static analysis of cables under self-weight and vertical point load. Furthermore, the behaviour of the cables under different temperature conditions is also investigated. Generally, the results of the static analysis can give valuable informations during the whole design process. For instance, these results can be very useful in designing the anchors. Dynamic analysis of the mass attached to pendulum that is sliding along the straight cable of negligible mass is performed. According to the characteristics obtained by static analysis, the most stretched cable is chosen for this analysis. Aerodynamic drag force is the only resistance included in the dynamic analysis. It is shown that, in order to obtain more realistic results, braking force should be included, too. Both analyses, static and dynamic, are performed using assumption that cable axial rigidity EA is constant. The nonlinear behaviour of the cable under tension force can be described using cable wire rope tensile stress-strain test curves, leading to appropriate description of the modulus of elasticity variation with respect to the tension force, and consequently to more precise cable system response. This nonlinear behaviour is not a subject of this paper, and it is left for future investigations.

By the presented approach, the use of more complex numerical analysis like finite element analysis is avoided. Anyway, some numerical procedures, e.g. for solving system of non-linear equations and for time integration of differential equations, are still required. MATLAB, as one great numerical tool, is used for that purpose and in-house code that combines all the previously mentioned analyses is developed. Finally, in order to validate the obtained results, in-situ measurements have to be performed.

ACKNOWLEDGEMENT

This paper is prepared in collaboration with “Malik d.o.o., Omiš”, and the authors are very grateful for their support.

REFERENCES

- [1] Marušić, N. (2017). *Strukturna analiza Zip line konstrukcije (in Croatian)*. Diploma thesis. University of Split, FESB.
- [2] Mimica, D. (2012) *Adrenalinski park - ZIP Line*. Omiš, Croatia
- [3] ERCA (2007). *Professional Standards for Mobile and Permanent Rope Courses*. Hannover, Germany
- [4] EN 15567-1:2015 (2015). *Sports and recreational facilities-Ropes courses, Part 1: Construction and safety requirements*. European Committee for Standardization.
- [5] ANSI/ACCT (2016). *Challenge Courses and Canopy/Zip line tours standards*. IL, USA.
- [6] Alamoreanu, M., & Vasilescu, A. (2014). Theoretical Aspects of Zip Line Analysis. In. M. Gašić (Ed.), *VIII International Conference "Heavy Machinery-HM 2014"*, (pp. A131-136), Zlatibor, Serbia
- [7] Kožar, I., & Torić Malić, N. (2014). Analysis of body sliding along cable. *Coupled Systems Mechanics*, 3(3), 291-304.
- [8] Rukavina, T. & Kožar, I. (2017). Analysis of two time-delayed pendulums. *Engineering Review*, 37(1), 11-19.
- [9] Ju, B.S., Kim, J.S., Jung, W.Y. (2013). Structural Safety Evaluation of Zip-Line Dynamic Impact Load. *World Academy of Science, Engineering and Technology International Journal of Civil, Architectural Science and Engineering* 7 (10), Retrieved February 8, 2018, from <https://waset.org/publications/17309>
- [10] Denoël, V., Canor, T., Demanet, J. (2013). Dynamic computation and design of a world record death-ride. In. Papadrakakis et al (Eds.), *COMPADYN, 4th ECCOMAS Thematic Conference on Computational Methods in Structural Dynamics and Earthquake Engineering*, (pp. 1-11), Kos Island, Greece
- [11] MathWorks Inc., (2010). MATLAB, Ver. 2010.
- [12] Irvine, H. M. (1981). *Cable structures*. Massachusetts, USA: MIT Press
- [13] Lepidi, M. & Gattulli, V. (2012). Static and dynamic response of elastic suspended cables with thermal effects. *International Journal of Solids and Structures* 49, 1108-1116.
- [14] Tibert, G. (1999). *Numerical Analysis of Cable Roof Structures*. Licentiate Thesis, Royal Institute of Technology. Stockholm, Sweden
- [15] Hubbard, R.A., Merrel, D.S., Fox, A.D. (2017). *Environmental Effects on Zip Line Rider Speed*. Retrieved March 18, 2018, from <https://www.hubbardmerrell.com/2018/02/01/environmental-effects-zip-line-rider-speed>
- [16] Koo, M.H., & Al-Obaidi, A.S.M. (2013). Calculation of Aerodynamic Drag of Human Being in Various Positions. In The 1st Engineering Undergraduate Research Catalyst Conference, Kuala Lumpur, Malaysia

Hydraulic Hybrid Vehicle Configurations and Comparison With Hybrid Electric Vehicle

Vjekoslav Tvrđić
FESB, Split, Croatia
vtvrđic@fesb.hr

Srdjan Podrug
FESB, Split, Croatia
spodrug@fesb.hr

Igor Šuljić
Sveučilišni odjel za stručne studije, Split, Croatia
isuljic@oss.unist.hr

Bernard Matic
FESB, Split, Croatia
bernard.matic.02@fesb.hr

Abstract. In this paper three basic configurations of hydraulic hybrid vehicle are explained. An overview of literature for parallel, series and power-split hydraulic hybrid vehicles is presented. The main advantages and disadvantages, from the aspect of simplicity of implementation, fuel economy and overall efficiency, between individual configurations are also presented. In the end, a more detailed comparison was made between hydraulic hybrid vehicles with hybrid electric vehicles. The main advantages and disadvantages, from the aspect of energy and power density, efficiency of the regenerative braking, speed of the regenerative charging, and initial and maintenance costs of hydraulic hybrid vehicles and hybrid electric vehicles are also presented, as well as an overview of the literature that deals with the comparison of these two types of hybrid vehicles.

Key words: *Energy management strategy, Fuel economy, Parallel hydraulic hybrid vehicles, Powersplit hydraulic hybrid vehicles, Series hydraulic hybrid vehicles*

1. Introduction

Due to the adverse effects of fuel combustion in the transport sector, hybrid vehicles are an increasingly common subject of research around the world. The motivation for the study of hydraulic hybrid vehicles (HHV) is to get a vehicle that has significantly lower emissions and better fuel economy than a conventional vehicle. In recent years, fuel consumed by trucks grows at a much faster rate than that of passenger cars [1]. This is a consequence of increased proportion of light trucks and buses, as well as a higher demand for ground transportation of goods. Heavy vehicles or trucks already have very efficient diesel engines. Finally, for further reducing fuel consumption and harmful emissions in this part of the transport sector, it is necessary to devise a new concept of hybrid vehicles.

A hybrid vehicle contains two sources of power consisting of an internal combustion engine and a second power source that allows for energy storage. For HHV energy sources are the internal combustion engine and the hydraulic pump / motor. Permanently saving energy is possible in the hydraulic accumulator. Hydraulic pumps, motors and accumulators have a very high-power density (about 500 to 1000 W / kg). Hydraulic components are in relation to

electrical components cheaper and easier to maintain. In other words, for certain types of vehicles (heavy vehicles) in the transport sector, hybridization using hydraulic components is very likely in the future.

To compliment the hybrid vehicle, an appropriate energy management strategy (EMS) must also be developed to distribute the power between the two power sources as efficiently as possible. Over 90% of commercialization effort has focused on hybrid electric vehicles (HEV) and virtually all commercially available passenger cars and light truck hybrids are electric hybrids today. Hydraulic pumps/motors and accumulators are able to capture and reuse a higher percentage of kinetic energy than their electric counterparts. HHV is able to capture and reuse 70-80% of braking energy, on the contrary for HEV the percentage of regenerative braking, however, is around 20 to 30% [2, 3]. This feature is especially beneficial for truck applications in significant stop-and-go activity.

2. Hydraulic Hybrid Vehicle Configurations and Comparison Between Them

The main issue for HHV design is controlling the energy transfer from sources to the loads with minimum loss of energy which depends on the driving cycles. Depending on the secondary power source of the hydraulic hybrid vehicle, three main types of models exist: parallel, series, and power-split. In this section, the overall operation of each will be described along with reviewing the literature for each of the above terms.

2.1 Parallel hydraulic hybrid vehicle

A parallel hydraulic hybrid vehicle (PHHV) uses a conventional mechanical drive train. Schematic illustration of the configuration of a PHHV is shown in Figure 1. The engine shaft is directly connected to a transmission, which is connected to a differential to provide power to each wheel. In addition, the hydraulic pump/motors are connected to the drive shaft between the engine and the transmission to provide hydraulic energy stored in the accumulator for driving or store hydraulic energy during deceleration of the vehicle. Also, a clutch is placed between the engine and hydraulic pumps/motors so the engine can be decoupled completely

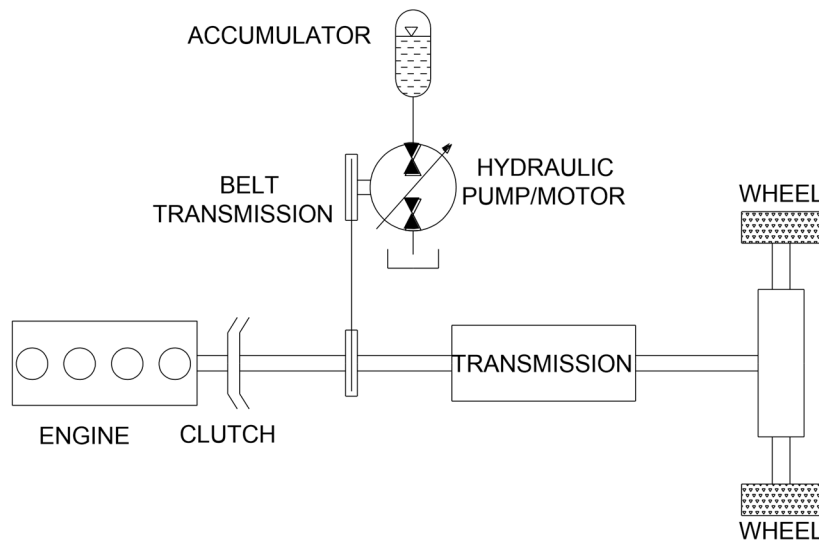


Figure 1 Configuration of a parallel hydraulic hybrid vehicle (PHHV)

from the road load and powered entirely by hydraulics if enough energy is contained in the accumulator. This allows the engine to be turned off when not needed and turned back on when the accumulator becomes low. Optimal engine management cannot be obtained since the engine speed is related to the wheel speed by the transmission gear ratio [1, 2, 3].

Wu et al. [4] presented the development of power management strategies tailored specifically to a medium truck with parallel hydraulic hybrid powertrain. MATLAB / Simulink were used for vehicle modelling. A rule-based power management strategy was used along with the use of a dynamic programming (DP) algorithm for finding the optimum for gear shifting and powersharing between the internal combustion engine / hydraulic motor. Stelson et al. [5] presented parallel, series, and power-split architectures in the MATLAB environment using variable efficiency hydraulic pump/motor models. The DP algorithm was used to determine the optimal trajectories for engine/hydraulics power splitting for each of the architectures over urban and highway drive cycles. Sakota et al. [6] proposed parallel hydraulic hybrid model in AVL Cruise environment. Simulation results show that this model can achieve significant savings in fuel consumption, especially in case of vehicle motion purely based on hydraulic drive. Liu et al. [7] presented the control strategy of regenerative braking in PHHV. The paper establishes the backward simulation model of the HHV in MATLAB/Simulink. The simulation results in this article show that this strategy can provide significant savings in fuel consumption. Hilman et al. [8] designed and evaluated a PHHV over US06 aggressive drive cycle to demonstrate significant reduction in gas emissions and improvement in fuel consumption. The system has been controlled by a fuzzy logic system and simulated using ADVISOR 2002. Mrdja et al. [9] presented parallel and series architecture for hydraulic hybrid bus. This analysis shows that it is possible to save more than 15% of fuel only by turning off the engine. Deppen et al. [10] presented a model predictive control (MPC) approach for solving the energy management problem in a PHHV. A model predictive controller was successfully able to track the desired wheel torque, while utilizing the energy storage capabilities to improve fuel economy. Wu et al. [11] presented a methodology for developing a power management strategy tailored specifically to a PHHV configured for a medium-size delivery truck. The HHV was modelled in the MATLAB/Simulink environment. New control strategy in this paper takes advantage of high power density and efficiency characteristics of hydraulic components and minimizes disadvantages of low energy density. Simulation results indicate that the potential for fuel economy improvement of medium trucks with hydraulic hybrid propulsion can be as high as 48%. Tao et al. [12] introduced an energy control strategy based on the logic threshold methodology for PHHV. In this paper, the simulation model for the analysis of the whole vehicle dynamic performance was developed using Simulink. The multi-objective genetic algorithm (GA) optimization method was employed to get the optimal working modes. The simulation results show that the dynamic performance of the vehicle can be enhanced with the proposed energy control strategy.

2.2 Series hydraulic hybrid vehicle

In a series hydraulic hybrid vehicle (SHHV), the mechanical drive train is removed, and the vehicle is powered by a hydrostatic drive. The engine shaft is directly connected to a hydraulic pump/motor, which is connected to an accumulator to allow for energy storage. A hydraulic pump/motor is placed at each wheel to provide power and propel the vehicle. A clutch is again placed immediately downstream of the engine to allow for decoupling of the engine and on/off engine management. This configuration not only allows the engine output power to not match load demand, but also the speed does not need to match wheel speed due to the pump/motor at the wheels, allowing for optimal engine management. Schematic illustration of the configuration of a SHHV is shown in Figure 2.

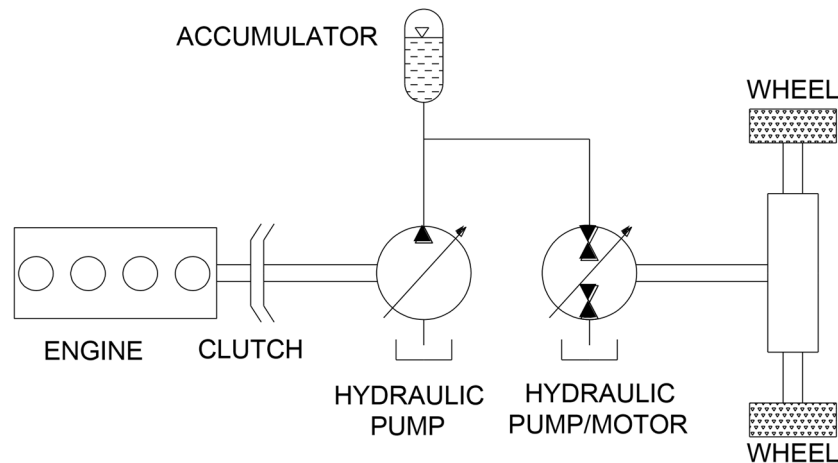


Figure 2 Configuration of a series hydraulic hybrid vehicle (SHHV)

Hatti [13] presented a SHHV drive train to improve the fuel efficiency of a passenger car. The novel innovation in this paper allows independent wheel torque control. Vu [14] presented different rule-based control schemes for a 3.5-ton SHHV. With this control strategies, the SHHV offers a fuel economy improvement of 35% to 43% in comparison to the conventional vehicle. Chen et al. [15] presented DP optimal control technique for a SHHV model. The improvement of fuel economy of the proposed system has been investigated over Japan 1015 Drive Cycle with different control strategies. Simulation results show that the fuel economy improvement of the proposed system using rule-based control strategy can be up to 80% in comparing with a traditional hydrostatic control strategy. With DP technique, the results of fuel economy improvement can be up to 112% and 88% respectively. Chen et al. [16] described configuration and working principle of SHHV based on the hydraulic transformer (HT) to extend its energy-regenerated potential. The simulation result shows that the series accumulator was better than the parallel accumulator in terms of pulsation damping of hydraulic transformer with considering the pipeline effect. Baer et al. [17] modified the existing SHHV model to show the possibility of focusing the combustion engine's operating points on a smaller range with the potential of more fuel-efficient driving. The light-weight vehicle design was studied concerning the effect of its main hydraulic components' sizing, particularly in terms of down-sizing without compromising on the accuracy, drivability and the effect of energy recuperation over urban drive cycles. Feng et al. [18] presented a forward-facing simulation model of a SHHV and its use for evaluation of power management strategies. In conjunction with the proposed hierarchical control architecture, a thermostatic state of charge (SoC) based supervisory power management strategy was thoroughly analyzed. Simulation of the vehicle over a complete FUDS driving cycle shows that the fuel economy could be improved by 96.5% with engine shutdown and 71.9% with engine idling over conventional vehicles. Filipi et al. [19] proposed an engine-in-the-loop (EIL) methodology for considering a combined hybrid system fuel economy and emissions objective. The EIL study confirms advantages of a modulated state-of charge control over the thermostatic approach and demonstrates the ability of the SHHV to improve the fuel economy of the medium truck by 72%, while reducing the particulate emission by 74% compared to the conventional vehicle. Payeganeh et al. [20] presented the idea of braking energy regeneration and reusing that energy during acceleration for a SHHV refuse truck. The powertrain of the truck and the elements of the hydraulic powertrain were modelled in MATLAB/Simulink. Fuzzy control strategy was designed and modelled to improve the fuel consumption of the truck with hybrid powertrain. Li et al. [21] presented the control system design based on controller area network (CAN) technology for SHHV. Experiments in this paper show that the system with CAN bus has a high communication reliability and high

accuracy of dynamic coupling. Hiremath et al. [22] proposed a new configuration of the SHHV system. The dynamic response of the system was studied using simulation results of the system model in AMESim tool. The results after optimization show that optimal system parameters significantly improve energy efficiency. Mahmoodi et al. [23] presented series hybrid hydraulic/electric system (SHHES). The innovated model was presented for heavy hybrid vehicles. The torque control strategy based on fuzzy logic controller was proposed to achieve better vehicle performance while the fuel consumption was minimized. Chen et al. [24] applied successfully DP optimal control technique for the SHHV system. The optimal trajectories have been studied and adopted to establish implementable rule-based control strategy. The control strategy has been simulated in the MATLAB/Simulink environment to predict the improvement of fuel economy of the proposed system in different modes.

2.3 Power-split hydraulic hybrid vehicle

The power-split hydraulic hybrid vehicle (PSHHV) configuration combines the parallel and series architectures into one. Schematic illustration of the configuration of a PSHHV is shown in Figure 3. The mechanical drive train is conventional as in the PHHV design. However, hydraulic pump/motors are also connected to the drive wheel shafts as in the SHHV design. This configuration allows for optimal engine management since, even though the engine is coupled mechanically to the drive wheels, the pump/motors at the wheels can be used to achieve desired wheel speed. The clutch immediately downstream of the engine allows the engine to be decoupled from the load, just as in the parallel and series configurations. The power-split combines the advantages of both the parallel and series configurations: the mechanical drive

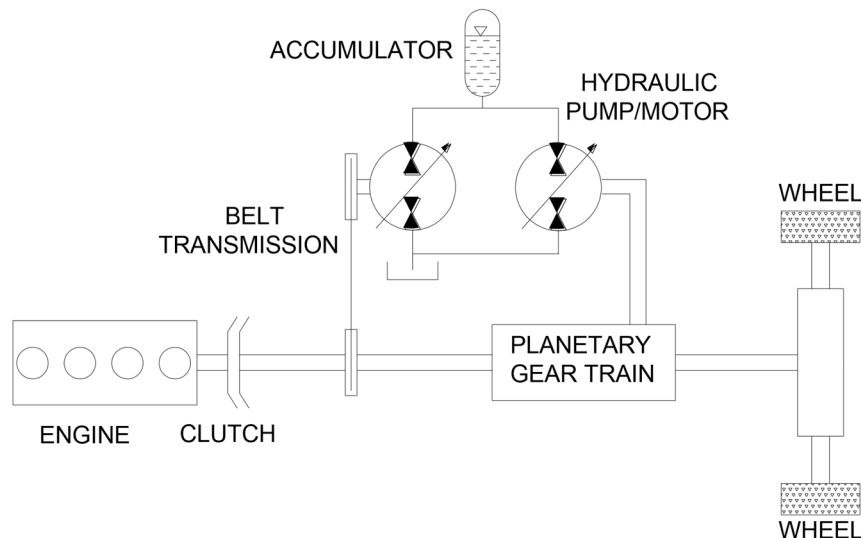


Figure 3 Configuration of a power-split hydraulic hybrid vehicle (PSHHV)

train enables highly efficient power transfer from engine to wheels of the parallel architecture while maintaining the optimal engine management of the series architecture.

Li et al. [25] proposed a power coupling system of the hydraulic hybrid city bus, and analyzed the operating modes of the system. Simulation was proposed under MATLAB/Simulink. The results show that this power coupling system could solve the coupled problem of the hydraulic bus effectively. Compared with the traditional city bus, the low-powered engine can be taken into the hydraulic hybrid city bus to improve the fuel economy and emission performance. Cheong et al. [26] proposed an approach for optimizing the configuration and sizing of a PSHHV transmission. In this paper different configurations were presented such as input coupled, output coupled and compound configurations. A case study on a compact sized vehicle

indicates that the optimized compound power-split and input coupled power-split have better fuel economy and require smaller pumps/motors than an optimized output coupled power-split.

2.4 The similarities and differences between the configurations of hydraulic hybrid vehicles

Each of the three different types of configurations have their own advantages and disadvantages. While parallel is easy to implement on existing non-hybrid configurations, the fuel savings are not as great because the engine operation is not independent of the wheel load. The series configuration accomplishes this goal but with a penalty of transmission efficiency. The power-split is a combination of the parallel and series, which also means it is the most complex to control and the most efficient control strategy is not apparent.

3. Comparison of HHV with HEV

One of the biggest disadvantages of a HHV is low energy density. Energy density is the amount of energy stored in a given system or region of space per unit volume. So, to save energy and re-use it in HHV it is necessary to have a relatively large container (hydraulic accumulator). The vehicle must also have a fuel tank with additional hydraulic low and high pressure accumulators. It is important to emphasize that for heavy vehicles this disadvantage is not so pronounced as there is enough space for all HHV equipment. HEV do not have this problem because the electric battery has a relatively high energy density. This is why HEV are used for smaller passenger vehicles. Many scientific researches today deal with the problem of increasing the energy density of hydraulic accumulators. When it comes to power density, HHV has no competition among other hybrids. Power density or volume power density is the amount of power per unit volume. HHV have very high-power density unlike HEVs that have low power density. In other words, HHV can deliver big amount of energy in very short periods of time. This, for example, comes to light when sudden acceleration is required under heavy loads. Another very popular thing about hybrid vehicles is regenerative braking. By regenerative braking the hybrid vehicle system captures the kinetic energy of stopping the vehicle instead of losing that energy through conventional braking. Energy stored in electric batteries or in a hydraulic accumulator via regenerative braking can be reused for starting a vehicle, accelerating, etc. The efficiency of the regenerative braking in HHV is much higher than that of the HEV regenerative braking efficiency [2]. For the same amount of energy, the hydraulic hybrid vehicle can save almost 80% of the kinetic energy and re-turn it into useful work, while the hybrid electric vehicle can only use 30% of the kinetic energy of the vehicle. Efficiency of hydraulic components, hydraulic transformation into mechanical energy and vice versa is considerably higher than for electrical components. This is the reason for this significant difference in the efficiency of regenerative braking. The main advantages and disadvantages of HHV and HEV are shown in Table 1. It is very important how quickly you can save energy in a hybrid vehicle. Regenerative charging at HHV is considerably faster than at HEV. The reason for this is the relatively slow charge of the electric battery compared to the fast and efficient conversion from mechanical to hydraulic energy. Today, product prices and maintenance costs determine product competitiveness on the market. Initial investment in hydraulic equipment is lower than the investment in HEV electrical equipment. This is especially true for electric batteries that are expensive. The investment return period for HEV in the category of heavy vehicles is very large or none at all.

Table 1 Comparison between HHV and HEV

Parameter	HHV	HEV
Energy density	Low	High
Power density	High	Low
Braking regeneration efficiency	80%	30%
Regeneration charging	Quick	Slow
Power to weight ratio	High	Low
Initial cost and maintenance cost	Low	High

Also, it is much easier and cheaper to maintain hydraulic systems than electrical ones. From all this it can be seen that HHV possesses different advantages over HEV. There is a problem with the space for hydraulic tanks due to low energy density, although perhaps even a bigger problem is the low representation of HHV in the market. It is necessary to improve the marketing of HHV and to familiarize the wider population with the advantages and opportunities of such hybrid systems.

Rydberg [27] presented the advantages of hydraulic hybrid systems over electric hybrids and how to succeed with the hybrid system design. Chen [28] adopted MATLAB/Simulink to construct complete HHV and HEV models for backward simulations. New European Driving Cycles were used to determine the changes in fuel economy. The simulation results show that fuel consumption was 21.80% lower in the SHHV compared to the series hybrid electric vehicle; additionally, fuel consumption was 3.80% lower in the parallel hybrid electric vehicle compared to the PHHV. The simulations indicated that hydraulic-electric hybrid vehicle could provide the best energy cost among all the configurations studied in this paper. Louvigny et al. [29] compared both HEV and HHV buses. The fuel consumption was simulated using ADVISOR on the basis of three different driving cycles. The results showed that the HHVs are penalized by their weight but this type of vehicles can be economically interesting because of the lower cost and longer lifetime of the hydraulic system. Louvigny et al. [30] investigated and compared, from an economical and technical point of view, both HHV and HEV buses using batteries or super capacitors as energy storage systems. The results show that HHV and HEV with super capacitors can't rival from the consumption point of view with the HEV using batteries as the energy storage system.

4. Conclusion

Hybridization of vehicles is necessary to reduce fuel consumption and emissions of harmful gases. The natural resources of this planet are limited and it is important to get energy-efficient hybrid vehicles as soon as possible. Today the market of hybrid vehicles is mostly represented by the HEV, and because of that majority of the commercialization efforts is made in the field of the HEV. The aim of this paper is to introduce a greater number of scientists to the concept of HHV. PHHV is the simplest HHV configuration but fuel savings are not so great. The SHHV configuration has significant fuel savings but has reduced transmission efficiency. The PSHHV configuration is most complex for control, although it provides a compromise between PHHV and SHHV configuration. The main disadvantage of the HHV in relation to HEV is low energy density, and that makes them unsuitable for passenger cars. But, for heavy duty vehicles, due to high power density, and low initial and maintenance costs of the hydraulic components, hybridization using hydraulic components is very likely in the future.

REFERENCES

- [1] Meyer, J. (2014). *The development of a power management strategy for a hydraulic hybrid passenger vehicle*. Unpublished doctoral dissertation, University of Minnesota Digital Conservancy.
- [2] Karbaschian, M. (2014). *Improving system design and power management for hybrid hydraulic vehicles minimizing fuel consumption*. Unpublished doctoral dissertation, Universitat Duisburg-Essen.
- [3] Mingwei, S. (2009). *Modelling and control strategy for series hydraulic hybrid vehicles*. Unpublished doctoral dissertation, The University of Toledo.
- [4] Wu, B., Lin, C., Filipi, Z., Peng, H., Assanis, D. (2002). Optimization of Power Management Strategies for a Hydraulic Hybrid Medium Truck. *Proceedings of the 2002 Advanced Vehicle Control Conference*. Hiroshima Japan.
- [5] Stelson, K., Meyer, J., Alleyne, A., Hancey, B. (2008). Optimization of a passenger hydraulic hybrid vehicle to improve fuel economy. *Proceedings of the 7th JFPS International Symposium on Fluid Power*. ToyamaA.
- [6] Sakota, Z., Jovanovic, Z., Diligenski, Dj., Zivanovic, Z., Nikolic, D. (2013). Improving the fuel economy by using hydraulic hybrid powertrain in passenger cars. *Machines, technologies, materials*. ISSN 1313-0226. ISSUE 4/2013.
- [7] Liu, T., Zheng, J., Su, Y., Zhao, J. (2013). A Study on Control Strategy of Regenerative Braking in the Hydraulic Hybrid Vehicle Based on ECE Regulations. *Mathematical Problems in Engineering*, Volume 2013, Article ID 208753, 9 pages.
- [8] Hilman, N., Saw, L., Hamdi, M., Norhirni, M. (2010). Performance Evaluation of Parallel Hydraulic Hybrid Vehicle using EPA US06 Aggressive Drive Cycle Simulation. *International Postgraduate Students Conference on Engineering*. Bandung Indonesia.
- [9] Mrdja, P., Miljic, N., Popovic, S. (2012). Assessment of Fuel Economy Improvement Potential for a Hydraulic Hybrid Transit Bus. *GDC2012 Conference*.
- [10] Deppen T.O., Alleyne, A., Stelson, K., Meyer, J. (2011). A Model Predictive Control Approach for a Parallel Hydraulic Hybrid Powertrain. *2011 American Control Conference*, San Francisco California USA.
- [11] Wu, B., Lin, C., Filipi, Z., Peng, H., Assanis, D. (2004). Optimal power management for a hydraulic hybrid delivery truck. *Vehicle System Dynamics*, 42 , 23-40.
- [12] Tao, L., Jincheng, Z., Shuwen, W., Fangde, Gu. (2013). Logic threshold based energy control strategy for parallel hydraulic hybrid vehicles. *Research Journal of Applied Sciences, Engineering and Technology*, 6, 2339-2344.
- [13] Hatti, R (2015). Hydraulic Hybrid Vehicle. *International Journal of Engineering Research and General Science*, 3 (1), 85-90.
- [14] Vien Vu, T. (2016). Different Rule-based Control Schemes for a Series Hydraulic Hybrid Vehicle. *Studies in Engineering and Technology*, 3, 101-108.
- [15] Chen, C., Vien Vu, T., Hung, C. (2013). System Modelling and Control Strategy Development for a Series Hydraulic Hybrid Vehicle. *Proceedings of the International MultiConference of engineers and Computer Scientists 2013*. Hong Kong.
- [16] Chen, Y., Liu, S., Jiang, J., Shang, T., Zhang, Y., Sui, H. (2015). Pulsating characteristic of the hydraulic hybrid vehicle system with pipeline effect. *Mechanical Engineering Science 2015*, 229.
- [17] Baer, K., Ericson, L., Kraus, P. (2014). Component sizing study for a light-duty series hydraulic hybrid vehicle in urban drive cycles. *ABCMSymposium Series in Mechatronics*, Ribeirao Preto Brazil.
- [18] Feng, D., Huang, D. (2012). Modelling and Control of a Series Hydraulic Hybrid Vehicle, *Journal of Computational Information Systems*, 5, 1805–1819.
- [19] Filipi, Z., Kim, Y. (2010). Hydraulic Hybrid Propulsion for Heavy Vehicles: Combining the Simulation and Engine-In-the-Loop Techniques to Maximize the Fuel Economy and Emission Benefits, *Oil & Gas Science and Technology – Rev. IFP*, 65, 155-178.

- [20] Payeganeh, G., Esfahanian, M., Bonab, S. (2014). Modelling and Fuzzy Control Strategy Design for the Hydraulic Hybrid Refuse Truck, *International Journal of Automotive Engineering*, 4(2), 685-698.
- [21] Li, S., Liu, D., Xie, B. (2014). The Control System Design of Hydraulic Hybrid Vehicle Based on CAN Bus, *The Open Mechanical Engineering Journal*, 8, 739-743.
- [22] Hiremath, S., Ramakrishnan, R., Singaperumal, A. (2013). Optimization of process parameters in series hydraulic hybrid system through multi-objective function. *The 13th Scandinavian International Conference on Fluid Power - SICFP2013*, Linköping Sweden.
- [23] Mahmoodi, S., Guoqing, H., Khajavi, M. (2016). Investigation of control model in a series hybrid hydraulic/electric system for heavy vehicles based on energy efficiency, *Chinese Journal of Engineering*, Volume 2016, Article ID 2417946, 9 pages.
- [24] Chen, C., Vu, T., Hung, C. (2013). Control strategy development and optimization for a series hydraulic hybrid vehicle, *Engineering letters*, Advance online publication.
- [25] Li, X., Qu, J., Wei, W., Tian, X. (2014). Modelling and Simulation of Power Coupling System in Hydraulic Hybrid City Bus, *Energy and Power Engineering*, 6, 119-132.
- [26] Cheong, K., Li, P., Chase, T. (2010). Optimal Design of Power-Split Transmissions for Hydraulic Hybrid Passenger Vehicles, *Energy and Power Engineering*.
- [27] Rydberg, K. (2009). Energy Efficient Hydraulic Hybrid Drives. *The 11:th Scandinavian International Conference on Fluid Power - SICFP'09*. Linköping Sweden.
- [28] Chen, J. (2015). Energy Efficiency Comparison between Hydraulic Hybrid and Hybrid Electric Vehicles, *Energies*, 8, 4697-4723.
- [29] Louvigny, Y., Nzisabira, J., Duysinx, P. (2007). Analysis of hydraulic hybrid vehicles and economical comparison with hybrid electric vehicles. *EET-2007 European Ele-Drive Conference*. Brussels Belgium.
- [30] Louvigny, Y., Nzisabira, J., Duysinx, P. (2008). Analysis of hybrid hydraulic vehicles and comparison with hybrid electric vehicles using batteries or super capacitors. *EET-2008 European EleDrive Conference International Advanced Mobility Forum*. Geneva Switzerland.

Three-Axis Force Load Cells Comparative Analysis

Dražen Kustura, Tomislav Matić
Faculty of Science, Split, Croatia
{drazen.kustura, tomlav.matic}@pmfst.hr

Frane Vlak, Stipe Perišić
Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Split, Croatia
{frane.vlak, stipe.perisic}@fesb.hr

Abstract. In this paper, comparative analysis based on the crosstalk effect was performed. For that purpose, a three-dimensional finite element analysis on two types of three-axis load cells was used. The first load cell type is a commercial K3D400 load cell and the other one is a load cell whose design is based on the Maltese cross configuration. The results of these analyses are presented and discussed.

Key words: *load cell, finite elements, crosstalk*

1. Introduction

A load cell is a device that is used for measurement of force intensity. When a force is applied to it, a load cell produces an output signal that is proportional to the applied force [1]. Amongst many types of load cells, the ones most used are strain gauge load cells (SGLC). Their essential components are: (i) an object, that deforms when the load is applied on it, and (ii) the strain gauges, that are attached to that object [2]. The deformation of that object causes deformation of the strain gauge, and consequently the change of its electrical resistance. Strain gauge output signal is a voltage change in its electrical circuit, typically a Wheatstone bridge, and it is proportional to the applied force. In the case when more strain gauges are attached to the load cell, different types of Wheatstone bridge circuits are used for arbitrary addition or subtraction of their corresponding signals. The result of these operations is also proportional to the applied force. SGLC measuring capacity varies, but as their capacity increases, less of them can be found on the market. Custom three-axis SGLC, based on the Maltese cross configuration [3], was designed with the purpose of determining the force that is the result of the specific loading condition [4]. According to the authors' knowledge, one of a few commercially available three-axis SGLC capable of measuring that same force is K3D400 SGLC [5, 6]. Thus, comparative analysis between the custom SGLC and K3D400 SGLC is performed. Amongst many SGLC parameters, the crosstalk is taken to be the most important for this comparative analysis. Crosstalk is an unwanted transfer of signals between communication channels [7] and it appears in every multi-axis load cell. In this paper crosstalk is expressed as an absolute value of the ratio of two resulting deformations corresponding to the force component determined in the Cartesian coordinate system. When only arbitrary force component is loaded on the load cell, the observed force component resulting deformation is taken as the numerator of that ratio. The denominator of that ratio is also the observed component resulting deformation, but in this case only the observed component is loaded on the load cell. Solid model of the custom SGLC is obtained using *Inventor 2017* [8], and both load cells are analysed using FEA software *Simulation Mechanical 2017* [9].

2. K3D400 SGLC Crosstalk Analysis

The K3D400 SGLC solid model [6] is shown in Figure 1, while the assembly used in its analysis is shown in Figure 2. The *Grounded Bolt* type is used for modeling the bolts used for connecting SGLC model and the base plate, while the *Bolt Without Nut* type is used for modeling all other bolts. The remaining parts are modeled using tetrahedron finite elements and data related to this analysis is given in Table 1. The base plate and the load plate were specially designed, and their purpose is same in both analyses. Surface, on which SGLC would have been mounted, is represented with the base plate, while the external load is applied to the load plate upper surface. Both parts are considered rigid therefore, their elasticity modules are enlarged one hundred times compared to the load cell material. The adapter plate was used in order to mount the load plate to the SGLC. Considering that custom SGLC is specially designed for determination of the specific force, $F = 266 \text{ i} - 375 \text{ k}$ kN, both analyses are performed for that load scenario. Due to the orientation variability of the K3D400 SGLC, the horizontal force component can be declared either as F_x or F_y . Therefore, three load cases are sufficient for K3D400 SGLC crosstalk analysis and their details are given in Table 2.

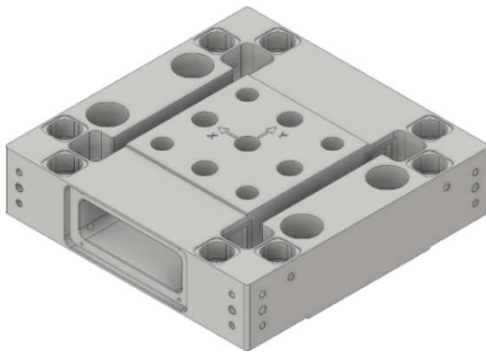


Figure 1 K3D400 SGLC solid model [6]

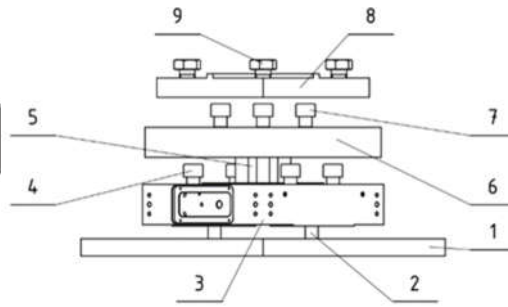


Figure 2 K3D400 SGLC assembly

Table 1 K3D400 SGLC analysis parts

Part no.	Name	Material	Quantity	Details
1	Base plate		1	Stiffness
2	Centring pin	EN 1.2344	2	$\Phi 30$
3	K3D400 SGLC	EN 1.2344	1	[6]
4	M30 bolt	EN 1.2344	4	$T_a = 1800 \text{ kN}\cdot\text{m}$
5	Centring pin	EN 1.2344	5	$\Phi 30$
6	Adapter plate	EN 1.2344	1	
7	M30 bolt	EN 1.2344	4	$T_a = 1800 \text{ kN}\cdot\text{m}$
8	Load plate		1	Stiffness
9	M42 bolt	EN 1.2344	4	$F_a = 620 \text{ kN}$

Table 2 K3D400 SGLC analysis load cases

Load case	$F_x / [\text{N}]$	$F_y / [\text{N}]$	$F_z / [\text{N}]$
1	0	0	-375000
2	266000	0	0
3	0	266000	0

In this paper K3D400 SGLC force components are determined with assumed directions of the strain gauges (longitudinal strain gauge axis is parallel with the respective force component). It is also assumed that the horizontal force components are determined using the uniaxial strain gauges, while the vertical force component is determined using the shear strain gauges. The strain gauge centers are coincident with the centers of respective measuring surfaces and their positions and orientations are shown in Figure 3. The other ten strain gauges that are not shown in Figure 3 are positioned on their respective surfaces in the same way. Deformation values, from the uniaxial strain gauges, are represented as the mean deformations from surface nodes of the corresponding finite elements. These surfaces are taken to be rectangular (3x4 mm) and their positions and orientations match to the respective strain gauges. Shear strain gauges have two measuring grids aligned on 45° and 135° with respect to its longitudinal axis and deformations corresponding to these grids are obtained by strain transformations. Again, the finite elements surface nodes that correspond to the strain gauges are taken to be rectangular (5.7x7 mm) and their position and orientation also match to the respective strain gauge. All that results in two deformation values for each shear strain gauge position, and one deformation value for each uniaxial strain gauge position. Strain gauges connection principle in a Wheatstone bridge electrical circuit is used for determination of the resulting deformation corresponding to the force component. When the SGLC is loaded by only the observed force component, this principle leads to the maximal value of the resulting deformation.

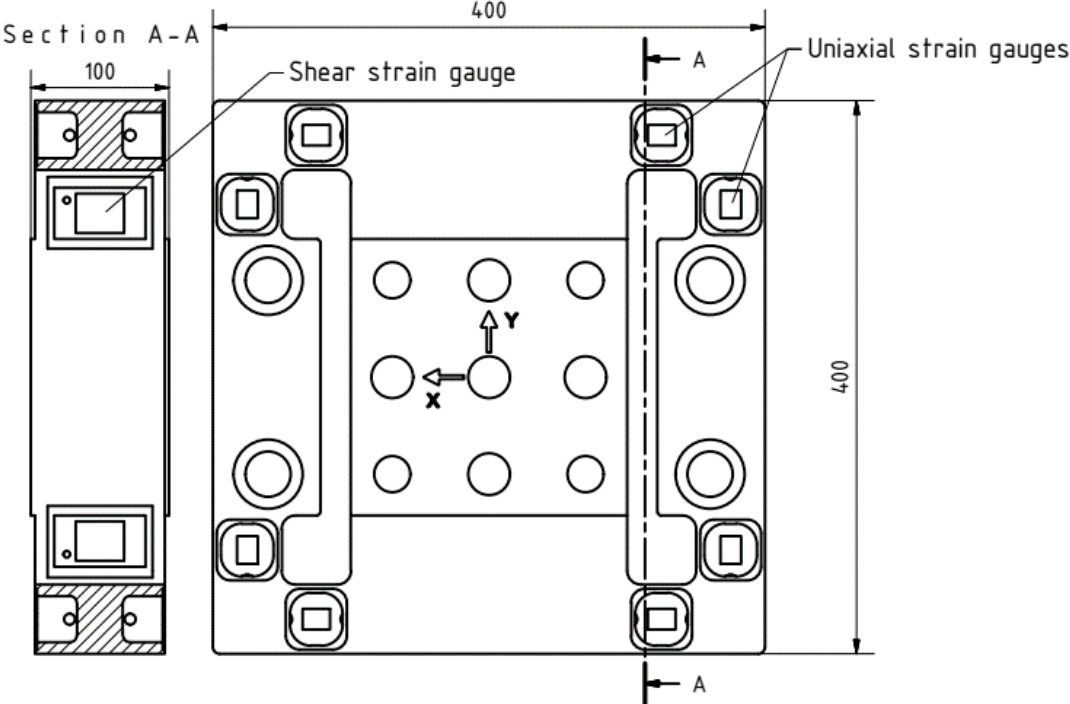


Figure 3 K3D400 SGLC [6] assumed strain gauges positions and orientations

Two pairs of crosstalk analysis results, based on K3D400 SGLC orientation, were acquired and they are: (i) $CT\ x/z = 0.022\%$ and $CT\ z/x = 0.04\%$, and (ii) $CT\ y/z = 0.03\%$ and $CT\ z/y = 0.192\%$. $CT\ x/z$ is the crosstalk error of the z -component of the force due to the x -component of the force being applied to the load cell. In this case, according to the crosstalk definition in the Introduction, the z -component of the force is the observed component, while the x -component of the force is the arbitrary one. $CT\ z/x$, $CT\ y/z$, and $CT\ z/y$ are expressed and calculated correspondingly.

3. Custom SGLC Crosstalk Analysis

The custom SGLC solid model, designed in [4], is shown in Figure 4, while the assembly used in its analysis is shown in Figure 5. All parts are modeled in the same manner as the K3D400 SGLC ones, while the data related to this analysis is given in Table 3. The base plate, the adapter plate and the load plate were also specially designed. In this case the purpose of the adapter plate is separation of the load plate and the custom SGLC. The load plate is same as in the first analysis and the load is also applied to its upper surface. Due to the orientation invariability of the custom SGLC, only two load cases are needed for its crosstalk analysis, and these two load cases are first two load cases declared in Table 2.

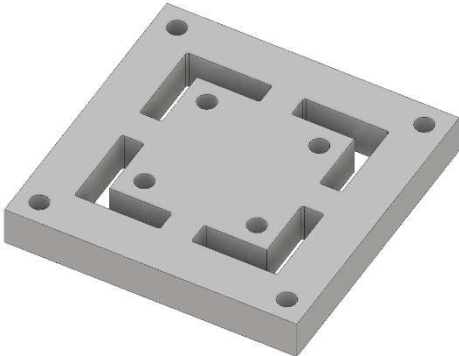


Figure 4 Custom SGLC solid model [4]

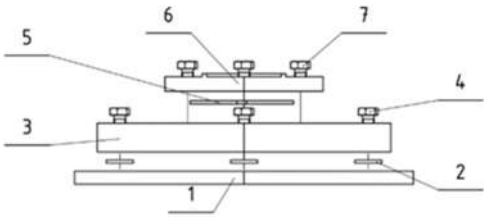


Figure 5 Custom SGLC assembly

Table 3 Custom SGLC analysis parts

Part no.	Part name	Material	Quantity	Details
1	Base plate		1	Stiffness
2	Washer	EN 58E	4	
3	Custom SGLC	EN 58E	1	[4]
4	M42 Bolt	EN 58E	4	$F_a = 620 \text{ kN}$
5	Adapter plate	EN 58E	1	
6	Load plate		1	Stiffness
7	M42 Bolt	EN 58E	4	$F_a = 620 \text{ kN}$

The horizontal force component is determined using strain gauges whose longitudinal axes are parallel to the custom x -axis, while the vertical force component is determined using strain gauges whose longitudinal axes are parallel to its y -axis. In this case the uniaxial strain gauges are used for determining both force components. Strain gauge centres and orientations are shown in Figure 6, while the other four strain gauges that are not shown in Figure 6 are positioned on their respective surface in the same way. Their respective deformations are also represented with the mean deformations from corresponding finite elements surface nodes. These surfaces are also rectangular (3x4 mm) and their positions and orientations match to the respective strain gauges. Their resulting deformation connection principle, for each force component, is same as one in K3D400 SGLC. This analysis has obtained one crosstalk result pair: $CT_{x/z} = 0.469\%$ and $CT_{z/x} = 0.062\%$. It is important to notice that, due to the custom SGLC orientation invariability, $CT_{y/z} = CT_{x/z}$ and $CT_{z/y} = CT_{z/x}$. Custom SGLC analysis model, for the second load case from Table 2, is shown in Figure 7 while the K3D400 SGLC model, for the third load case, is shown in Figure 8.

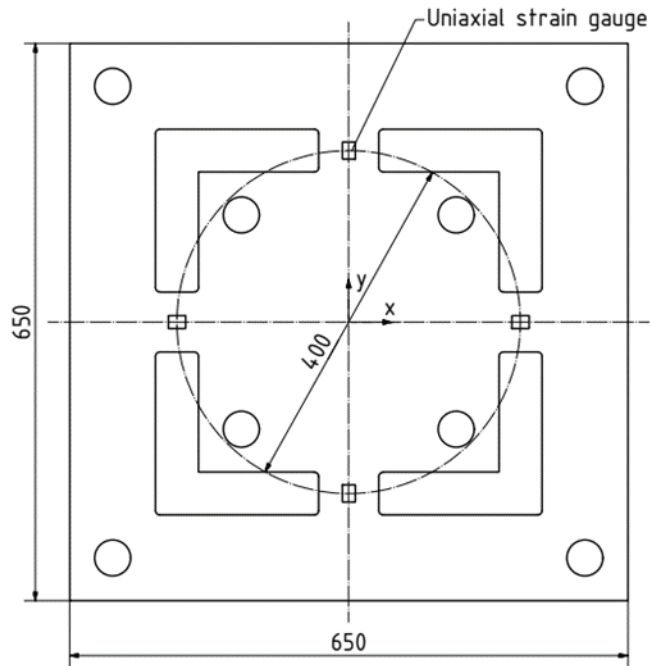


Figure 6 Custom SGLC strain gauges positions and orientations

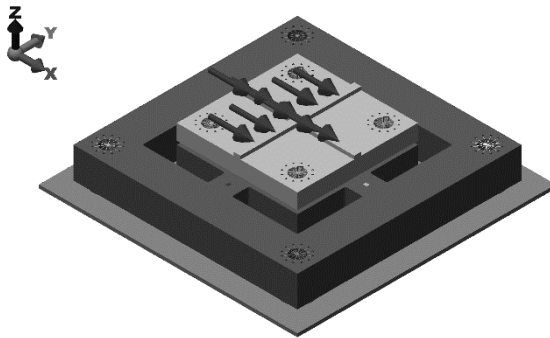


Figure 7 Custom SGLC analysis model

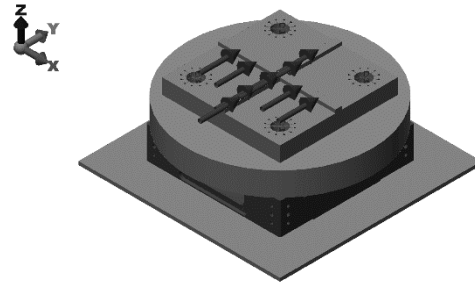


Figure 8 K3D400 SGLC analysis model

4. Conclusions

Since the custom load cell is not manufactured, this finite element analysis is the most appropriate manner to compare *SGLC* crosstalk values. The K3D400 *SGLC* technical documentation [5, 6] declares that its $CT_{x/z}$ and $CT_{y/z}$ are 2% of a full scale at rated load, while its $CT_{z/x}$ and $CT_{z/y}$ are 1% of a full scale at rated load. Therefore, the K3D400 *SGLC* crosstalk analysis results, obtained with this investigation, can be accepted and following conclusions can be made. Custom *SGLC* crosstalk, for the case when the vertical force component is observed, is significantly larger than the K3D400 *SGLC* corresponding crosstalk values. On the contrary, if the observed component is horizontal, custom *SGLC* crosstalk is between the K3D400 *SGLC* corresponding crosstalk values. As a conclusion, in this analysis the force F is most accurately determined in the case when K3D400 *SGLC* model is used and its x -axis is parallel to the horizontal force component. These results are valid only for this analysis scenario and for their experimental validation custom *SGLC* must be manufactured.

REFERENCES

- [1] Scale Manufacturers Association. (2010). *Load Cell Application and Test Guideline* [White paper]. Columbus, Ohio: Scale Manufacturers Association. Retrieved April 10, 2018, from Scale Manufacturers Association:
<http://scalemanufacturers.org/PDF/LoadCellApplicationTestGuidelineApril2010.pdf>
- [2] Interface. (2009). *Load cells, a Primer on the Design and Use of Strain Gage Force Sensors* [White paper]. Scottsdale, Arizona: Interface. Retrieved April 11, 2018, from Diversified Technical Systems: <http://dtsweb.com/library/tech/Load%20Cell%20Primer.pdf>
- [3] Stefanescu, D. M. (2016(+)). *Handbook of Force Transducers: principles and components*. Berlin, Germany: Springer.
- [4] Kustura, D. (2017). *Dizajn mjerne doze za određivanje kapaciteta vitla* (diploma thesis).
- [5] ME-Meßsysteme. (2017). *3-Axis Force Sensor K3D400 Datasheet*. Hennigsdorf, Germany: ME-Meßsysteme. Retrieved January 17, 2018, from ME-Meßsysteme:
<https://www.me-systeme.de/docs/en/datasheets/k3d400.pdf>
- [6] ME-Meßsysteme GmbH. (2017). *3-Axis Force Sensor K3D400 model*. Hennigsdorf, Germany: ME-Meßsysteme. Retrieved January 17, 2018, from ME-Meßsysteme:
<https://www.me-systeme.de>
- [7] Citation. (2018). *Oxford Dictionary*. Retrieved April 1, 2018, from <https://en.oxforddictionaries.com/definition/crosstalk>
- [8] *Inventor 2017* [Computer software]. (2017). Retrieved from <https://www.autodesk.com/education>
- [9] *Simulation Mechanical 2017* [Computer software]. (2017). Retrieved from <https://www.autodesk.com/education>

A Short Review of Calculation of Normal and Shear Stresses in a Cantilever Thin-Walled Bar with Asymmetric Open Cross-Section

Ado Matoković

University Department of Professional Studies, Split, Croatia
amatokov@oss.unist.hr

Bože Plazibat

University Department of Professional Studies, Split, Croatia
bplazibat@oss.unist.hr

Abstract. A cantilever thin-walled bar with open cross-section is considered in this paper. The thin-walled bar with asymmetric C cross-section loaded by a concentrated force parallel to x – axis at free end is given as an illustrative example. The thin-walled bar is subjected to tension, to bending about two principal cross-section axis and to torsion with restrained warping. Because of that, in an arbitrary point of cross-section contour, normal stresses due to tension, bending and restrained warping including shear stresses that consist of Saint Venant shear component and warping component appear.

All geometrical properties of asymmetric C thin-walled cross-section needed for calculation of normal and shear stresses are given in numerical and graphical outputs using the programme package SEKTOR. Distributions of normal and shear stresses over cross-section contour at several sections perpendicular to the x – axis are given. The obtained values are compared with those obtained by means of the finite element method.

Key words: *thin-walled bar, open cross-section, restrained warping, normal and shear stresses*

1. Introduction

Thin-walled bars with open cross-section are often parts of modern metal construction and are used extensively in steel bridges, ships, aircraft, mining head frames, gantry cranes and other structures where weight and cost are prime consideration. Thin-walled structures are very light when compared with alternative structures. The basic characteristic of thin-walled bar is that thickness of its cross section is small compared with other dimensions of cross-section which are in turn often small compared with the length of the bar.

The theory of thin-walled bars with open cross-section, as well as their torsion and bending are given in [1], [2].

There are some particularities in computing of normal and shear stresses in bars with thin-walled open cross-section. The intention of this paper is to emphasize the difference in computing of normal stresses in bars with thin-walled open cross-section in comparison with the classical theory when the bars are subjected to tension and bending. A short review of the computing of normal and shear stresses in a thin-walled bar with open-cross-section is presented in this paper. Similar examples with symmetric C and T thin-walled cross sections are considered in [3], [4], [5]. A cantilever bar with asymmetric C thin-walled cross-section with length $l = 2$ m, loaded by a force at free end with material properties $E = 210$ GPa and $\nu = 0.3$ is chosen as an illustrative example (Fig. 1).

The thin-walled bar is subjected to tension, to bending about two principal cross-section axis and to torsion with restrained warping. Because of that, in an arbitrary point of cross-section contour normal stresses due to tension, bending and restrained warping including shear stresses that consist of Saint Venant shear component and warping component appear.

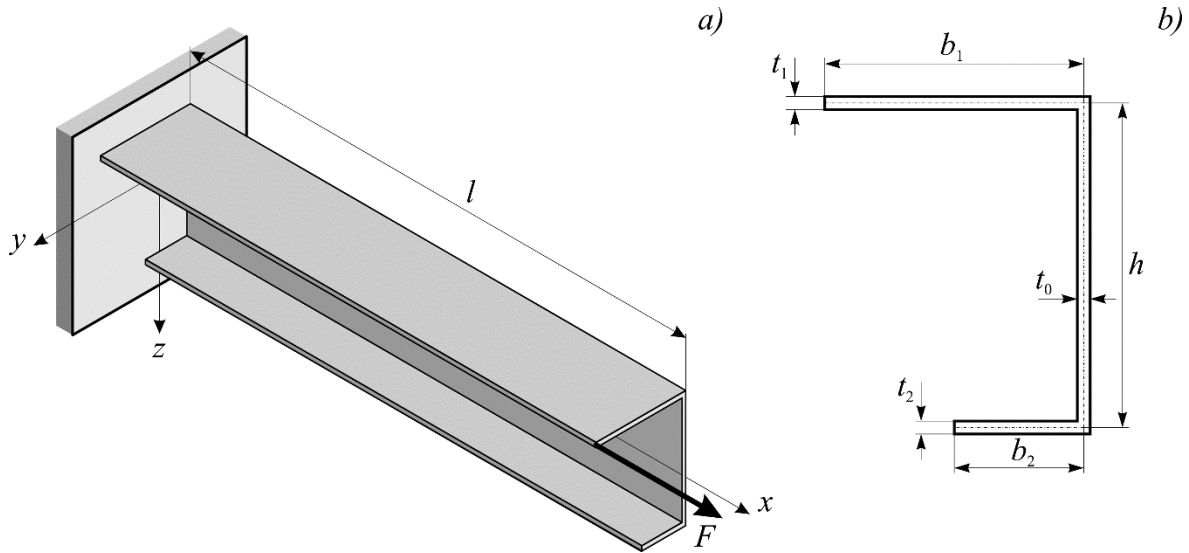


Figure 1 a) a cantilever bar loaded by a force at free end, b) thin-walled open cross-section of the bar

2. Geometrical Properties of Cross-Section

The cross-section middle line is shown in Fig. 2.a, since the cross-section middle line with centroid and principal axis y_0 and z_0 as well as the principal pole are shown in Fig. 2.b

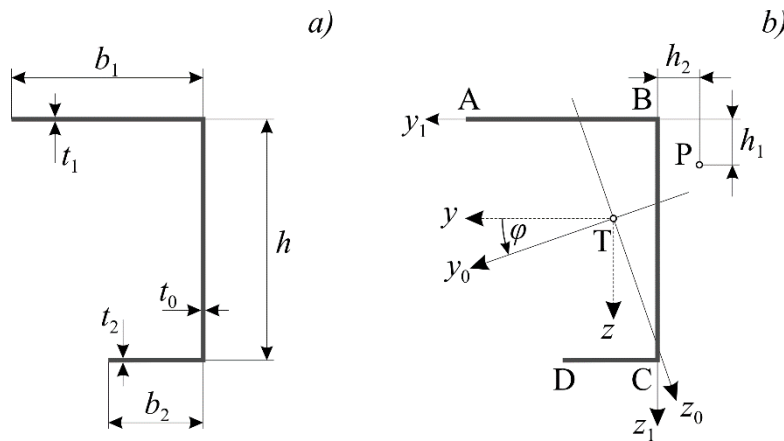


Figure 2 a) the cross-section middle line; b) the cross-section middle line with centroid, principal axis and pole

The thin-walled open cross-section shown in Fig. 2.a has the following dimensions

$$b_1 = 200 \text{ mm}; \quad h = 250 \text{ mm}; \quad b_2 = 100 \text{ mm}; \quad t_1 = 10 \text{ mm}; \quad t_0 = 8 \text{ mm}; \quad t_2 = 10 \text{ mm}.$$

All geometrical properties needed for calculating normal and shear stresses are computed using the program package SEKTOR [6], [7] and they are as following:

$$\begin{aligned} y_{T1} &= 50 \text{ mm}; & z_{T1} &= 100 \text{ mm}; & h_1 &= 43.860 \text{ mm}; & h_2 &= 44.737 \text{ mm}; \\ A &= 5000 \text{ mm}^2; & I_{y_0} &= 58.0225 \cdot 10^6 \text{ mm}^4; & I_{z_0} &= 13.6441 \cdot 10^6 \text{ mm}^4; \\ \varphi_0 &= 17.14^\circ; & I_\omega &= 8.4064 \cdot 10^{10} \text{ mm}^6; & I_t &= 0.1427 \cdot 10^6 \text{ mm}^4. \end{aligned}$$

Distributions of principal coordinates y_0 and z_0 as well as principal sectorial coordinate ω_0 over cross-section contour are shown in Fig. 3.

Principal coordinates y_0 and z_0 are computed according to

$$y_0 = y \cdot \cos \varphi + z \cdot \sin \varphi ; \quad z_0 = -y \cdot \sin \varphi + z \cdot \cos \varphi . \quad (1)$$

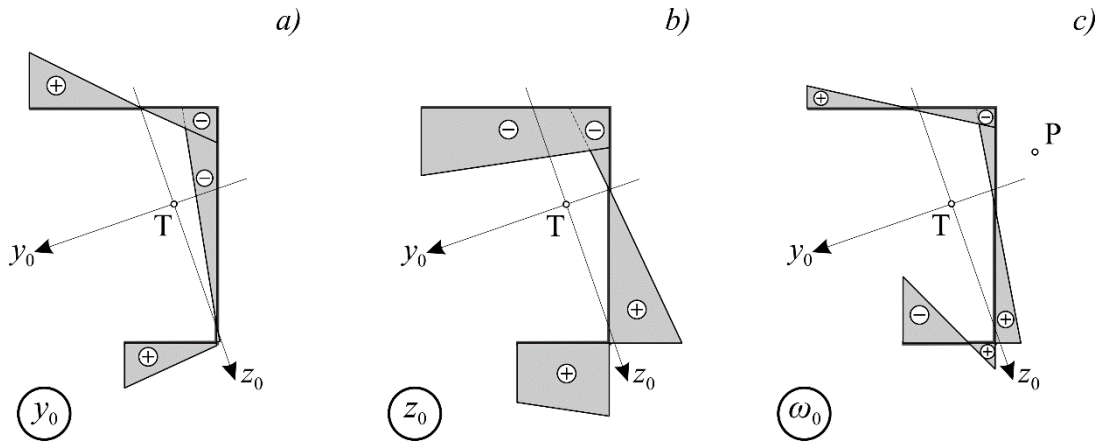


Fig. 3 a) principal coordinate y_0 , b) principal coordinate z_0 , c) principal sectorial coordinate ω_0

Values of principal coordinates y_0 and z_0 as well as values of principal sectorial coordinate ω_0 for characteristic points of cross-section contour A, B, C and D are given in Table 1.

Table 1 Principal coordinates y_0 and z_0 , principal sectorial coordinate ω_0 at characteristic points A, B, C and D of cross-section contour

Point of the cross-section contour	y_0 mm	z_0 mm	ω_0 mm ²
A	113.86	-139.77	4605.3
B	-77.26	-80.82	-4166.7
C	-3.56	158.07	7017.5
D	91.99	128.60	-13596.5

3. Internal Forces

Internal forces [1], [2], [3], [4], [5], at cross-section are

N - axial force;

M_y - bending moment about principal axis y_0 ;

M_z - bending moment about principal axis z_0 ;

B - bimoment;

M_ω - warping torsion moment,

M_{ts} - Saint Venant torsion moment,

M_t - total torsion moment, computed according to

$$M_t = M_{ts} + M_\omega . \quad (2)$$

The first three of six internal forces written above can be obtained as in classical theory when the bar is subjected to tension and bending about principal axis:

$$N = F = 50 \text{ kN};$$

$$M_{y_0} = F \cdot z_{0,A} = 50000 \cdot (-139.772) = -6.989 \cdot 10^6 \text{ N} \cdot \text{mm};$$

$$M_{z_0} = -F \cdot y_{0,A} = -50000 \cdot 113.859 = -5.693 \cdot 10^6 \text{ N} \cdot \text{mm}.$$

Bimoment, warping torsion moment and Saint Venant torsion moment can be obtained according to

$$B = -E \cdot I_\omega \cdot \frac{d^2 \alpha}{dx^2}; \quad M_\omega = -E \cdot I_\omega \cdot \frac{d^3 \alpha}{dx^3}; \quad (3)$$

and Saint Venant torsion moment according to

$$M_{ts} = -M_\omega, \quad (4)$$

since the total torsion moment M_t is equal zero.

The angle of torsion α in Eq. (3) can be obtained as a solution of differential equation

$$\frac{d^4 \alpha}{dx^4} - \frac{k^2}{l^2} \cdot \frac{d^2 \alpha}{dx^2} = \frac{1}{E \cdot I_\omega} \cdot \left(m_p + \frac{db}{dx} \right). \quad (5)$$

Because the cantilever beam is loaded only by concentrated force at free end Eq. (5) becomes

$$\frac{d^4 \alpha}{dx^4} - \frac{k^2}{l^2} \cdot \frac{d^2 \alpha}{dx^2} = 0, \quad (6)$$

where

$$k = l \cdot \sqrt{\frac{G \cdot I_t}{E \cdot I_\omega}}. \quad (7)$$

General solution of Eq. (6) is

$$\alpha = C_0 + C_1 \cdot x + C_2 \cdot \text{sh} \frac{k}{l} x + C_3 \cdot \text{ch} \frac{k}{l} x. \quad (8)$$

Integration constants in Eq. (8) are obtained according to the boundary conditions [1], [4]

$$\alpha(0) = 0; \quad \frac{d\alpha}{dx}(0) = 0; \quad M_t(l) = 0; \quad B(l) = B^* \quad (9)$$

where B^* is concentrated bimoment at free end given by

$$B^* = F \cdot \omega_{0,A} = 50000 \cdot 4605.263 = 2.3026 \cdot 10^8 \text{ N} \cdot \text{mm}^2.$$

The angle of torsion α referring to Eqs. (8) and (9) may be written

$$\alpha = \frac{B^* \cdot l^2}{E \cdot I_\omega \cdot k^2} \cdot \frac{1}{\text{ch} k} \left(\text{ch} \frac{k}{l} x - 1 \right). \quad (10)$$

Finally, bimoment, warping torsion moment and Saint Venant torsion moment referring to Eqs. (3) and (4) are

$$B = B^* \cdot \frac{1}{\text{ch} k} \cdot \text{ch} \left(k \cdot \frac{x}{l} \right); \quad M_\omega = -M_{ts} = \frac{B^*}{l} \cdot \frac{k}{\text{ch} k} \cdot \text{sh} \left(k \cdot \frac{x}{l} \right). \quad (11)$$

Values of these internal forces at free end $x/l=1$ referring to Eq. (11) are

$$B = B^* = 2.3026 \cdot 10^8 \text{ N} \cdot \text{mm}^2;$$

$$M_\omega = -M_{\omega s} = 0.1719 \cdot 10^6 \text{ N} \cdot \text{mm}.$$

Diagrams of internal forces expressed as $B / B(l)$; $M_\omega / M_\omega(l)$ are presented in Fig.4.

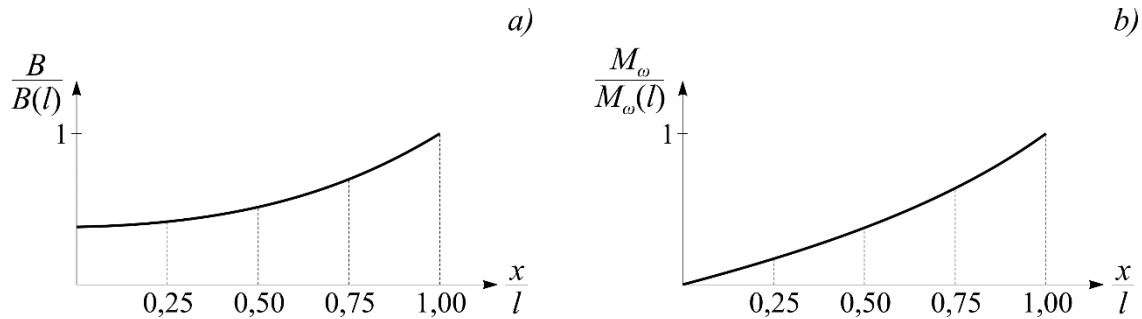


Fig. 4 a) normalised bimoment $B / B(l)$, b) normalised warping torsion moment $M_\omega / M_\omega(l)$

4. Normal and Shear Stresses

Because the bar is subjected to tension, bending about two principal axis and to torsion with restrained warping, normal stress could be computed according to [1], [2], [3], [4], [5], [8]

$$\sigma = \frac{N}{A} + \frac{M_{y_0}}{I_{y_0}} \cdot z_0 - \frac{M_{z_0}}{I_{z_0}} \cdot y_0 + \frac{B}{I_\omega} \cdot \omega_0. \quad (12)$$

Maximal total normal stress is at free end in point A of cross-section contour and according to Eq. (12) is

$$\begin{aligned} \sigma &= \frac{50 \cdot 10^3}{5 \cdot 10^3} + \frac{-6.989 \cdot 10^6}{58.0225 \cdot 10^6} \cdot (-139.772) - \\ &\quad - \frac{-5.693 \cdot 10^6}{13.6441 \cdot 10^6} \cdot 113.859 + \frac{2.3026 \cdot 10^8}{8.4064 \cdot 10^{10}} \cdot 4605.263 \\ \sigma &= 10 + 16.835 + 47.507 + 12.614 = 86.957 \text{ MPa} . \end{aligned}$$

The last term in Eq. (12) is normal warping stress and in calculating total normal stress has significant role as is presented in Table 2.

Table 2 Total normal stress and warping normal stress computed at characteristic points of cross-section contour at free end of a cantilever bar

	Total normal stress and warping normal stress MPa - at free end of a cantilever beam	
Point of the cross-section contour	Total normal stress	Warping normal stress
A	86.96	12.61
B	-23.91	-11.41
C	8.70	19.22
D	-4.35	-37.24

The results for total normal stresses for characteristic points of cross-section contour are compared with those obtained by FEM as is shown in Table 3.

Table 3 Total normal stresses computed analytically and using FEM at $x = 1.5$ m and at $x = 1.75$ m for characteristic points of cross-section contour

Point of cross-section contour	Normal stresses MPa - at $x = 1.5$ m		Normal stresses MPa - at $x = 1.75$ m	
	Analytically	FEM	Analytically	FEM
A	83.16	86.93	84.84	87.48
B	-20.48	-23.88	-22.00	-24.75
C	2.91	8.65	5.48	7.56
D	6.86	-4.26	1.89	-3.67

Total shear stress can be calculated as

$$\tau = \tau_{ts} + \tau_{\omega}, \quad (13)$$

where

$$\tau_{ts} = \frac{M_{ts}}{I_t} \cdot t; \quad \tau_{\omega} = \frac{M_{\omega} \cdot S_{\omega}^*}{I_{\omega} \cdot t}. \quad (14)$$

In Eq. (14) S_{ω}^* is the sectorial moment of the cut-off portion of area with respect to the principal sectorial coordinate ω_0 given by [5], [8]

$$S_{\omega}^* = \int_{s^*} \omega_0 \cdot t \cdot ds^*, \quad ds^* = -ds. \quad (15)$$

Distribution of S_{ω}^* over the cross-section contour is done by Eqs. (16) and shown in Fig. 5.c. [9].

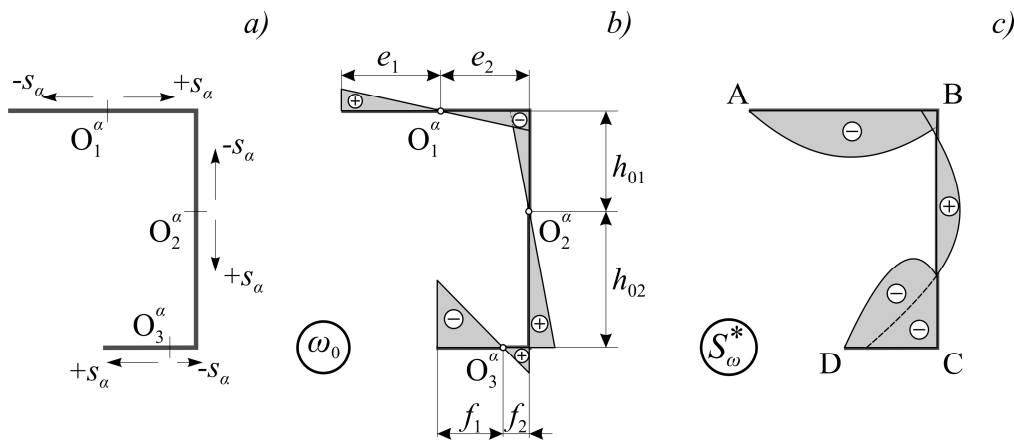


Fig. 5 a) positive and negative coordinate s_{α} over cross-section contour; b) distribution of principal sectorial coordinate ω_0 over cross-section contour; c) distribution of S_{ω}^* over cross-section contour

$$S_{\omega}^* = \frac{t_1 \cdot h_1}{2} \cdot (s_{\alpha}^2 - e_1^2) \quad -e_1 \leq s_{\alpha} \leq e_2;$$

$$S_{\omega}^* = -\frac{t_2 \cdot b_2 \cdot (h - h_1) \cdot (f_1 - f_2)}{2} + \frac{t_0 \cdot h_2}{2} \cdot (h_{02}^2 - s_{\alpha}^2) \quad -h_{01} \leq s_{\alpha} \leq h_{02} \quad (16)$$

$$S_{\omega}^* = -\frac{t_2 \cdot (h - h_1)}{2} \cdot (f_1^2 - s_{\alpha}^2) \quad -f_2 \leq s_{\alpha} \leq f_1.$$

For given cross-section middle line according to Fig. 5.b and values for ω_0 in Table 1 the following can be obtained:

$$e_1 = 105 \text{ mm}; e_2 = 95 \text{ mm}; h_{01} = 93.137 \text{ mm}; h_{02} = 156.863 \text{ mm};$$

$$f_1 = 65.957 \text{ mm}; f_2 = 34.043 \text{ mm}.$$

Values for S_{ω}^* referring to Eqs. (15), for Saint Venant torsion stresses τ_{ts} and for warping torsion stresses τ_{ω} according to Eq. (14), in characteristic cut sections contour are:

- cut section **a-a** (for $s_{\alpha} = 0$, $S_{\omega}^* = -2.418 \cdot 10^6 \text{ mm}^4$):

$$\tau_{ts} = \frac{-0.1719 \cdot 10^6}{0.1427 \cdot 10^6} \cdot 10 = -12.046 \text{ MPa},$$

$$\tau_{\omega} = \frac{0.1719 \cdot 10^6 \cdot (-2.418 \cdot 10^6)}{8.4064 \cdot 10^{10} \cdot 10} = -0.495 \text{ MPa};$$

- cut section **b-b** (for $s_{\alpha} = 0$, $S_{\omega}^* = 1.664 \cdot 10^6 \text{ mm}^4$):

$$\tau_{ts} = \frac{-0.1719 \cdot 10^6}{0.1427 \cdot 10^6} \cdot 9 = -10.842 \text{ MPa},$$

$$\tau_{\omega} = \frac{0.1719 \cdot 10^6 \cdot 1.664 \cdot 10^6}{8.4064 \cdot 10^{10} \cdot 9} = 0,378 \text{ MPa};$$

- cut section **c-c** (for $s_{\alpha} = 0$, $S_{\omega}^* = -4,484 \cdot 10^6 \text{ mm}^4$):

$$\tau_{ts} = \frac{-0.1719 \cdot 10^6}{0.1427 \cdot 10^6} \cdot 10 = -12.046 \text{ MPa},$$

$$\tau_{\omega} = \frac{0.1719 \cdot 10^6 \cdot (-4.484 \cdot 10^6)}{8.4064 \cdot 10^{10} \cdot 10} = 0.917 \text{ MPa}.$$

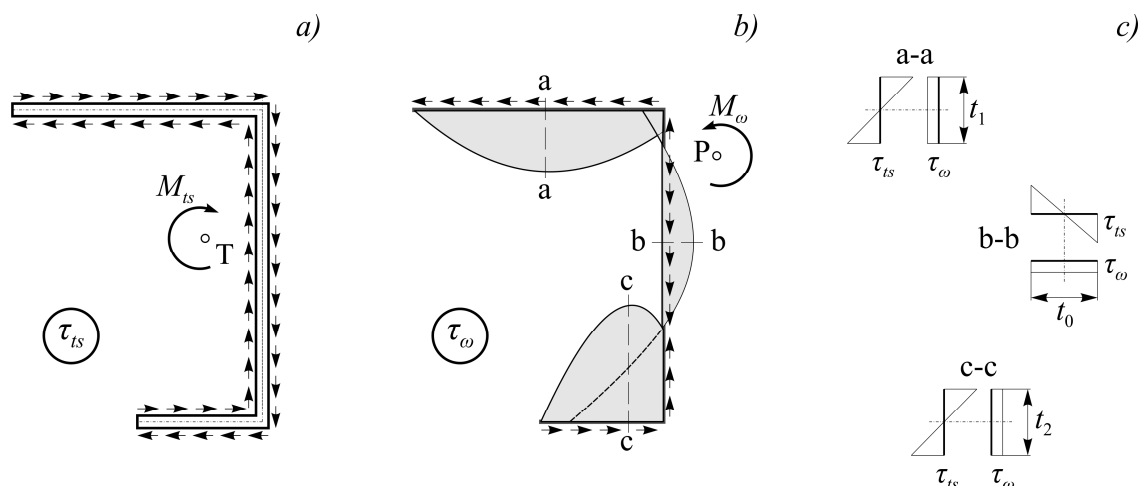


Fig. 6 a) Saint Venant torsion stresses; b) shear flow due to warping torsion; c) distribution of τ_{ts} and τ_ω in cut sections a-a, b-b, and c-c

Saint Venant torsion stresses, shear flow due to warping torsion as well as distribution of τ_{ts} and τ_ω stresses in cut-sections computed above are shown in Fig. 6.

5. Conclusion

The calculation of the normal and shear stresses in the case of thin-walled bars with open cross-section is different in comparison with the classical theory. In this paper, in an illustrative example, the importance of warping normal stress in computing total normal stress is emphasized.

REFERENCES

- [1] Pavazza, R. (2007). *Uvod u analizu tankostjenih štapova*, KIGEN, Zagreb.
- [2] Murray, N. W. (1981). *Introduction to the theory of thin-walled structures*, Oxford engineering science series.
- [3] Pustaić, D., Tonković, Z., Wolf, H. (2014). *Mehanika deformabilnih tijela – 2. Čvrstoća elemenata konstrukcija*, Zagreb, Udžbenici Sveučilišta u Zagrebu.
- [4] Šimić, V. (2002). *Otpornost materijala II*, Školska knjiga, Zagreb.
- [5] Pavazza, R., Vlak, F., Vukasović, M. (2016). Short steel thin-walled columns subjected to eccentric axial loads. *Procedia Engineering*, 161, 349-355.
- [6] Plazibat, B., Matoković, A. (2011). Computer program for calculating geometrical properties of symmetrical thin-walled cross section. *Transactions of FAMENA*, 35, 65-84.
- [7] Plazibat, B., Matoković, A., Štingl, Z. (2014). Computer program for calculating geometrical properties of thin-walled cross section. *CIET 2014. - Conference Proceedings, Track 03*, P-313-324.
- [8] Pavazza, R., Matoković, A., Plazibat, B. (2013). Torsion of thin walled beams of symmetrical open cross-sections with influence of shear. *Transactions of FAMENA*, XXXVII -2, Zagreb, 1-14.
- [9] Matoković, A. (2012). *Savijanje i uvijanje štapova otvorenog tankostjenog presjeka s utjecajem smicanja*. Unpublished doctoral dissertation, FESB, Sveučilište u Splitu.

Design of Energy Efficient Fishing Winch Systems

Ivo Jerčić

University Department of Professional Studies at the University of Split, Split, Croatia
ijercic@oss.unist.hr

Nenad Prizmić

Adria Winch, Split, Hrvatska
prizmic@adriawinch.com

Abstract: This paper presents the analysis of the possible energy savings by using modern high efficient electric winch systems with regulated electric drives on fishing trawler vessels. High intensity operation profile of fishing trawlers with specific trawling operations offers the possibility of using high efficiency electric winch systems to recover or regenerate a significant percentage of the energy during trawling operation back into the ship electric system or batteries. The paper gives analysis of winch system dynamics and energy requirements during trawling operations and possible overall savings in ships emissions compared to classic hydraulic or electric winch systems by exploiting modern electric winch drive systems for energy recovery.

Key words: *winch, equipment, efficiency, energy, trawling, design*

1. Introduction

Over 90% of the world's living mass is found in the oceans and fisheries, being an economic activity based on available biological resources, has always contributed significantly in ensuring food source for human consumption. In 2015, global catch and aquaculture of fish, molluscs, crabs and other aquatic organisms reached 170 million tons with a tendency of steady growth, however while the catch stagnates and aquaculture grows, in a few years the amount of aquaculture products will surpass the quantity of organisms obtained from catch. About 76% of the catch is used for human consumption. The average inhabitant of the Earth in 2015 consumed 20.3 kg of aquatic organisms, or about 20% of proteins from animal origin. Unfortunately, the amount of catch has reached its maximum and with overexploitation of 80% of organisms that are caught we have exceeded the sustainable amounts, thus facing a reduction in the fish stock with this inadequate and ineffective management procedures. Since it is estimated that by 2050 the population of the Earth will reach more than 9 billion people, the increased need for this type of food will have to be ensured by aquaculture supported with better management, less waste, and more efficient practice. Therefore, it is of the utmost importance to establish a long-term sustainable approach to fisheries and aquaculture that will, on one hand, preserve natural resources and ensure availability of this type of food for future generations, and on the other hand stimulate economic growth, improve life and protect the environment (FAO, 2016).

Green house gases (GHG) emissions, primarily carbon dioxide (CO₂) and nitrogen oxides (NO_x), are fueling global warming and affecting climate and weather conditions on Earth. The greatest impact on global warming is GHG, which is mainly due to the use of fossil fuels. The governments of most countries have signed a Kyoto Protocol aimed at reducing GHG, because continuing to

increase GHG emissions would lead to large, and for some parts of mankind, catastrophic consequences. There is scientific consensus on the need to control GHG emissions by keeping global warming of the Earth within the limits of 2°C over the pre-industrial period. It is estimated that the oceans have the ability to absorb one-third of the amount of CO₂ released as a result of human activity, which at first glance works favorably because it slows global warming. However, over the past 10 years, various studies have confirmed that dissolving CO₂ in the oceans decreases its pH value which is slightly alkaline (pH=8.15), thus leading to ocean acidification. Increasing ocean temperature and acidity has potentially damaging consequences for marine organisms and can endanger food webs as well as devastate ocean's biological resources (Phillips & Pérez-Ramírez, 2018). The impact of increased GHG emissions on the ecosystem is still difficult to estimate, but it is certain that ocean acidification, temperature rise and changes in salinity, oxygen and ocean currents will have a negative impact on fisheries as the evolution of organisms will not be able to follow the rapid changes in the environment (Mora et al., 2013). Fishing industry and fishing fleets use large amounts of fuel further contributing to increased GHG emissions. Due to the need to leave a sustainable life environment for future generations, we have been focusing on the rational use of energy, especially fossil fuels, and thus the reduction of GHG emissions in recent years. On the land, GHG emission reductions are fueled by various measures and emission taxes and are regulated by legislation (OECD, 2015).

2. Energy Efficiency And The Reduction Of GHG Emissions From Ships

According to data from *International Maritime Organization* (IMO) in international navigation in 2012, ships have emitted the total of 796 million tons of CO₂, which is about 2.2% of total CO₂ emissions for that year (IMO, 2014). Due to global growth, efficiency and lower impact on the environment, there is a further increase in ship transportation. By 2050, an increase of 50% to 250% is expected, all depending on general economic growth, energy situation and politics.

Although shipping is the most energy efficient mode of transport, efforts are made to reduce CO₂ emissions. To this end, the IMO identified the types of ships responsible for about 85% of the CO₂ emissions of maritime transport and gave regulations to reduce CO₂ emissions for new ships. Commercial ships have a lifetime of 25 to 35 years, therefore it is to be expected that after 2050 all freight vessels in international traffic will be subject to energy efficiency requirements.

As a measure of energy efficiency, the IMO has identified the "Energy Efficiency Design Index (EEDI)" (IMO, 2009a), which is defined as:

$$EEDI = \frac{\text{Impact to environment}}{\text{Benefit for society}} = \frac{\text{CO}_2 \text{ emission}}{\text{Transport work}} \left(\frac{\text{g CO}_2}{\text{ton} \cdot \text{mile}} \right)$$

and applies to cargo ships with gross tonnage above 400 GT. The EEDI certificate is mandatory and the ships must have EEDI smaller or equal to the required for specific ship size. For new ships EEDI is the most important technical measure aimed at encouraging the use of energy-efficient equipment and engines. It is expected to stimulate continuous innovation and technical development of all components that affect energy efficiency throughout the life cycle of the ship.

The EEDI application does not apply to ships of less than 400 GT and, in general, for ships not intended for cargo, such as: passenger ships, ferries, tugs, fishing boats, warships, ships with electric, hybrid or turbine propulsion systems.

In addition to EEDI, it is mandatory to use the *Ship Energy Efficiency Management Plan* (SEEMP), which requires that new and old ships have developed and implemented operational plan that maximizes vessel efficiency (IMO, 2009b). According to the *Second IMO GHG Study 2009*,

SEEMP's application enables reduction of CO₂ emissions of the global fleet by 10 to 15%. There is a wide discussion on improving the EEDI definition, calculation methodology, application of new, more efficient technologies, and its application to the remaining types of vessels.

In order to analyze, compare and encourage energy savings on ships exempt from the EEDI mandate and in addition to SEEMP, the IMO has also developed the "Energy Efficiency Operational Indicator (EEOI)" (IMO, 2009c), which is defined as the ratio of mass of emitted CO₂ per unit of transport work:

$$EEOI = \frac{\text{actual CO}_2 \text{ emission}}{\text{performed transport work}} = \left/ \frac{\text{g CO}_2}{\text{transport work}} \right/ \quad (1)$$

The basic expression for EEOI for a voyage is defined as:

$$EEOI = \frac{\sum_j FC_j \cdot CF_j}{m_{\text{cargo}} \cdot D} = \left[\text{g CO}_2 / \text{t}_{\text{cargo}} \cdot \text{NM} \right] \quad (2)$$

where:

- FC_j • the mass (in grams) of consumed fuel by main and auxiliary engines and oil fired boilers at the execution of operational task;
- j • fuel type;
- CF_j • conversion factor expressed by the relation of CO₂ mass (tones) produced from the combusting of one ton of j type fuel;
- m_{cargo} • cargo carried (tons) or work done;
- D • distance in nautical miles corresponding to the cargo carried or operational task performed.

EEOI is a tool for monitoring the effectiveness of fleet management over time. It allows quantifying the fuel economy of the vessels in operation and assessing the effect of changes in work, e.g. better navigation planning, propeller replacement, more frequent cleaning of the hull and propeller or introducing other technical measures such as waste heat recovery systems.

Behrendt (2014) suggests that EEOI is used to monitor the energy efficiency of fishing vessels. From the above expression (2) it is evident that the energy efficiency of fishing will also increase activities such as:

- reduction of distance from the port to the fishing area
- use the nearest catch unload site
- optimizing the route and the fishing process itself.

EEOI (2) will also be heavily dependent on sea conditions, fishing techniques, target fish species, fishing gear and fishery efficiency (Tydmers et al., 2005).

3. Emission Control Areas (ECAs)

Fuel combustion at high temperatures in a diesel engine produces nitrogen oxides or NO_x that include NO and NO₂ gases. NO_x is the well-known ozone depleting substance, but also the GHG gas harmful to human health, especially for people with respiratory disease. IMO MARPOL Annex VI, prescribes maximum permissible NO_x content and SO_x sulfur oxides. In the ECAs areas (Figure 1), for all new ships with a power output of more than 130 kW, the highest levels of NO_x in the exhaust gases of the IMO NO_x Tier III standard have been prescribed, which came into effect on 2016. The permitted NO_x emission values are given in Table 1 representing 20% of the permissible values according to Tier I, thus representing an enormous reduction (IMO, 2008).

Table 1 The IMO NO_x Tier III emission standard

Engine's rated speed	$n \leq 130$ rpm	$130 < n \leq 2000$ rpm	$n > 2000$ rpm
NO _x emission limit (gNO _x / kWh)	3.4	$9 \cdot n^{-0.2}$	2.0

ECAs include areas of intensive fishing and the IMO NO_x Tier III standard will have significant implications to the engines of fishing ships. In addition to satisfying the regulations, ships with engines technology that meet Tier III standards also have financial benefits through discounts on port fees and access to more funds for environmental protection, such as NO_x Found Norway. A further introduction of new ECAs areas (Figure 1), has been already announced by IMO.

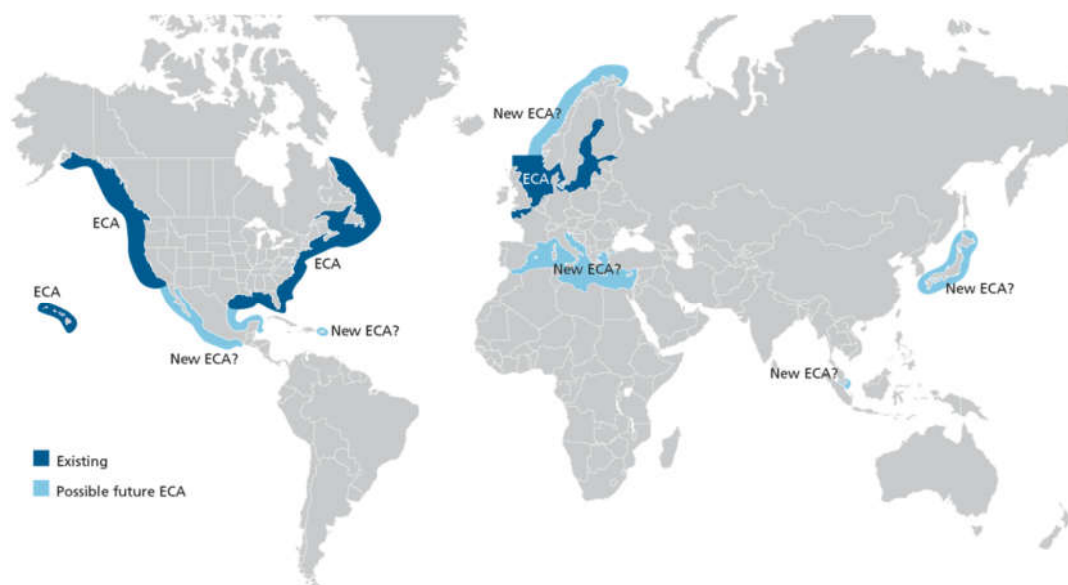


Figure 1 Emission Control Areas -ECA for Tier-III-and possible future ECA-as indicated by DNV

4. World Fisheries and Aquaculture

In 2014, FAO estimated that 56.6 millions of people participated in primary fisheries (catch and aquaculture), and 36% of them with full time employment. Globally, the number of people employed in fishing decreases, and increases in aquaculture. The number of fishing boats is estimated at 4.6 million, of which 75% in Asia, 15% in Africa, 6% in South America; 2% in North America and 2% in Europe. Of this number of vessels, only 23,000 are registered through IMOs as fishing vessels. Today, global fishing capacities are higher than the available living resources. Based on the FAO analysis of the total available fish stocks, only 10.5% accounts as underfished stocks, allows greater catch, 58.1% is fully exploited, and 31.4% is overexploited at a biologically unsustainable level (FAO, 2016).

The production of aquatic organisms in aquaculture is steadily growing and soon will be equal to the amount of catches on the world level. In Europe, the share of aquaculture in total European fisheries production is 20%, also with a growth trend. Therefore, it is of great importance to

establish long-term sustainable access to fisheries and aquaculture that preserves natural resources and ensures availability of this type of food and future generations, but also stimulates economic growth, improves people's lives and protects the environment.

In recent years, the fishing industry has been faced with increased demand, increased costs, reduced resources and demands for greater profitability. Fishing is an energy-intensive method of getting food, and now almost entirely dependent on internal combustion engines and diesel fuel. The reason for this is high energy content in diesel fuel (40MJ / kg) and at this point there is no appropriate alternative, so for a long time the internal combustion engine will be the prime mover within the main propulsion systems of fishing vessels. Long-term oil prices on the world market are constantly on the rise and this makes fishing with inadequate ships, fishing gear and fishing methods not profitable. This affects the possibility of producing this type of food for a wide circle of consumers. It is assumed that in the next decade fishing will take place in the conditions of unfavorable environmental changes, further reduction of resources, worse macroeconomic conditions and higher energy prices, which will further increase the fishing costs.

By increasing the energy efficiency of fishing vessels and systems used in fisheries it is possible to increase the profitability of this economic branch and reduce the impact on the environment. Primarily, measures should be taken to reduce the high dependence on energy, especially on fossil fuels (EC, 2011).

Compared to fishing, aquaculture is less energy dependent but energy needs are also important, especially for breeding species that are on the top of the food chain. In addition to the energy needed for providing food for cultured animals, energy for cage construction and maintenance, energy for maintenance of suitable living conditions, especially in intensive breeding, is also needed. This activity requires new biotechnologies, new technical systems, automation and specialized vessels to support construction and maintenance of farms.

Because of the global importance, fisheries will be under the stronger influence of society and politics. It is possible to expect the use of market mechanisms in the form of excise duties on fossil fuels and the mandatory application of more energy efficient technical solutions. This will place subjects that act responsibly in terms of conservation of natural resources and global warming issues, into a more favorable position.

5. Energy Saving Potential on Fishing Vessels

Fuel consumption per ton of catches is steadily increasing. Global fishing now consumes 50 million tons of fuel for about 90 million tons of catch, or about 670 liters per ton of catches. This makes about 1.2% of global oil consumption that emits 160 million tons of CO₂ (Tydmers et al., (2005). Generally speaking, the fishing fleet is not energy efficient at all. The main reasons for energy inefficiency are structural disadvantages, technological obsolescence, relatively inexpensive fuel due to excise duty, inadequate fishing tools and fishing techniques, all that accompanied by low profitability. Fuel consumption in fisheries is the largest item in costs and may in some cases amount to up to 40% of operating costs. The efficiency of fishing is expressed by the ratio of the amount of fuel consumed and the quantity of fish caught (liters / kg) or total energy consumed per kilogram of fish caught (MJ / kg) It depends heavily on energy efficiency of vessels, fish species, fishing techniques, fishing gear and sea condition. There are several options to reduce fuel consumption, or to increase energy efficiency of fisheries.

6. Fishing Trawlers

The most important fishing method in Europe is trawling and it requires large amounts of energy. Depending on the type of fishing and area of operation, fishing trawlers are arranged for single and double trawl operation, using bottom, large pelagic and semi-pelagic trawls. Ships are designed and built as factory trawlers that catch and process fish at sea mainly as headed and gutted fish products or frozen fillets that are stored in freezers after processing. Fish offal (e.g. guts, skin and bones) and bycatch is in general also processed as fish meal and fish oils. Main fish species caught by this type of fishing are ground fish and pelagic fish species such as cod, haddock, redfish, shrimp, pollock and herring ect. European fishing fleets consume significantly more fuel than the global average. For a sustainable fishing industry it is important to increase the energy efficiency of this industry. Fishing efficiency measured by the ratio of catches and liters of spent fuel is constantly decreasing, mainly due to the fact that the fishing capacity is higher than the fish resources, so for this reason new resources as well as deep-sea fishing are being considered. Trawlers operate all year around changing fishing grounds and target species depending on the season and available quotas for specific type of catch. Harbor time for this type of vessels is reserved only for unloading processed frozen catch, resupply or repairs. To minimize time off the fishing grounds the cargo offload and replenishment is usually carried offshore to reefer vessels moored alongside while at sea. Information of typical sailing speeds for one cycle of fishing is given in Table 2.

Table 2 Typical operational profile for fishing trawler

Fishing operation	Description	Typical vessel speed (knots)
1. Sailing departing	Sailing from the harbor to the first fishing position and sailing between the fishing grounds	10 ÷ 12
2. Searching	Searching of the schools	7 ÷ 10
3. Shooting	Shooting the gear at sea, towing cables releasing	5.5
4. Trawling	Trawl net towing	4.5
5. Hauling	Gear hauling operations	1.5
6. Towing cables recovery	Recovery of the towing cables, just after the trawling	2.5
7. Sailing back	Sailing from the last fishing grounds to the harbor	10

More than 90% of the fuel amount consumed is spent for operations 1, 2, 4 and 7. Operations 1, 2 and 7 are similar and the main influence on fuel consumption in these operations is the speed of the ship. Significant reductions in fuel consumption in these phases of fishing can be achieved by reducing boat speed, for example, by 1 knot. The reduction in speed depends on the availability of fishing time, but also on the type of fish the trawler is catching. During trawling operation, usually the largest amount of fuel per hour (kg/h) is consumed. The greatest impact on fuel consumption at this stage is the fishing gear - the net (Khaled et al., 2012), the depth of fishing, the sea condition

and the energy efficiency of the winch (Hansen & Tørring, 2012). The propulsion of ships at operations 1, 2, 4 and 7 sets opposite requirements which cannot be effectively addressed by a ship with a fixed pitched propeller propulsion system. Although it is considerably more expensive and more demanding for maintenance, the energy-efficient solution is a controllable pitch propeller propulsion system. An alternative solution is a gearbox with two different transmission ratios. By upgrading the existing systems of existing fishing boats and by installing more efficient engines (fuel consumption of about 165 g/kWh), fuel savings of up to 20% could be achieved., furthermore better fishing gear and more efficient fishing winches can even save up to 15%. Efficient management and optimization of routes and operations can save up to 8%.

In order to reduce harmful emissions, primarily NO_x and SO_x, it is possible to use a LNG, CNG LPG engine with fuel. By using LNG, CO₂ emissions are reduced by 23%, and NO_x for enormous 92%, and SO_x at zero (IMO, 2016). This would surpass the requirements set for ships navigating and operating in the ECAs areas (EC, 2012). Obstacle to implementing this is the huge cost of engine outfitting to work with two types of fuel, larger space is needed for storing fuel on board the ship and, for now, the lack of adequate infrastructure. LNG is currently the most apparent alternative to diesel fuel (Jafarzadeh & Paltrinieri, 2012). The European Commission (EC) with various regulations and incentive measures is aiming to increase the energy efficiency of the fisheries sector while simultaneously protecting natural resources and reduce the impact of fisheries on the ecosystem (EC, 2014). In order to reduce GHG emissions, particularly NO_x and SO_x, the EC commits all its members to ensure the supply of LNG fuel to all major European ports by the end of 2025.

7. Fish Farm Service Vessels

Further development of aquaculture will require the design of specialized vessels for construction support and maintenance of fish farms. The energy efficiency of these vessels will be achieved primarily by a specific design of vessels and its systems according to operations that have to be carried out. The lower mass of equipment significantly affects the fuel consumption of the vessel in navigation. This is especially important for vessels that support fish farms and which are constantly operational.

Equipment manufacturers will require first and foremost complete adaptation of the equipment's performance characteristics and the use of materials suitable for food industry, maximum environmental safety, low noise and low mass of the equipment. It is to be assumed that the electric drive system powered by electric batteries will primarily be considered due to the minimal environmental impact, short distances and the need for frequent stops for this type of ship. Depending on the operations to be carried out, a wide-ranging application of a hybrid diesel electric drive is also expected. In this way, the benefits of both types of drives are used with high energy efficiency and operational safety. The fishing vessel M.S. Frøyanes has been designed upon these principles by Marin Teknikk AS and has been in service since 2012.

Due to greater energy efficiency, environmental safety and low noise for fishery equipment on these ships, priority should be given to electric drives. Challenge for designers and manufacturers is to develop equipment, in cooperation with customers, that needs to carry out various operations on fish farms, taking into account energy efficiency and maximum environmental safety.

Today completely electric vessels are being developed for different purposes. The Dutch company Port-Liner, with financial support from the EU, is building electrically driven barges to be in service by the end of 2018. They will transport ship containers, connecting the ports of Antwerp,

Amsterdam and Rotterdam. The barges will operate completely autonomous, without crew. The batteries will allow them to work up to 15 hours.

8. Energy Efficient Electric Fishing Winch System

Winches on the fishing trawlers are an essential part of the fishing equipment and while the trawl nets and net rigging are different depending on the type of fishing, the winches and winch operations and procedures are the same.

The energy efficiency of fishing winches has not the same impact level as the ship design, propulsion system, fishing technique and fishing gear and net rigging, but it may significantly, directly and indirectly affect the energy efficiency of a fishing vessel. The direct impact is by using more energy efficient winch drives, and the indirect impact is through the designing lighter fishing winches.

For fishing winches, two types of drive systems are used: hydraulic and electric. Hydraulic drive systems have been traditionally used for fishing winches. The reason for this is the simple control of the winch speed and pull force through hydraulic flow and pressure control. Disadvantages of the hydraulic drive system in general are their low efficiency of ~60%, high noise levels, high risk of pollution and limitations of their operations in low temperature areas.

Electric drive systems are generally more energy efficient compared to hydraulics with an average efficiency of ~80%. Modern AC powered electric motors driven through variable frequency converter drive (VFD) allow the control of spindle rotation speed from zero to 2 to 3 times above the nominal. Torque control of the motor is possible throughout entire spindle rotation range, thus allowing fully controlled net and gear release and retrieve operations. Electric energy generated by electric motors, when the net and gear is released under loads, can be returned to the ship's electric grid via VFD and active front end (AFD) drives. This is economically viable for winches that work longer periods in this mode. Compared to hydraulic driven winches, control is simpler and it is easier to achieve different levels of automation.

9. Trawl Winches

Typical trawler is equipped with up to 10 different types of winches. On fishing grounds, trawlers operate continuously 24h/day with an average of 8 net releases or (net shoots) per day. During this period the trawl winches operate 85% of the total winch operation time. From this 85% of time in operation, trawler winches operate 90% in net shoot and net trawl modes that offer the possibility of generating electrical energy by use of modern electric motors and VFD and AFD drives. Trawl winches have high nominal power up to 500kW (Figure 2). During fishing in trawling mode, trawl winches operate on average 20 h/day, while maintaining constant tension and length of trawl ropes through which the fishing net is pulled by the vessel.

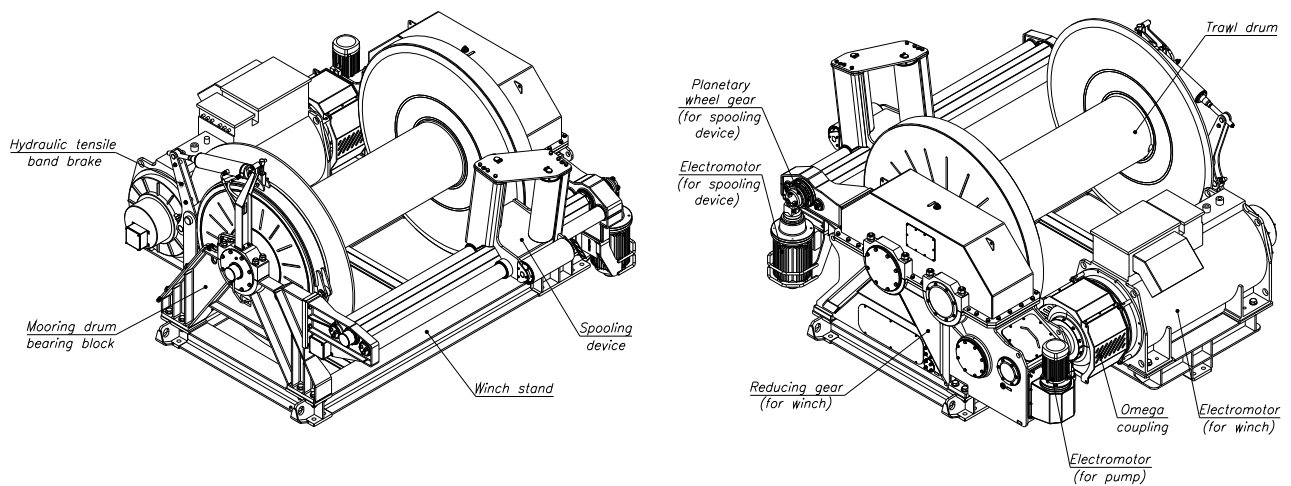


Figure 2 Modern electric driven trawl winch layout with AC electric motor and energy regenerating option

In heavy seas, winches operate in cyclic mode by winding up and releasing the ropes, keeping the net hydrodynamically stable in the sea. Generated energy in rope release periods is significant and economically viable by returning it through the VFD and AFD to the ship's electrical grid or batteries. Mathematical model of trawl winch operation during trawling in heavy seas with a preset winch pull force can be presented in graph Power P (kW) vs time t (s) as a sine wave function (Figure 3).

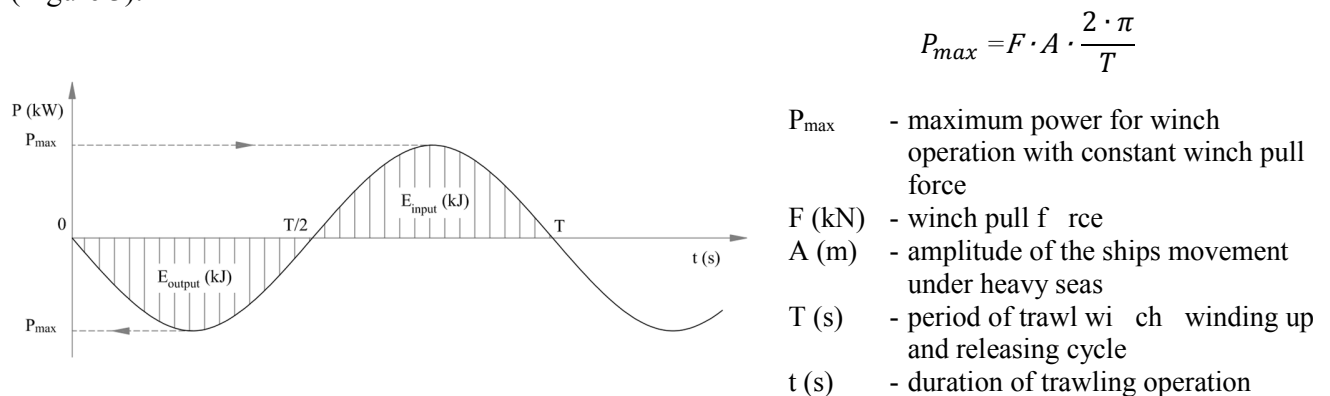


Figure 3 Power (kW) vs time (s) graph for trawl winch operation

The area E_{output} (kJ) represent the energy that in period from 0 to $T/2$ can be retrieved from the system and E_{input} (kJ) from $T/2$ to T that we need to input for trawl winch operation. Theoretically E_{output} and E_{input} are equal meaning that energy gained equals energy that the system is using. However, the difference is in the way efficiency coefficients of system elements affect the trawl operation winding up and releasing of the ropes in constant tension mode.

The efficiency coefficients that affect the trawl system operation are:

- winch gearbox efficiency
- electric motor efficiency depending on the regime in which the motor is operating
- VFD efficiency depending on the regime in which the electric motor is operating

- AFD efficiency depending on the regime in which the electric motor is operating
- electric grid/installations efficiency.

The sine wave half period is divided in 6 parts to be enabled to calculate energy input and output taking into account different levels of efficiency of trawl system elements in different operating regimes from 0 to 100% of the winch electric motor power (Figure 4).

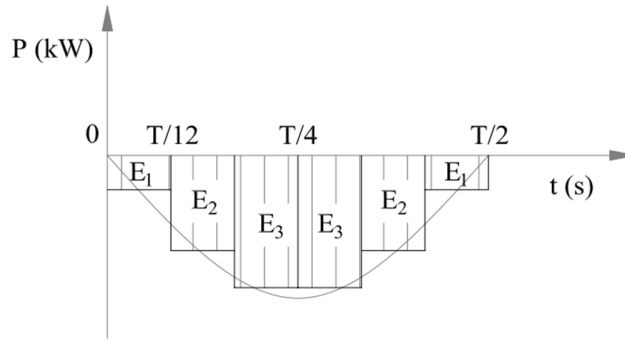


Figure 4 Sine wave half period divided in 6 parts

Table 2 Typical operational profile for fishing trawler

Input of energy in cycles of winding up of rope:	Output of energy in cycles of release of the ropes:
$E_{input} = 2 \cdot (E_1 + E_2 + E_3)$ $E_1 = E_{1,0} / \eta_G \cdot \eta_{EM1} \cdot \eta_{VFD1} \cdot \eta_{AFE1}$ $E_2 = E_{2,0} / \eta_G \cdot \eta_{EM2} \cdot \eta_{VFD2} \cdot \eta_{AFE2}$ $E_3 = E_{3,0} / \eta_G \cdot \eta_{EM3} \cdot \eta_{VFD3} \cdot \eta_{AFE3}$	$E_{output} = 2 \cdot (E_1 + E_2 + E_3)$ $E_1 = E_{1,0} \cdot \eta_{GB} \cdot \eta_{EM1} \cdot \eta_{VFD1} \cdot \eta_{AFE1}$ $E_2 = E_{2,0} \cdot \eta_{GB} \cdot \eta_{EM2} \cdot \eta_{VFD2} \cdot \eta_{AFE2}$ $E_3 = E_{3,0} \cdot \eta_{GB} \cdot \eta_{EM3} \cdot \eta_{VFD3} \cdot \eta_{AFE3}$

where:

- $E_{1,0}, E_{2,0}, E_{3,0}$ - theoretical energy for a given part of the winch operation cycle
- E_1, E_2, E_3 - actual energy for a given part of the winch operation cycle
- η_G - trawl winch gearbox efficiency
- $\eta_{EM 1, 2, 3}$ - electric motor efficiency depending on motor operating range
- $\eta_{VFD 1, 2, 3}$ - variable frequency drive efficiency depending on el. motor operating regime range
- $\eta_{AFE 1, 2, 3}$ - active front end efficiency depending on el. motor operating regime range

As per equations presented in Table 3, the output of energy, or the energy that can be regenerated in the system, is significantly lower than the energy required for winch operation, however it is valuable.

Energy regeneration is dependent on sea conditions, but in general it is possible to get 30-50% of the energy input for winch operation back in the system depending on the sea condition. Even at calm seas, when there is no possibility of regenerating cycles, because of their better efficiency over hydraulic system, electric winches should be preferred.

Taking into account the higher overall efficiency of the electric trawl system with additional benefits of regenerative system, compared to hydraulic system, it is possible to save up to 60-70% of energy needed for trawl winch operations. Energy efficiency and mass reduction can be further increased by using electric motors with permanent magnets. For compactness, electric motors can be cooled with water.

10. Conclusion

Fishing is a significant source of human food supply and an economic activity that has a significant impact on earth environment. IMO regulations already placed limitation on emission of NO_x gasses for fishing ships in ECAs areas of intense fishing.

Interest and focus of the fishermen and fishing companies themselves is to reduce the cost of ton of fuel per ton of catch, reduce bycatch and reduce the impact of their activity to a minimum by using modern and innovative fishing gear, techniques and technology available. Most recently, fishermen and fishing companies already started the renovation of the fishing fleets by ordering and building new fishing ships and fishing trawlers to meet the highest standards required.

Challenges placed on designers of new fishing ships, apart of using new and improved propulsion systems, is designing systems and equipment that is more efficient, with lower weight, low noise, lower risk of pollution and risk to the environment as well as durable considering high intensity operational profiles. Designers of trawler fishing winches should be guided by the same principles.

This paper gives an overview of the possibilities of using high efficient fishing winch systems that can contribute to the overall better efficiency of the whole ship. Modern electric drives ensure higher efficiency compared to the classical hydraulic systems, with the possibility of regenerating energy back to the ship's electrical batteries or grid. Trawl winches especially have the possibility of recovering up to 30-50% of the energy used for their operation.

For modern trawler, the electric trawler winch is now regarded as a standard piece of equipment.

Regenerative system can be applied to other types of winches on a fishing trawler, but their overall time in operation is in total 10% of the total winch system operating time. The regenerated energy needs to be reused for other functions on the ship, so just regenerating is not enough. There needs to be a determined plan on how and when to use the newly available power.

When opting for the option of regenerative drives for other winches on the ship, a deeper analysis should be carried out to find out if the increased investment in such a system is economically justified compared to ships size and their exploitation period.

REFERENCES

- Behrendt, C. (2014). Energy saving technologies for fishing vessels. *Scientific Journals of the Maritime University of Szczecin*, 39(111), 11-15.
- EC (2011). *Information Collection in Energy Efficiency for Fisheries, (ICEEF 2011)*. European Commission.
- EC (2012). *Information Collection in Energy Efficiency for Fisheries, (ICEEF 2012)*. European Commission.
- EC (2014). *Information Collection in Energy Efficiency for Fisheries, (ICEEF-3)*. European Commission.
- FAO (2016). *The state of world fisheries and aquaculture*. Food and Agriculture Organization of The United Nations, Rome.

- Hansen, U. J., & Tørring, P. (2012). Best Available Technology makes Drastic Cuts in Fuel Expenses in Trawl Fisheries. *Second International Symposium on Fishing Vessel Energy Efficiency E-Fishing*. Vigo, Spain.
- IMO (2008). *Amendments to the technical code on control of emission of nitrogen oxides from marine diesel engines*. Resolution MEPC.177(58) NOx Technical Code 2008, London.
- IMO (2009a). *Consideration of the Energy Efficiency Design Index for new ships*. GHG-WG 2/2/7, London.
- IMO (2009b). *Guidance for the development of a Ship Efficiency Management Plan*. MEPC.1/Circ. 683, London.
- IMO (2009c). *Guidelines for voluntary use of the ship energy efficiency operational indicator (EEOI)*. MEPC.1/Circ.684, London.
- IMO (2014). *Third IMO GHG Study 2014*. International Maritime Organization (IMO) London.
- IMO (2016). *Studies on the feasibility and use of LNG as fuel for shipping*. International Maritime Organization (IMO) London.
- Jafarzadeh, S., & Paltrinieri, N. (2017). LNG-fuelled fishing vessels: A systems engineering approach. *Transportation Research Part D: Transport and Environment*, 50, 202-222.
- Khaled, R., Priour, D., & Billard, JY. (2012). Numerical optimization of trawl energy efficiency taking into account fish distribution. *Ocean Engineering*, 54, 34-45.
- Mora, C., Wei, C. L., Rollo, A., Amaro, T., Baco, A. R., et al. (2013) Biotic and Human Vulnerability to Projected Changes in Ocean Biogeochemistry over the 21st Century. *PLoS Biology*, 11(10): e1001682. doi:10.1371/journal.pbio.1001682.
- OECD (2015). *Green Growth in Fisheries and Agriculture*. Organization for Economic Co-operation and Development, OECD Publishing, Paris.
- Phillips, B. F., & Pérez-Ramírez, M. (Eds.) (2017). *Climate Change Impacts on Fisheries and Aquaculture*. Wiley-Blackwell.
- Tydmers, P. (2004). *Encyclopedia of Energy*. Vol. 2. Fisheries and Energy Use. Elsevier.
- Tydmers, P. H, Watson, R., & Pauly, D. (2005). Fueling Global Fishing Fleets. *AMBIO, A Journal of the Human Environment*, 34(8), 635-638.

Creating Smart Cities

Mikela Jozić

University of Split, University Department of Professional Studies, Split, Croatia
mikela-jozic@hotmail.com

Vjekoslav Zrno

University of Split, University Department of Professional Studies, Split, Croatia
vzrno@oss.unist.hr

Slobodanka Jelena Cvjetković

University of Split, University Department of Professional Studies, Split, Croatia
sjcvjet@oss.unist.hr

Abstract. Smart cities refer to integrated cities where the essential is interconnectedness and smart development of the economy, people, management, mobility, environment and living. What makes a city smart is connected to following elements:

- the strong introduction of Information and Communications Technology (ICT) into the business and private process
- the application of smart network where all the elements of the system are connected in an intelligent and energy-efficient way
- Internet connection of all objects (Internet of Things) using M2M (Machine to Machine) communication
- reducing environment pollution through the introduction of intelligent transport systems
- increasing energy efficiency through the application of smart metering, but also by introduction innovative solutions in construction

Key Words: *ICT, IoT, M2M, smart metering*

1. Introduction

If we want to meet the goals of smart city that supports sustainable high-quality life for citizens, we need a smart network for smart cities. Smart cities are the future vision of urban development that each city can develop for themselves.

For smart cities, a variety of Information and Communication technology (ICT) and various IoT (Internet of Things) are integrated to be safe and effective way to manage the city's assets. Smart cities are developed urban areas, which can integrate all of the functions of public services such as lighting, transport or energy production. In this way, it can increase their efficiency, reduce costs, accelerate communication and significantly reduce CO₂ emissions.

As far as electric power is concerned, it is necessary to strengthen the development trend of smart cities that are fully energy – efficient. Smart cities are cities that have a high percentage of electricity and heat from renewable sources, most often from hydro power plants, solar photovoltaic energy, geothermal energy, wind energy and biomass.

2. Concept of "Smart Cities"

The goal of any construction is to provide conditions for life and work in economically acceptable conditions with respect to nature [1]. Using technology and processes in the creation

of smart cities must be safe and operationally efficient for citizens. In recent years, the category and concept of smart cities have been discussed. Today's findings are that the concept of "smart cities" is not clearly defined. Cities are brought to the stage of development where the redesign is inevitable and the only solution. Information and Communication Technology (ICT) are starting to be used wisely in order to improve the quality and performance of urban services where there is a reduction in costs and resource consumption.

Also, because of the greenhouse gas emissions it is crucial to develop sustainable strategies for manufacturing, distribution, transportation, water management, urban planning and the development of green building. In addition, some cities are facing the problem of the limited budget, so the development of smart cities is an ideal solution to long-term savings and improving the lives of citizens. Connecting these following elements which unites the concept of "Smart Cities" is shown in Figure 1.

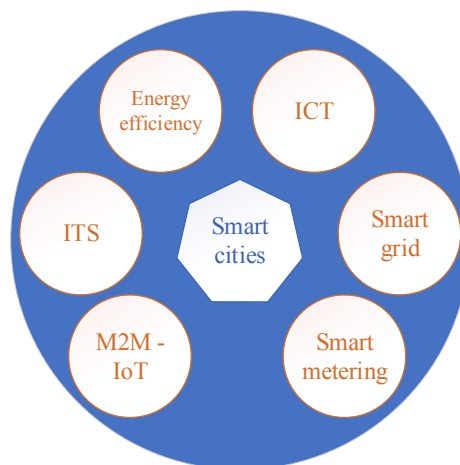


Figure 1 Concept of smart cities

The concept of a smart city makes:

- Information and Communications Technology (ICT)
- Smart grid
- Smart measurement
- Machine to Machine (M2M) and Internet of Things (IoT)
- Intelligent Transport System (ITS)
- Energy efficiency

It is necessary to introduce strong information and communication technologies into all business and private processes. Energy less demanding products and services can be achieved by applying ICT solutions in:

- Production
- Transmission and distribution of electricity
- Increasing energy efficiency in buildings, households, industry and transport

2.1 Information and Communication Technology (ICT)

Connecting Information and Communications Technology (ICT) and other various devices connected to the network is the concept of a smart city to optimize the efficiency of city services. Information - communication technology is used to improve the quality of life in cities and reduce costs.

In the process of generation, transmission and distribution of electricity, as well as to increase energy efficiency in buildings, private homes, industry and transport, the application of ICT technology is making a significant shift towards energy-less demanding products and

services. Significantly reduces environmental pollution and emissions of greenhouse gases by using ICT solutions.

In the implementation process it necessary to take into account the architecture of the ICT communication network and data which satisfy requirements of different services. Broadband access systems provide data exchange between consumer, electricity producers and network infrastructure. It is necessary to ensure effective control of the quality of the supplied electricity and interactive communication with users.

2.2 Smart grid

A smart power grid is the main component of the utility to the user. It uses analogue and digital information and communication technologies to collect information about quality, energy consumption and eliminating energy loss in the network. The main objective of building smart grid is to improve the efficiency, reliability, cost-effectiveness and sustainability of power grid production and distribution.

Smart grid, therefore, is primarily characterized by high flexibility, high quality supply, energy efficiency and cost effectiveness. Smart grid are a prerequisite for other innovative services such as smart meters, smart homes, e-energy or even a virtual power plant.

Smart network provides high-quality and reliable connection and ensures optimum functioning of all components of the power system (Figure 2):

- Generators,
- Transmission system,
- Distribution system,
- Smart measurement,
- Supply and demand matching system,
- Network connection system,
- An administrative system that is in direct communication with electricity consumers.

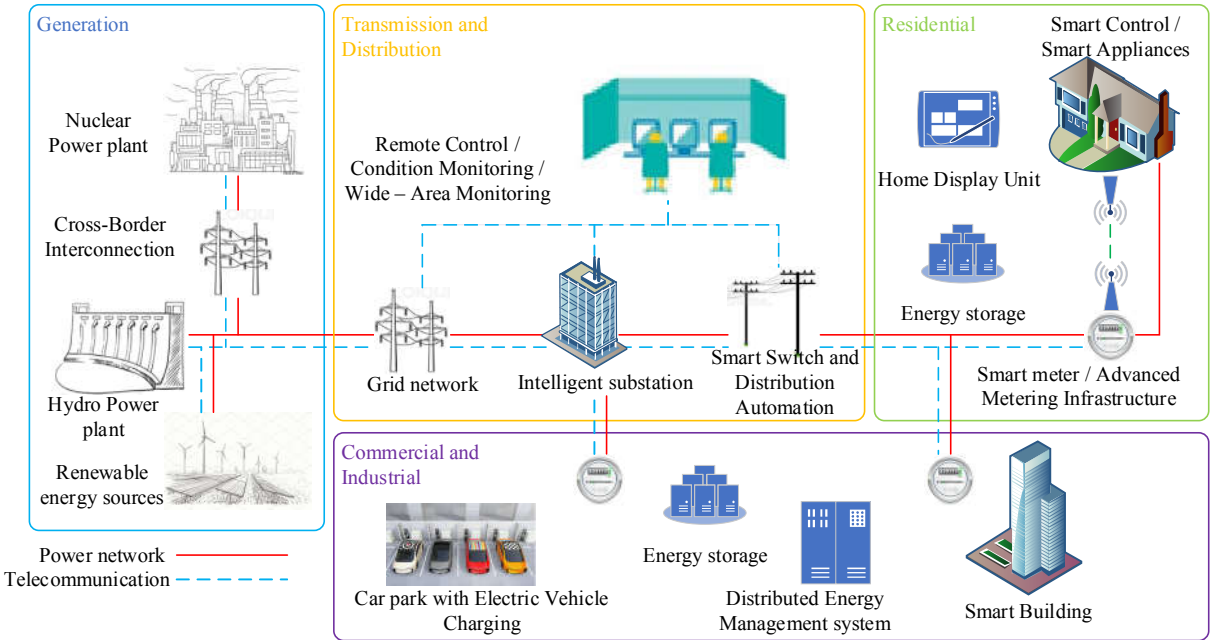


Figure 2 Power grid

2.3 Smart measurement

Smart measurement is the main part of the smart network system [2]. It allows to reduce electricity consumption, reduce costs and reduce greenhouse gas emissions. The smart metering system is used to register the power consumption and the collected data automatically sent to the supplier via fixed or mobile network. Benefits measurements are accurate data on energy consumption, not the estimated energy consumption. Smart meters can communicate between themselves and execute remote and local fixed signals, and perform better the problems that occur in the electricity network.

Using a smart system has a lot of advantages, including less measurement costs, energy savings for small consumers, greater reliability in the measurement of the different costs that can attract customers. Smart meters can be used to monitoring and control home appliances and devices and simultaneously collect information about the distribution network. Smart grid system support smart metering of electricity consumption, supported by a decentralized system of electricity production (Figure 3).

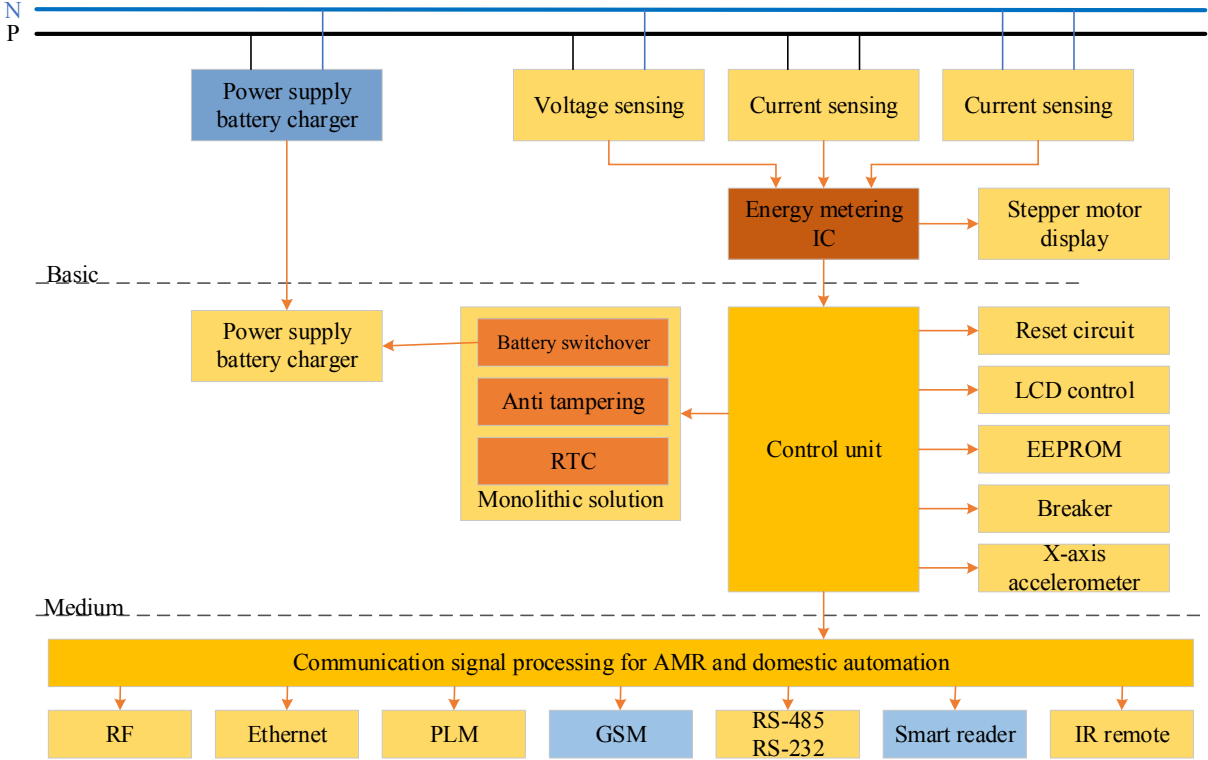


Figure 3 Concept smart meters

2.4 Intelligent Transport Systems (ITS)

Intelligent Transport Systems (ITS) is traffic and transport systems where it can achieve improved performance of transport and more efficient transport of people and goods with significantly less environmental pollution. The system provides better communication, management and improved control of the transport system. ITS's a concept that should replace present access and the development trend of traffic science and technology transportation of people and goods. This system reduce traffic jams and CO₂ emissions, improve transport efficiency and protect people. ITS system is an upgrade of an existing system based on the information and communication technology. Functionality and upgrades to the classic functions of the transport and traffic systems creates new possibilities in solving the problem. The main

components of ITS system are sensors, information and communication technology and various algorithms.

In the Intelligent Transport System (ITS) there are several technology for developing transport:

- Basic Management System (Auto Navigation)
- Traffic signaling management and control
- Transport management systems
- Traffic Signal Management
- Security systems
- Advanced application that integrate live data and feedback from other sources

2.5 Energy efficiency

One of the key initiator for system integration and the creation of intelligent buildings and homes is saving energy. There is a growing demand for clean technology that will provide intelligent management of all system and the creation of “green” growth.

The EU has committed that by 2020 to achieve the objectives in the field of energy in order to:

- Reduction of greenhouse gas emissions to 20%
- Increase the production of electricity from renewable sources to 20%
- Improving energy efficiency with the aim of reducing primary energy consumption by 20 %

3. Communication of Intelligent Devices and Infrastructure

The development of telecommunications technology in the future predicts exponential growth in the number of intelligent devices communicating via the internet. Unlike traditional communications that support the exchange of data, calls and messages, the development of M2M technology (Machine to Machine) is complete automatization of electronic system. M2M communication opens new research in the field of new technology, protocols, standards and network architecture, which achieved an area known as Internet of Things (IoT).

M2M technology allows automated communication of different devices and communication with a global network. Communication takes place through the IP protocol. The development of M2M communications has launched a wide range of application such as smart metering, remote sensing, management and vehicle tracking and automation industry.

The advantages of M2M technology are:

- Permanent connection to devices in remote places
- Centralized management of devices
- Real-time monitoring and failure detection
- Optimization and automation of the process

M2M system consists of several components that can be complex systems, depending on the user’s need. Most of these systems can be divided into 5 main parts shown in Figure 4.

1. M2M Service Capabilities
2. M2M device
3. M2M Area Network
4. M2M Gateway
5. M2M Application

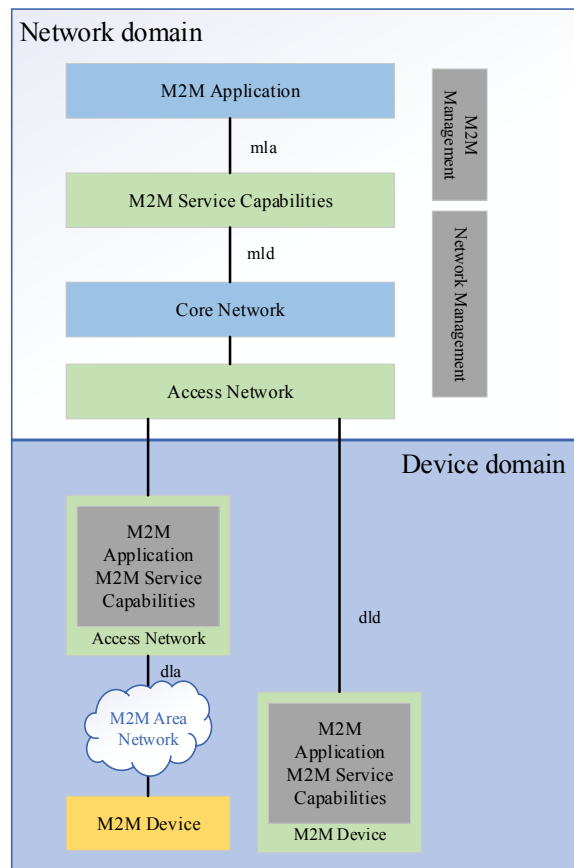


Figure 4 Infrastructure of the M2M system

3.1 Advance power network for M2M technology

M2M communication system is a technology that allows devices to communicate with each other via a wired or wireless network [6]. The main function of the system is to collect data from sensors and other various devices that are connected to the power grid. The devices in the power grid are managed in real-time and follow a series of indicators in the power system. It can be monitored by consumption of electricity losses in the transmission and distribution of electricity, detection of failures in the network, the performance of individual devices and components in the network and a number of other measurements and parameters.

The devices are connected via a communication network with operational support systems. Allows to send information to the central information system for monitoring and control over the power grid from one location. The operating system support incoming data, thus enabling savings in the generation, transmission, distribution and consumption of electricity. Further integration with users of electricity is achieved by improving the quality and efficiency of the electricity grid.

To achieve an advanced power grid, it is necessary to have a set of industry standards that will ensure the security, reliability and interoperability of the entire system. One of the basic components of electric power grid is smart metering, where we mentioned in chapter 2.3. Smart measurement is an electronic meter of electricity, water, gas, heat and other parameters that can measure and store metering data. Communication is bi-directional with central system for monitoring and calculation of electricity.

A system that measures, collects and analyses data on the use of electricity and who will be able to communicate with metering devices such as an electric meter or gas meter , water meters or heat according to a customer request or a defined schedule is called Advanced

Metering Infrastructure (AMI). The system includes hardware, software, communications between devices, energy parameters and controllers for customers, the system used by the customers, applications where can manage and monitor the measurement results. AMI system is shown in Figure 5.

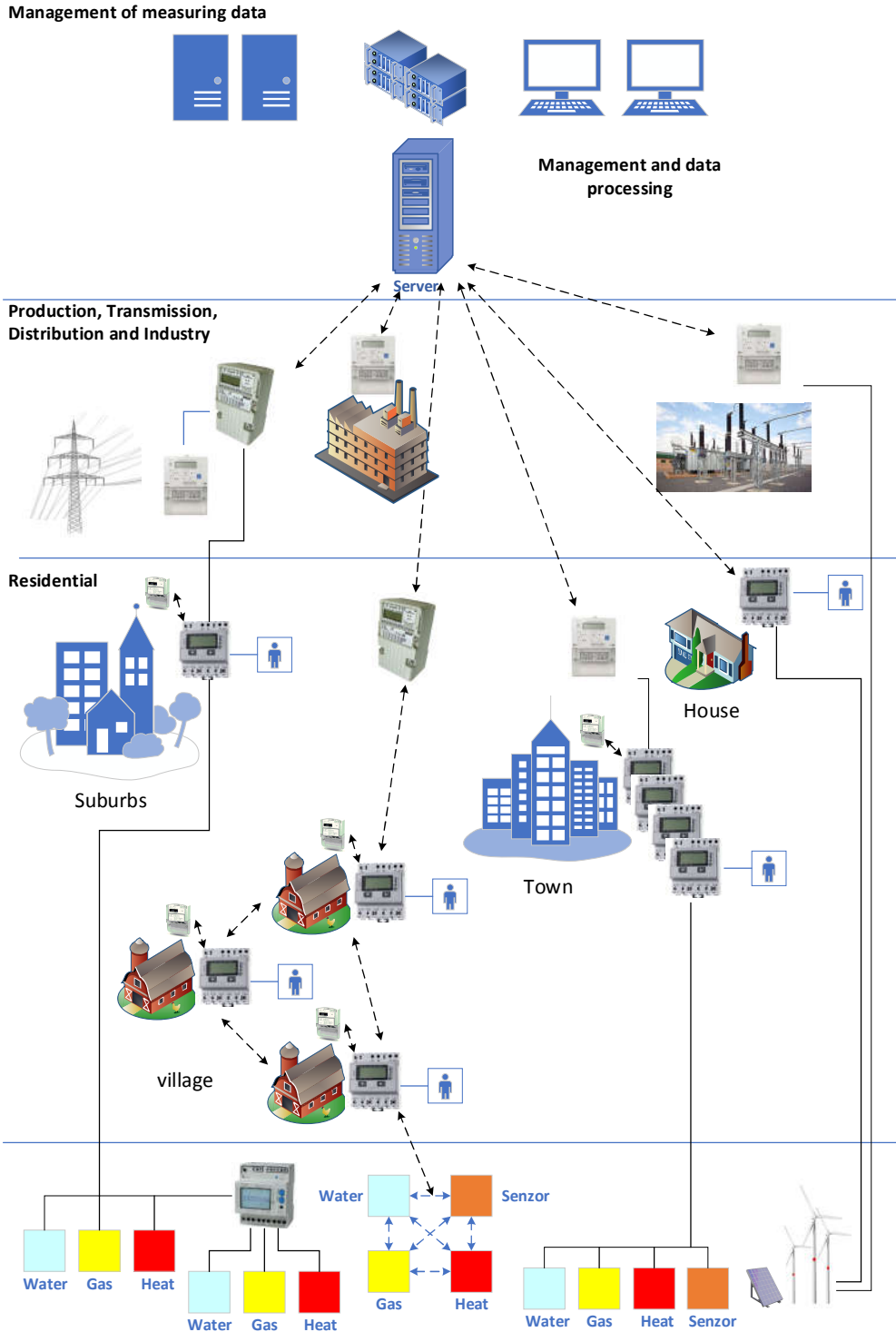


Figure 5 Advanced Metering Infrastructure (AMI)

This system is designed to follow the use of electricity in real-time to all the necessary places in the electricity network and provides feedback to the user. The advantage of the system is the ability to communicate with customers where they can monitor power quality and the ability to manage workloads. AMI system should provide interfaces to public standards for ease

of upgrade and possible extensions, built to integrate with a variety of products that will be in the concept of smart grid which enables the expansion of energy services. The architecture should be stable, flexible future communication media and need to guarantee a secure exchange of data.

3.2 Internet of Things (IoT)

Internet of things (IoT) is a new area of information technology that is rapidly evolving. Internet intelligence allows connecting a large number of users, devices, services and applications to the internet. Devices connected to other devices and applications can directly and indirectly exchange data between themselves. End users use web and mobile applications to access this data, set up device configurations and manage and maintain IoT facilities.

The development of Internet technologies, IPv6 protocols and new developments in Nano technologies enable design, production, installation and networking of a large number of devices equipped with sensors and actuators. These devices can be accessed and managed over the Internet in real time. Devices that are connected to the Internet can communicate with other devices.

The intelligent device structure can be divided into 3 layers for simpler analysis and design: hardware, infrastructure, applications and services, as shown in Figure 6.

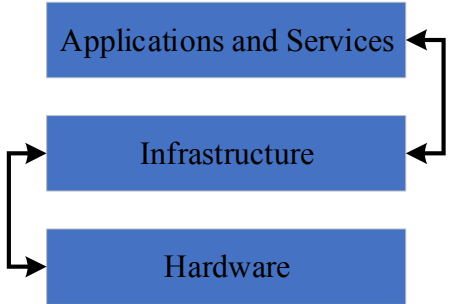


Figure 6 Basic layers of Internet Intelligent Devices

The first and lowest layer IoT is hardware for connecting the physical devices. Only those devices that are connected can share information. The goal is to build devices and systems with built-in computer functionality and intelligence for proactive thinking and behaviour.

Infrastructure as the second layer of IoT allows to connect your device to a wireless or other computer network, provides an application development for data and control information management (Figure 7).

The third and largest layer of IoT are applications and services for obtaining data from devices, processing and delivery. Improving applications and services is a prerequisite for developing smart environments and meaningful application of subjects in different areas.

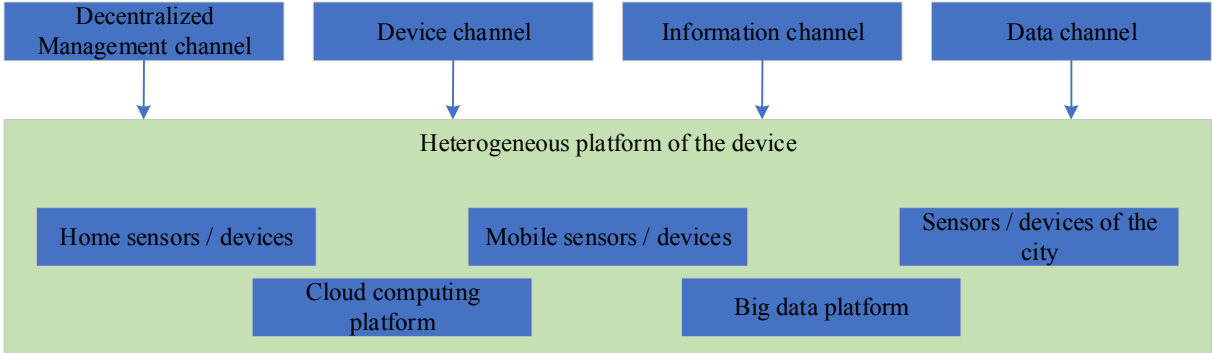


Figure 7 Infrastructure Internet of Things (IoT)

The smart device is an instrument with characteristics of computers. Its main feature is it can communicate with other devices in the environment and perform intelligent operations. Such a device must have the following physical components: power, memory, processor, and communication interface.

Smart devices can be powered through electrical networks, batteries, solar panels, etc. Intelligent smartphone memory enables data storage from the sensor and realization of the operations for which the devices are programmed. IoT devices consist of an input / output interface for sensors and actuators, Internet interfaces, storage and memory, audio and video interfaces [3]. IoT devices include:

- Condition monitoring sensors and information about environmental applications.
- Actuators performing physical activities based on detected changes in the environment.
- Modules that allow you to receive commands at a certain time
- Microcontrollers with built-in memory, timer and hardware for connecting to external devices such as sensors, actuators, and wireless transceivers
- Microcomputer with microprocessor, memory and input / output devices on one chip
- The characteristics of the device IoT are:
- Dynamic self-adaptability. They dynamically adapt to the environment and react to changes in the environment
- Configure with minimal user involvement
- Interoperability of communication protocols. Communicate with each other through standardized interoperable communication protocols
- Unique identity. They have a unique symbolic or numeric identifier, such as an IP address or Unique Resource Identifier (URI). With a unique identifier, users access the device over the Internet, remotely manage the device, configure and track device status
- Network connectivity. They are connected to a computer network that enables them to communicate and visually interact with other devices and applications

Technologies used to develop intelligent devices include network technologies and protocols, sensor networks, mobile technology, cloud computing, and large data (Big Data).

Intelligent devices can be connected to a Personal Area Network (PAN), Local Area Network (LAN), Metropolitan Area Network (MAN), Wide Area Network (WAN), and Sensor Networks (Figure 8). Mobile technologies can contribute to the development and application of intelligent devices such as Bluetooth, RFID, WiMAX, Global Positioning System (GPS), Near Field Communication (NFC), ZigBee, and others.

Cloud computing and Big data infrastructure can be used to build infrastructure quality IoT [4 and 3]. Cloud computing represents the delivery of computing resources as a service. IoT services can be delivered via cloud. As regards the integration of IoT with cloud, the following conditions must be fulfilled:

- Cloud services should facilitate the communication of hardware and software in the IoT system.
- Cloud flow support is required, such as Websocket, REST, MQTT and CoAP
- Support for securely remote software update on devices is required
- Web and mobile applications should allow data viewing, data processing, and remote device management

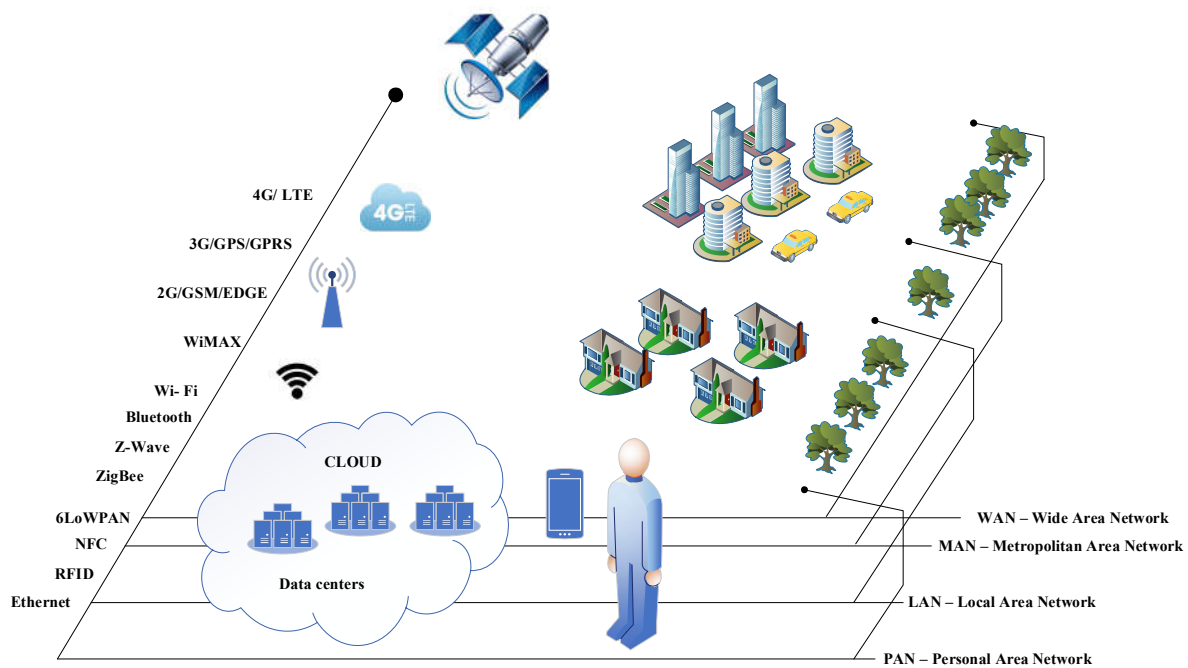


Figure 8 Technologies for the Development of Intelligent Devices

4. Conclusion

Smart cities represent the future of developed society. Purpose of the Smart cities is to encourage economic growth and improve quality of life by allowing the development of the local area and use of technology. New green areas around the cities are being developed to adapt the population growth in urban areas. The application of smart solutions will enable cities use technology, information and data for the improvement of infrastructure and services. Comprehensive development in this way will improve the quality of life.

Using technology will improve the efficiency of electricity distribution and save electricity with intelligent distributed system management. Distributed power systems can be robust and affordable, providing a way to break the link between economic growth and climate-indicating emissions.

Automation enables monitoring and control of all network nodes and users to provide bi-directional stream of information and power from the power plant at all hubs during transmission and distribution. Precise measurements, complementary power supplies, high power efficiency coefficients, high quality electrical power, security of electricity supply and energy savings will mean that the system will be clean, efficient, safe and reliable.

REFERENCES

- [1.] Branko Burazer, Standardization in the process of creating "smart cities" [Accessed: 20.03.2018.]
- [2.] Lee H. Goldberg, "Accurate Power Measurement in Smart Meters" [Accessed: 22.03.2018.]
- [3.] T. Kovačević, S. I. Vrdoljak, S. Jenčić, Internet of Things: Standards of wireless communication technology [Accessed: 25.03.2018.]
- [4.] M. Meštrović, V. Žižić, T. Kovačević, T. Kozina, IoT Cloud solutions [Accessed: 25.03.2018.]
- [5.] <http://www.elab.rs/udzbenik-internet-inteligentnih-uredaja/uvod-u-internet-inteligentnih-uredaja/> [Online, Accessed: 15.03.2018.]
- [6.] Vanesa Čačković, Advanced power network for communication modules [Accessed: 16.03.2018.]

Marine Energy

Mikela Jozić

University Department of Professional Studies, Split, Croatia
mikela-jozic@hotmail.com

Zdravko Jadrijević

University Department of Professional Studies, Split, Croatia
zdravko.jadrijevic@hep.hr

Abstract. Marine energy increasingly takes special attention when it comes to renewable energy sources. In this paper, we will look back on the description of technology and their implementation. Each of these technologies uses the energy of the sea as its source to initiate a generator that converts energy into electrical energy. Marine energy is sustainable and there is a huge potential for wave energy and tidal range in the global market. The total theoretical wave energy potential is 32 PWh/y., while heterogeneous and geographically distributed, technological costs for marine energy are still very high, preventing implementation. Although it is a renewable source of energy, ecological impact on marine animals, underwater noise and disruption of natural movement of water is still a challenge.

Key words: *marine energy, renewable energy sources, sustainability*

1. Introduction

Transforming ocean energy resources into electricity could play an important role in meeting the growing global demand for energy, mitigating climate change, diversifying energy supply and strengthening economic activity. However, only a few commercial ocean projects have been delivered to date, reflecting the current immaturity and high costs of these technologies, as well as the challenging market environment in which they operate. Together, ocean energy represents a huge unused resource available to most coastal countries in one or another form.

2. Wave Energy

2.1 Energy potential

The waves are formed by winds blowing over the surface of the sea. The wavelength generated will depend on the speed of wind, its duration, and the distance of water over which it blows (the fetch), the bathymetry of the sea bottom (which can focus or scatter wave energy) and currents. The resultant of the water movement carries kinetic energy which can be used by wave energy devices.

Estimates of potential energy wave production vary, but everyone agrees that the size of the awards is significant which varies from 4 000 TWh/year to 29 500 TWh/year. Europe consumes around 3 000 TWh/year.

The countries most suitable for ocean wave energy conversion are the United Kingdom, Ireland and Norway (see Figure 1), New Zealand and South Australia and Chile, followed by Northern Spain, France and Portugal, and the North American and South American coasts and South Africa.

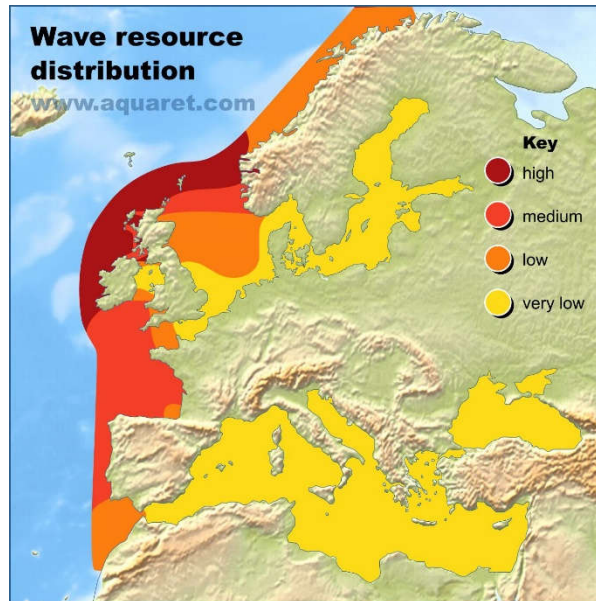


Figure 1 Wave resource map based on size of swell and windblown waves [1]

2.2 Technologies

Wave energy devices can be located in three different ocean environments: onshore, nearshore and offshore. In the following chapters we can find a description of these devices.

2.2.1 Onshore devices

Oscillating water columns (OWC) (see Figure 2) convert the rise and fall of waves into movements of air flowing past turbines to generate power [1].

Overtopping devices or terminator WECs (see Figure 3) have a wall over which waves break into a storage reservoir which creates a head of water. The water is released back to the sea through a turbine to generate power [1].

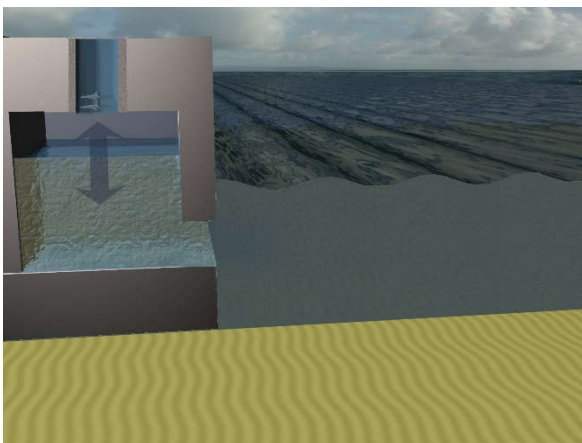


Figure 2 Oscillating water columns (OWC) [1]

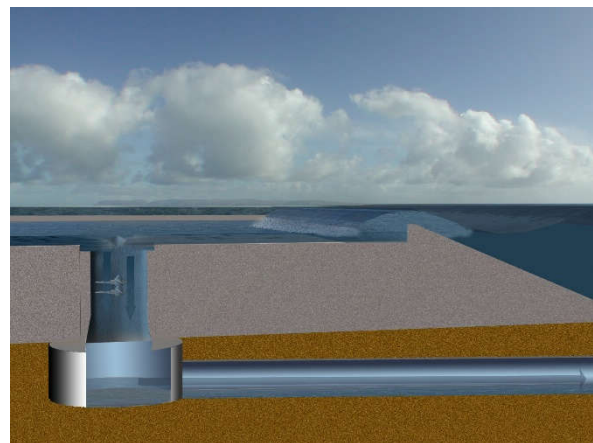


Figure 3 Overtopping devices or terminator WECs [1]

2.2.2 Nearshore devices

Oscillating wave surge converters (see Figure 4) converters are near-surface collectors, mounted on an arm which pivots near the sea bed. The water particles in the waves cause the arm to oscillate and generate power [1].

Point absorber (see Figure 5) are floating structures that can absorb energy from all directions. They convert the motion of the buoyant top relative to the base into electrical power [1].

Submerged pressure differential devices (see Figure 6) capture energy from pressure change as the wave moves over the top of the device causing it to rise and fall [1].

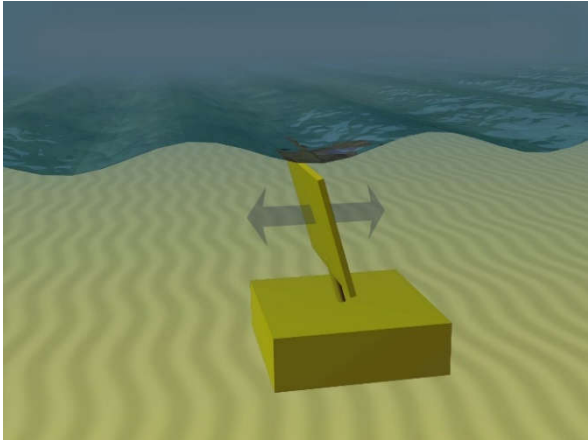


Figure 4 Oscillating wave surge converters [1]

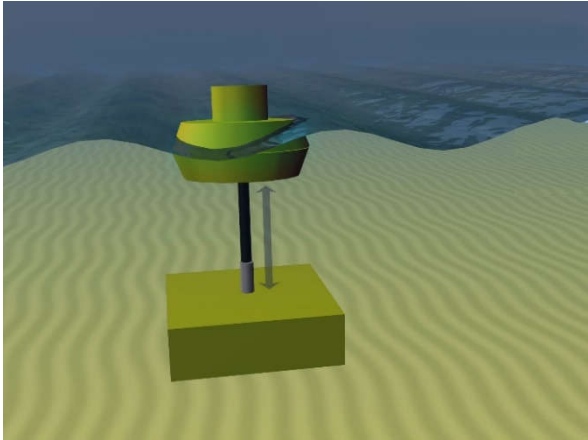


Figure 5 Point Absorber [1]

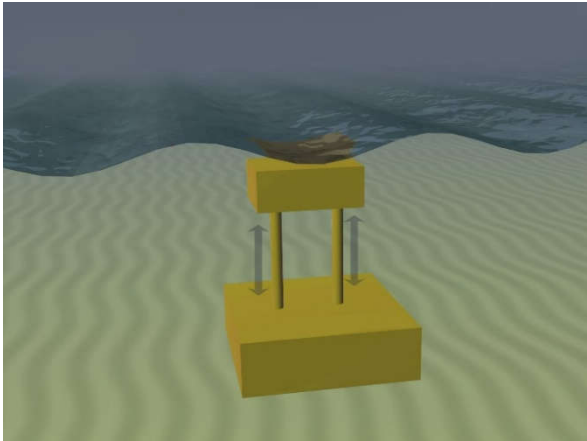


Figure 6 Pressure Differential devices [1]

2.2.3 Offshore devices

Attenuator (see Figure 7) are floating devices that are aligned perpendicular to the waves. These devices capture energy from the relative motion of the two arms as the wave passes them [1].

Bulge wave devices (see Figure 8) technology consists of a rubber tube filled with water, moored to the seabed heading into the waves. The water enters through the stern and the passing wave causes pressure variations along the length of the tube, creating a 'bulge'. As the bulge travels through the tube it grows, gathering energy which can be used to drive a standard low-head turbine located at the bow, where the water then returns to the sea [1].

Rotating mass converters (see Figure 9) have two forms of rotation that are used to capture energy by the movement of the device heaving and swaying in the waves. This motion drives either an eccentric weight or a gyroscope causes precession. In both cases the movement is attached to an electric generator inside the device [1].

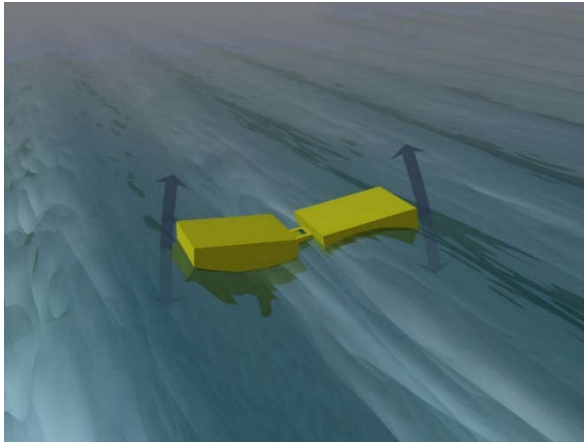


Figure 7 Attenuator [1]

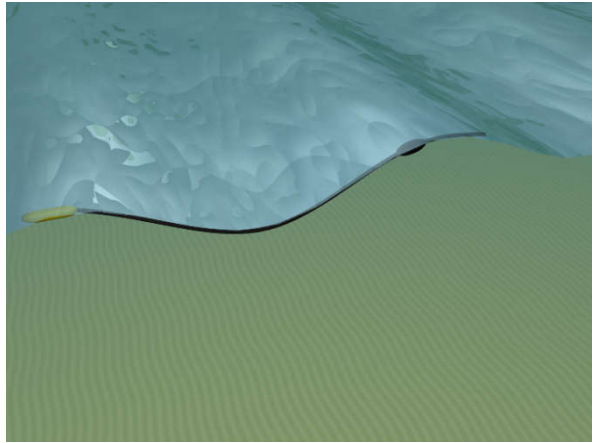


Figure 8 Bulge wave devices [1]

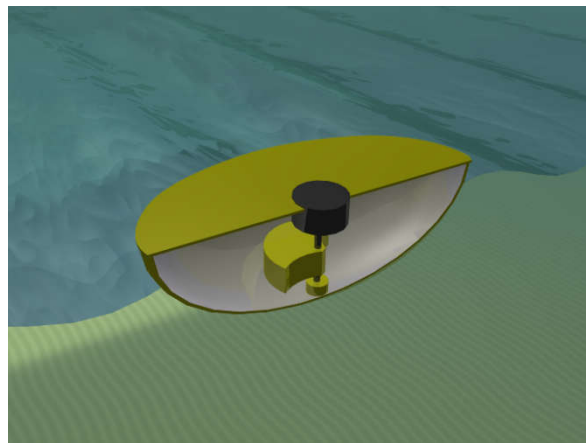


Figure 9 Rotating mass converters [1]

2.3 Technology implementation

The Wello company from Finland has tested its full-scale wave power converter, The Penguin (see Figure 10), in Orkney Scotland since 2012. During that time, the device experienced the toughest conditions in the ocean and survived several storms with wavelengths up to 12 meters. To this day, all original internal components from 2012 deployment to Penguin remain the same. Further build confidence in the survival of the Penguin and the ways in which it can be implemented with minimal service needs. This simple and patented device is aimed at producing electricity at a lower price than the coastal wind. Wave energy converter, the Penguin is 30 meters long, 16 m wide, 220 tons heavy and has nominal power of 600 kW.



Figure 10 The Penguin wave energy converter (600 kW) [2]

The roller of the device spins the rotator inside the device, directly capturing energy in the waves (see Figure 11). Power is supplied from the rotor to the generator by the same shaft that eliminates conversion losses.

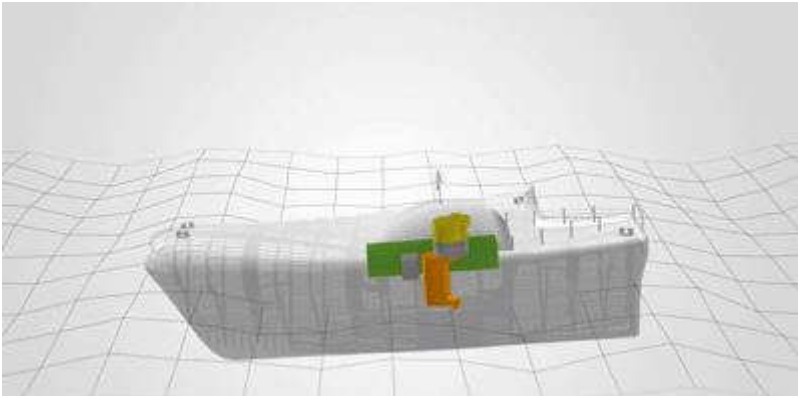


Figure 11 All the moving components are located inside the hull of the Penguin to ensure survivability [2]

3. Tidal Stream

3.1 Energy potential

The tides are generated by gravitational forces between the earth, the moon and the sun. This relative movement creates tidal currents that contain a huge amount of energy. Since the positions of the sun and the moon can be predicted with complete accuracy, so is the tide movement and the speed of stream. The energy potential of tidal currents is usually found in areas with the highest tidal range. Thus, Figure 10 is a good indicator where there is the greatest potential of tidal current.

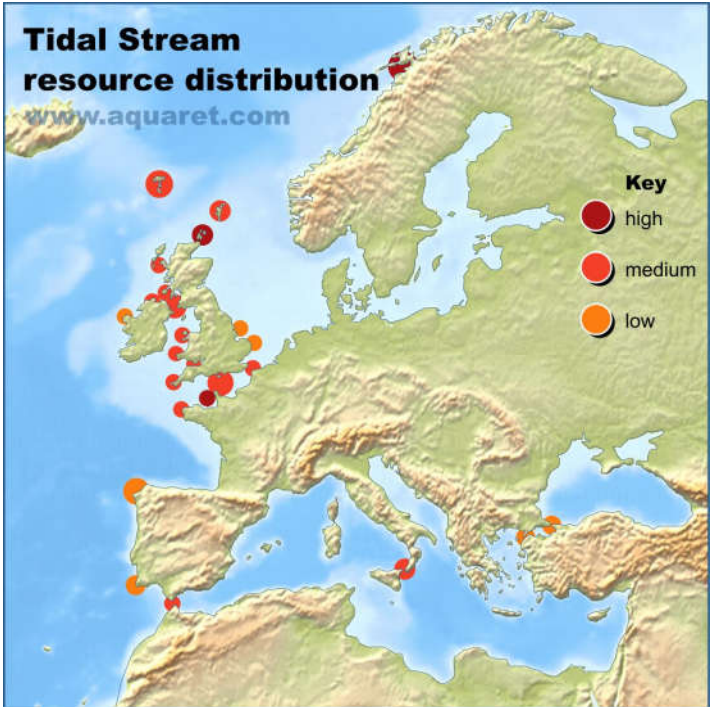


Figure 10 Tidal stream resource map based on velocity of currents [1]

Appropriate locations need average spring peak tidal currents that are faster than 2-2.5 m/s in order to offer energy density that enables an economically viable project, counting the fact as the tide changes there will be little or no horizontal flow of water. The main streams of

tides are identified along the coast of each continent, making it global resources (see Figure 11). For example, at the European level, 106 sites with strong tidal stream potential have been identified, which together offer 48 TWh/year resource potential.

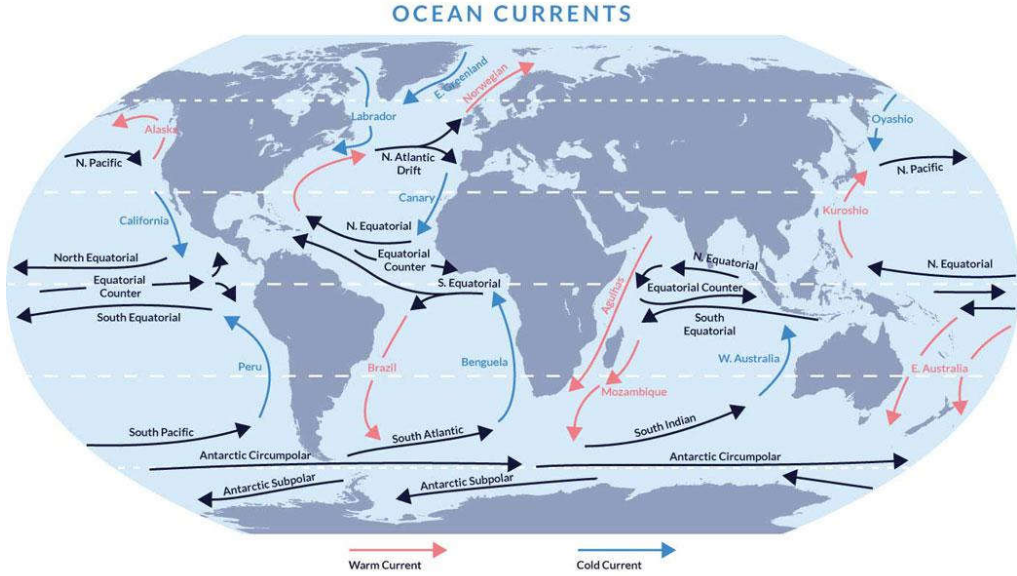


Figure 11 Ocean currents [3]

3.2 Technologies

Tidal stream devices convert the kinetic energy of free water flowing into electricity by the flow of tidal water and accelerating coastal topography.

Horizontal axis turbines (see Figure 12) work in a similar manner to wind turbines. The turbine is placed in the water and the tidal stream causes the rotors to rotate around the horizontal axis and generate power [1].

Vertical axis turbines (see Figure 13) work in a similar manner to horizontal axis turbines but the tidal stream causes the rotors to rotate around the vertical axis and generate power [1].

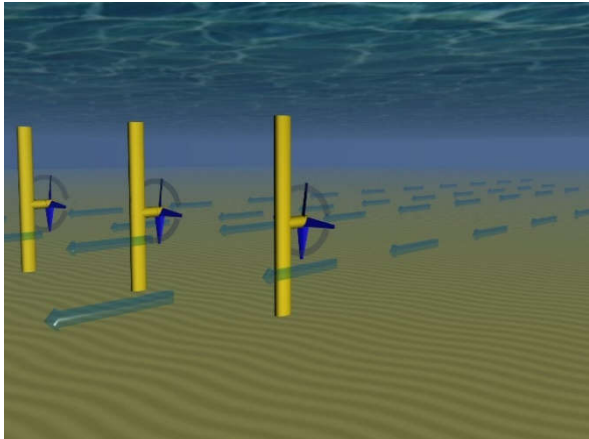


Figure 12 Horizontal-Axis turbines [1]

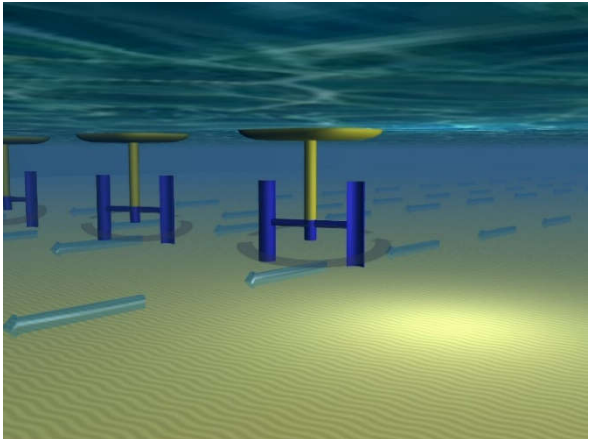


Figure 13 Vertical axis turbines [1]

Reciprocating hydrofoils (see Figure 14) have a hydrofoil attached to an oscillating arm. The lift caused by the tidal stream causes the arm to oscillate and generate power [1].

Venturi effect devices (see Figure 15) are devices which funnel the water through a duct, increasing the water velocity. The resultant flow can drive a turbine directly or the induced pressure differential in the system can drive an air turbine [1].

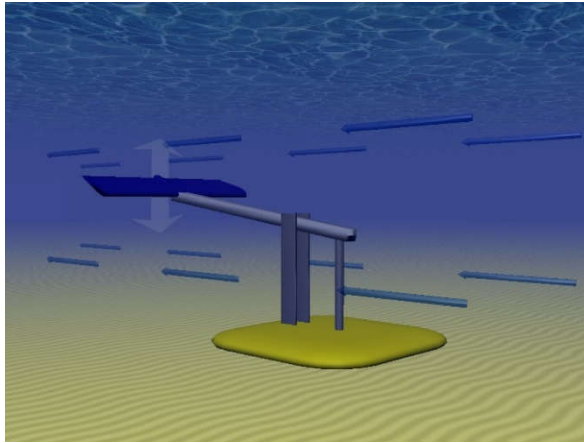


Figure 14 Reciprocating hydrofoils [1]

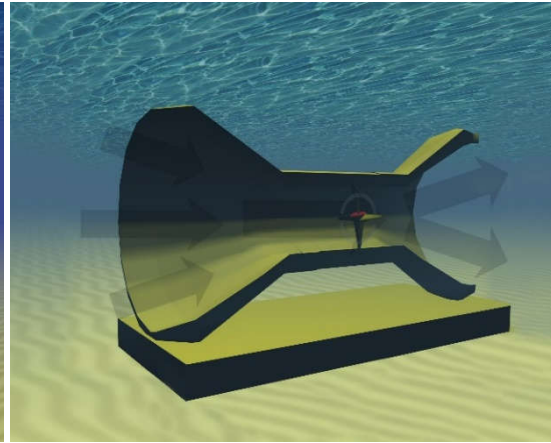


Figure 15 Venturi effect devices [1]

The Archimedes screw (see Figure 16) is a helical corkscrew-shaped device (a helical surface surrounding a central cylindrical shaft). The device draws power from the tidal stream as the water moves up/through the spiral turning the turbines [1].

A tidal kite (see Figure 17) is tethered to the sea bed and carries a turbine below the wing. The kite ‘flies’ in the tidal stream, swooping in a figure-of-eight shape to increase the speed of the water flowing through the turbine [1].

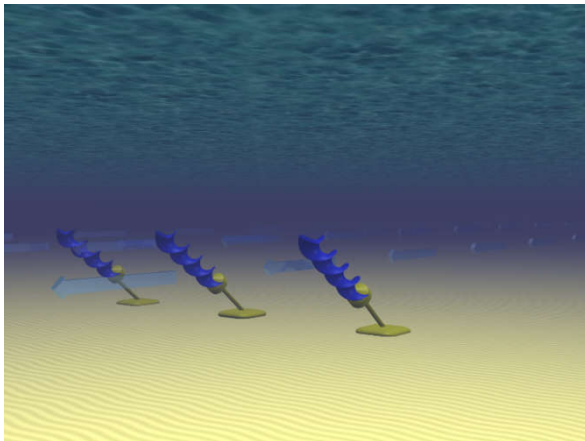


Figure 16 The Archimedes screw [1]

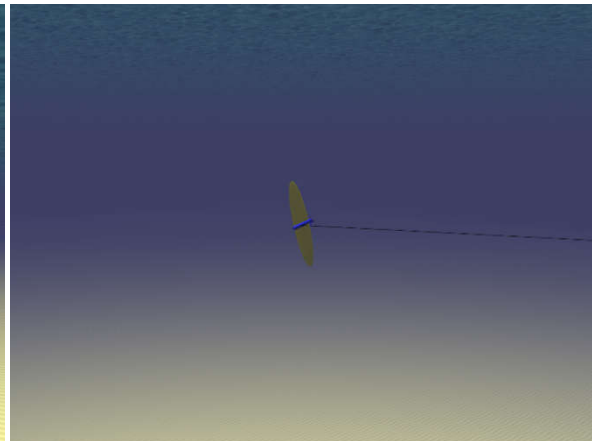


Figure 17 Tidal kite [1]

3.3 Technology implementation

Minesto has developed a unique technology for the cost-efficient production of electricity from the tidal and ocean currents, known as Deep Green (see Figure 18). The full tidal power plant, known as the Deep Green Utility, resembles an underwater kite consisting of a small turbine wing attached to the its bottom, connected to the bottom of the seabed (see Figure 18). Technology takes advantage of a hydrodynamic lift created by the wing while the water current flows over the device. In this case, the device can move at speeds greater than the current speed, while being steered in a figure-of-eight, allowing Deep Green to be used in areas of lower current velocity compared to other tidal technologies. Tidal velocity of the Deep Green technology requires tidal velocities within the range of 0.5 to 2.2 m/s, the most suitable water depth is 50 to 120 m and ideally significant wave heights should less than 4 m.

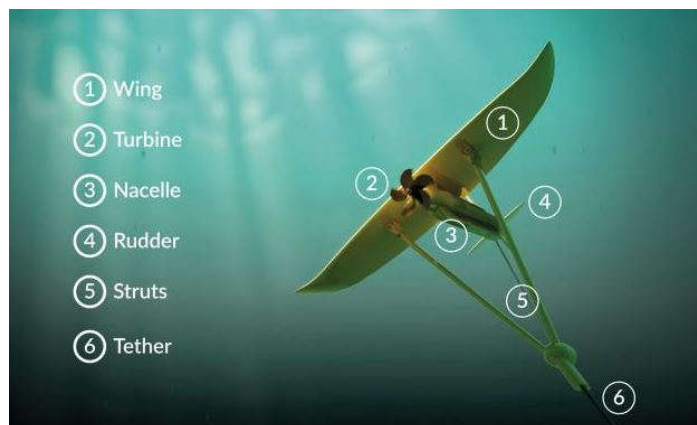


Figure 18 Deep Green technology [3]

The site has the most favourable tidal velocities for the DGU device, so would potentially yield the most electricity - tidal velocities fall within the operational range (0.5 to 2.2 m/s) for energy generation more than 75% of the time, and are within the optimal range (1.0 to 2.2 m/s) for the Deep Green technology for almost 50% of the time [3].

4. Tidal Impoundment

4.1 Energy potential

Tides are caused by the gravitational pull of the sun and the moon on the sea. This creates a daily cycle of rising and falling sea levels, and the resulting upstream flows and downstream ebbs in tidal inlets and river estuaries. Tidal impoundment technologies use the gravitational potential energy of water heads captured in basins to generate energy. Tidal impoundment technologies are best in shallow water with a high tidal range (see Figure 18). Tidal ranges considerably increase towards the coast.

Local topography can enhance the tidal range in places to produce local hot spots, particularly in large estuaries where the best tidal ranges tend to be found. This is mainly caused by shelving of the seabed and funnelling of the water by the estuaries [1].

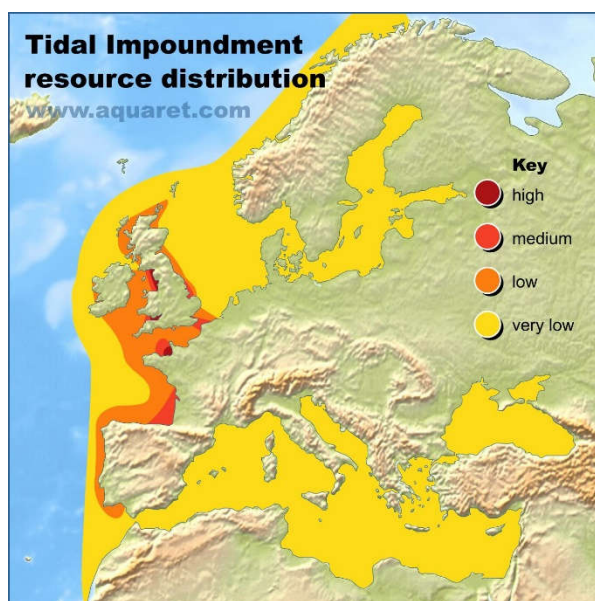


Figure 18 Tidal impoundment resource map based on tidal range

4.2 Technology

Tidal barrages and lagoons are large individual installations. The size of the area that can be seized in both barrages and lagoon schemes is highly specific for the site, and will depend mainly on local topography, environment and costs. The concept of tidal impoundment power plants is to impound large quantities of water in an area where a head difference can be made, and then allow water to pass through or out of area through low-head hydroelectric turbines.

The plants can be operated on ebb or flood tide generation, or both. The most commonly used method is ebb generation [1]. Here, as the tide comes in water would flow in through sluice gates. The sluices are then closed and the tide begins to ebb. When the water level outside the barrage is sufficiently low to create a suitable head, the sluices are opened and the water in the impounded area is released back to the sea through the turbines [1].

Tidal barrages (see Figure 19) involve building a dam across an estuary with a high tidal range, therefore creating an impoundment upstream of the barrage. The tidal barrage plant generates energy by allowing water to flow in and/or out of the estuary through low head hydro turbines [1].

Bunded tidal lagoons (see Figure 20) are impoundments constructed against the banks of a tidal estuary or basin, in shallow water areas. They operate in a similar way to tidal barrages except that they would not fully obstruct an estuary [1].



Figure 19 Tidal barrages [1]

Figure 20 Bunded tidal lagoons [1]

Offshore tidal lagoons are the most recent proposal which, if proven, would be capable of moving beyond the strict geographic walls of tidal estuaries and basins. They are a completely artificial offshore impoundment, and would be built on tidal flats in high tidal range areas. Single basin offshore tidal lagoons would be built on tidal flat in areas with high tidal ranges (see Figure 21). Multiple basin offshore tidal lagoons are built on tidal flat in areas with high tidal ranges (see Figure 22) [1].

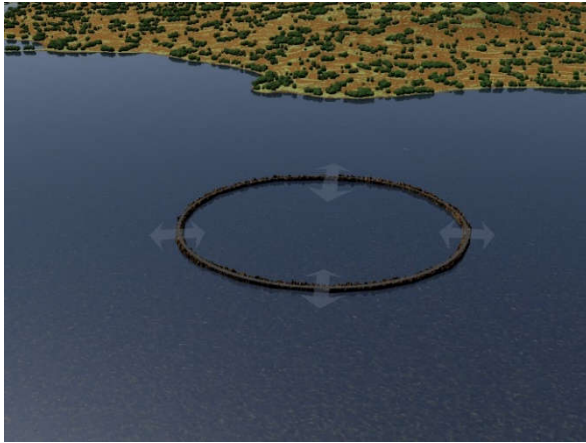


Figure 21 Single basin offshore tidal lagoons [1]



Figure 22 Multiple basin offshore tidal lagoons [1]

4.3 Technology implementation

Following 25 years of research and 6 years of construction work, the 240MW La Rance Barrage (see Figure 23) became the first commercial-scale tidal power plant in the world. It was built as a large scale demonstration project for low-head hydro technology. The construction of the tidal power plant started in 1961, and was completed in 1967. The Rance estuary has one of the highest tidal ranges in the world (an average of 8 meters, reaching up to 13.5 metres during equinoctial spring tides) which makes it an attractive site for tidal impoundment power generation. The complete barrage is 750m long and 13m high with a reservoir of 22km² capable of impounding 180 million m³ [1].



Figure 23 La Rance tidal barrage

(source: <https://tidalenergytoday.com/2017/07/24/iea-france-top-tidal-energy-generator-in-2016/>)

5. Environmental Impact

There is great influence on the interaction of marine animals with devices. There is a danger that animals will collide with moving parts of device (turbine blades of tidal currents can hit animals). This interaction can be harmful to animals and to the device. Devices may also be an obstacle to natural movements or animal migrations.

Underwater disturbances caused by ocean energy devices such as wave energy and tidal devices could affect the behavior of marine animals, such as some types of whales, dolphins, seals, sea turtles, migratory fish and invertebrates. This is because animals tend to use underwater sound, not light for communication, movement, etc., so any surrounding noise can affect their ability to perform these functions. Given the low level of implementation, so far, there is a clear lack of empirical information on how these devices affect sea animals.

Ocean technology could have potential effects where ocean energy installations could have on the flow of water such as tides, waves, ocean currents, and densities in response to the removal of energy from the marine environment or the natural flow of water [4].

6. Conclusion

Costs of various ocean energy technologies are still an important obstacle to implementation. Innovation will be key to cost reduction and efforts will be needed to focus on subcomponents (e.g. control systems), component integration, and field optimization. In addition, various socioeconomic, infrastructure and environmental barriers need to be addressed such as the development of stimulating energy market conditions, infrastructure provision, networking, growing supply chains and environmental impact reduction.

REFERENCES

[1] <http://www.aquaret.com>

[2] <https://wello.eu>

[3] <https://minesto.com>

[4] The World Energy Council, " World Energy Resources | 2016“, The World Energy Council 2016, 2016.

Development of Application Model for Blockchain Data Analysis

Nikola Grgić

University Department of Professional Studies, Split, Croatia
nikola.grgic@oss.unist.hr

Jelena Ružić

University Department of Professional Studies, Split, Croatia
jelena.ruzic@oss.unist.hr

Ivica Ružić

University Department of Professional Studies, Split, Croatia
ivica.ruzic@oss.unist.hr

Abstract. Blockchain was introduced in the White Paper written by Satoshi Nakamoto in 2008 and in a short time it found multiple applications in modern society. It is fundamental technology for almost all cryptocurrencies. Nowadays it is used in various areas, especially in the financial sector. If properly analysed, blockchain can be important source of information. This was motivation to start development of application which would represent blockchain data in a form suitable for statistical analysis. With this application, analysing blockchain data will be much easier. Also, application would provide synthesized data for various purposes. In this paper, blockchain data structure is described, statistical methods that could be applied in blockchain analysis are suggested, and design of application model is presented.

Key words: *Blockchain, Big Data, Statistical Methods, Software Design, Bitcoin*

1. Introduction

Blockchain data structure represents a set of cryptographically connected data blocks which allows adding new pieces of information to it, yet it strongly protects existing data from modification.

First public implementation of Blockchain was published in January 2009 to cryptographic mailing list [1] in form of a program named Bitcoin v0.1 which had functions for reading, interpreting and storing data in Bitcoin blockchain. Bitcoin is decentralized electronic payment system as described in whitepaper [2] written by anonymous author(s) who used pseudonym Satoshi Nakamoto.

Invention of Blockchain was a start of proliferation of other blockchains with various application scenarios and many other cryptocurrencies. Bitcoin blockchain is the oldest and historically most important blockchain, which functions since 2009 without any significant malfunctions. It stores Bitcoin transactions, and its size constantly grows (over 150 GB and 300 million transactions, as of April 2018).

Bitcoin transactions are combined in blocks which are the basic building element of blockchain. Every block (except the first one) contains cryptographic hash sum of the previous block which prevents modification of older blocks without breaking existing structure. New blocks are being added through the mining process, where users compete in a search for the new blocks. Users are motivated to use their computing resources to search for the block hash sums which fit inside a range specified by protocol, as these blocks ensure a

miner award in a form of newly generated coins. Bitcoin network is designed to generate six new blocks per hour on average, while a miner gets new coins and all the transaction fees inside the block. The amount of new bitcoins depends on the block height (its position in blockchain), and its issuing rate decreases 50% with every 210000 blocks mined, starting with 50 bitcoins per block.

This article describes some of the technical details about Bitcoin blockchain, but according to presented model, data analysis and processing could be applied to any blockchain. In order to ease statistical analysis, application model should gain access to all the information which is written in a blockchain and, also, to their basic derivations. Blockchain, as a global data structure, does not contain a single data field, but many values can be derived from its sub-elements (as displayed in Table 1):

Table 1 Bitcoin blockchain fields

Field	Derived	Description
bcBlockCount	Yes	Total number of blocks (block height)
bcSize	Yes	Total size of blockchain, equal to the sum of all block sizes
bcTotalBitcoins	Yes	Sum of all newly generated bitcoins in the blocks

Block is a basic building element of a blockchain and it contains the fields which are defined by Bitcoin reference implementation [3]. Software model for the software analysis contains all the standard fields, as well as derivate ones (Table 2):

Table 2 Bitcoin block

Field	Derived	Description
blockHash	Yes	Block identifier, hash of the block header
blockHeight	Yes	Block position in a blockchain
blockMagicNumber	No	Magic number (fixed value)
blockSize	No	Size of a block, in bytes
blockVersion	No	Version of the block format
blockPreviousHash	No	Hash of the previous block header
blockMerkleRootHash	No	Hash of the Merkle root of all transaction hashes
blockTime	No	Time of the block generation
blockTargetThreshold	No	Mining difficulty target threshold
blockNonce	No	Number which was chosen by mining the algorithm to produce hash value below the difficulty target threshold
blockTransactionNumber	No	Total number of the transactions in block
blockListOfTransactions	No	List of the transactions in block

blockDifficulty	Yes	Difficulty in mining the block, derived from block target threshold
blockCoinbaseReward	Yes	Mining reward in a form of newly generated coins
blockTotalFees	Yes	Mining reward as a sum of all transaction fees in block
blockTotalReward	Yes	Sum of the rewards in coinbase transaction (first transaction in block) and in all transaction fees
blockCoinbaseText	Yes	Text in a coinbase transaction

Bitcoin transaction is cryptographically signed element of block which defines value transfer from its inputs to its outputs as displayed in Table 3:

Table 3 Bitcoin transaction

Field	Derived	Description
blockHash	Yes	Identifier of a block in which transaction is listed
txHash	Yes	Identifier of a transaction, its hash value
txVersion	No	Version of the transaction format
txType	Yes	Type of transaction
txInputNumber	No	Number of inputs in transaction
txInputList	No	List of inputs in transaction
txOutputNumber	No	Number of outputs in transaction
txOutputList	No	List of outputs in transaction
txLockTime	No	Minimum block number or number for including transaction in block
txIsTimeLocked	Yes	Defines if transaction is locked
txIsCoinbase	Yes	Defines if transaction is coinbase
txIsRbf	No	Defines if transaction is replaceable by fee (RBF)
txIsSegwit	No	Defines if transaction is in segwit format
txInputTotalValue	Yes	Value of all inputs
txOutputValue	Yes	Value of all outputs
txFee	Yes	Transaction fee (miner reward)

Every transaction besides of coinbase has inputs which are references to outputs of some other transaction. Transaction input fields are shown in Table 4.

Table 4 Bitcoin transaction input

Field	Derived	Description
txHash	Yes	Identifier of the transaction which this input is a part
inputPreviousTxHash	No	Identifier of the previous transaction (transaction which has output that has been used as the input)
inputPreviousTxOutputIndex	No	Position (index) of the output in previous transaction
inputScriptSig	No	Input script signature
inputAmount	Yes	Amount of bitcoins in input (as defined in referenced output)
inputAge	Yes	Age of referenced output

Every transaction has the outputs which define value of transferred bitcoins as well as a script with transfer rules. Fields of transaction output are listed in Table 5.

Table 5 Bitcoin transaction output

Field	Derived	Description
txHash	Yes	Id of transaction of which this output is part
outputValue	No	Value of transferred coins
outputScript	No	Output script
outputPubKey	Yes	Public key of receiving address, if exists
outputIsSpent	Yes	Boolean value which defines if output is spent

Bitcoin address is a plain number which can receive some bitcoin value. Addresses are usually perceived as some sort of wallets which contain bitcoins. Technically, Bitcoin protocol does not send any value from the addresses, neither the transaction inputs have any reference to addresses (previous outputs are used). However, bitcoin address and related balances are interesting for the statistical analysis, so the application model should implement the fields for easy access to their properties, as displayed in Table 6:

Table 6 Bitcoin address

Field	Derived	Description
addressId	No	Address identification
addressType	No	Address type
addressListOfTransactions	Yes	List of transactions which use this address
addressCoinsReceived	Yes	Sum of coins received
addressCoinsSent	Yes	Sum of coins sent
addressFinalBalance	Yes	Final balance at address

2. Statistical Searches

Since all the data in blockchain is stored in the database, it is possible to perform different statistical searches. All data can be exported in a form that can be used in various tools specializing in statistical searches. This data can be processed through some of the older statistical tools as SPSS and Statistica. Also, it is possible to use modern approach as programming language R.

It is also possible through the application to express all variants of the interdependence of any data contained in the database.

For example, it would be interesting to know how many blocks were generated in a given time period. Then, in that same period, find the average difficulty of mining the block. And finally, calculate the average mining reward in the form of newly generated coins in that same period. Comparing these results for different time periods would surely bring interesting results.

This is just an example, and there are also all other variants of the interdependence of any data from the database. Also, interesting findings can be obtained from analysing user searches.

3. Application Model

3.1 Motivation

Accurate and on-time information is the key to successful business. Individuals and companies can not make decisions without quality information. The cryptocurrency research is currently enabled mainly by providing information on market capitalization, price and volume, as well as circulating supply, as is at coinmarketcap.com, the most popular Internet site with a review of the market value of cryptocurrencies. These are the data that can be helpful for making decision about investment in cryptocurrencies, but for more detailed study, one needs to have insight into the data contained in the blockchain structure itself, that is, in every block or transaction.

If we provide a simplified overview of all the data in the blockchain structure, it would be good to know which information is interesting to users or which queries users set up to such structured data.

Our application would provide a detailed blockchain data analysis on the one hand and, on the other hand, it would also enable a detailed search analysis performed by users during blockchain data analysis.

3.2 System architecture

Because of the openness of the data that would be offered to application users, that is, because of its basic purpose, the security for a user-oriented part of the application is not critical. Today, there are many application development tools, and user front-end could be made in the Laravel framework. Laravel enables object-oriented programming in the PHP programming language and it has integrated Eloquent, currently one of the best Object Relational Mapping systems. Eloquent successfully links the database and manages relationships with the database model. Laravel also uses the standard model-view-controller architecture that ensures fast application development while retaining all the postulates of modern programming methods. For security reasons, Laravel offers Middleware, which provide a convenient mechanism for filtering HTTP requests. For the user's interaction with the application, some part of the application will be written in the JavaScript language program which communicates well with the part of the application written in Laravel. To write this element, we could use some of the mainstream frameworks such as AngularJS.

To enable user queries, data must be extracted from the raw blockchain. We would set up Node as a part of the Network, which would collect raw data. The element of application named ParserEngine would handle this data and systematically fill digested data in database. ParserEngine would be made in one of the modern programming languages. In our example, we would use Java programming language. That part of the application would be unavailable to users who would search only structured data in DB-Main database.

So far described is associated with a detailed analysis of the blockchain. The part that would allow detailed analysis of user searches would be linked to a database containing user queries (DB-Query). This could be integrated into the part of the application written in Laravel. In this case, a special database would be created that would collect the user queries and its metadata. That would be a much better solution than implementation into an existing database because it could overload the data search due to a large data.

Application architecture is a graphically displayed on Figure 1.

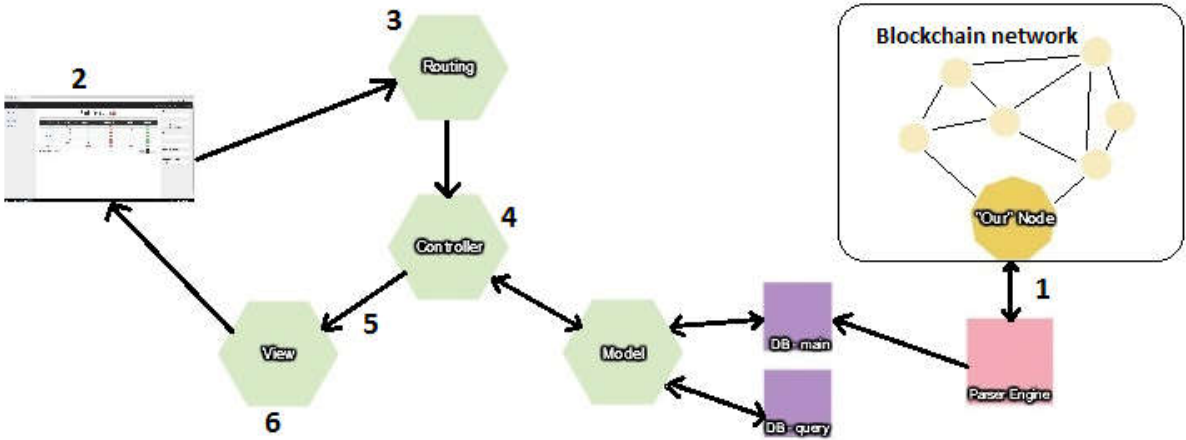


Figure 1 Application architecture

3.2.1 Procedures for blockchain data analysis

OurNode would collect raw data from network that would be converted to useful data via ParserEngine (Step 1 on Figure 1). These data would be recorded in the database (DB-Main). The user would submit a request with the query (Step 2). The request would be checked with Middleware and passed to the Controller (Step 3). All necessary actions would take place via the Controller in order to ensure the necessary system protection. Only the Model has access to the database and all queries should be made through it (Step 4). In order to generate reply, appropriate Controller has to approve it (Step 5). At the end, View renders web page in user browser (Step 6).

All statistical searches on database would be available through these procedures.

3.2.1 Procedures for analysing user searches

There are two approaches in procedures for analysing user searches. The first - analysis of user searches could be implemented into ParserEngine. In this way, maximum security of this part of the application could be realized. This is because ParserEngine is completely unavailable to users. However, the required level of security can be enabled in the other ways, i.e. through the Laravel framework over its Middleware. It is only necessary to provide the required Roles and allow access only to those data and sites that the Role has permissions. In this way, access to data from entire application would be unified. This would be the best approach for implementation of user searches analysis functionality. Various statistical searches could be enabled. This would also make a step in further research in the Big Data area.

The definition we most often find for Big Data is "3V" [4]:

Volume - a large amount of data collected, processed and made available for analysis

Velocity - continuous collection and analysis of large amounts of data in real time

Variety - data is available in various forms and sources, and are actually mostly unstructured

Through our application, by all parameters of the Big Data it could be perform cryptocurrencies analysis.

4. Database

Based on our previous experiences, we recommend mySQL as RDBMS (*relational database management system*) as it works excellent with all selected technologies. MySQL, Laravel and AngularJS will be joined to a system that is proven to work well. The database model follows blockchain structure (described in Table 1, Table 2, Table 3, Table 4, Table 5 and Table 6). Thus we can identify entities: Blockchain, Block, Transaction, TransactionInput, TransactionOutput and Address. The Blockchain entity is necessary if we want to write data about different cryptocurrencies (e.g. bitcoin and litecoin), otherwise we do not need it. Attributes are identical to those identified in the structure. The redundancy of some data is intentional as it provides required speed of performing certain queries. Such fields are marked as "Derived" in tables.

Relationships between individual entities are listed in Table 7. For each relation are specified the relation type as well as the cardinality of each entity in the relation.

Table 7 Relationships between Entities, Relationship type and Cardinality of Entities in Relationship

Relationships between Entities	Relationship type	Card (E1,R)	Card (E2,R)
tbBlockchain - tbBlock	One to many	Card(tbBlockchain, R)=(1,n)	Card(tbBlock, R)=(1,1)
tbBlock - tbTransaction	One to many	Card(tbBlock, R)=(1,n)	Card(tbTransaction, R)=(1,1)
tbTransaction - tbTransactionInput	One to many	Card(tbTransaction, R)=(1,n)	Card(tbTransactionInput, R)=(1,1)
tbTransaction - tbTransactionOutput	One to many	Card(tbTransaction, R)=(1,n)	Card(tbTransactionOutput, R)=(1,1)
tbTransaction - tbAddress	Many to many	Card(tbTransaction, R)=(0,n)	Card(tbAddress, R)=(1,n)

The full E-R diagram for DB-Main is in Figure 2.

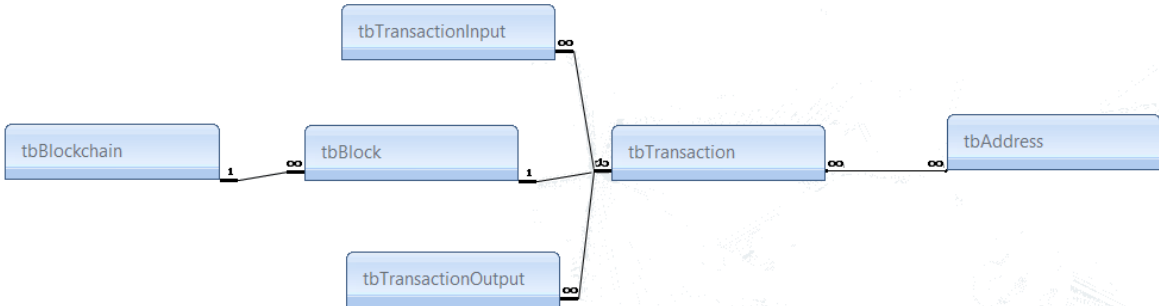


Figure 2 E-R diagram DB-Main

Also, we would create a DB-Query that contains information about queries and users. This table would be used for analysing user searches,

5. Conclusion

Blockchain is a fundamental technology for almost all cryptocurrencies. It is used in various areas and if properly analysed, blockchain can be a major source of information for many business decisions.

This paper presents a detailed elaborated blockchain structure. This structure is base for database of application model that could perform statistical operations. The proposed architecture of the application would provide the necessary security requirements. It would be easy to set up statistical searches. It would also be possible to export data for specialized statistical tools. All searches will be recorded which would allow further analysis of user interests. Assuming that queries would be made on a large amount of unstructured data in real-time, there will be research in the area of Big Data. The development of smart search algorithms would be a continuation of the development of this application.

REFERENCES

- [1] Nakamoto, S. (2009), Bitcoin v0.1 released. Cryptography Policy Mailing List. Retrieved April 15, 2018, from <http://www.metzdowd.com/pipermail/cryptography/2009-January/014994.html>
- [2] Nakamoto, S. (2008), Bitcoin: A Peer-to-Peer Electronic Cash System. Retrieved April 15, 2018, from <https://bitcoin.org/bitcoin.pdf>
- [3] Bitcoin developers (2018), Bitcoin Core master branch source code. Retrieved April 15, 2018, from <https://github.com/bitcoin/bitcoin>
- [4] Reeve, A. (2013), Managing Data in Motion: Data Integration Best Practice, Techniques and Technologies, Morgan Kaufmann, Waltham.

Design and Implementation of 3D Printers for Application in Education

Joško Smolčić

Marjan auto d.o.o., Split, Croatia
josko1911@gmail.com

Perica Perković

University of Split – University Department of Professional Studies, Split, Croatia
perica3993@gmail.com

Filip Perković

University of Split – University Department of Professional Studies, Split, Croatia
filiperkovic92@gmail.com

Tonko Kovačević

University of Split – University Department of Professional Studies, Split, Croatia
tkovacev@oss.unist.hr

Abstract. Three dimensional (3D) printing is a process of making three dimensional physical objects from a digital design using additive technologies. Low-budget 3D printers have become popular in manufacturing of various models and enabled a wider population to produce a variety of items at lower cost of production and maintenance. This paper presents a process of designing and manufacturing a low-budget 3D printer through teaching activities that are carried out at the University Department of Professional Studies. Main teaching outcomes of the project are experience in practical and team work and use of open source technologies and modern software tools. In addition, 3D printing technology can be used in education to create a variety of 3D models that are used in designing different student projects and thus contribute to the further development of student creativity.

Keywords: 3D printer, Arduino, driver, G-code

1. Introduction

Three-dimensional printing (3D printing) is a process of making three dimensional physical objects from a digital design using additive technologies and computed numerated control (CNC) devices. Generally, 3D printing is performed so that the fragments of the specific material fit in one plane in thin layers according to a predefined algorithm. Using this type of prototype design, it is possible to achieve complicated and multitasking prototypes that cannot be made by conventional CNC machines. Areas of 3D printing apply to numerous professional domains such as medicine, bio-modeling, aeronautics, education and many more. Figure 1 shows a commercial available 3D printer.

In this paper we present a process of designing and manufacturing a low-budget 3D printer through teaching activities that are carried out at the University Department of Professional Studies, University of Split. The rest of this paper is organized as follows: In Section II, we describe the 3D printing technology. We explain in details the 3D printer design in Section III and Section IV the device drive. In section V we give the 3D object process building, while the conclusions are drawn in Section VI.



Figure 1 The commercial available 3D printer

(source: <https://www.amazon.co.uk/LulzBot-TAZ-Desktop-3D-Printer/dp/B01FU1OEVO>)

2. The 3D Printing Technology

There are different 3D printing technologies that differ from printing methods (photopolymerization, extrusion, lamination, etc.) and used materials (metal, plastics, composites). The fused deposition modeling (FDM) is the most used 3D printing technology.

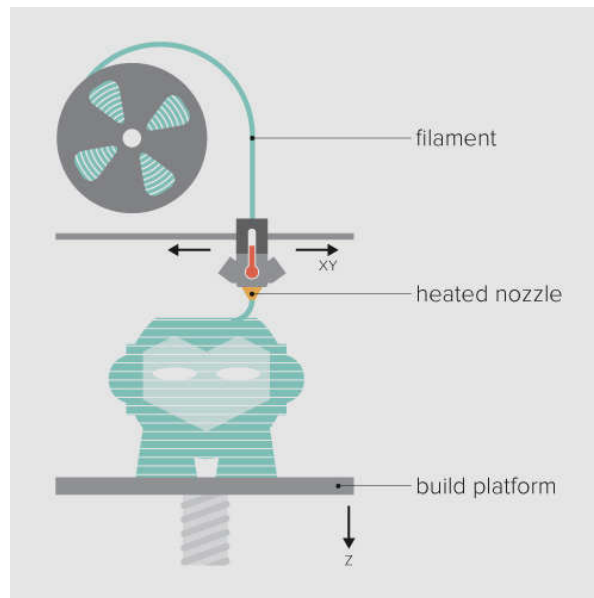


Figure 2 The FDM 3D Printing Technology

(source: <http://rookieelectronics.com/3d-printing-technologies-types/>)

The basic model of the FMD 3D printer is shown in Figure 2 and consists of 3 components: printing material (filament), an extruder that melts and directs the material, and a construction bed [1]. The material from which the object is made comes in the form of a thread coiled on the roller that freely rotates. The filament is firstly supplied into the heated nozzle using the

motor, then melted at the certain temperature and finally directed to the heated bed. After that, the liquid filament is bonded to the bed and transformed into the solid state. The extruder and the bed perform pre-programmed motion by commands received from the computer, thereby controlling the filament melt position on the bed. The filament melts until a very plane thin layer of the model is obtained. This procedure is repeated until the desired shape is achieved. Generally, the print resolution is larger at the brim of the object than the print resolution inside of the object. Using this printing method the used material is reduced and the process lasts for a shorter time with satisfying (or expected) mechanical properties.

FDM printing technology uses wired material with a standard diameter of 1.75 mm or 3 mm in different colors that is coiled on the roller. The two most commonly used materials are acrylonitrile butadiene styrene (ABS) and polylactide (PLA) [2]. ABS is an amorphous thermoplastic polymer formed by polymerization of acrylonitrile and styrene in the presence of polybutadiene, Figure 3 [1]. This polymer is characterized by good mechanical properties (hardness and impact resistance) which can be significantly enhanced by adding different additives. ABS has poor weather resistance and can be used in a temperature range of -20 to +80 °C.

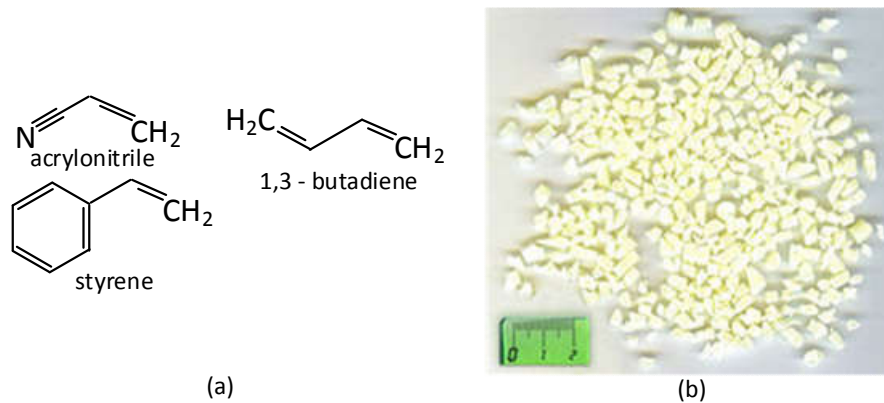


Figure 3 (a) Chemical formula; (b) ABS polymer grains

This material can be processed with pressing or extrusion processes and it is the most used 3D printing material. Benefits of using ABS are: low price, good mechanical properties, simple cleaning and simple bonding of the detached parts using acetone. The main drawbacks of using ABS plastic are: it is not biodegradable, the melting ABS plastic creates smoke that can disturb people's health, and it has a higher melting point requiring a higher bed temperature than PLA plastics. PLA is a biopolymer made from plants such as corn starch or sugar cane. PLA is a solid material that has the following properties:

- it could be easily broken,
- items made from PLA can be cut, polished or painted,
- it is not toxic,
- it is recyclable and
- due to the low melting temperature PLA is not suitable for use in all temperature ranges (at 50 °C it considerably softens).

When printing with the PLA, the extruder head can be clogged due to the increased viscosity of the material and the fact that it expands at higher temperatures than ABS. Cases in which the is damaged are very rare. Although it is recommended, PLA does not require the heated bed. Table 1 compares the thermal properties of PLA and ABS plastics [3], where:

- the flow in liquid form is a measure for the quantity of volume material passed through a precise capillary in 10 min
- the transitional temperature is the temperature at which the material passes from the current state to the state where it operates like rubber.

Table 1 Thermal properties of PLA and ABS materials

Thermal properties	PLA	ABS
Flow in liquid form (MVI) [cm ³ /10 min]	10.3	9.7
Transitional temperature [°C]	60-65	105
Melting point [°C]	160-190	210-240
Print temperature [°C]	190-220	230-250
Recommended bed temperature [°C]	50-70	80-120

3. 3D Printer Design

The 3D printer can be imagined as a set consisting of these elements: mechanical construction, electromotor drivers, heated bed, control electronics and software. The mechanical construction is the base of the 3D printer structure and its functionality. The 3D printer consists of the flat square steel plate, the steel C profile and the INOX bearer as shown in Figure X. The X-axis is mounted on the base plate by means of two linear guides. On these linear guides the ball bearings and the ball spindle with the stepper motor are also mounted. The Y-axis is made so that the steel square plate (board) is placed on the ball bearings of the X-axis. There are two linear guides mounted on the board and a step motor bearer. On the ball bearings of the Y-axis there is a heated bed.

The Z-axis is significantly different from the X and Y axes and consists of two steel L profiles. The first profile is statically mounted on the bearing profile while the second L profile is set onto the first one, with the linear guides that allow its vertical movement. The threaded spindle is positioned vertically on the two L profile plates of the Z-axis, and the stepping motor is placed directly on the first profile.

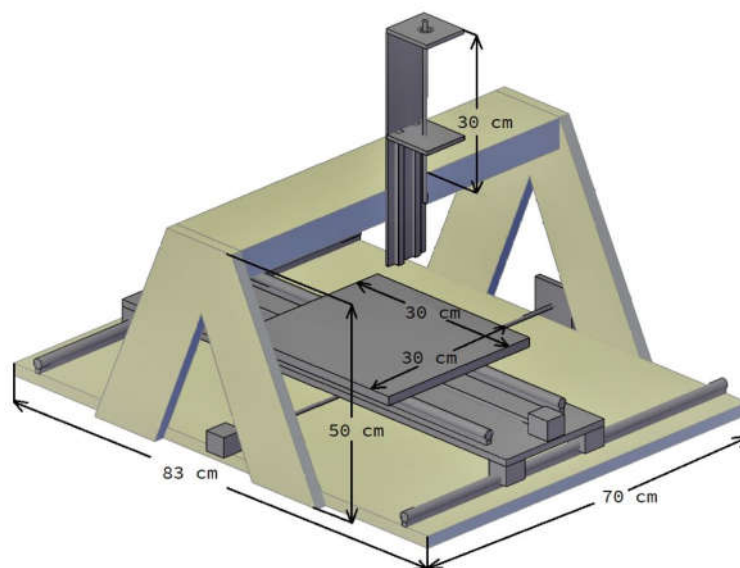


Figure 4 The construction base

Figure 5 shows the manufactured 3D printer which is based on the RepRap platform, and consists of:

- RAMPS 1.4 Add-on for Arduino Shield,
- Arduino MEGA 2560 microcontroller and
- H bridge stepper motor drive.

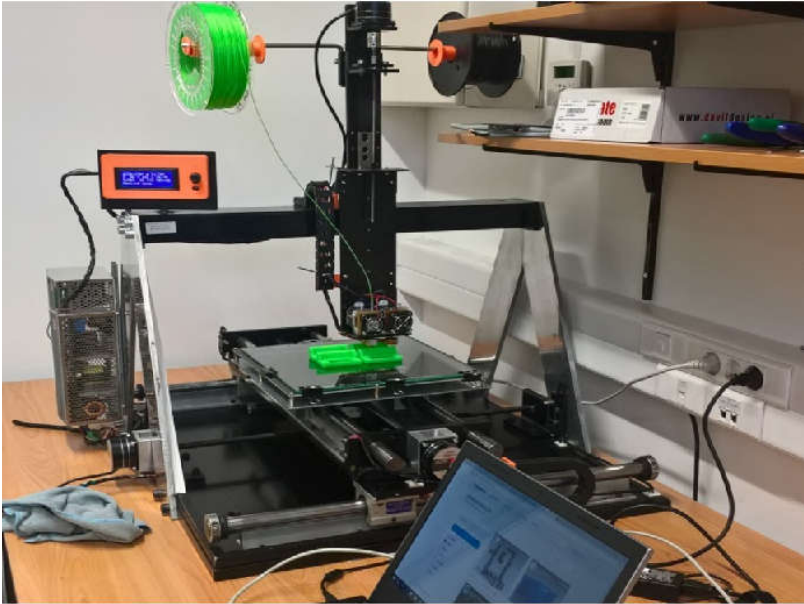


Figure 5 The manufactured 3D printer

The block diagram in Figure 6 shows a simplified 3D printer design. From the block diagram it is apparent that the entire system is powered by one 12 V and one 24 V power sources [4]. The RAMPS 1.4 module was set up on the Arduino platform as its extension. The heater bed has separate power supply which is controlled via the relay.

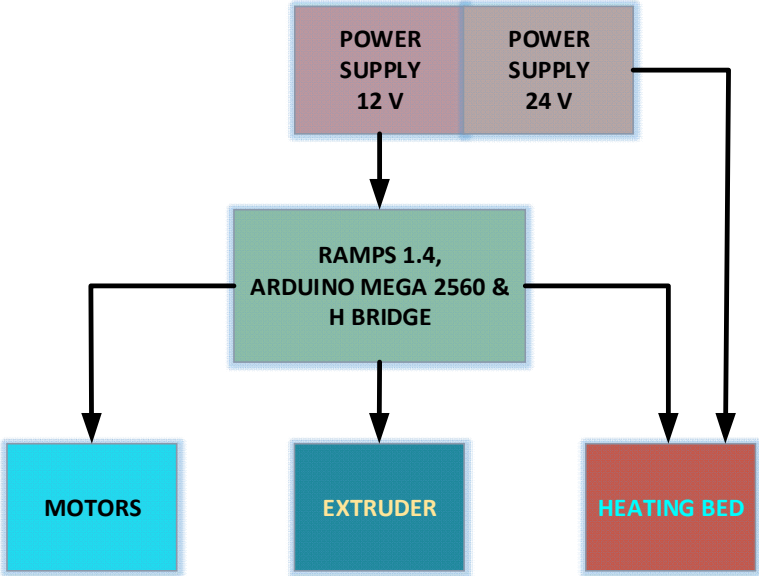


Figure 6 The block diagram of the 3D printer

Figure 7 shows the functional scheme of the 3D printer while Figure 8 shows the electrical

scheme. The main components of the 3D printer are:

- the RAPMS 1.4 board,
- the end switches and motors for the X, Y and Z axes,
- the relay that turns on the heater plate,
- the extruder temperature sensors, nozzles and motors,
- the power supplies,
- the temperature sensor and heating bed and
- LCD display.

4. Device Driver

3D printers based on 8-bit microcontrollers use the built-in software that was previously created, configured and transferred to the platform by the user. The role of such a program is to get a G-code, make a move, and finally print out the object. Through the G code commands, the program manipulates with the motors speed and displacement, and the system temperature. Some of the most used drivers are: Marlin, Sprinter, Teacup and RepRap Firmware.

All these programs are compatible with the RepRap platforms and are found in many commercial printers. The Marlin has been often used due to its much better features, greater availability of information, more configuration instructions and supports a larger number of platforms belonging to the RepRap community versus other programs.

Marlin is a replication rapid reporter (RepRapper) driver for 3D printers [5]. Marlin works on printers that extrude plastic filaments (materials, threads) by using the heated nozzle in the process which is called fused filament fabrication (FFF). Marlin is a program located in the core of the computer whose task is to control and coordinate the motors, control the heaters and the sensors according to the set commands. The Marlin regulations say that every manufacturer that uses this program must allow its availability in the original code. The Marlin 1.0.2 version has been accepted by many manufacturers of commercial printers such as Prusa Research, Ultimaker and Printrbot which distribute this program in their printers. It works on simple 8-bit Atmel Avr microcontrollers, such as open source Arduino/Genuino platform. The Marlin reference platform is Arduino Mega 2560 with RAMPS 1.4. This program is adaptable to existing boards and configurations, customizable, expandable and economical and because of that used by printer manufacturers and people who look at printing as a kind of hobby. Some of the main features are:

- optimized G-code language,
- intelligent planer of movement,
- fast, dashed movements,
- linear acceleration,
- PID closed loop heat regulator,
- thermal protection and safety features,
- LCD driver and
- support for filament consumption.

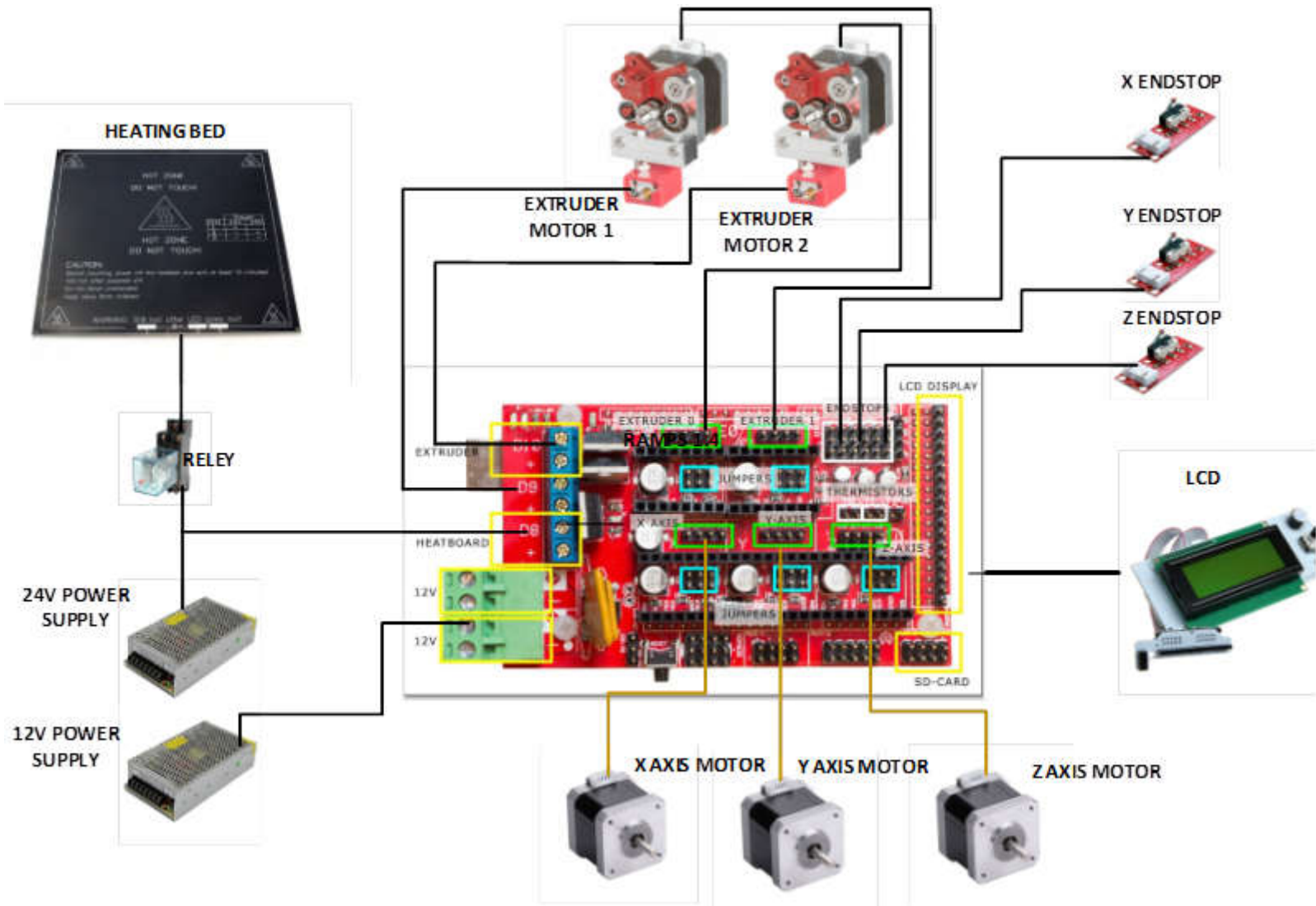


Figure 7 The functional scheme of the 3D printer

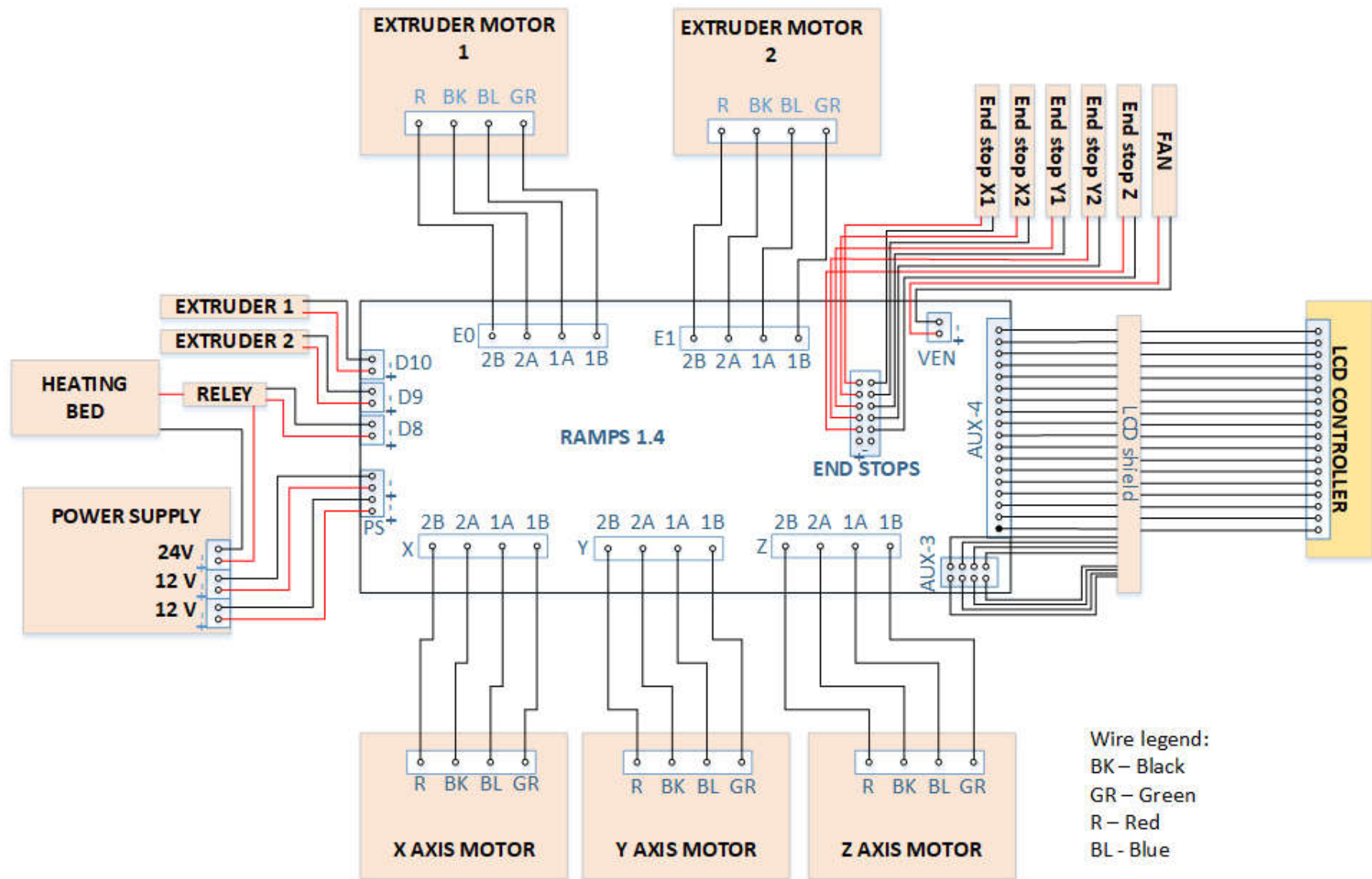


Figure 8 The electrical scheme of the 3D printer

The Marlin is designed for 3D printers that perform additive production by modeling with melted filament, and the driver is located on the 3D printer motherboard. This driver can scan the USB port and read files from other devices. The Marlin receives G-code commands and execute them to make simple things like, for example, "set heater from 1 to 180" or "move XY to speed F". There are two configuration files:

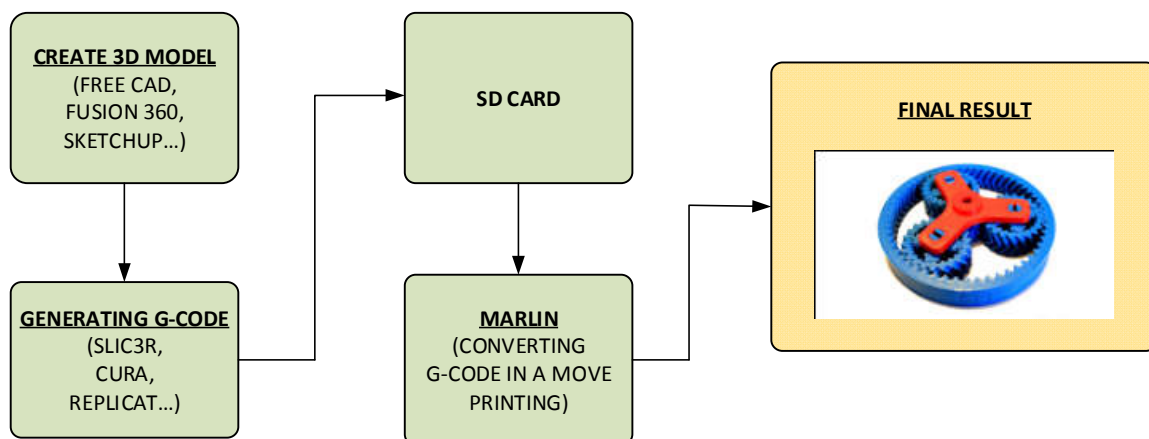
- *Configuration.h* contains the elementary settings for the hardware, language and choice of the controller, settings for the most common features and components and
- *Configuration_adv.h* serves contains the advanced settings, for example the detailed possibilities of adjustment and some experimental features.

Below is an example of the step motors settings for the XYZ axes and the extruder:

```
#define DEFAULT_AXIS_STEPS_PER_UNIT {251.986,251.986,4000,130}
//default steps per unit for X, Y, Z, E
#define DEFAULT_MAX_FEEDRATE {20, 20, 2, 13} //(mm/sec)
#define DEFAULT_MAX_ACCELERATION {600,600,20,62}
//X, Y, Z, E the maximum start speed for accelerated moves
```

5. Building 3D Objects

First of all, the 3D model must be created in one of the tools suited for that purpose. There are different programs that translate digital 3D models which are in some of the standard formats (.stl, .obj or .amf) into instructions that are understandable to the 3D printer. After that, the model is processed in one of the tools that can generate the G-code such as: Slic3r, Cura, Replicat, CraftWare, KiSSlicer, Repetier and OctoPrint. Figure 9 shows the object building workflow.



code that was generated, transferred to the SD card and inserted into the printer. This example presents the 3D object building process through the following steps:

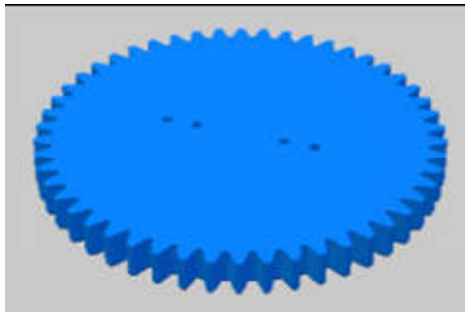
1. The G-code was generated using the Slic3r which translates the digital 3D model into understandable instructions for the 3D printer.
2. The printer configuration:
 - **Printer settings:** these options define the capability of a printer.
 - **Filament settings:** these options define specific features of the filament, such as the diameter, temperature and cooling.
 - **Printing setting:** these options define printing styles that can be used for every print, for instance, a user prefers different vase profiles, mechanical objects, high quality models, etc.

Export of the G-code starts after configuring before mentioned settings and below is an example [6]:

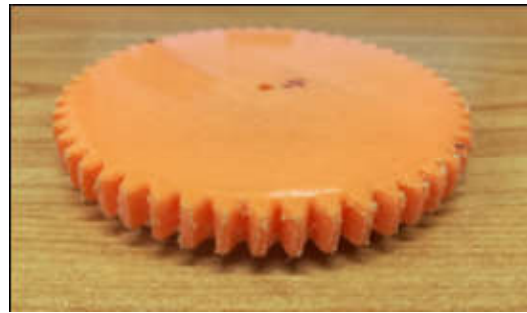
```
G0 X12                ; move to 12mm on the X axis
G0 F1500              ; Set the feedrate to 1500mm/minute
G1 X90.6 Y13.8 E22.4 ; Move to 90.6mm on the X axis and 13.8mm on the Y axis
                    ;while extruding 22.4mm of material
G1 F1500              ; Set feedrate to 1500mm/m
G1 X50 Y25.3 E22.4   ; Move and extrude
G1 F1500              ; Feedrate 1500mm/m
G1 X50 Y25.3 E22.4 F3000 ; Accelerate to 3000mm/m
```

After this process is performed the G-code is copied to the SD card and inserted into the 3D printer. The last phase of building an object is its printing. The well configured settings in the driver and in the user program will result in high-quality printing. The 3D printing system is a system which requires a very high motion precision of moving parts and specified temperature conditions to achieve the products high quality. For each 3D printer different options and parameters should be set. As with any production process, some problems can be encountered during the 3D printing. This section lists the most common problems encountered by users when working with a 3D printer. One of the main problems is referred to the 3D printer bed. The bed must have such properties that the object was adhered during the printing and it can be easily removed from the bed after completion of the printing process. The lack of adhesion to the surface can occur for several reasons: the working surface is not cleaned, the nozzle is not low enough at the startup, too low the bed or extruder temperature. In case that the object was excessively sticed to the bed surface, the object can be damaged or it will not be removed without damaging the bed. This occurs when the used material is not compatible with the bed.

Figure 10(a) and 10(b) shows the 3D moel and the printed 3D object from the model with satisfactory quality, respectively. The only thing which could be performed after printing is the object polishing to make the gear teeth look better.



diameter: 78,00 mm
thickness: 7,00 mm
(a)



diameter: 77,90 mm
thickness: 6,96 mm
(b)

Figure 10 (a) The 3D model; (b) The printed object

6. Conclusion

In this paper we presented a process of designing and manufacturing a low-budget 3D printer through teaching activities that are carried out at the University Department of Professional Studies. The main teaching outcomes of the project are experience in practical and team work and use of open source technologies and modern software tools. In addition, 3D printing technology will be used in education to create a variety of 3D models that are used in designing different student projects and thus contribute to the further development of student creativity. In designing this printer, special attention is paid to the way of fabricating and connecting mechanical components to obtain the most accurate precision of making prototypes at the expense of its printing speed. The electronic components are selected to meet all the requirements of the prototype making process and meet all the conditions required for optimum functioning of the system. The well-defined parameters and well-made calibration process of 3D printers ensure high quality printing, and thus the best way to eliminate problems during the printing is the process monitoring and the trouble detection.

REFERENCES

- [1] https://en.wikipedia.org/wiki/Acrylonitrile_butadiene_styrene, (online, accessed 5.1.2018.)
- [2] https://en.wikipedia.org/wiki/Polylactic_acid (online, accessed 12.11.2017.)
- [3] https://en.wikipedia.org/wiki/3D_printing_filament (online, accessed 19.11.2017.)
- [4] <http://www.mouser.com/ds/2/260/DR-120-spec-1109610.pdf>
- [5] <http://marlinfw.org/docs/basics/introduction.html>
- [6] <https://en.wikipedia.org/wiki/G-code>

Internet of Things Platform for Environmental Monitoring

Marko Meštrović

Polytechnic "Marko Marulić" in Knin, Croatia
mmestrovic@veleknin.hr

Luka Tomasović

University of Split – University Department of Professional Studies, Split, Croatia
ltomasov@oss.unist.hr

Marija Jelović

University of Split – University Department of Professional Studies, Split, Croatia
naukaotoplini@gmail.com

Tonko Kovačević

University of Split – University Department of Professional Studies, Split, Croatia
tkovacev@oss.unist.hr

Abstract. The development of the Internet of Things has significantly facilitated environmental monitoring because there are a number of applications used for monitoring air quality. This paper presents a way for creation an IoT platform that consists of wireless sensor nodes based on Arduino devices, a Raspberry Pi gateway which enables network connectivity for sensor nodes, and network applications which are used for collecting data and their visual presentation to the end user through web interface and/or mobile application. LoRaWAN technology was used for connecting sensor nodes to the cloud application due to the number of advantages such as the range of communication and the power consumption over competitive technologies. The Things Network as a globally distributed network platform was chosen for the data transport, and data visualization was done by myDevices Cayenne application.

Keywords: *Internet of Things, sensor, LoRaWAN, The Things Network, mydevices Cayenne*

1. Introduction

Today, there are a number of applications used for monitoring air quality. These numerous applications use different radio technologies such as ZigBee, WiFi, UMTS / LTE, LoRaWAN, etc. The growth of the Internet of Things will strengthen the trend of development of these technologies [1]. Suppliers already provide single chip solutions with built-in LoRaWAN functionality and these modules become cheap and more widely available. There are different solutions, with sensor nodes, actuators, gateways, applications for visualization and management of data, and end user applications.

In this paper we present a way for creating an IoT platform which consists of wireless sensor nodes based on LoRaWAN radio technology, Arduino devices, a Raspberry Pi gateway which enables network connectivity for sensor nodes, and network applications which are used for collecting data and their visual presentation to the end user through web interface and/or mobile application.

2. LoRaWAN Technology

The LoRa Alliance is the fastest growing technology alliance. This is a non-profit association of more than 500 member companies, committed to enabling large scale deployment of Low Power Wide Area Networks (LPWAN) IoT through the development and promotion of the LoRaWAN open standard [2,3]. LoRaWAN is a LPWAN technology that relies on the LoRa signal coding principle. This signal coding principle is based on spread spectrum technology and communication is enabled on multiple channels with different spreading factors. It is optimized to transfer small amounts of data at speeds from 0.3 kbps up to 50 kbps. LoRa provides an adaptive data rate and output power of the transmitter.

From Figure 1 it is apparent that devices that are closer to the main transmitter (gateway) can communicate at higher data rates, using the lower spreading factor and the lower energy/airtime factor. As the distance of the end device increases from the gateway, the maximum data rate at which stable and reliable communication can be achieved decreases, and the message transfer time becomes greater.

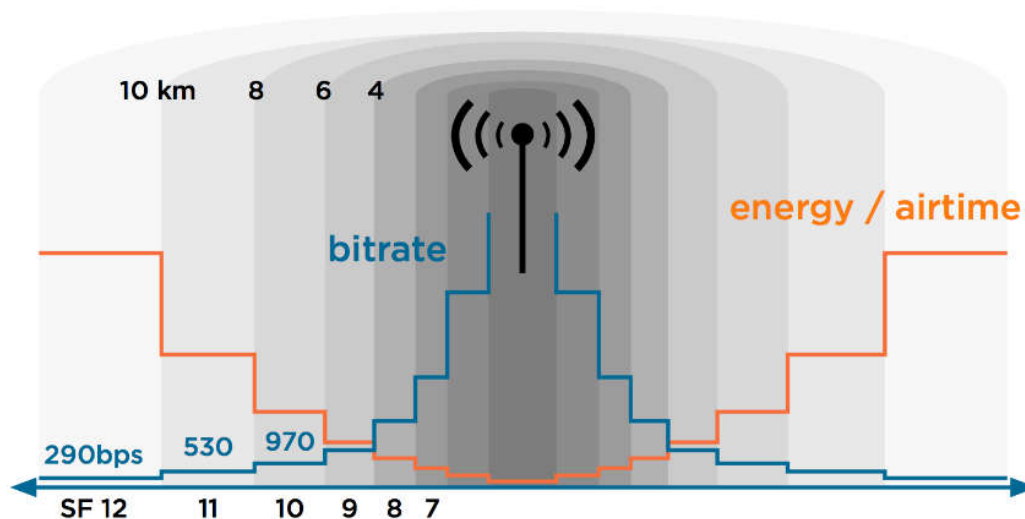


Figure 1 Comparison of the data rate and the spreading factor depending on the distance
(Source: <http://jensd.be/755/network/lorawan-simply-explained>)

The main characteristics of this technology are:

- ability to work at great distances between devices, so the range of devices in urban environments ranges from 2 to 5 km, and about 15 km in rural areas, under conditions of optical visibility,
- low power consumption, whereby one end device can work for months, even years, powered from one battery cell and
- a very high level of the security, as complete communication is secured from end to end using AES-128 encryption.

LoRaWAN technology is not intended for real-time data transfer, but relies on the assumption that the end devices send very small amounts of data (several bytes) every few minutes or hours, depending on the application.

A typical network architecture based on LoRaWAN technology is shown in Figure 2. Sensor nodes as end devices use LoRa modulation to communicate with the gateway which then transmits the information through the public network infrastructure to the network server. The network server then sends the data to a user application, which usually provides the ability to visualize data in the form of graphs over a period of time.

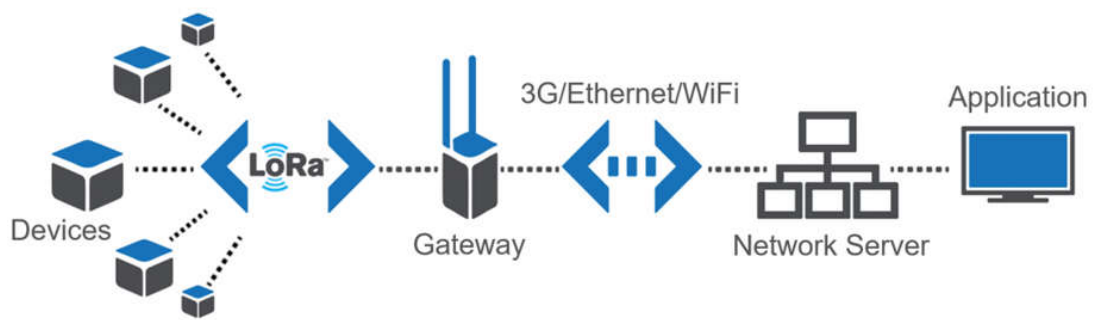


Figure 2 LoRaWAN architecture

(Source: <http://jensd.be/755/network/lorawan-simply-explained>)

LoRaWAN devices work in the ISM (Industrial, Science and Medicine) unlicensed areas of the radio spectrum. These areas of the radio spectrum, the frequency, can be used without the need to obtain an RF spectrum license. Unlike Wi-Fi and some other technologies, LoRaWAN uses lower radio frequencies (below 1 GHz) which allows them to reach a higher signal range. Users are allowed to operate at 433 MHz, 868 MHz and 915 MHz frequencies as regulated by statutory acts depending on the region. The data transfer rate depends on the selected bandwidth and the spreading factor, and the channel bandwidths could be 125 kHz, 250 kHz or 500 kHz. In Europe LoRaWAN uses the 868 MHz and 433 MHz frequencies with the maximum active time (duty cycle) of 1%. The maximum duty-cycle is defined as the maximum percentage of time during which an end device can occupy a radio channel. In some very large networks this period may even be 0.1%. The United States and Australia allocated 915 MHz frequency for LoRaWAN, and China uses two frequency ranges, one from 779 MHz to 787 MHz and the second from 450 MHz to 510 MHz.

Each LoRaWAN device has a unique 64-bit device identifier (DevEUI) assigned to it by the manufacturer. However, 32-bit device address (DevAddr) is used for online communication. In this case the 7 bits are used for the network address, and the remaining 25 bits can be used to address individual devices in the activation process.

Activation can be performed in two basic ways:

- OTAA (Over The Air Activation) is the preferred method of activating the device, where each device receives the dynamic device address (DevAddr) and the security keys for protection of communication when it first time connects to the network.
- ABP (Activation By Personalization) is the process of activating a device in which the user first enters the device address (DevAddr) as well as the security keys, before the device connects to the network for the first time. This method is impractical if we need to connect a large number of devices, and less secure than the OTAA method.

Addressing the applications is done in such a way that the network platform generates a 64-bit unique identifier (AppEUI) when creating the application itself, while each gateway registers on the network by a unique identifier (GatewayEUI) based on its own MAC address.

LoRaWAN uses three different security keys to ensure the data confidentiality and integrity:

- The network session key (NwksKey): It is used for interaction between the node and the network. This key is used to check the validity of messages (MIC check).
- The application session key (AppSKey): It is used for encryption and decryption of the payload. The payload is fully encrypted which means that nobody except the owner is able to read the contents of messages.

- The application key (AppKey): It is used to generate two session keys in cases when the OTAA device activation method is used. This key can be the same for all devices in the network, and can be assigned individually to each device.

In addition to protecting the session-based communication, there is another mechanism that provides an additional layer of protection in LoRaWAN networks that prevents replay attacks. Since the message content is encrypted and its manipulation is disabled, it may happen that the attacker captures the message content and later re-emits it. This can lead to sending the wrong information to the application, which may have unwanted consequences. For this reason, a frame counter mechanism has been developed which is set to zero when activating the device on the network. Each new message increases the count by one, and if the network receives a message that has the same, or lower counter value than the last received message, it will be discarded. It is important to optimize energy consumption since the devices are battery-powered.

3. Nodes and Gateway

Client nodes are based on:

- Arduino Pro Mini platform
- Sensors for measuring physical quantities
- RFM95 transceiver [4].

RFM95 is a transceiver that provides ultra-long range communication and high resistance to interference. It is characterized by a very low energy consumption, small dimensions, and a wide communication range that makes it extremely suitable for usage in the battery-powered sensor networks. Figure 3 shows RFM95 a wiring diagram RFM95 transceiver module and Arduino Uno (R3).

It is possible to select any spreading factor from 7 to 12 and bandwidth from 7.8 to 500 kHz. Lower communication rate brings greater sensitivity and better resistance to disturbances, which further increases the network range. In addition to LoRa modulation, this module also supports communication using standard modulation techniques such as FSK, GFSK, MSK, GMSK, and OOK. The RFM95 can be integrated into systems that rely on standards such as the Wireless M-Bus standard (WMBus) and IEEE802.15.4g. This module has 256 bytes of RAM that can be used in the LoRa mode and serves as a data buffer. The maximum size of the useful information is 64 bytes and it is limited by the size of the built-in FIFO buffer.

This radio module operates at voltage levels from +1.8 to +3.7 V with the maximum current of 14 mA in the receiving mode and 28 mA in the transmission mode with 13 dBm output power. In the sleep mode its consumption drops to 0.2 μ A.

The RFM95 module with an external 5 dBi antenna can reach a couple of kilometers in urban environments and ten kilometers in the open, under normal operating conditions. This module has a sensitivity of -148 dBm and it is fully compatible with the SemTech SX1276 module. The maximum output power is +20 dBm or 100 mW, what guarantees a wide communication range. The module has a built-in temperature sensor as well as a low-level battery detector, and it is also possible to read the received signal strength (RSSI) and the signal-to-noise ratio (SNR). Communication with the microcontroller is achieved by using the SPI interface in the half-duplex mode. The Arduino Uno is the Master device and the RFM95 transceiver module is the slave device.

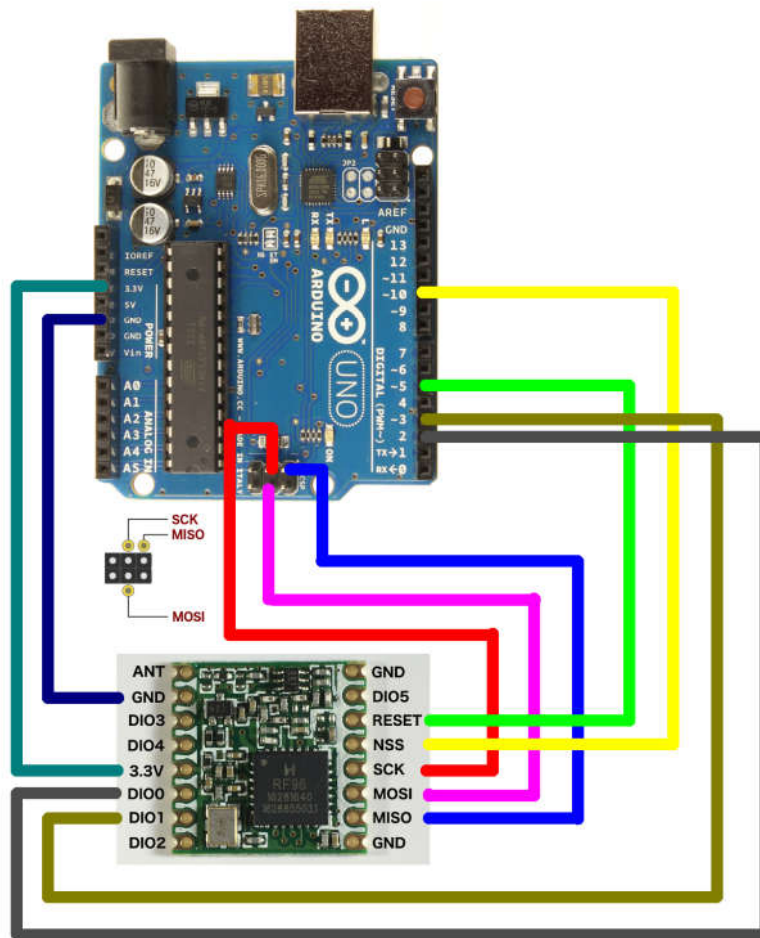


Figure 3 RFM95 transceiver wiring diagram

The central unit of the LoRaWAN network is a communication gateway [5]. Its main functions are to enable data connection between sensor nodes and application. The gateway in this project is based on a Raspberry Pi 3 computer and an IMST iC880a radio module. IMST iC880a LoRaWAN gateway works at 868MHz, and it has the receiver sensitive of -138 dBm the transmitter output power of +20dBm (100 mW). The module power consumption is 500mA at 5 V. Communication with computer could be done through the built-in USB or SPI interface. An external GPS receiver could be connected to this module. This module has the ability to decode up to 8 independent data streams simultaneously without them affecting each other. Data streams could have different spreading factors and radio channels. The communication range of this gateway is few km in an urban area and up to 15 km in a rural area.

Whole module is organized around the central SX1301 DSP circuit which is responsible for digital processing of data. Figure 4 shows IMST iC880a LoRa module internal structure. Two SX1257 transceivers are used for converting radio signals into two separate orthogonal channels I and Q. When the LoRa packet is received, it is demodulated in the central DSP, and forwarded to the built-in the RX FIFO buffer that is connected to the MCU through the SPI interface. Otherwise, when we want to send some data to the LoRa network, the MCU first write data into the TX FIFO, and after that data are modulated depending on the used communication type (LoRa or GFSK) and finally sent through I and Q channels to the transceivers.

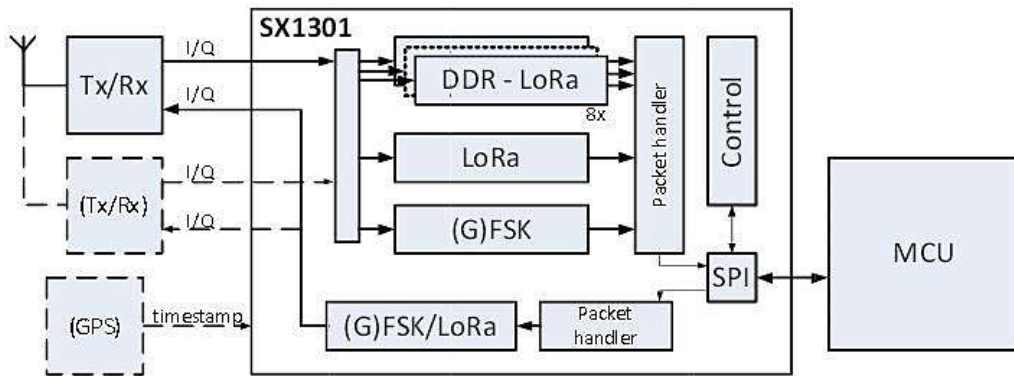


Figure 4 IMST iC880a LoRa module internal structure

4. The Realized Sensor Network

Figure 5 shows a realized sensor network architecture. The sensor nodes acquire data about: air temperature, atmospheric pressure, air humidity, air quality, level of illumination and UV radiation levels. These sensors are selected primarily because they are directly applicable to a large number of users and allow us to monitor environmental parameters, but any other sensor could be implemented very easily using the appropriate software library. In this project we use the following sensors:

- Bosch BMP 280 for measurement of temperature, atmospheric pressure and altitude,
- BH1750 for the ambient light measurement,
- ML8511 for the UV radiation level measurement,
- AM2302 (DHT22) for the air humidity and temperature measurement.

All sensor nodes communicate with the LoRaWAN gateway which collects and then sends them to the cloud application server.

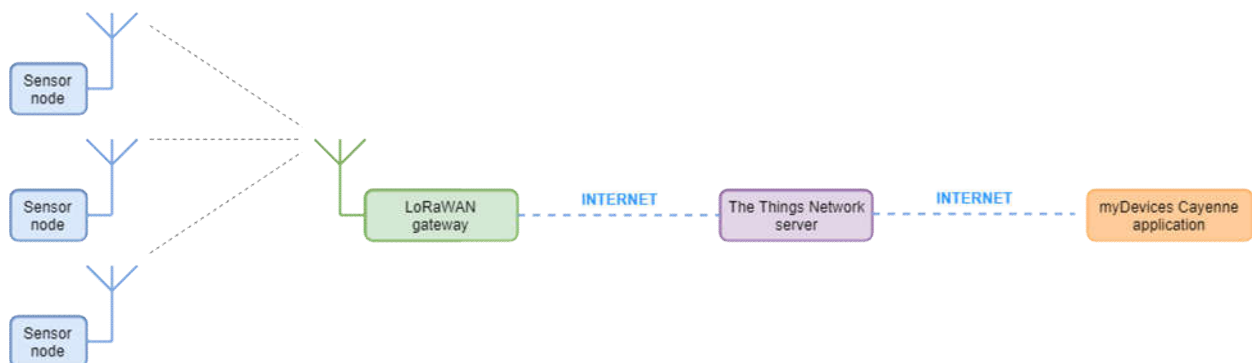


Figure 5 The realized sensor network

The Things Network (TTN) [6] platform was used to connect sensor devices with the cloud server. Figure 6 shows TTN architecture. Every network that relies on The Things Network infrastructure consists of four basic components:

- End devices - used for collecting data from the environment and for their periodic transmissions. It is mainly about small amounts of data from several bytes emitted at intervals of several minutes to several hours, depending on the purpose of the device
- Gateway - used to receive end-user messages and forward them to TTN servers.
- The Things Network Server - used to receive data from end-users and their routing to user applications, and vice versa. TTN servers are not conceived as databases but are concerned only with their delivery,
- User applications - connect TTN services.

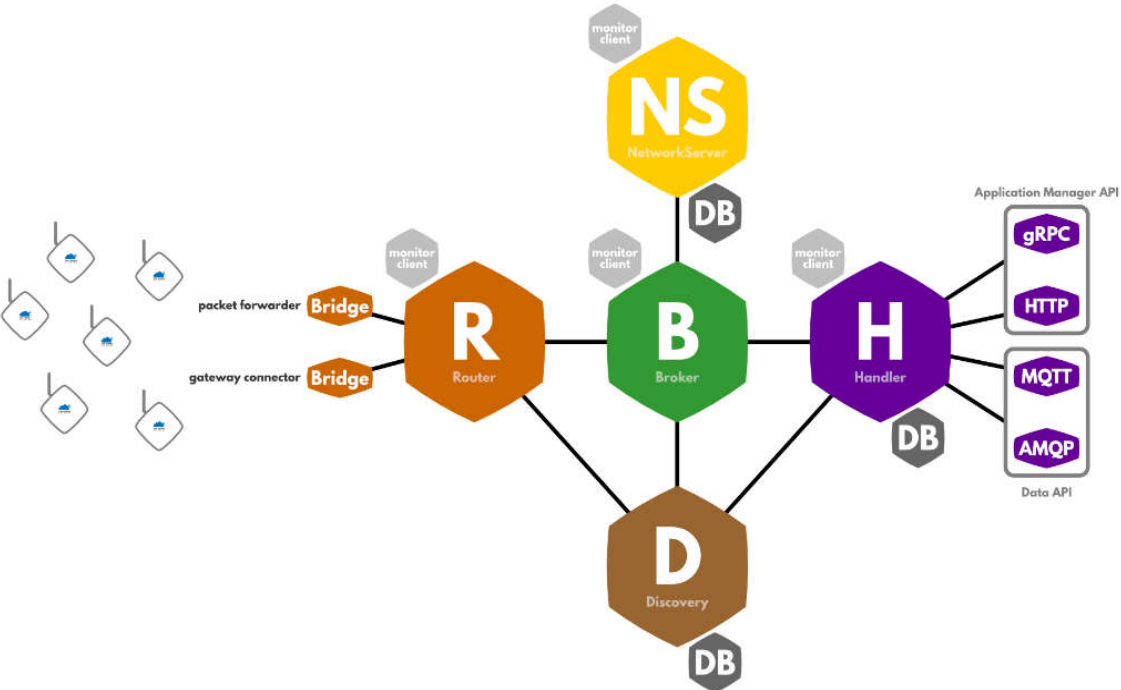


Figure 6 The Things Network architecture

(Source: <https://www.thethingsnetwork.org/docs/network/architecture.html>)

Figure 7 shows the LoRaWAN packets successfully received at the gateway using TTN. These data include: frequency, encoding mode, factor spreader, bandwidth, packet count, address of the sensor node, and the size of the useful package contents. Since packet content is encrypted with AES-128 from end to end, the gateway owner is unable to decrypt the packet contents itself and access useful information. Figure 8 shows detailed parameters after decryption within the end user application. In addition to reading the sensor node, there are metadata that provide us with information on the actual data transfer.

GATEWAY TRAFFIC beta

time	frequency	mod.	CR	data rate	airtime (ms)	cnt	
▲ 14:05:48	868.1	lora	4/5	SF 7 BW 125	61.7	44	dev addr: 26 01 19 44 payload size: 24 bytes
▲ 14:04:04	868.1	lora	4/5	SF 7 BW 125	61.7	43	dev addr: 26 01 19 44 payload size: 24 bytes
▲ 14:02:20	868.1	lora	4/5	SF 7 BW 125	61.7	42	dev addr: 26 01 19 44 payload size: 24 bytes
▲ 14:00:35	868.1	lora	4/5	SF 7 BW 125	61.7	41	dev addr: 26 01 19 44 payload size: 24 bytes
▲ 13:58:51	868.1	lora	4/5	SF 7 BW 125	61.7	40	dev addr: 26 01 19 44 payload size: 24 bytes
▲ 13:57:07	868.1	lora	4/5	SF 7 BW 125	61.7	39	dev addr: 26 01 19 44 payload size: 24 bytes
▲ 13:55:22	868.1	lora	4/5	SF 7 BW 125	61.7	38	dev addr: 26 01 19 44 payload size: 24 bytes
▲ 13:53:38	868.1	lora	4/5	SF 7 BW 125	61.7	37	dev addr: 26 01 19 44 payload size: 24 bytes
▲ 13:51:54	868.1	lora	4/5	SF 7 BW 125	61.7	36	dev addr: 26 01 19 44 payload size: 24 bytes
▲ 13:50:09	868.1	lora	4/5	SF 7 BW 125	61.7	35	dev addr: 26 01 19 44 payload size: 24 bytes

Figure 7 TTN gateway traffic data

THE THINGS NETWORK CONSOLE COMMUNITY EDITION

Applications > testarduino > Devices > node1 > Data

Filters: uplink | downlink | activation | ack | error

time	counter	port
<pre>{ "barometric_pressure_2": 985.6, "relative_humidity_3": 52.5, "temperature_1": 26.4 }</pre>		
<p>Metadata</p> <pre>{ "time": "2018-04-22T12:07:33.088955451Z", "frequency": 868.1, "modulation": "LORA", "data_rate": "SF7BW125", "coding_rate": "4/5", "gateways": [{ "gtw_id": "eui-b827ebfffeede425", "timestamp": 2158295395, "time": "2018-04-22T12:07:33.046893Z", "channel": 0, "rssi": -87, "snr": 9.8, "rf_chain": 1, "latitude": 43.522984, "longitude": 16.450407, "location_source": "registry" }], "latitude": 43.510284, "longitude": 16.407896, "location_source": "registry" }</pre>		

Figure 8 TTN data about actual transfer

In this project we use the myDevices Cayenne online platform to visualize the data obtained from sensor nodes [7]. This platform allows the collected data through the The Things Network platform to be presented to users in a visually attractive manner via web sites or free mobile applications that can be downloaded at the Apple Store or the Google Play Store. Figure 9 shows the tabular representation of the sensor data for node 1 and the pressure graph. Sensor node 1 provides atmospheric pressure information over the past hour (h). Readings can be displayed in real time - last minute, hour, day or week, 1/3/6/12 months or for a custom period. The displayed readings can be exported to comma separated value (CSV) format so that the measurements can be processed on a computer or imported into another system.

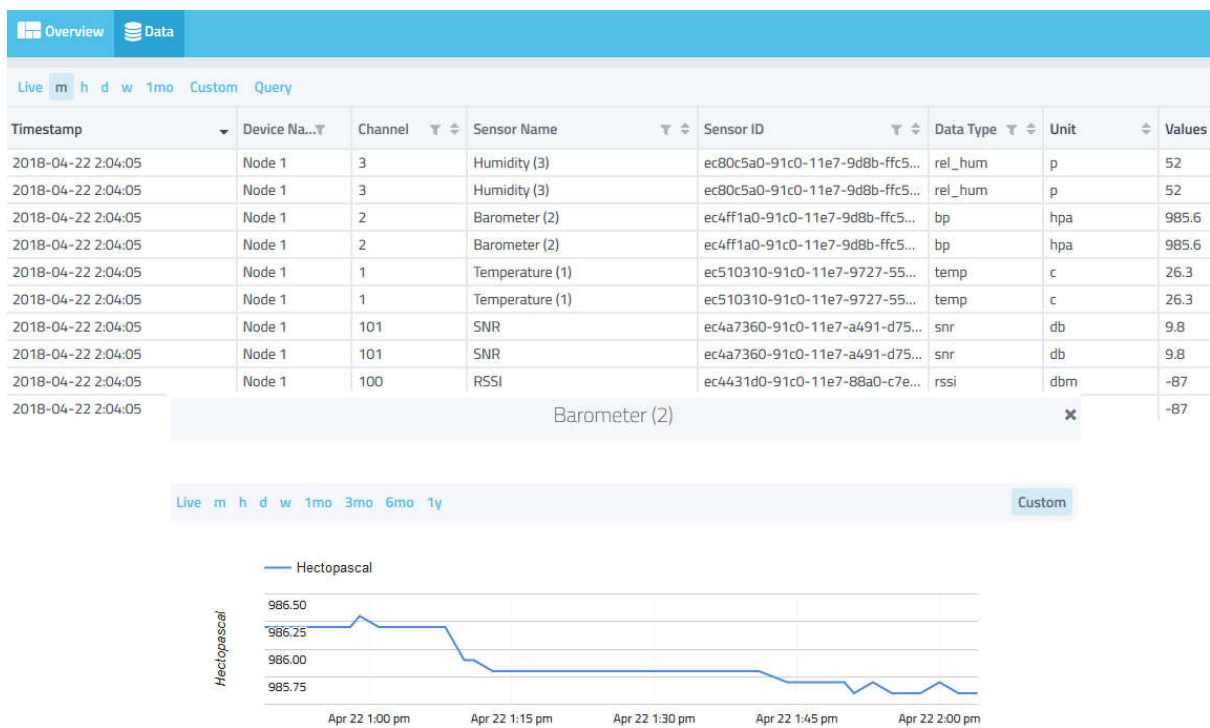


Figure 9 myDevices Cayenne visualization

5. Conclusion

In this paper we presented the sensor network based on LoRaWAN radio technology and open source software platforms. LoRaWAN technology was used for connecting sensor nodes to the cloud application due to the number of advantages such as the range of communication and the power consumption over competitive technologies. After analyzing the available network server solutions, it was concluded that the development of one's own network server was too complicated because there are a large number of free and open network platforms designed to connect things to the Internet. The Things Network as a globally distributed network platform was chosen for the data transport. Data visualization was done by using myDevices Cayenne application because this platform has already built-in support for Arduino, Raspberry Pi, ESP8266 and LoRaWAN devices. The future of this project lies in the expansion of the sensor network throughout the Split area through student activities carried out at the University Department of Professional Studies.

REFERENCES

- [1] <https://www.technolution.eu/en/about-us/publications/430-the-power-of-lorawan-for-sensor-networks.html>, (online, accessed 15.1.2018.)
- [2] <https://lora-alliance.org/>
- [3] <http://jensd.be/755/network/lorawan-simply-explained> (online, accessed 7.12.2017.)
- [4] http://www.hoperf.com/upload/rf/RFM95_96_97_98W.pdf, (online, accessed 7.12.2017.)
- [5] <https://wireless-solutions.de/products/radiomodules/ic880a.html> (online, accessed 5.1.2018.)
- [6] <https://www.thethingsnetwork.org/>
- [7] <https://mydevices.com/>

ZigBee Wireless Sensor Network for Indoor Air Quality Monitoring

Ante Botica

University of Split – University Department of Professional Studies, Split, Croatia
anteboticaa@gmail.com

Tonko Kovačević

University of Split – University Department of Professional Studies, Split, Croatia
tkovacev@oss.unist.hr

Silvano Jenčić

University of Split – University Department of Professional Studies, Split, Croatia
sjencic@oss.unist.hr

Siniša Zorica

University of Split – University Department of Professional Studies, Split, Croatia
szorica@oss.unist.hr

Abstract. Although the number of wireless standards with the development of new technologies is increasing, ZigBee protocol still finds its way to be dominant technology for low-cost and low-power applications that are used in wireless monitoring and control systems. Open source standard and the mesh networking provide high reliability and larger range. ZigBee has been designed to support thousands of networked devices. This paper presents design of wireless sensor network for monitoring air temperature and humidity in classrooms. ZigBee modules are configured to run in API mode using mesh topology. To achieve greater scalability coordinator node periodically scans entire network and updates monitoring data in case of disconnected or newly added nodes. Wireless sensor network is designed using Arduino platform and XBee modules based on IEEE 802.15.4/ZigBee standards.

Keywords: *ZigBee, XBee, Wireless sensor networks, Network topology, Arduino*

1. Introduction

ZigBee protocol is a very common technology used for wireless control and monitoring applications such as smart energy systems, health care, industrial and home automation. The key reasons for its wide deployment arises from low-cost, low power consumption, small footprint and mesh networking supporting communication among large number of devices. ZigBee technology provides additionally very reliable, secure, flexible and self-healing network architecture easy to deploy and expand. This paper presents design of ZigBee wireless sensor network used for monitoring air temperature and humidity in classrooms. Monitoring system is based on Arduino boards, XBee modules and DHT11 sensors that are today very popular due to their low cost, wide accessibility and simplicity of installation. Additional advantage is that Arduino boards already come with libraries for interfacing XBee modules and analog and digital sensors. The designed sensor network contains five nodes. Master node (coordinator) collects periodically data from slave nodes (routers) and updates address list of active nodes. Any failure in node operation or new node connection is promptly detected and reported to the user. Mesh networking supported by ZigBee protocol provides dynamical allocation of nodes and reconfiguration of network topology without necessity to change nodes parameters. Communication between nodes is accomplished using XBee API mode. API mode

provides more flexibility in managing data transmission, but requires knowledge of API frame structure and certain level of programming knowledge.

1.1 ZigBee and IEEE 802.15.4 Standard

ZigBee protocol is based on the OSI (Open System Interconnect) reference model and defines only the networking, application, and security layers of the protocol. It uses IEEE 802.15.4 Physical (PHY) and Media Access Control (MAC) layers as part of the networking protocol. IEEE 802.15.4 standard was developed for low-rate WPANs (LR-WPANs) independently of the ZigBee standard and does not specify any requirements regarding higher protocol layers. Therefore, it is possible to build a short range network based on IEEE 802.15.4 without implementing ZigBee layers. A simplified view of ZigBee protocol stack is shown in Figure 1.

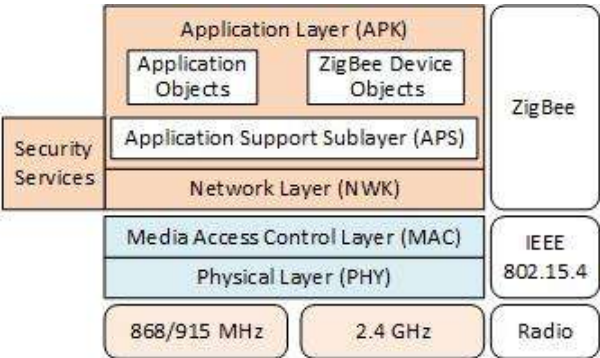


Figure 1 The ZigBee Protocol Stack

IEEE 802.15.4 PHY layer specifications define modulation, demodulation and physical transmission of messages over the air. This includes parameters such as frequencies of operation, data rate, receiver sensitivity requirements, device types and functionalities like energy detection (ED) measurement, channel selection, link quality estimation, clear channel assessment (CCA) etc.

Physical layer supports three license free frequency bands with 27 radio channels: 868 MHz band (with 1 channel) used in Europe, 915 MHz band (with 10 channels) used in N. America and Australia and worldwide used 2.4 GHz band (with 16 channels) as shown in Table 1 [1].

Lower bands 868/915 MHz support 20 and 40 kb/s data rate respectively and 2.4 GHz band supports 250 kb/s. Since 2006 IEEE 802.15.4 specification provides also the possibility to use two optional modes for 868/915 MHz bands to work with higher data rate of 100 and 250 kb/s. Specification still requires to use higher data rates in optional mode only if it is not possible to operate in the 2.4 GHz band due to interference or any other reason. Transceivers for 868 and 915 MHz bands must support both frequencies so they are always bundled together.

IEEE 802.15.4 uses three modulation types: binary phase shift keying (BPSK) for standard lower bands and offset quadrature phase shift keying (O-QPSK) for higher band. In optional mode amplitude shift keying (ASK) and O-QPSK are used. To improve signal reception and reduce the effect of multipath environment spreading techniques are employed, direct sequence spread spectrum (DSSS) and parallel sequence spread spectrum (PSSS), as shown in Table 1.

Table 1 IEEE 802.15.4 Data Rates and Frequencies of Operation

	Frequency (MHz)	Channel	Modulation	Bit rate Kb/s	Spreading Method
	868 – 868.6	0	BPSK	20	Binary DSSS
	902 – 928	1-10	BPSK	40	Binary DSSS
	2400 – 2483.5	11-26	O-BPSK	250	16-array DSSS
Optional	868 – 868.6	0	ASK	250	20-bit PSSS
	902 – 928	1-10	ASK	250	5-bit PSSS
Optional	868 – 868.6	0	O-BPSK	100	16-array DSSS
	902 – 928	1-10	O-BPSK	250	16-array DSSS

For operations in 2.4 GHz band receivers require minimum sensitivity of -85 dBm. In 868/915 MHz band, with BPSK in use, required sensitivity is -92 dBm and in optional 868/915 MHz bands -85 dBm. Sensitivity of receiver is defined as the lowest received signal power that yields a packet error rate (PER) of less than 1%. Transmitter output power needs to be at least -3 dBm with the possibility of 30 dB adjustable range. Transmission distance depends on power output and environmental characteristics and is usually from 10 to 100 m (indoors up to 30 m).

IEEE 802.15.4 MAC layer provides the interface between PHY layer and ZigBee network (NWK) layer. It is responsible for assembling and decomposing data frames, frame validation, maintaining nodes synchronization, controlling the association and choosing the Guaranteed Time Slot (GTS) mechanism. MAC layer handles all access to physical radio channels by employing the Carrier Sense Multiple Access with Collision Avoidance (CSMA-CA) mechanism. This mechanism evaluates the channels allowing transmission of data frames only if the channel is free. Otherwise, the algorithm waits for certain time before accessing the channel again. This is especially important when ZigBee network coexists with other networks in the same frequency range (e.g. WiFi). MAC layer also defines network topologies, which ZigBee use and improves at higher levels of the stack.

1.2 IEEE 802.15.4 Networking Topologies and Device Types

Based on data processing capabilities IEEE 802.15.4 specifies two different types of physical devices: full function devices (FFD) and reduced function devices (RFD). The full function device (FFD) supports all 802.15.4 functions and features specified by the standard. FFD can perform any role in network. It can operate as coordinator, router or end device and must be constantly powered.

Devices in IEEE 802.15.4 can be connected in two topologies: star and peer-to-peer as shown in Figure 2. Network topology describes how devices are connected in network, physically or logically. The physical topology shows geometric shape between the connected devices and logical topology how data flow between devices.

In a star topology every device in the network can communicate only with the personal area network (PAN) coordinator which can be only a FFD device. Other devices can be FFD or RFD devices.

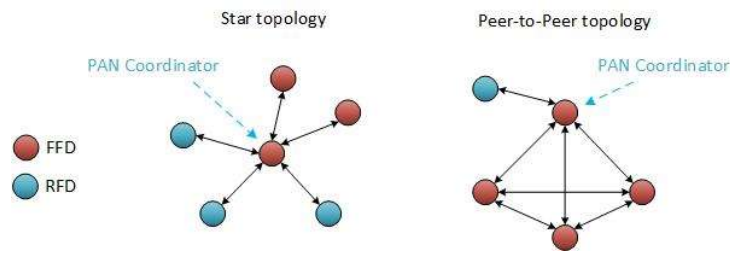


Figure 2 IEEE 802.15.4 Network Topologies

In a peer-to-peer topology every device can communicate with any other device placed in a range of communication. The role of PAN coordinator can take any FFD device but only one coordinator can run in a network. All FFD devices can participate in routing the messages. RFD devices are not capable of routing the messages but they can, as end devices, collect and exchange its data in network with another FFD device (a router or a coordinator).

Devices can use 64-bit IEEE and optional 16-bit short addressing. Shorter addressing reduces packet size and enables working in both addressing modes – star and peer-to-peer.

However, PHY and MAC layer define only communication between devices that are in transmission range. For creating larger network, it is necessary to use network layer.

1.3 ZigBee Protocol

ZigBee protocol specifies only the networking, application, and security layers of the protocol.

ZigBee network layer is responsible for routing and managing the network. It includes tasks like starting the network, assigning network addresses, adding and removing network devices, discovering and maintaining the routes and applying security.

In a ZigBee, network devices can perform three different roles (node types): Coordinator, Router and End Device.

- *Coordinator* - is responsible for initiating and controlling the network, selecting the network operational parameters such as frequency channel, unique network identifier etc. and running other services such as routing or security services. It can also store information about network or security keys. In every ZigBee network can exist only one coordinator.
- *Router* – is responsible for routing messages to other nodes in network. In this way it is possible to extend the network coverage, obtain dynamical routing around obstacles, and provide additional routes in case of network congestion or device failure.
- *End Device* – is a simple node that can collect various information from sensors and switches. It can send and receive messages but cannot perform any routing operations. It needs to be connected to coordinator or other routers.

The network layer supports three topologies: star, tree and mesh, as shown in Figure 3. ZigBee tree and mesh topology extends underlying MAC layer peer-to-peer topology. In a tree topology routers are connected to the coordinator as child nodes. Every child node can have a leaf node that can be a router or end device. Child node can communicate only with parent node (up the tree). However, if for any reason router fails, that part of a network will become disconnected without possibility to use alternative route.

In mesh topology router can communicate with any device in its range. This means that coordinator can use different routes to reach certain node and in the case of failure finds the best alternative route.

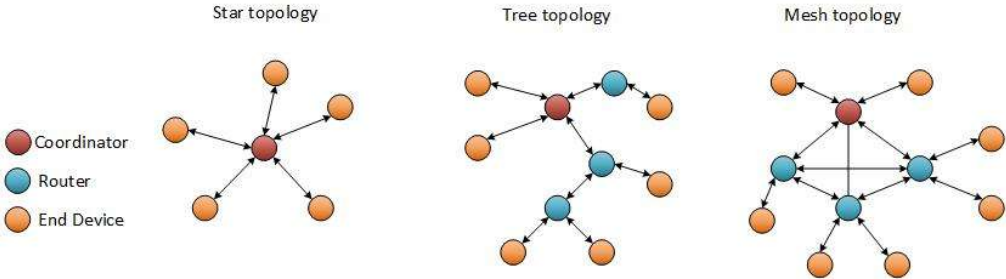


Figure 3 ZigBee Network Topologies

The application layer is the highest protocol layer in a ZigBee network. It represents interface of the ZigBee system to the end user. Application layer comprises three different sublayers: Application Support Sublayer (APS), ZigBee Device Objects (ZDO) and Application Objects (APO). The APS sublayer provides an interface between application layers and network layer through a set of services. It performs filtering of incoming and outgoing frames and managing cryptographic keys. The ZDO is responsible for overall device management. It defines the operating mode of device as coordinator, router or end device, discovery of new devices, security management, managing binding requests etc. The APO objects control and manage protocol layers in ZigBee device. Manufacturers develop APO objects to customize a device for various applications. Each ZigBee device can have 240 application objects that must be in conformance with application profile accepted by ZigBee Alliance. An application object actually implements the function of the device (e.g. a light switch or a sensor). ZigBee protocol provides also security services for network and application layers. Security services include frames protection, device management and methods for key establishment and transport.

2. Hardware Overview

Each node in a sensor network consists of an Arduino UNO R3 board, an Xbee shield and Digi XBee S2 RF module as shown in Figure 4. Router (slave) nodes additionally use DHT11 sensors for measuring air temperature and humidity.



Figure 4 Hardware layout of Coordinator and Router device

Arduino UNO R3 board is based on the ATmega328P microcontroller with 32 KB Flash, 2 KB SRAM and 1 KB EEPROM memory [6]. It contains 14 digital I/O pins, 6 analog pins, USB

connection and I2C and SPI interface for communication with other devices. Recommended power supply voltage for the board is 7-12 V which provides necessary 5 V operating voltage for the microcontroller.

DHT11 digital sensor is a composite sensor that gives on its signal output calibrated digital signal of the temperature and humidity [7]. Each sensor is calibrated in a laboratory and provides high accuracy with long-term stability. Sensor comes in a package with 4 pins: (1) VDD - power supply 3-5.5 V DC, (2) DATA - serial data, (3) NC - empty pin and (4) GND - ground, the negative power. It is recommended to use 5K pull-up resistor for sensor cable connection shorter than 20 meters. Temperature measurement range is 0 – 50°C with accuracy of $\pm 2^\circ\text{C}$, and for humidity 20 – 90% RH with accuracy of $\pm 5\%$ RH. Typical current consumption during stand-by mode is approximately 130 μA for 5 V power supply. During measuring cycles consumption reaches up to 1.5 mA. The only drawback of this sensor is that you can get new data from it once every 2 seconds although specified sample rate is 1 Hz.

Communication between nodes is accomplished with *XBee Series 2 RF modules* manufactured by Digi International. The modules operate within the ISM 2.4 GHz frequency band supporting point-to-point, point-to-multipoint, peer-to-peer and self-routing mesh networking topology. The basic characteristics of these modules are shown in Table 2 [8].

Table 2 The Characteristics of XBee S2 Modules

Performance	Power Requirements
<ul style="list-style-type: none"> • Distance Range (Indoor/Outdoor line-of-site): 40 / 120 m • Transmit Power: 2 mW (+3dBm) • Receiver Sensitivity: - 95 dBm • Data Rate: 250 kbps • Serial Interface Data Rate: 1.2 – 230.4 kbps 	<ul style="list-style-type: none"> • Supply Voltage: 2.8 – 3.4 V • Transmit/Receive Current: 40/40 mA (@ 3.3 V) • Power-Down Current: < 1 μA @ 25°C

3. Network Configuration

Wireless Sensor Network consists of five nodes, one coordinator and four routers, connected in mesh topology, as shown in Figure 5. All XBee S2 modules (product family XB24-ZB) are configured to work with API function set and latest version of firmware. When configuring coordinator and router module, user needs to select appropriate API function set (e.g. Zigbee Coordinator API (firmware 21A7) or ZigBee Router API (firmware 23A7)). Configuration of XBee modules is accomplished with XCTU software tool and XBee USB Explorer (adapter) as hardware interface. XCTU is available free of charge from Digi International web site [9]. This software provides also built in tools for testing communication and analyzing network topology. XBee USB Explorer on the other hand is very suitable for configuring XBee modules. User needs only to insert XBee module in explorer, plug the explorer directly into the USB port of PC and start XCTU software.

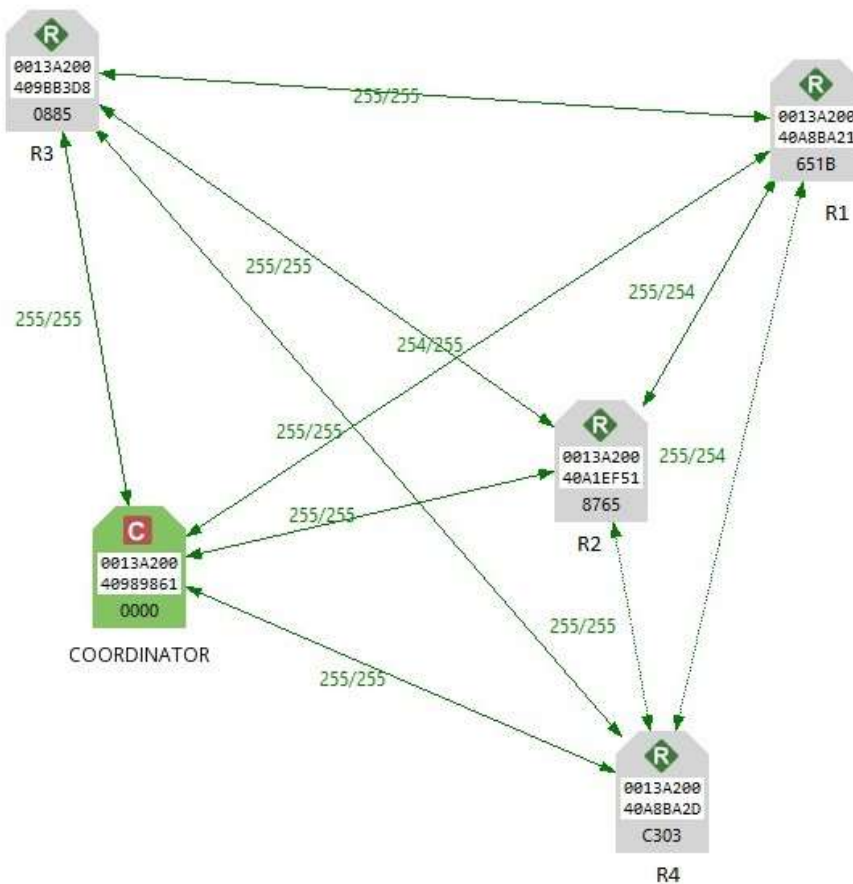


Figure 5 ZigBee Wireless Sensor Network Topology

To enable ZigBee networking it is necessary only to adjust some basic parameters in Serial Interfacing, Networking and Addressing section of XCTU software, as shown in Figure 6. Other parameters user can leave unchanged.

In this project all XBee modules are configured to work in API mode with escaping. Communication data rate is set to default 9600 bauds. In order to join the network, routers must have the same PAN ID (Personal Area Network Identifier) as coordinator. For each network PAN ID is unique and can be defined by user.

Each module in network is identified with node identifier and addresses. Node identifier represents description label of a module and addresses are used for communication. Each module uses two different addresses: 64-bit and 16-bit address. A 64-bit extended address is preconfigured in all XBee modules in factory and cannot be changed. It is unique for each module. This address can be found under SH and SL parameter and printed on the module itself. A 16-bit short address is used for normal communication within network and is assigned to module automatically under *MY 16-bit Network Address* setting. When your module is configured as coordinator, it gets always MY address 0x0000. Destination address represents address of receiver module. To establish communication between modules transmitter (router) destination address must always match MY address of receiver (coordinator). Setting coordinator destination address DL=0xFFFF and DH=0x0000 means that all messages from coordinator are broadcasted to all routers.

Serial Interfacing
Change modem interfacing options

AP API Enable API enabled (1), o... with escaping (2)

Networking
Change networking settings

ID PAN ID

Addressing
Change addressing settings

SH Serial Number High	13A200
SL Serial Number Low	40989861
MY 16-bit Network Address	0
DH Destination Address High	<input type="text" value="0"/>
DL Destination Address Low	<input type="text" value="FFFF"/>
NI Node Identifier	<input type="text" value="KOORDINATOR"/>

Addressing
Change addressing settings

SH Serial Number High	13A200
SL Serial Number Low	40A1EF51
MY 16-bit Network Address	8765
DH Destination Address High	<input type="text" value="0"/>
DL Destination Address Low	<input type="text" value="0"/>
NI Node Identifier	<input type="text" value="R1"/>

Figure 6 Common XBee S2 Module Patrameters

4. API Mode

As mentioned before , communicaton in our sensor network is accomplished using Application Programming Interface (API) mode. This means that messages between modules are sent through structured frame interface called API frames. Each of these frames contains four fields as shown in Figure 7 [8]:

- Starting byte has fixed value 0x7E indicating the beginning of frame,
- frame length has two bytes indicating the length of frame data (max used is 255 bytes),
- frame data contain actual sending data which content depends on API frame type (defined with first byte of this field) and
- checksum byte is used for error checking control of received frame.

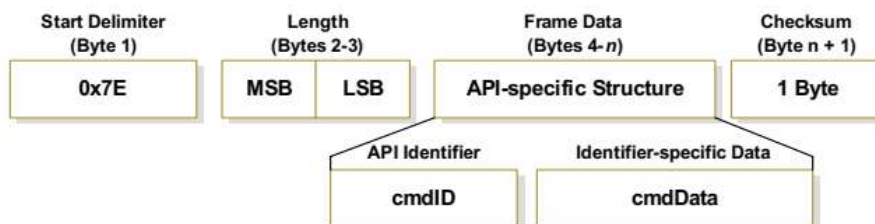


Figure 7 API frame structure

API operating mode with escaping used in this project provides more flexible and reliable RF transmission in noisy network environment. In this mode some bytes can be escaped by using appropriate characters so they do not interfere with the data frame sequence.

Communication in API mode enables us to send different types of frames to different nodes without need to change configuration. In this way it is possible to identify the source of each received frame and receive the status of each transmitted frame. Each frame type has its own structure, containing data that indicate what operation should take place, or what type of event occurred. For data exchange in sensor network we used five different types of API frames: *AT Command Immediate* (id = 0x08), *AT Command Response* (id = 0x88), *TX Request* (id = 0x10), *TX Response* (id = 0x8B) and *RX Received* (id = 0x90). Example of API frame for sending *AT Command Immediate* is shown in Figure 8. API identifier byte defines the type of frame, Frame ID byte if set to “1” requires that sender must receive acknowledgement of reception for this frame from receiving node and in bytes 6-7 AT command is represented with two ASCII characters (ND).

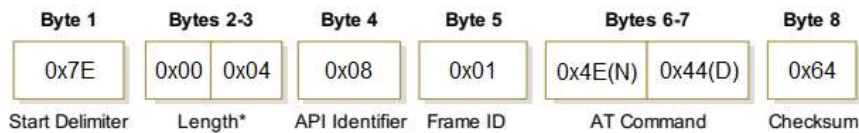


Figure 8 Example of API AT Command Immediate frame structure

5. Software Design

Programming code for network nodes was written in C++ using Arduino IDE development interface. Arduino boards already come with libraries for interfacing XBee modules and analog and digital sensors. For this project we used three libraries:

- *SoftwareSerial* allows serial communication on other digital pins of Arduino instead of hardware built-in pins 0 and 1. Library enables using hardware built-in pins for communication with the PC without interfering XBee communication and provides us, at the same time, with monitoring of measuring data. In our case XBee modules are connected to pins 10 (Rx) and 11 (Tx).
- *DHT-sensor-library-master* by Adafruit [10] is used to read temperature and humidity data from DHT11 sensors. Sensor data pin is connected to Arduino pin 2.
- *Simple-zigbee-master* library [11] enables communication with XBee S2 modules and working with API frames.

All libraries and variables need to be initialized at the beginning of the code. Programming code in Arduino consists of three parts: *initialization*, *void setup()* and *void loop()* function. Function *void setup()* is executed only once at start of the program and is used to set specific tasks like initialization of communication interfaces. All programming code that needs to be executed continuously must be located in *void loop()* function. Part of programming code for coordinator and router inside Arduino IDE interface is shown in Figures 9 and 10.


```

Coordinator-node | Arduino 1.8.5
File Edit Sketch Tools Help

Coordinator-node $
#include <SimpleZigBeeRadio.h>
#include <SoftwareSerial.h>
//Creating XBee object
SimpleZigBeeRadio xbee = SimpleZigBeeRadio();
//Creating SoftwareSerial object
SoftwareSerial xbeeSerial(10, 11); // (RX=>DOUI, TX=>DIN)
//Creating SimpleZigBeeAddress object
SimpleZigBeeAddress broadcast = SimpleZigBeeAddress();
// Packet to send: In this example, we will update
// the contents of a packet before sending it.
SimpleZigBeePacket zbp = SimpleZigBeePacket();
//Temporary variijable for tracking elapsed time
unsigned long previousMillis1 = 0;
unsigned long previousMillis2 = 0;
unsigned long interval1 = 180000;
unsigned long interval2 = 60000;
int number = 0;
int new_number = 1;
int control = 0;
uint8_t address_16_64[10][6];

```

Figure 9 Initialization of libraries and variables for Coordinator node

```

Router-R1-node | Arduino 1.8.5
File Edit Sketch Tools Help

Router-R1-node $
void loop() {
// temperature and humidity data readings
humidity = dht.readHumidity();
temp= dht.readTemperature();
while( xbee.available() ){
xbee.read();
if( xbee.isComplete() ){
// printout of received packet
Serial.print("\nReceived telegram: ");
printPacket( xbee.getIncomingPacketObject() );
//Checking packet type
if( xbee.isRX() ){
Serial.println( "RX packet received\n" );
SENSOR(node, humidity, temp);
}else if( xbee.isTXStatus() ){
Serial.println( "TXStatus packet received" );
Serial.print( "Status: " );
Serial.println(xbee.getTXStatusDeliveryStatus(), HEX);
}
}
}
}

```

Figure 10 Reading sensor data and checking incoming telegrams in Router nodes

The Figure 11. shows software flowchart of coordinator and router node. At the beginning of the program, coordinator sends, as a broadcast message, AT command *Node Discover* (ND) to all network nodes in order to receive 16-bit and 64-bit addresses, and Node Identifier string of all XBee devices connected in network. After that, it waits for incoming responses from sensor nodes. When coordinator receives telegram, it checks the type of API frame and collects data according to the frame. If the frame is response to AT Command, it contains addresses of sensor node that sends that frame. Addresses of all nodes are stored in local Address Matrix. If the type of received API frame is *RX Received*, it contains measuring data from sensors. Measuring data, temperature and humidity, are displayed in a printout window of Arduino IDE interface.

Request for updating sensor data is sent periodically from coordinator to all nodes every 1 minute through the *TX Request* API frames. These frames are sent only to nodes whose addresses are previously stored in address matrix. Coordinator also scans periodically the network every 5 minutes to check if some devices are removed or added to the network. This is achieved by sending again a broadcast *Node Discover* (ND) AT Command to all devices. After receiving responses from nodes, coordinator updates all node addresses in address matrix. Example of the printout of transmitted and received frames from/to coordinator is shown in Figure 12.

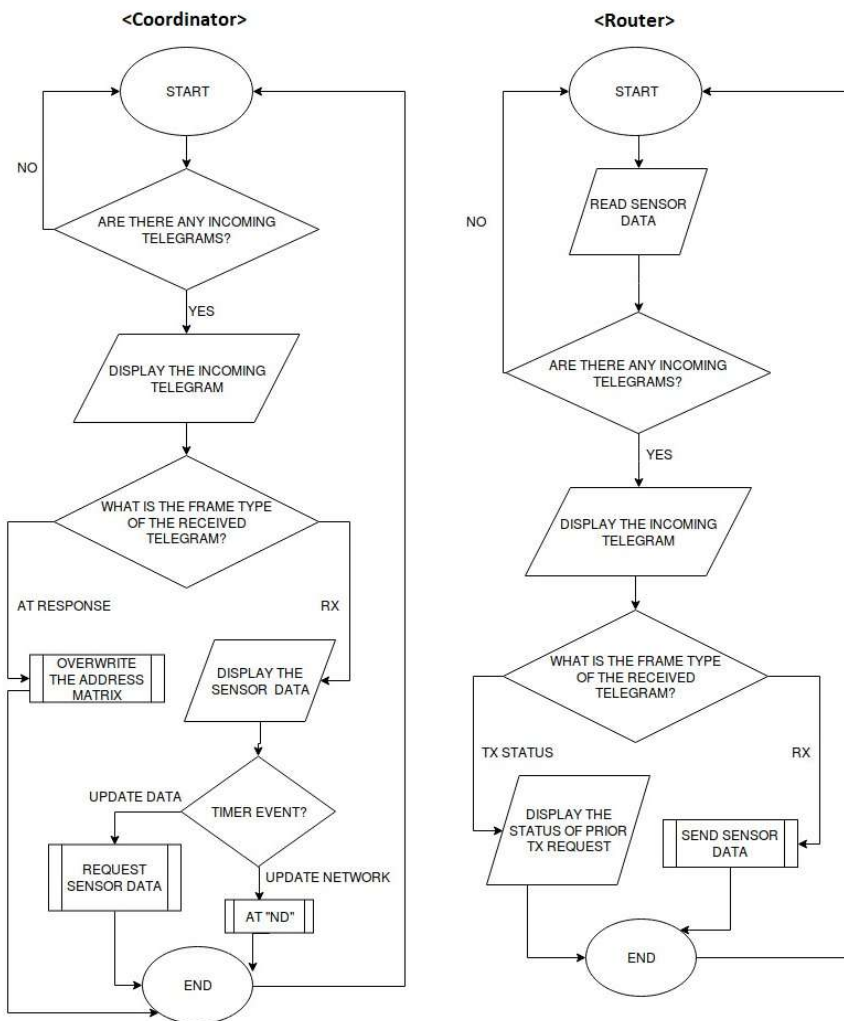


Figure 11 Coordinator and Router software flowchart

```

COM20 (Arduino/Genuino Uno)
Setting up the network, please wait..
Outgoing telegram: 7E 0 4 8 1 4E 44 64

Received telegram: 7E 0 1B 88 1 4E 44 0 EA F 0 13 A2 0 40 A8 B9 C2 20 52 33 0 FF FE 1 0 C1 5 10 1E 3C
AT command response received
Status: 0
AT command: 4E44
Payload: EA F 0 13 A2 0 40 A8 B9 C2 20 52 33 0 FF FE 1 0 C1 5 10 1E

Requesting sensor data..
Outgoing telegram: 7E 0 10 10 0 0 13 A2 0 40 A8 B9 C2 EA F 0 0 FF FF E0

Received telegram: 7E 0 F 90 0 13 A2 0 40 A8 B9 C2 EA F 1 2 1F 1A 22
RX packet received
Node: 2
Humidity: 31 %
Temperature: 26 degrees Celsius
  
```

Figure 12 Printout of transmitted and received frames from/to coordinator

As shown in Figure 11, router nodes continuously check for incoming messages. When router receives a telegram, it displays it in a printout Arduino window and then checks the type of API frame. If the frame type is *RX Received*, node interprets it as a request for sending measuring data. Measuring data are sent through *TX Request* API frame. When a *TX request* is completed, router receives *TX status* type of API frame from the coordinator which indicates if the message was transmitted successfully or there was a failure. Status of previously transmitted telegram is displayed in printout window. Example of the printout of transmitted and received frames from/to router is shown in Figure 13.

```

COM19 (Arduino/Genuino Uno)
Received telegram: 7E 0 E 90 0 13 A2 0 40 98 98 61 0 0 1 FF FF EA
RX packet received

Sending sensor data to Coordinator :
Outgoing telegram : 7E 0 11 10 1 0 0 0 0 0 0 0 0 0 FF FE 0 0 2 1F 1A B6

Received telegram: 7E 0 7 8B 1 0 0 0 0 0 73
TXStatus packet received
Status: 0

Received telegram: 7E 0 E 90 0 13 A2 0 40 98 98 61 0 0 1 FF FF EA
RX packet received

```

Figure 13 Printout of transmitted and received frames from/to router

6. Conclusion

In this paper, we presented how to design a ZigBee Wireless Sensor Network based on API operating mode. The main objective was to point out advantages of this type of communication and provide better understanding of API frames structure. Understanding of frames structure for students should be of great importance in order to develop a more advanced sensor network system. With the understanding of these basics, the network system can be further improved with better power management and data logging capabilities.

REFERENCES

- [1] Farahani, S. (2008). *ZigBee Wireless Networks and Transceivers*, USA: Elsevier Ltd.
- [2] Tomar, A. (2011) (in press). *Introduction to Zigbee Technology*, element14/theknode.
- [3] Somani, N.A., Patel, Y. (2012) ZigBee: A Low Power Wireless Technology for Industrial Applications, *International Journal of Control Theory and Computer Modelling (IJCTCM)*, Vol. 2, No. 3, (pp. 27-33).
- [4] Hilman, M. (in press). *An Overview of ZigBee Networks*, MWR InfoSecurity.
- [5] DainTree Networks (2008). *Getting Started with ZigBee and IEEE 802.15.4*, Grant Road, USA: DainTree Networks.
- [6] Arduino Web site, Retrieved March 15, 2018, from <https://store.arduino.cc/arduino-uno-rev3>
- [7] D-Robotics (2010) (in press). *DHT11 Humidity & Temperature Sensor (datasheet)*.
- [8] Farnell Web site, Retrieved March 15, 2018, from <http://www.farnell.com/datasheets/27606.pdf>, XBee OEM RF Modules □ ZigBee □ v1.x1x [2007.06.01].
- [9] Digi International Web site, Retrieved March 10, 2018, from <https://www.digi.com/resources/documentation/digidocs/pdfs/90001458-13.pdf>

[10] Adafruit/DHT-sensor-library Web site, Retrieved March 15, 2018, from <https://github.com/adafruit/DHT-sensor-library>

[11] ericburger/simple-zigbee Web site, Retrieved March 15, 2018, from <https://github.com/ericburger/simple-zigbee>

Pronoun Disambiguation Problem

Toma Rončević

University Department of Professional Studies, Split, Croatia
roncevic@oss.unist.hr

Haidi Božiković

University Department of Professional Studies, Split, Croatia
Haidi.bozikovic@oss.unist.hr

Abstract. In this paper we present current approaches for natural language understanding (NLU) applied on pronoun disambiguation problem (PDP). NLU is one of most fascinating fields within natural language processing (NLP) that deals with extraction of “deeper” meaning within text written in natural language. It is easy to demonstrate difficulties of understanding even simpler sentences like “Scientists have cloned monkeys.” unless we have a way of understanding that scientists don’t necessarily possess cloned monkeys but have made a scientific breakthrough. Natural language is full of such ambiguities, incompleteness or vagueness and relies heavily on “common sense” of the reader. One of the most representative problem within NLU is PDP, where task is to assign a pronoun to one of previously mentioned nouns. Classical example of this problem is sentence “The city councilmen refused the demonstrators a permit because they feared violence.” taken from Winograd’s test collection, where pronoun “they” refers to “councilmen” and not to “demonstrators” although both interpretations are syntactically and grammatically correct. This problem is often trivial for humans but very hard for known algorithms. Winograd, in his thesis, assumes that it is impossible to solve this problem without near-human understanding of the language and world in general, basically solving the problem of general artificial intelligence.

Key words: *natural language understanding (NLU), pronoun disambiguation problem (PDP), natural language processing (NLP)*

1. Introduction

Problem of understanding natural language has been an interesting area of research since beginning of the artificial intelligence field. Even restricting the language and domain there are still many problems in extraction and representation of knowledge exposed in natural language. Large part of this research was preoccupied with resolving superficial processing based on grammatical and syntactical rules. This is necessary but not sufficient for correct understanding of language, for example in machine translation. There is still large part of language that depends on background knowledge independent of simple grammatical rules. One problem that demonstrates well both parts of the problem is disambiguation of pronouns. Often the pronoun can be resolved as previously mentioned noun just by checking the gender and number agreement. An example of this “superficial” resolving would be a pair of sentences: “Packages couldn’t fit in the bus because it was too small” and “Packages couldn’t fit in the bus because they were too large”. According to grammatical rules for numbers and pronouns it is easy to assign “it” to “bus” in first sentence and “they” to “packages” in second sentence. However this is not the most interesting case. A pair of sentences that illustrates much more difficult problem would be: “Trophy couldn’t fit in the suitcase because it was too big” and “Trophy couldn’t fit in the suitcase because it was too small”, presented in [1]. This example shows that humans are able to resolve pronouns based solely on background knowledge without resorting to syntactical

or grammatical rules. This problem was first exposed in [2] and recently elaborated and formed in the Winograd Schema Challenge (WSC) [1]. WSC consists of sentence pairs that contain pronoun that needs to be resolved. Sentence pairs are almost identical but small difference in meaning changes pronoun resolution. These resolutions are simple for humans since they rely on “common knowledge” but are difficult for machines since they lack such knowledge. Couple of examples from [1] illustrate different kinds of necessary knowledge (**Table 1**).

Table 1 Several examples from WSC dataset that demonstrate different kinds of knowledge necessary to disambiguate pronoun as one of candidate nouns. Sentences come in pairs with slightly altered meaning, enough to change correct answer and additional data in XML format.

Sentence	Pronoun	Candidate answers	Answer
John couldn't see the stage with Billy in front of him because he is so short.	he	John, Billy	John
John couldn't see the stage with Billy in front of him because he is so tall.	he	John, Billy	Billy
They broadcast an announcement, but a subway came into the station and I couldn't hear over it.	it	announcement, subway	subway
They broadcast an announcement, but a subway came into the station and I couldn't hear it.	it	announcement, subway	announcement
John was jogging through the park when he saw a man juggling watermelons. He was very impressed.	he	John, juggler	John
John was jogging through the park when he saw a man juggling watermelons. He was very impressive.	he	John, juggler	juggler

This challenge was devised as a practical alternative to Turing test [3] since it requires demonstrating human-like capabilities of using background knowledge but its more restricted form allows automatic and more precise evaluation. First two examples rely on physical knowledge, personal experience and/or familiarity with situation. Third example draws from expected subjective experience. All three examples demonstrate difficulty of expressing and using these kinds of knowledge in common framework. In construction of these sentence pairs, [1] warns of few pitfalls where “shallow” semantic analysis could resolve pronoun based on word co-occurrence statistics. Example of such pitfall could be: “There was a phone on the nightstand and it was ringing”. Pronoun “it” can be resolved between nouns “nightstand” and “phone” by querying co-occurrence with verb “rings”. Today, this can be achieved, for example, by simply querying Google with both “phone rings” and “nightstand rings”. These queries would give number of results with ratio of about 30:1 for “phone rings”.

In this paper we describe two approaches for this problem that had success on part or all sentences given in WSC. One is based on extracting similar sentences from large corpus and mapping them on original sentence using predefined rules. This approach was developed for a subset of sentences that fit certain pattern. Other approach is based on capturing meaning of sentence with word embedding. This approach was applied in 2016. PDP competition both for WSC sentences and another similar set of sentences [4].

2. Approaches

We examine two approaches that describe a complete system for PDP resolution. Both solutions indirectly rely on knowledge base of common-sense facts and rules but they differ widely in how this knowledge is obtained and used.

First approach [5] that we examine is trying to describe different rules between concepts and events in form of semantic graph that is then compared with sentences obtained by querying large corpus of text. This approach can be extended on many problems but has severe drawback in that it works only for selected types of sentences since it is necessary to define rules of inference manually for each type of sentence. Authors automatized the process of extracting and using common-sense knowledge for subset of PDP sentences. They identified two types of sentences, valid for 71 sentences (out of 282 total sentences in dataset): direct casual events and casual attributive. Direct casual events describe two events where second event is consequence of the first event. Example of first type of sentence would be “*Paul tried to call George on the phone, but he wasn't available*”. This could be formalized as rule *IF (X tried to call Y) AND (Z wasn't available) THEN (Z==Y)*. Casual attributive type describes a situation where event implies certain trait for one of the candidate nouns. Example of second type of sentence could be “*The man couldn't lift his son because he was so heavy*”. This sentence could be formalized as *IF (X couldn't lift Y) AND (Z was so heavy) THEN (Z==Y)*. For both types, approach relies on logical formalization of sentences and then querying knowledge base (Google in their experiment) for more plausible resolution. More in detail, first step is finding a dependency parsing using Stanford Dependency Parser [6]. This will turn sentence into a graph where further simplifications can be applied to obtain semantic graph. Example of dependency graph is shown for sentence “The experiment proved the first and second thesis” (**Figure 1**).

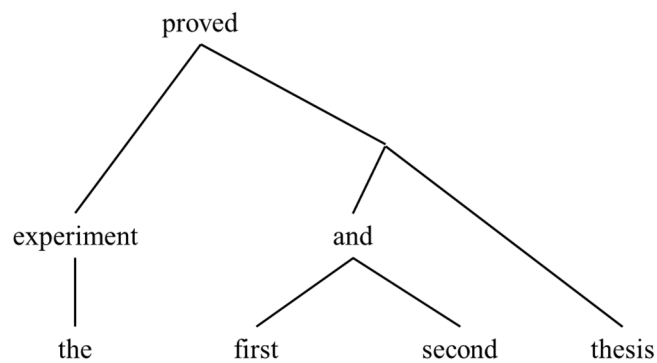


Figure 1 Example of dependency graph (tree). Such graph usually contains additional information about word's grammatical roles in sentence, like (N)oun, (V)erb, (P)ronoun, etc.

Simplification replaces all the words, except several key words necessary for query, with asterisks. Query is a string of key words and asterisks, for example: “**experiment.*proved.*thesis*”. Using WordNet [7] or other databases, more queries can be generated by replacing semantically similar words in the query. For example, from previous query we could generate also “**experiment.*proved.*assumption*”. These queries are then used to extract similar sentences from large corpus (Google search engine API in paper). These sentences are transformed in dependency graphs of similar structure as original sentence. From these graphs it is possible to resolve pronouns using shallow analysis and then map this solutions on original semantic graph/sentence. Out of 71 chosen sentences, this system could correctly resolve pronoun for 49 sentences, 5 were answered wrongly and 18 sentences were left unanswered since queries returned no appropriate sentence from corpus.

Second approach we present is using method of embedding words in vectors of numbers/features [8]. Embedding words into vectors was first proposed in [9]. It was shown that embedding was able to capture meaningful (semantic) similarities between words (like between “dog” and “hound”) by learning from their co-occurrences with other words. This method is based on old assumption predicting that similar words will appear in similar context. Converting words to meaningful vectors allows us to use many models from machine learning. This method in combination with other models (like neural nets) produced state of the art results on several natural language problems. Another benefit of this method is that embedding can be learned in unsupervised fashion from any text. If text is adequate for the task (domain), word embedding will capture relevant similarities. Vectors can be obtained by calculating word co-occurrences for all the words in the corpus as NxN matrix. This matrix then can be reduced in size to obtain vectors with d features. In reality, both steps can be done using stochastic gradient descent and maximising goal function Q :

$$Q = \frac{1}{T} \sum_{t=1}^T \sum_{j=-c, j \neq 0}^c p(w_{t+j}|w_t) \quad (1)$$

This function describes skip-gram model with goal of predicting words in window (context) of some each word w_c from some sequence of words w_1, w_2, \dots, w_T . This prediction is described by conditional probability of appearance of other words within window $p(w_{t+j}|w_c)$ calculated as softmax function. In [8], authors adapt word embedding to PDP by embedding semantic similarity using knowledge base of correlated facts. They used previously created knowledge base of common sense rules in format of cause-effect pairs. These pairs cover wide range of commonly assumed implications between verbs and adjectives. Examples of such pairs could be *(eat, full)*, *(fall, hurt)* and similar. Each cause-effect pair also has a confidence weight that is used in embedding. Authors captured these pairs in embedding by constraining vectors to reflect similarity between cause and effect words, e.g. the confidence weight. So in previous pair examples, similarity between vectors for words “eat” and “full” should be smaller than for words “fall” and “hurt” if confidence weight for *(eat, full)* is smaller than for *(fall, hurt)*. These constraints were added as a penalty to embedding function Q . Two models were using this embedding for PDP resolution: unsupervised semantic similarity model (USSM) and supervised neural knowledge activated model (NKAM). Both models use fixed-size ordinally-forgetting encoding (FOFE) for critical word context. This encoding sums words around central (critical) word weighted by distance. So, for example in sequence of words $(w_{c-1}, w_{c-2}, w_c, w_{c+1}, w_{c+2})$, encoding for central word w_c would first be converted to dictionary where each word corresponds to vectors e_t with 1-of-k representation and then calculated as:

$$z_t = \alpha z_{t-1} + e_t \text{ with } 1 < t < T \quad (2)$$

Alpha denotes how fast will weight decay with distance from central word with value between 0 and 1 (0.7 in paper). This encoding is done in both directions from central word and then multiplied with embedding matrix to obtain final encoding. Encoded vectors have fixed size, equal to word embedding vector size. This allows NKAM to use cosine similarity for PDP resolution. For example, for sentence “Bob couldn’t see John because he was hiding”, FOFE encoding would be calculated for “Bob”, “John” and “he”. Cosine distance between vectors for “Bob” and “he” against distance between “John” and “he” would indicate correct pronoun assignment. Advantage of this approach is completely unsupervised but results are weaker than with supervised model. Supervised NKAM model requires an extra step in training deep neural network to measure similarity instead of simple cosine distance. Training was done on labeled dataset: OneNote co-reference resolution dataset [10].

Models were built using two versions of Wikipedia corpus [11]. Results for both models trained with larger Wiki corpus are shown in **Table 2**.

Table 2 Number of correct answers for USSM, NKAM and combined models compared with random guessing. Since WS dataset can have more than two answers, random guessing is less than 50%.

Dataset	Random guess	USSM	NKAM	USSM+NKAM
Winograd Schema (60 sentences)	45%	52%	52.4%	52.8%
PDP (273 sentences)	50%	55%	56.7%	61.7%

Authors also compared results using general embedding and KEE embedding to prove that KEE is responsible for improvement. We repeated the part of verifying USSM model with four different embeddings and came to the same conclusion as authors: general embedding doesn't improve random guessing.

3. Conclusion

We presented two approaches for natural language understanding applied on pronoun disambiguation problem. First approach relies heavily on human expertise in comparing events extracted from PDP sentence with sentences extracted from corpus of plain text. This implicates difficulties in implementing similar solutions for other NLU problems. Yet, for a long time this was approach of choice for many NLU problems. Idea of embedding knowledge without any sentence analysis seems too simple to capture all the interactions between words. However, authors proved that embedding actually captures some of the common knowledge and it seems like a viable solution for many NLU problems. We could only repeat a small part of [8] since embedding and knowledge base used are not available publicly. Complete system that could reliably resolve PDP for all kinds of sentences is still far away, but word embedding and use of (deep) neural nets seems to be a promising direction. One possible improvements for second approach could be using recurrent neural nets as a replacement for, rather crude, FOFE encoding. Similar approach is used for state-of-the-art machine translation so it can be assumed that they capture at least part of deeper sentence meaning.

REFERENCES

- [1] H. J. Levesque, E. Davis, L. Morgenstern, The winograd schema challenge, in: *AAAI Spring Symposium: Logical Formalizations of Commonsense Reasoning*, Vol. 46, 2011, p. 47.
- [2] T. Winograd, *Understanding Natural Language*. Academic Press, New York, 1972.
- [3] A. M. Turing, Computing machinery and intelligence, *Mind* 59 (236) (1950) 433–460.
- [4] L. Morgenstern, Winograd schema challenge, Retrieved March, 30. 2018, from <http://commonsensereasoning.org/winograd.html>.
- [5] A. Sharma, N.H. Vo, S. Gaur and C. Baral, An Approach to Solve Winograd Schema Challenge Using Automatically Extracted Commonsense Knowledge, in: *AAAI Spring Symposium: Logical Formalizations of Commonsense Reasoning*, 2015.
- [6] M.C. De Marneffe and C. D. Manning, Stanford typed dependencies manual, Retrieved March, 30. 2018, from https://nlp.stanford.edu/software/dependencies_manual.pdf
- [7] G. A. Miller, Wordnet: a lexical database for english, *Communications of the ACM* 38(11):39–41. 1995.
- [8] Liu, Quan, Hui Jiang, Zhen-Hua Ling, Xiaodan Zhu, Si Wei and Yu Hu. “Commonsense Knowledge Enhanced Embeddings for Solving Pronoun Disambiguation Problems in Winograd Schema Challenge.” (2016).
- [9] T. Mikolov, K. Chen, G. Corrado and J. Dean, Efficient estimation of word representations in vector space. *arXiv preprint arXiv:1301.3781*. 2013.
- [10] R. Weischedel, et al. Ontonotes release 5.0 ldc2013t19. *Linguistic Data Consortium, Philadelphia, PA*. 2013.
- [11] C. Shaoul, The westbury lab wikipedia corpus. *Edmonton, AB: University of Alberta*. 2010.

Design of Small Power Solar System

Ivica Lovrić

University of Split, University Department of Professional Studies, Split, Croatia
ilovric@oss.unist.com

Marija Blažević

University of Split, University Department of Professional Studies, Split, Croatia
marija.blazevic9@hotmail.com

Vjekoslav Zrno

University of Split, University Department of Professional Studies, Split, Croatia
vzrno@oss.unist.hr

Slobodanka Jelena Cvjetković

University of Split, University Department of Professional Studies, Split, Croatia
sjcvjet@oss.unist.hr

Abstract. This paper will show the small power solar system with components and the fundamental principles of pairing the components will be pointed out. The goal of this project is to prepare Electrical engineering students to solve the terms of reference specific examples. It will be explained in detail how to obtain electricity through a solar cell, how solar cells connect to modules and finally calculate and install solar modules to build a small solar power system (in this case a solar power plant of 700 watts). They were compiled and explained, the basic components consisting of each solar power system, and the ways of connecting and operating particularly of a solar power system. The focus of work is on the design and installation of a solar power plant. The choice and dimensioning of the basic components of solar system, the safety of work and technical calculation of solar power plant which will ultimately help to assess the monthly or annual electricity production are described. Finally, the explanations of the ways of monitoring and controlling the station through both the control panel and the computer system for monitoring, measuring and managing industrial systems – SCADA have been provided in the paper.

Key words: *renewable source, solar power system, photovoltaic cells (modules), solar energy, SCADA*

1. Introduction

The sun is the largest source of energy. An increasing need to use this energy, i.e. it's conversion into electricity, is expected. For this purpose, the solar photovoltaic power plants are used. The paper will describe the design of small solar power system for educational purposes. The aim is to design a system in which students of electrical engineering will perform laboratory exercises and become acquainted with the functioning of the photovoltaic system, as well as the way in which the industrial systems are controlled. So, the emphasis is on designing a system that will meet these requirements.

2. Requirements for Solar Power System for Educational Purposes

For the educational needs of this system it is necessary to adapt the system to the conditions of safe operation with easy access to all its components.

2.1 System performance

The control panel of the system with all the elements should be visible for the purpose of students' education. The elements are easily accessible to ensure execution of all measurements. According to the regulations, dangerous voltages are defined above 50 V for alternating current (AC) and above 120 V for direct current (DC). Since different voltages are present on the system, all the 230V voltage elements must be placed in a closed box, while the DC voltage elements may be on the open panel. The signs of danger should be highlighted on the board. The system is performed so that the energy can go from photovoltaic modules to batteries, from batteries to consumers 24V DC, from battery to 230V AC consumers, from the public electrical grid 230V AC to battery and from the public electrical grid to consumers 230V AC. The control and monitoring of system will be performed by the method of controlling of industrial systems in order to familiarize students with the elements and the way of controlling in industry with Programmable Logic Controller (PLC) and Supervisory Control and Data Acquisition (SCADA) systems in real conditions. The system is executed, considering the dimensioning of the elements and cables and the available space on the control panel, with the aim of its possible subsequent modifications and upgrades.

2.2 The possibility of testing the system

The system will be exposed to the following experiments: charging and discharging batteries, operating of photovoltaic modules in a variety of compounds, operating of bidirectional inverter, operating of charge controller, and DC and AC consumers. Therefore, the system should have an option which simplifies switching from one operating mode to another. In addition, it is necessary to measure all the important parameters and store the measuring data on the computer in order to monitor the state of the system and perform all the necessary analyses. Measured sizes are read on the control panel and students thus monitor the actual state of the system while performing the exercises.

The system has been designed in this way in order to simulate various errors so that students can find faults with the help of an electrical scheme and eliminate the malfunction, and understand the system's operation principle as well as individual elements. The aim is to teach students to track the status of the system in accordance with its technical documentation.

3. Description of the components of a Solar Power System

Solar energy is a fundamental parameter in the design of photovoltaic systems. The importance of the photovoltaic system position in relation to the geometry of the Sun – Earth must be highlighted. The information about the energy of solar radiation and position of the photovoltaic systems are important for optimal energy usage.

The basic elements of our photovoltaic systems are two photovoltaic modules, charge controller, bidirectional inverter and two serially connected batteries. It should be noted that the configuration of the power system depends on the power load that will be connected to it. System configuration is calculated according to the area where it is installed, depending on the number of hours of sunshine per day and per year.

The support structure and photovoltaic modules will be located at the ground level on the south side of the building. The construction of the module is set in an orientation of the building which is a small deflection from the southern direction. The selected inclination of the solar modules is 30 degrees as the optimum requirement for maximum power installed on a given surface and with minimal shade in winter.

3.1 Photovoltaic modules

When the solar cell lights up electromotive force is induced at its ends. The solar cell becomes a semiconductor diode and behaves like a rectifier that is passing the current in only one direction. When the solar cell is illuminated, the incoming photons produce electron-hole pairs. If the solar cell is illuminated, the contact on the P-type becomes positive and the N-type is negative. If these contacts are connected to the external loads, electric current passes and solar cells become a source of electricity. By connecting multiple unit cells photovoltaic modules are formed [1]. Photovoltaic modules are converting solar energy into electricity. The current, voltage and power ratios of the photovoltaic module are shown in Figure 1. The blue curve shows the current-voltage characteristics, the open circuit voltage V_{oc} and the short circuit current I_{sc} . Open circuit voltage occurs when the photovoltaic module is switched off, i.e. no consumption. Short circuit current is the maximum current that the module can provide. The red curve represents the power that the photovoltaic module gives. This power is determined by the product of voltage and current at each point. Given these values, it is important to determine the point at which the power will be maximum (Maximum power point, MPP).

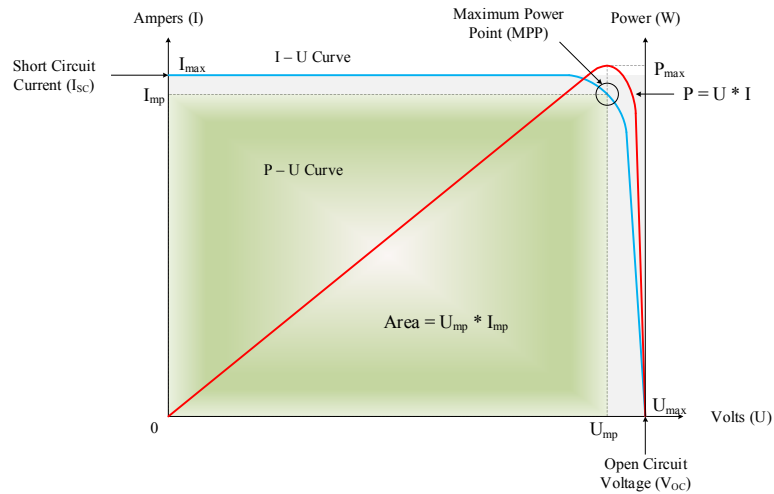


Figure 1 Current, voltage and power ratios of the photovoltaic module

The diagram in Figure 2 shows the comparison between different module connections – single, series or parallel [1]. Considering the type of connection, there are differences in the relationship between voltage, current and power.

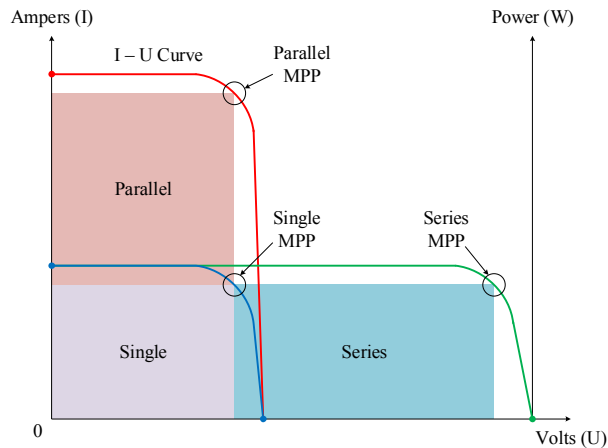


Figure 2 Type of connection of the photovoltaic modules

3.2 Charge controller

Battery charge controller is a key device in the design of the solar power system. Controller indicates the state of the batteries and thus protects the batteries against overcharging. It also serves as a safety device of the entire installation and short-circuit consumer protection. The charge controller charges the battery with energy provided by the photovoltaic modules. It controls input voltage and current, and modifies them for optimum charging. The controller uses technology of detecting maximum power with the help of advanced algorithms in a way that it follows the maximum power point (Maximum Power Point Tracking, MPPT) which changes with changing weather conditions in which there are modules. This provides maximum battery charging, which for the same level of brightness on photovoltaic module is up to 30% compared to standard chargers.

3.3 Bidirectional inverter

A bidirectional inverter, unlike a classic inverter, transmits energy in both directions: from a battery pack to an AC electrical grid or from an AC electrical grid to a battery. If it works in the inverter mode, it converts the direct current into alternating current and supplies AC consumers. AC consumers can be powered directly from the public electrical grid through bidirectional inverter. Another possibility is to work in the charger mode. In this way it charges the batteries when photovoltaic modules are not in function. If conditions for stable operations do not exist, changeover relay automatically switches from one operation mode to another or switches off devices. In Figure 3 the block diagram of the major components is shown - bidirectional inverter and possible directions of energy through the device.

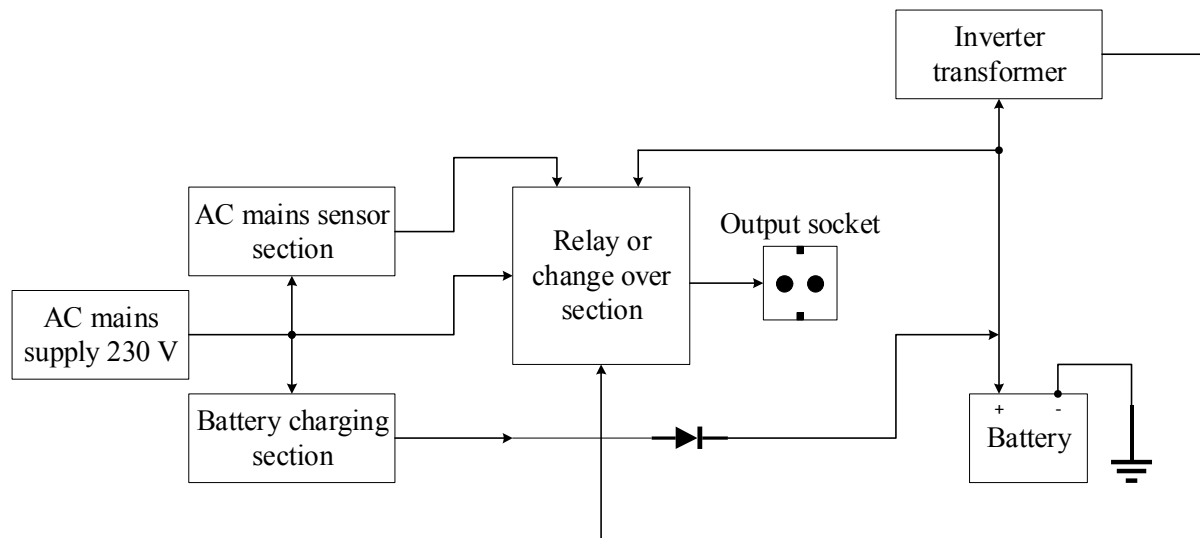


Figure 3 Block diagram of the bidirectional inverter

3.4 Batteries

Batteries are used to store electrical energy [2]. Deep cycle GEL 12 V batteries have an optimal ratio of discharge cycles and lifetime. High discharge current is possible due to low resistance. This type of battery allows deep discharge, which makes them suitable for use in inverter systems of solar power plants. The batteries have an extremely low self-discharge (only 2% per month at 20°C), which allows the preservation of battery charge for a long time. For longer battery life, the recommendation is a three phase charging. Figure 4 shows the voltage and current ratios for each charge phase. The first phase refers to the initial charging of a discharged battery with a maximum constant current. The second phase refers to the maximum constant voltage and current decreasing, and in the third phase the voltage is slightly higher than the battery voltage with low current ($I \sim 0$ A).

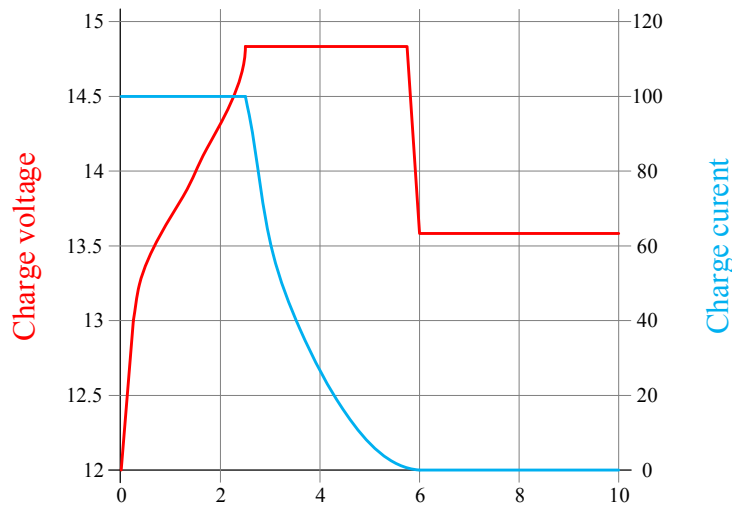


Figure 4 Relationship of voltage and current by individual charging stages

4. Energy calculation

The planned permanent system consumption refers to the consumption of control and monitoring of the system. This consumption is $P_s = 90W$. The basic parameters of our system can be found in Table 1:

Table 1 Parameters of system

Quantity	Symbol	Value
Battery voltage	U_s	24 V
Battery discharge depth coefficient	t_z	0.5
Charge efficiency	η	0.9
Duration of autonomy	$n_a(d)$	0.6
Complete system recovery	$n_e(d)$	1

*Depth of discharge (%) = $t_z * 100$*

When calculating battery capacity, it is important to focus on the consumption and duration of autonomy. The planned daily consumption of system E_c is:

$$E_c = P_s * 24 = 2160 Wh$$

According to the following calculation, the battery capacity $K = 108 Ah$, so the battery 110 Ah is taken.

$$K = \frac{n_a * E_c}{U_s * t_z} = 108 Ah \rightarrow 110 Ah$$

The daily charge of our batteries is:

$$Q_p = \frac{1}{\eta} * K * \frac{t_z}{n_e} = 61 Ah$$

$$E_p = k * U_s * Q_p = 1610 Wh$$

Q_p – required daily charging in Ah

E_p – required daily charging in Wh

The charge voltage is 110% of the battery voltage and so is the charge factor $k = 1.1$ [4]. Therefore, to meet all these conditions, two batteries are connected in series. The technical characteristics of the battery are given in Table 2.

Table 2 The technical characteristics of the battery

Battery Deep Cycle GEL	
Battery voltage	12 V
Battery capacity C	110 Ah
Recommended depth of discharge	50 %
Optimal discharge current	0.05 C = 5.5 A
Maximum charge current	0.2 C = 22 A (If > 0.2C temperature compensation is required)
The 3-step charge curve	recommended
Charge voltage 'absorption'	14.1 - 14.4 V
Charge voltage 'float'	13.5 - 13.8 V
Charge voltage 'storage'	13.2 - 13.5 V

The system consists of two photovoltaic modules that will connect individually, into a serial or parallel connection. Technical characteristics of photovoltaic modules are shown in Table 3.

Table 3 Technical characteristics of photovoltaic module

Photovoltaic module 250 Wp	
Nominal current	8.056 A
Short circuit current	8.59 A
Nominal voltage	31.16 V
Open circuit voltage	37.93 V

Table 4 shows the expected daily and monthly energy production on photovoltaic modules and energy consumption.

Table 4 Estimates of electricity generation and consumption

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
E_c (kWh)	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16
E_p (kWh)	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
E_d (kWh)	1.05	1.46	1.96	2.17	2.37	2.49	2.63	2.48	2.11	1.67	1.07	0.94
E_m (kWh)	32.7	41.0	60.9	65.0	73.4	74.6	81.6	76.8	63.2	51.9	32.0	29.0

E_c - Planned daily consumption

E_p - Required daily charging (if batteries discharged 50% of capacity)

E_d - Average daily electricity production from the given system (0.5kWp) according PVGIS

E_m - Average monthly electricity production from the given system (0.5kWp) according PVGIS

PVGIS (Photovoltaic Geographical Information System) for location: 43°31'22" North, 16°27'2" East, Split, Croatia, fixed system: inclination=30 deg., orientation=5 deg. [3]

If we compare the technical characteristics of the charge controller and the bidirectional inverter with the system parameters (Table 5), we conclude that the devices are compatible.

Table 5 Comparison of the technical characteristics of devices

System parameters		Technical characteristics of devices		
Quantity	Value	Charge controller	Bidirectional inverter	
			Inverter	Charger
Battery voltage	24 V	24 V	19-33 V DC	24 V
The 3-step charge voltage curve	28.2 - 28.8 V 27 - 27.6 V 26.4 - 27 V	28.8 V (adjustable) 27.6 V (adjustable)		28.8 V 27.6 V 26.4 V
Maximum charge current	22 A	30 A (temp. comp.)		16 A
PV open circuit voltage	75.86 V	100 V		
PV short circuit current	17.18 A	30 A		
PV maximum power	500 W	880 W		
AC voltage output	230 V, 50 Hz		230 V, 50 Hz	
Maximum AC power output	700 W		700 W	

5. Technical Description of the Solar Power System

The photovoltaic system consists of two photovoltaic modules P₁ and P₂, two batteries connected in series B, the charge controller CH MPPT and the bidirectional inverter CH/INV which contains the charger and the inverter (Figure 5). Battery charging is performed with the photovoltaic module through the charge controller. If the modules are not in use, the charging is automatically switched on by the charger from the public electrical grid. Energy stored in batteries will be able to be consumed by inverter on 230V AC output or directly from batteries on 24V DC output.

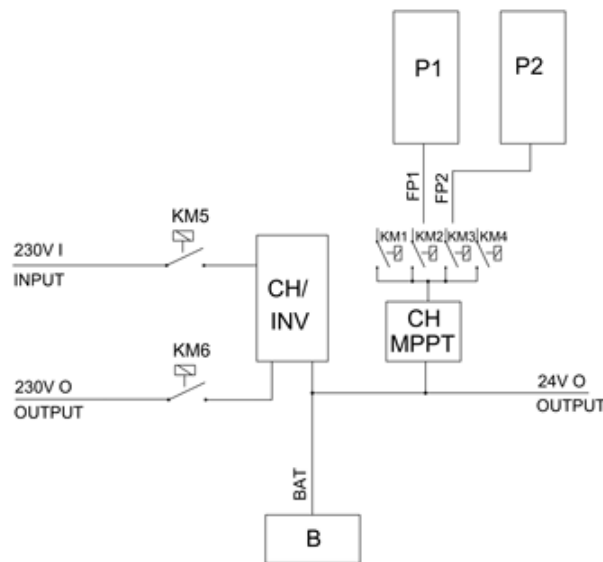


Figure 5 Single-pole scheme of the photovoltaic system

Overcurrent protection is performed in all circuits with circuit breakers. Overvoltage protection is performed by surge arresters (K₁, K₂, K₃ and K₄) on the charge controller input (Figure 6). Residual-current device (FID) is on the 230V AC output of bidirectional inverter. Bidirectional inverter is protected against short circuit on the output side, against overload and overheating and against too low and too high battery voltage. The charge controller has short circuit protection on the output side and overheating protection. Turning off switches QS₁, QS₂, QS₃ and turning off the fuse, FU₆, the off-state is achieved on the Control Panel.

Control voltage can be taken directly from the battery or from the power supply PS 24V, which is supplied by the public electrical grid. Voltage selection is done with the SA₃ switch. System control is performed using the contactor via push buttons on the control panel or via a computer system for monitoring, measurement and control of industrial systems (SCADA). By controlling contactors - KM₁, KM₂, KM₃, KM₄, it is possible to include photovoltaic modules individually or combine them in series or parallel. Contactors KM₅ and KM₆ control 230V AC input and 230V AC output.

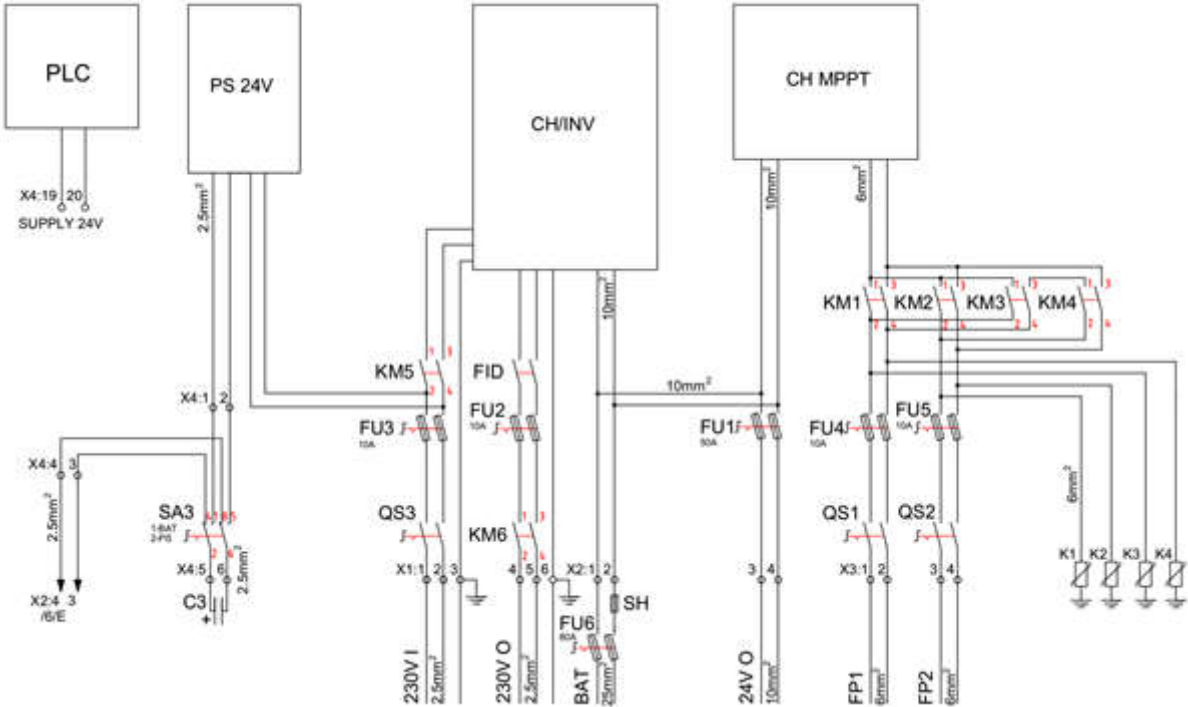


Figure 6 Electrical scheme of the photovoltaic system

By turning the switch SA₁ choose the local or remote control mode (Figure 7). Selecting local control, voltage is directed towards the push-buttons (SB₁-SB₁₀) on the control panel which control relays. These relays control aforementioned contactors KM. Diode (D₁-D₁₀) are used to prevent the return of power to the control circuits that need to be switched off. By selecting the remote mode on the switch, the power is directed to a Programmable Logic Controller (PLC) that takes over the control. Normal close contacts (NC) of relays KA₁, KA₂ and KA₃ prevent simultaneous switching of parallel and series connections. The switch EC is used in an emergency so that the power is interrupted to all relays and main contactors. Once disconnected, they are ejected from the drive.

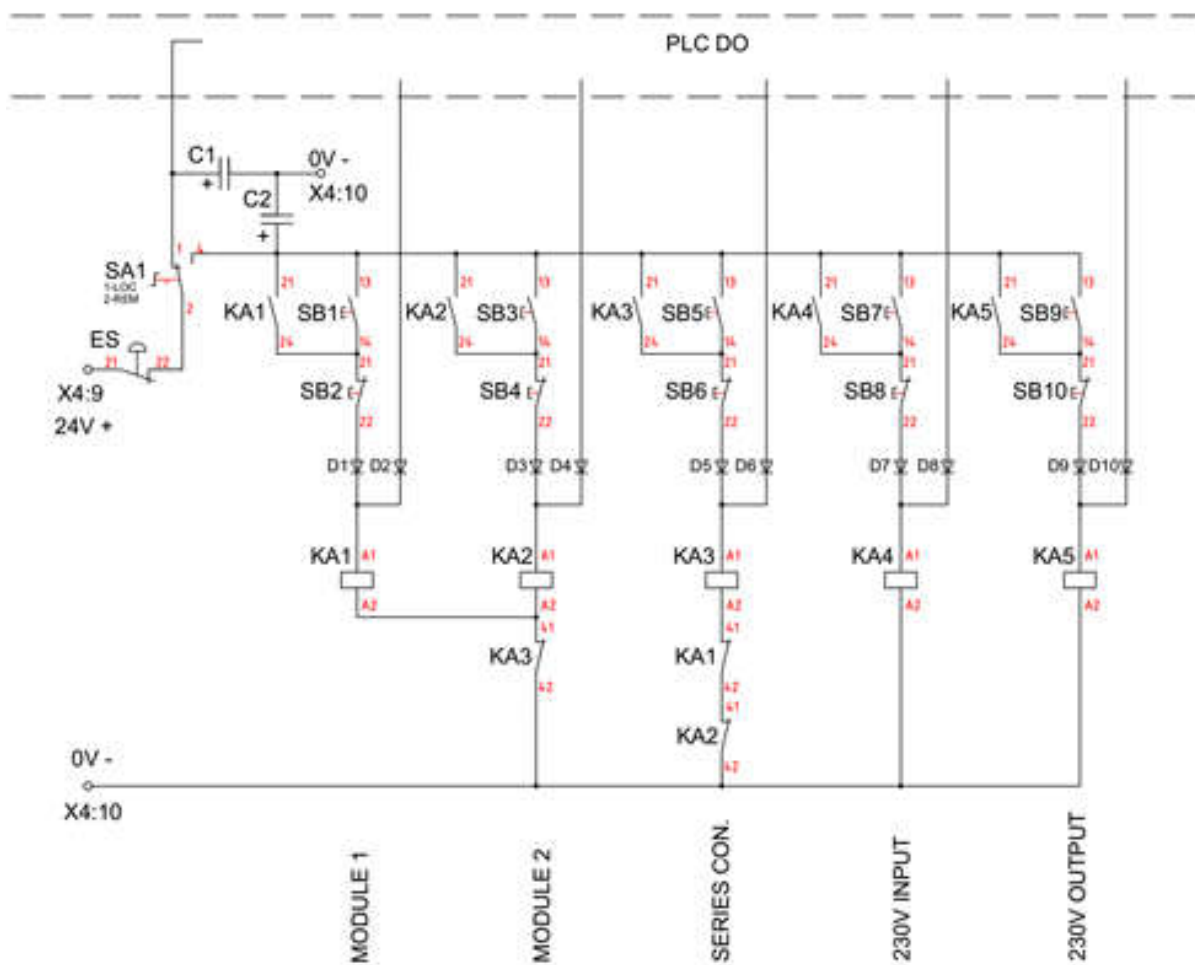


Figure 7 Control of the photovoltaic system

The system is equipped with transducers (T₁-T₉) to measure voltages and currents on all relevant power circuits (Figure 8). The image shows the measuring points on the control panel of the photovoltaic system. Solid lines with arrows represent guides which lead to the voltage transducers, while the dashed lines relate to the input side of the current transducers which is not separated outside the transducers, but the current is measured directly on the conductor passing through the transducer. From the output of the transducers, the information is led to the PLC. The voltage transducer T₉ can measure the voltage of individual modules or the total value, which is achieved by using the SA₂ switch to select the desired measurement. All data can be monitored on the control panel via the built-in screen. The control panel is equipped with light signals and light and audio alarms.

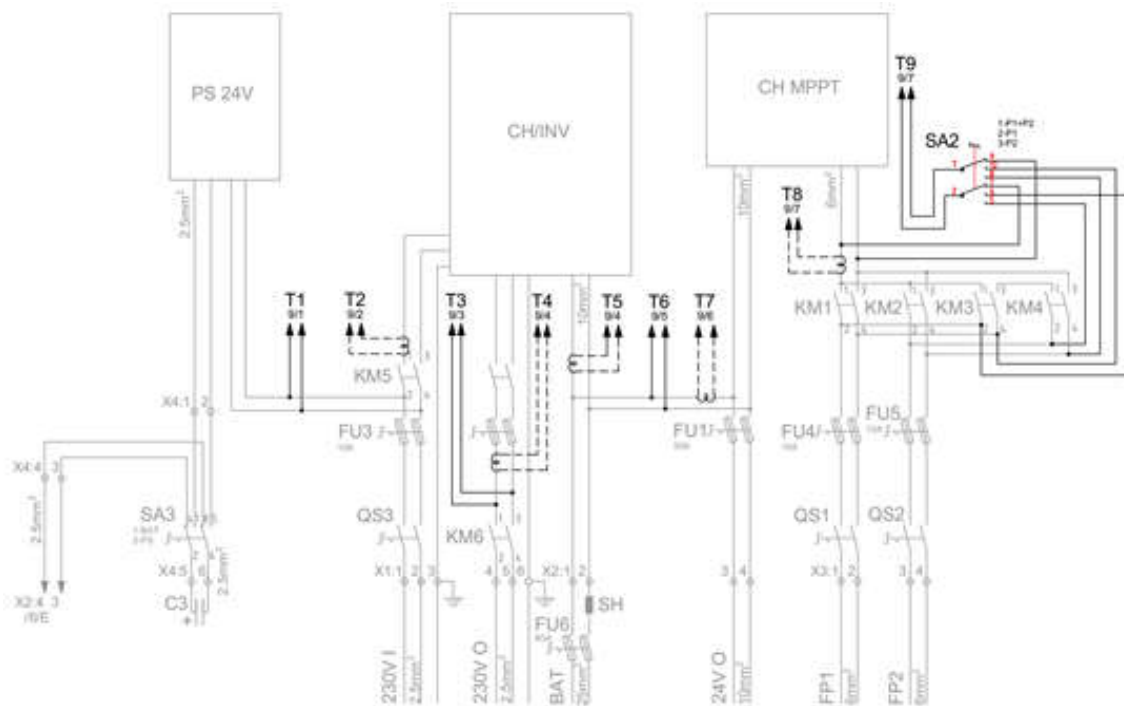


Figure 8 Measuring points display on the photovoltaic system

6. Conclusion

The increase in utilization of solar energy for electricity production is expected. Designing and analysing photovoltaic systems requires a wide range of knowledge from various fields of science and technology (astronomy, optics, materials technology, electrical engineering etc.). For this reason, the paper discusses the basic parameters of the photovoltaic system. Due to the complexity of the photovoltaic systems the authors have not provided a detailed analysis of their components.

The creation of the system has been primarily aimed at educating students about the exploitation of solar energy in everyday life.

REFERENCES

- [1.] <http://www.alternative-energy-tutorials.com/energy-articles/solar-cell-i-v-characteristic.html> [Online, Accessed: 09.03.2018.]
- [2.] <https://www.victronenergy.com/upload/documents/Datasheet-GEL-and-AGM-Batteries-EN.pdf> [Online, Accessed: 09.03.2018.]
- [3.] <http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php#> [Online, Accessed: 11.03.2018.]
- [4.] https://www.schrack.hr/fileadmin/f/hr/Bilder/pdf_dokumenti/Schrack_otocni_fotonaponski_sustav.pdf [Online, Accessed: 12.03.2018.]
- [5.] Jovanović, N.; *Transforming solar energy into electrical – photovoltaic systems*, final work, Sarajevo, 2009. [Accessed: 11.03.2018.]
- [6.] Majdandžić, L.J.; *Renewable energy sources*, Graphics Zagreb, 2008. [Accessed: 05.03.2018.]
- [7.] Šimić, Z.; *The Sun's Energy*, Faculty of Electrical Engineering and Computing, Zagreb 2007. [Accessed: 06.03.2018.]
- [8.] Šimić, Z.; *Using sun energy to produce el. energy (and heating)*, teaching material, FER, Zagreb, 2008. [Accessed: 06.03.2018.]

Design and Usage of CNC Mill

Roko Rogulj, bacc. ing. el.

University Department of Professional Studies, Split, Croatia
roko.rogulj@hotmail.com

Predrag Đukić, PhD.

University Department of Professional Studies, Split, Croatia
predrag.dukic@oss.unist.hr

Tonko Kovačević, PhD.

University Department of Professional Studies, Split, Croatia
tkovacev@oss.unist.hr

Marko Vukšić, PhD.

University Department of Professional Studies, Split, Croatia
vuksic.marko@oss.unist.hr

Abstract. University of Split (UNIST) faced the task how to improve courses according to the new teaching standards aiming that students not only gain knowledge of the field, but also become self-directed learners who develop problem-solving skills. University Department of Professional Studies uses the problem-based (PBL) learning techniques in the courses. In the problem-based learning courses, students work with colleagues to solve complex and authentic problems that help develop content knowledge as well as problem-solving, reasoning, communication, and self-assessment skills. PBL learning is extended to a few courses including Mechatronics. During the course Mechatronics students faced the construction of the milling and drilling CNC machine. CNC milling machines can be found in various industries such as automotive, military, medical and construction. This paper deals with the process of design, manufacturing, testing and use of three-axis CNC milling machine carried out by students. The mechanical and electrical subsystems were built and tested at UNIST laboratories. In this paper the CNC mill mechanical and electrical systems are outlined and basic subsystems are presented.

Key words: *learning techniques, CNC mill, mechanical and electrical system*

1. General Idea of CNC Machining

CNC machines are devices that execute commands using a computer/control device [2]. Usually, commands are made of string of numerical algorithms and they are all stored in control device. All commands are converted into electric impulses that drive the actuation group and the end-tool along with the sensory control. The user operates and monitors the operation of the machine using a Human Machine Interface Device (HMID) where feedback of machine operation is obtained through sensor connection. The CNC block diagram is shown in Figure 1.

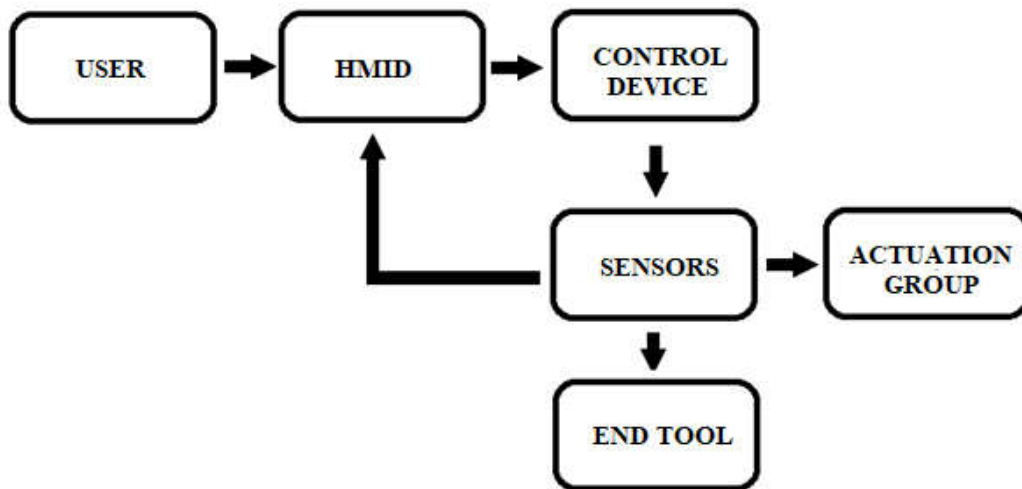


Figure 1: CNC system block schematics

The complexity of CNC machines is most often determined by the number of moving axes [2]. The moving axis is part of the machine's system that performs the desired motion method using one or more parts of the actuation group. The number of axes and their dimensions represent the working envelope of the machine, thus, increasing the number of axes, achieves a larger dimension of workspace (the number of points of space from which the end-tool can access to one particular point increases with higher dimensions). For the purpose of this project, it was adequate to design a CNC machine with three axes, which is suitable for any material processing by 2D cutting. Initial design of the machine is shown in Figure 2.

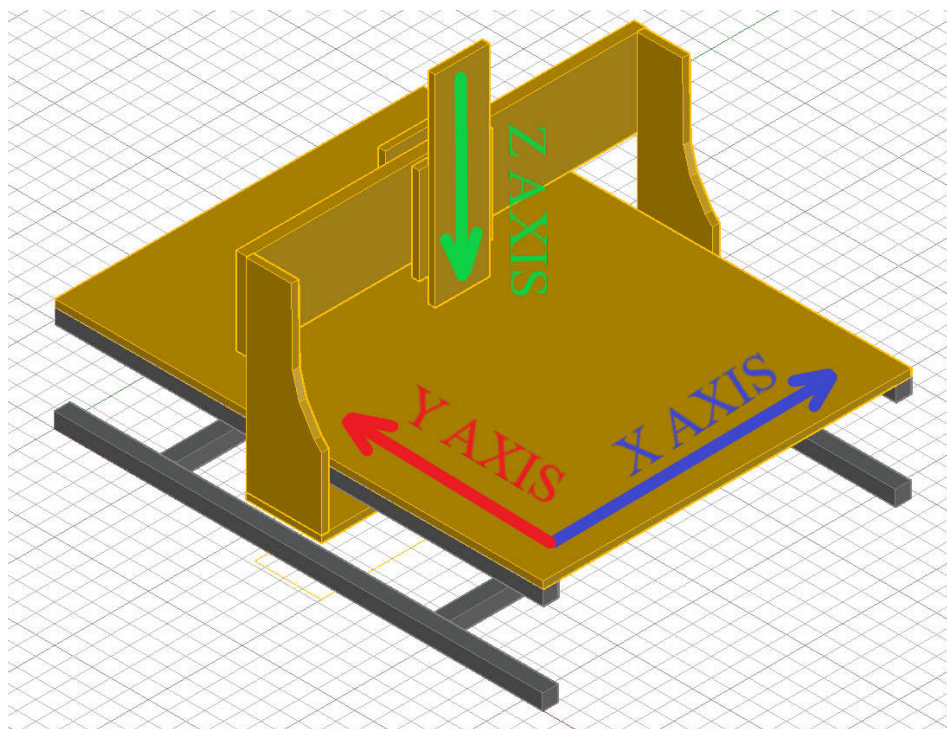


Figure 2: CNC CAD design

Axes are marked with the letters X, Y and Z and represent the basic setup of the three-dimensional CNC coordinate system. The arrows (Figure 2) represent a positive direction of the axis movement and each point in space inside of the work envelope of the machine can be

described with three coordinates: X, Y and Z. The starting point of this coordinate system is variable and is configured when the machine is started.

2. Elements of CNC System

The mechanical construction of the CNC machine is made as a combination of wood and steel. The structural base is made of steel square tubes (40x40x2 mm) on top of whom a flat square wooden plywood, measuring 1300x998x18 mm is laid, which is used as a base work surface during the processing of the material. The base of the X axis is laid between nearer sides of wooden plywood with the help of ball bearings. Top part of X axis sets the base for Y and Z axes that both also use ball bearings to provide free movement.

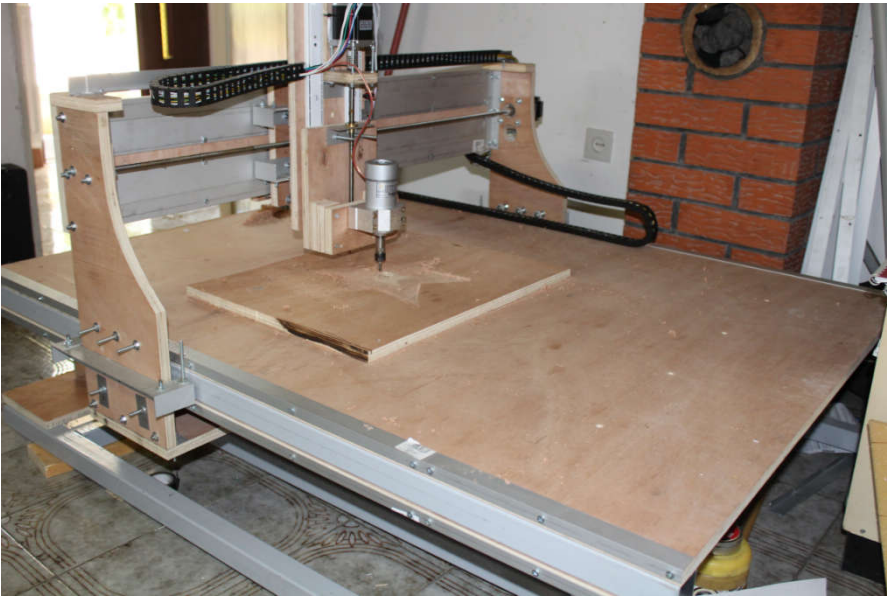


Figure 3: Working CNC mill

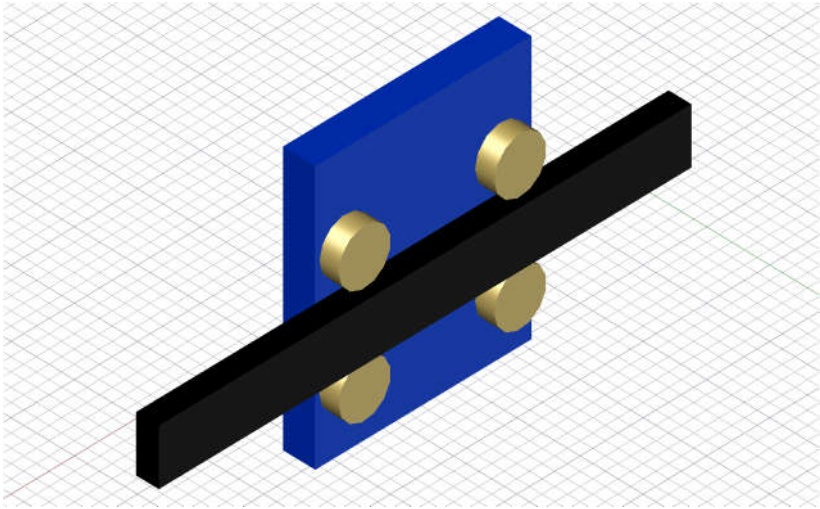


Figure 4: Linear guidance system

Linear motion is achieved with the help of ball bearings as shown in Figure 4. Four ball bearings envelop metal rail thus providing linear movement. This “four wheel” construct can be found

on both counter sides of each axis providing stability and securing that axes don't fall from their mechanical limits. Example of this construct can be seen in Figure 5.

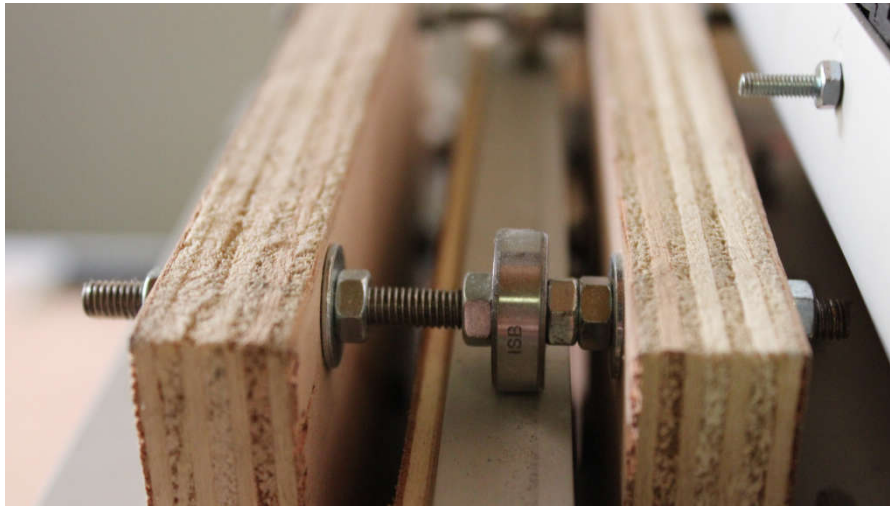


Figure 5: Implementation of ball bearing as linear guide

All supporting elements are either joined together with M5 hexagonal screws or welded (steel construction). Aluminum profiles are used for merging wooden parts of the machine and as smooth surfaces on which ball bearing make their movement. During the process of making this construction, a great deal of effort was made to make these parts as precisely as possible.

Linear actuation was achieved using threaded rod and ball bearings. As shown in FIGURE XX, threaded rod is placed in between support ball bearing and motor. When the motor is rotating, it makes threaded nut placed on base of complementary axis to move. Moving motor in precise increments allows controlled motion of axis. All three axes were made using this principle.

To achieve a precise and numerically controlled motion stepper motors can be used. The stepper motors are a type of electric motor that achieves motion in "steps". By sending an impulse to motor inputs, motor rotates for a certain angle called the step. The size of the step is defined by the motor configuration and build. By controlling step size and number of impulses at the motor input, precise motion can be achieved which is adequate for use with CNC machines. Building this machine, NEMA 23 23HS8430 motors were used because of their work momentum which is enough to drive all axes of this machine.

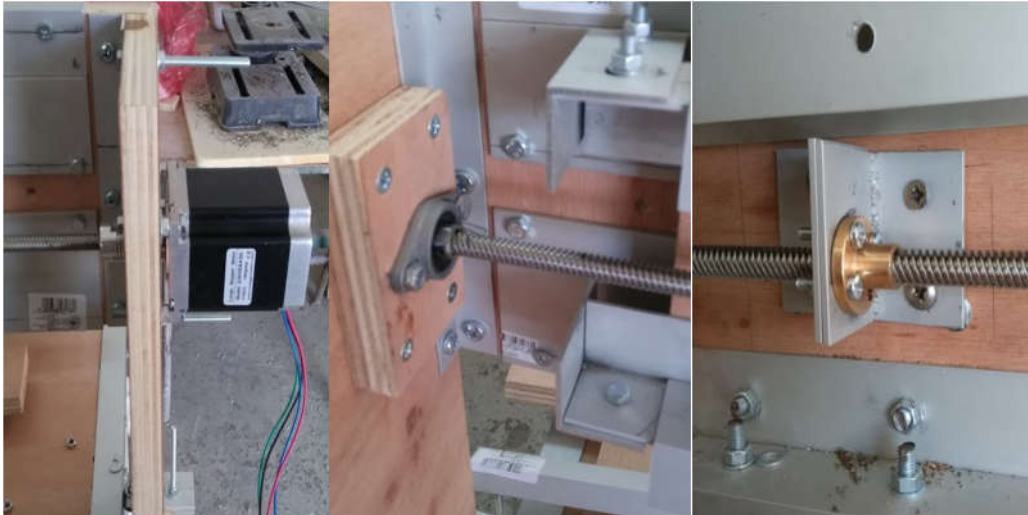


Figure 6: NEMA 23 motor [Left], threaded rod with ball bearing[Middle] and Threaded Nut for Y-axis guidance[Right]

The end-tool is a part of a CNC machine that defines the function of the entire system. As an end tool variety of devices can be used, but for the purpose of cutting and processing of wood, we will be using a DC 300W power motor with a drill bit with sizes ranging from 1 to 10 mm which is powered by an AC / DC converter of 300 W / 50 V.

3. Program Control and Electronics

Central unit of the CNC systems is Arduino platform, a programmable microcontroller based on ATmega168 chip. It possesses Digital and Analogue inputs/outputs and its being very cheap to acquire, makes it perfect controller for this project. Arduino connects with PC via Serial Port and is programmed using Arduino IDE software.

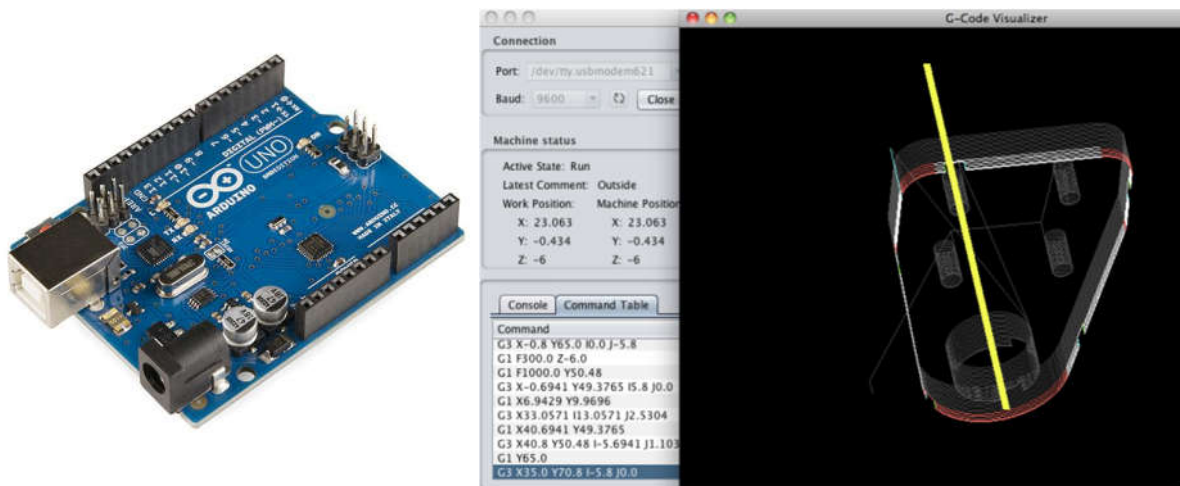


Figure 7: Arduino [Left] and UGCS interface [Right]

There are multiple open-source controller unit programs for CNC machining available online. The most recognizable is GRBL [4], software made exclusively for Arduino platform with support for up to five axis CNC machines. GRBL is uploaded to Arduino via Arduino IDE and it should be noted that GRBL doesn't include user interface. For that purpose UGCS is used.

UGCS (Universal G-code Sender) is Java application that provides a user interface for control and visualization of CNC machining. All necessary parameters (home position, speed, acceleration, step size etc.) in GRBL can be programmed within this interface using serial monitor (user enters series of numerical strings for configuring every parameter). To achieve movements pre drawn from a CAD file, user needs to upload CAD file to UGCS where it is converted to G-code and sent to Arduino.

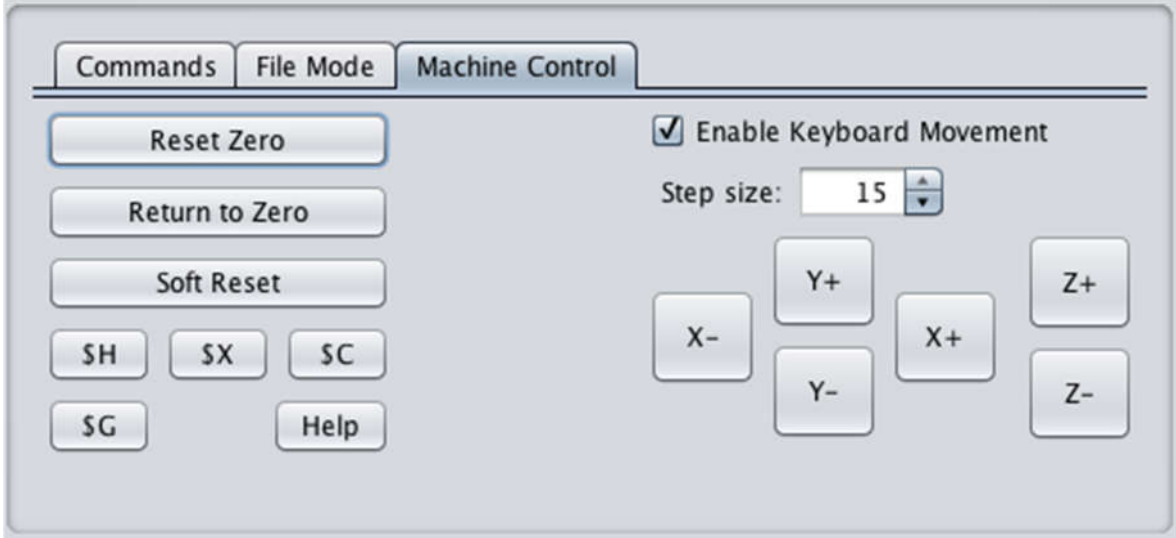


Figure 8: UGCS control interface

Table 1: GRBL command lines with explanations

<i>Command line</i>	<i>Explanation</i>
\$0=10	Step impulse duration [μ s]
\$3=4	Change of positive and negative axis direction
\$21=1	End-stop activation
\$100=200.000	Number of necessary steps to achieve axis movement of 1 mm [X axis]
\$101=200.000	Number of necessary steps to achieve axis movement of 1 mm [Y axis]
\$102=200.000	Number of necessary steps to achieve axis movement of 1 mm [Z axis]
\$110-112=400	Axis speed [millimeters per minute]
\$130-132=700	Axis length
\$120-121=10	Axis acceleration[millimeters per second squared]

Command lines, like ones in Table 1, can be used to change GRBL parameters. Each command consists of two parts: command number and value that is given to that command e.g. command “\$21” activates end stop modules by appointing value of ‘1’ and deactivates end stop module by appointing value ‘0’. Other than command lines, there are system information commands that provide user with different information e.g. ‘\$I’- system information ‘\$N’- startup block etc.

```
G1 F1200 X92.617 Y92.870 E0.01964
G1 X93.518 Y92.412 E0.03865
G1 X94.458 Y92.141 E0.05705
G1 X95.218 Y92.072 E0.07141
G1 X95.998 Y92.064 E0.08608
G1 X96.894 Y92.071 E0.10294|
G1 X98.900 Y92.070 E0.14067
G1 X100.514 Y92.071 E0.17103
G1 X101.565 Y92.065 E0.19080
G1 X102.277 Y92.081 E0.20420
G1 X102.421 Y92.091 E0.20691
G1 X103.374 Y92.066 E0.22484
G1 X103.774 Y92.065 E0.23237
G1 X104.490 Y92.070 E0.24584
G1 X106.878 Y92.069 E0.29076
```

Figure 9: G-code example

During automatic mode, GRBL uses G-code [3] as a set of instructions to run motors. G-code is serial algorithm (information is read one after another). It is made of modal groups where each group represents specific instruction. Modal groups are followed by number that represents specific subset that modal group belongs to. We can see in Figure 10 that more modal group can be programmed in one line.

Here is the list of all modal groups used to run CNC system [5]:

1. **Group 1** = {G00, G01, G02, G03, G38.2, G80, G81, G82, G84, G85, G86, G87, G88, G89} motion
2. **Group 2** = {G17, G18, G19} plane selection
3. **Group 3** = {G90, G91} distance mode
4. **Group 5** = {G93, G94} feed rate mode
5. **Group 6** = {G20, G21} units
6. **Group 7** = {G40, G41, G42} cutter radius compensation
7. **Group 8** = {G43, G49} tool length offset
8. **Group 10** = {G98, G99} return mode in canned cycles
9. **Group 12** = {G54, G55, G56, G57, G58, G59, G59.xxx} coordinate system selection
10. **Group 13** = {G61, G61.1, G64} path control mode

Arduino uses voltage levels from 0 to 5 V across all of its digital outputs and that kind of power isn't enough to make NEMA motors start since their operating voltage is from 3.3 to 24V. TB6600 is a driver device that is able to take low microcontroller signals and convert them to suitable “high” voltage signals [1]. Each driver is connected to a single motor and has external power supply of 350 W/ 24 V.



Figure 10: TB6600 controller

As mentioned before, each axis has its mechanical limit. It can travel only a certain amount of distance until boundaries imposed by the length of threaded rod prohibit further movement. NEMA motors have enough power to break those boundaries and possibly damage the whole system. To prevent that from happening end-stop system is used. End-stop system a combination of two optical switches placed at the far ends of each axis. When axes travel towards an end point they trigger switches and Arduino places machine in STOP mode (a mode where all movement is disabled until microcontroller is restarted). This mechanism can also be used as a method to place machine axis in specific starting position determined by user. This is called “Homing Cycle” [4]. While a machine is in this procedure, each axis travels to end stop switch, briefly triggering it, and then moving into opposite direction. This causes a state where user knows exactly how much distance away is each axis from its “null” position. Using “Homing Cycle”, user can check machine state and prepare better for milling operations.

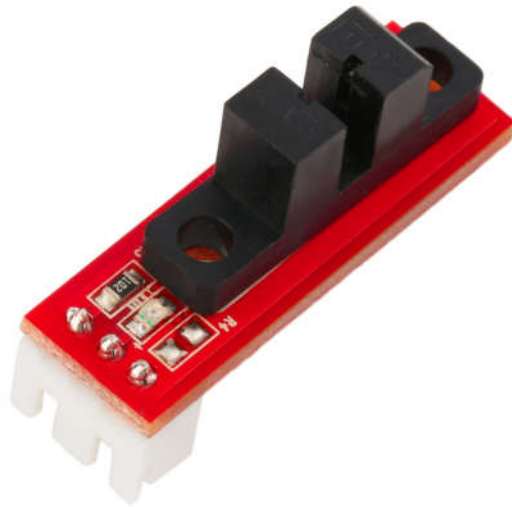


Figure 11: End-stop switch



Figure 12: End-stop positioning on Y axis

Arduino operates using only digital inputs and outputs since no analog sensors or controller are connected. Connection diagram between Arduino, TB6600, optical sensors and motors is shown in Figure 13.

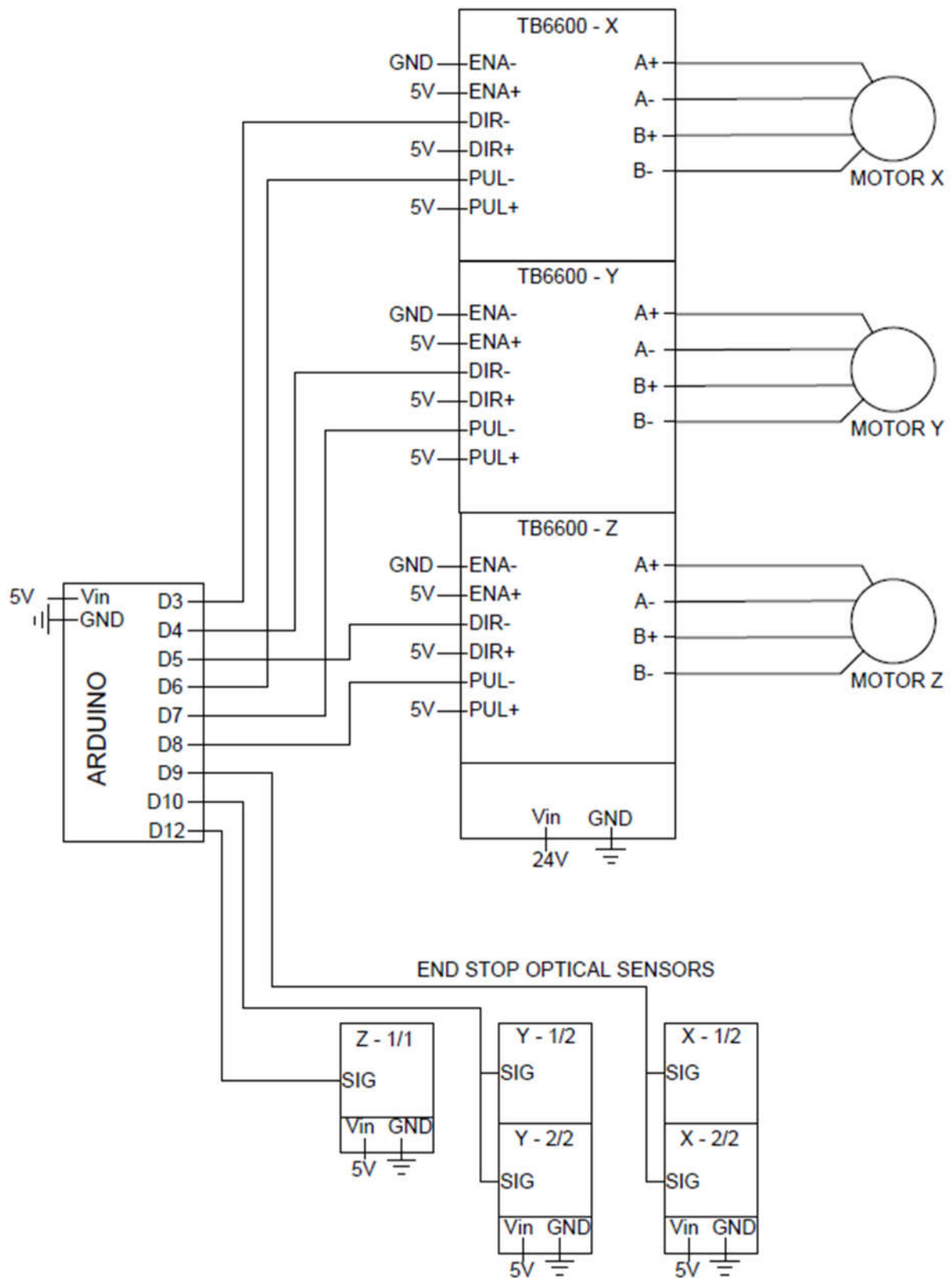


Figure 13: Electrical schematics

4. Testing CNC Environment

After machine was assembled and all of the electronics connected, necessary tests of structural integrity and milling capabilities had to be run. Tests were conducted in four stages (introducing greater forces to mechanical construction with each higher stage), within each measuring precision, repeatability and speed while looking out for any sort of structural deformities. Four stages were as follows:

4.1 Testing precision repeatability with no work load

- a) Machine was doing preprogrammed motion (basic geometrical shapes) with speeds ranging from 50 to 600 mm/min*
- b) Average deviation in precision was less than 0.1mm with 98.9% repeatability**

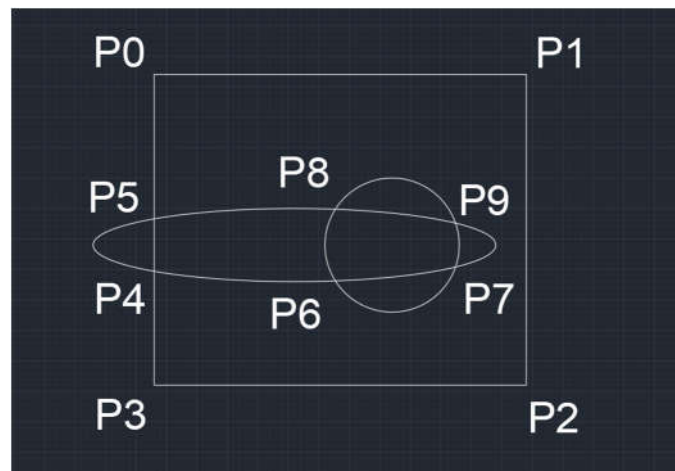


Figure 14: Programmed motion for test 1

4.2 Testing precision repeatability with a pen as an end-tool

- a) Complicated artistic forms were drawn during this test
- b) Since pen's trail is not unified across tests (it deviates in size) it was hard to take any serious repeatability/precision measurements

*Average speed of machine is measured as a distance in millimeters that the “logical center” of end-tool traverses in one minute. Logical center of end-tool is a programmed point of space inside of end tool that is used to calculate height of tool and appropriate speeds.

**Repeatability was measured as function of precision over distance, e.g. if arbitrary line was 1000 mm long and machine only deviated at 5mm across that line, repeatability would be 99.5% (as long there was consistent speed across line). Acceleration was not taken into consideration when calculating repeatability.

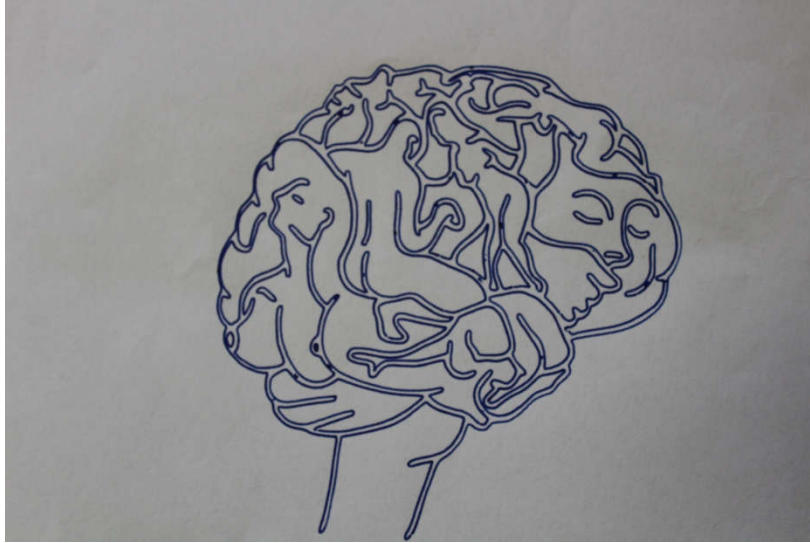


Figure 15: Pen plotter testing

4.3 Testing milling capabilities/precision/speed while milling polyurethane foam

- a) Five decagonal samples were made from 2.5 mm thick polyurethane foam with density of 0.3 kg/m³
- b) Each sample was cut with different speed ranging from 50 to 600 mm/min while system wasn't showing any restraints or mechanical deformations during all processes
- c) Samples were measured and there was no deviations greater than 0.1 mm

4.4 Testing milling capabilities/speed/precision while milling wood

- a) Series of test with different milling tools were conducted
- b) It was shown that in order to keep necessary precision within range of 0.1 mm a tool with 6.35 mm radius shouldn't go over speeds of 150 mm/min (while milling with surface diameter)



Figure 16: Wood milling

5. Conclusion

The accessibility and popularity of the Arduino, GRBL and UGCS platforms made it easy to create CNC machines where user saves significantly on the cost of making one. For this reason, the CNC machines (milling machines, 3D printers, laser cutters / laser engravers, lathes) have been popularized among small businesses and users who do not have high production requirements.

While designing a CNC milling machine more than 80% of the time has been invested in creating mechanical parts. Getting the coherence of all the parts for achieving great precision was a difficult and lengthy process. During testing the machine, it was established that all parts of the system are in working order and that the system is working optimally for wood processing. Due to the fact that the Y and Z axes construction itself was made of wood, it could not be expected that hard metal materials could be processed. Another problem was that processing speeds are low, what can easily be fixed with future upgrades.

The future of this project lies in the upgrades of the mechanical construction of the Y and Z axes (making the overall structure of aluminum), by placing a finishing tool of greater power (> 1.5 kW) and by changing the type of linear actuation. Initially, when this idea was considered it was concluded that there would be a significant increase in the quality of the machine (reduction of processing time, processing of hard materials) but the price of whole system would skyrocket.

REFERENCES

- [1] https://www.dfrobot.com/wiki/index.php/TB6600_Stepper_Motor_Driver_SKU:_DRI004
- [2] https://en.wikipedia.org/wiki/Numerical_control
- [3] <https://en.wikipedia.org/wiki/G-code>
- [4] <https://github.com/grbl/grbl>
- [5] https://www.tormach.com/modal_groups_table.html

Design and Manufacturing of a Robotic Hand

Nikola Padovan

University of Split – University Department of Professional Studies, Split, Croatia
nikola.padovan@gmail.com

Marko Srdarev

University of Split – University Department of Professional Studies, Split, Croatia
srdarev.m@gmail.com

Predrag Đukić

University of Split – University Department of Professional Studies, Split, Croatia
pdukic@oss.unist.hr

Tonko Kovačević

University of Split – University Department of Professional Studies, Split, Croatia
tkovacev@oss.unist.hr

Abstract. Nowadays robotic hands or arms are used in performing various tasks in the fields of medicine, automotive industry, oil industry, household chores etc. A significant application of a robotic hand is as a prosthesis, which is an artificial device that replaces missing body parts, most often limbs or parts of limbs. It is possible to distinguish prostheses of upper or lower limbs, and prostheses of just a hand. This paper presents the design and production of a robotic hand driven by human hand movement and the student's project was realized within the courses of Robotics, Programming, Team Project and Final Paper using the problem-based learning (PBL) techniques at the University Department of Professional Studies. The first part of the paper presents the design of the robotic hand and the sensory glove. The second part of the paper includes software support for controlling the robotic hand: acquisition of data from flex sensors on the glove, Bluetooth communication between the sensory glove and Arduino driven robotic hand and usage of the acquired data for the hand actuation.

Keywords: *robotic hand, sensory glove, Bluetooth, Arduino*

1. Introduction

A robotic hand is a type of programmable mechanical hand with similar functions to a human hand, and may be the sum of the mechanism or part of a more complex robot [1]. Figure 1 shows a commercially available robotic hand. In this paper we present a process of designing and manufacturing of a simplified, low-budget robotic hand. The work was performed through teaching activities that are carried out at the University Department of Professional Studies, University of Split. To keep down the expenses and complexity of the finished design, only five degrees of freedom were implemented for the hand movement, which includes a single DOF for each finger or thumb. It was possible through use of cheap, mass produced and easily obtainable flex sensors, servo motors and “Arduino” family of microcontroller PCB's and accessories. Every DOF of movement consists of a combination of one sensor and one servo-motor actuating a single finger. One microcontroller collects sensor data and transfers them to another microcontroller which controls finger motors.

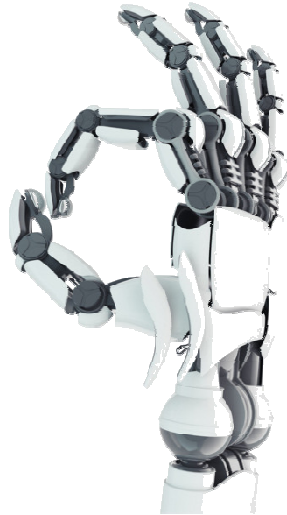


Figure 1 The commercially available robotic hand
(source: https://pngtree.com/freepng/robot-hands-gesture-ok_3119916.html)

2. The Control Glove

Robotic hand control glove (Figure 2) consists of Lilypad Arduino PCB (Printed Circuit Board) [2], 5 flex sensors [3] and bluetooth module HC-05 [4]. Additionally, it uses battery power supply (4.5V) and 47 k Ω resistor for each finger.

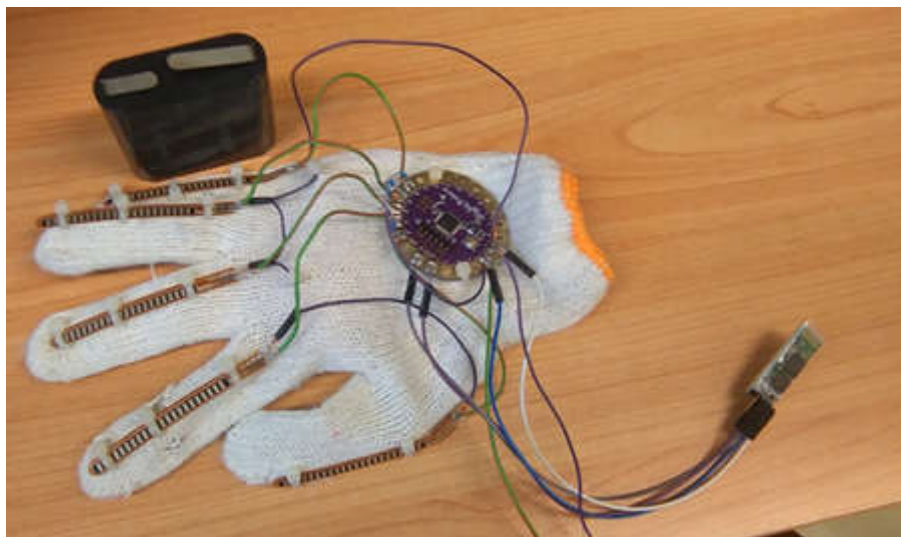


Figure 2 The robotic hand control glove

Figure 3 shows the robotic hand control glove connection diagram. Lilypad Arduino offers the same functionality found in other Arduino boards, in a light, round package designed to reduce weight and dimensions, with large soldering pads, easy to sew to some fabric or cloth.

PCB is even water washable, but unpowered. Diameter of the PCB is 50 mm. LilyPad Arduino contained ATmega328 microcontroller with Arduino bootloader and minimal number of external components to keep as small and simple configuration. LilyPad Arduino can be supplied through USB connection or by external PSU. External power, when used, should be between 2.7 and 5.5 volts. LilyPad Arduino can be programmed using Arduino IDE.

Lilypad technical specification:

- Mikrocontroller ATmega328
- Oscilator 8 MHz
- 14 digital I/O pins
- 6 analog inputs
- 16KB flash memory
- Working voltage 2,7-5,5 V.

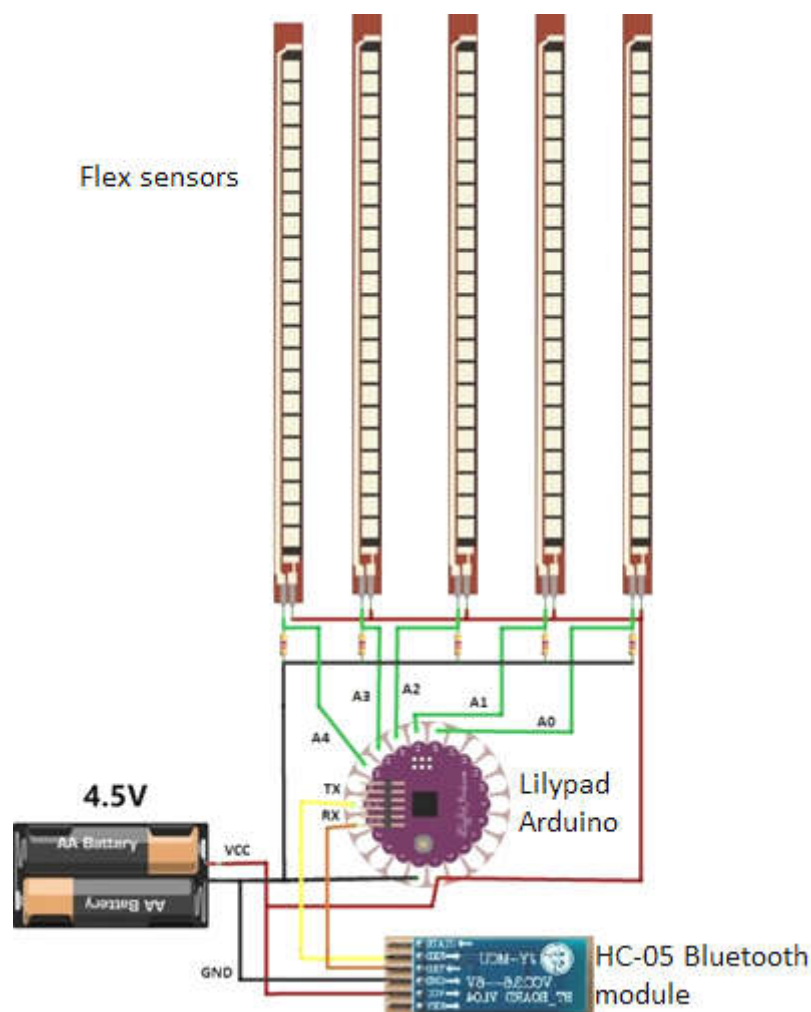


Figure 3 The robot hand control glove connection diagram

Flex sensor is a variable resistor. As the sensor bends, so the terminal voltage changes. Straight sensor has resistance of 30 kΩ, while sensor bent at an angle of 90° has resistance of 70 kΩ. Change in resistance can be read using multimeter. Sensors like this can be used in robotics, medical devices, video games, musical instruments etc. Flex sensors come in two sizes: 2,2" (5,588 cm) and 4,5" (11,43 cm)length.

Bluetooth module HC-05 is a programmable MASTER/SLAVE module, which depending on its role transmits or receives wireless 2.4 GHz signal. Bluetooth module HC-06 can be used only as a SLAVE module.

3. The Robotic Hand

This robotic hand (Figure 4) is made of four pieces of olive wood. The first phase was to manufacture fingers, and then palm and aluminum holder-structure for servo motors, Arduino Uno [5] and Arduino servomotor shield [6], and finally pedestal, which is also made of wood. Robotic hand employs 5 servo motors [7], Arduino Uno, Arduino servomotor shield, fishing line which is attached to the servo motors for finger movement, 220V to 5V/4A converter and slave bluetooth module HC-06.

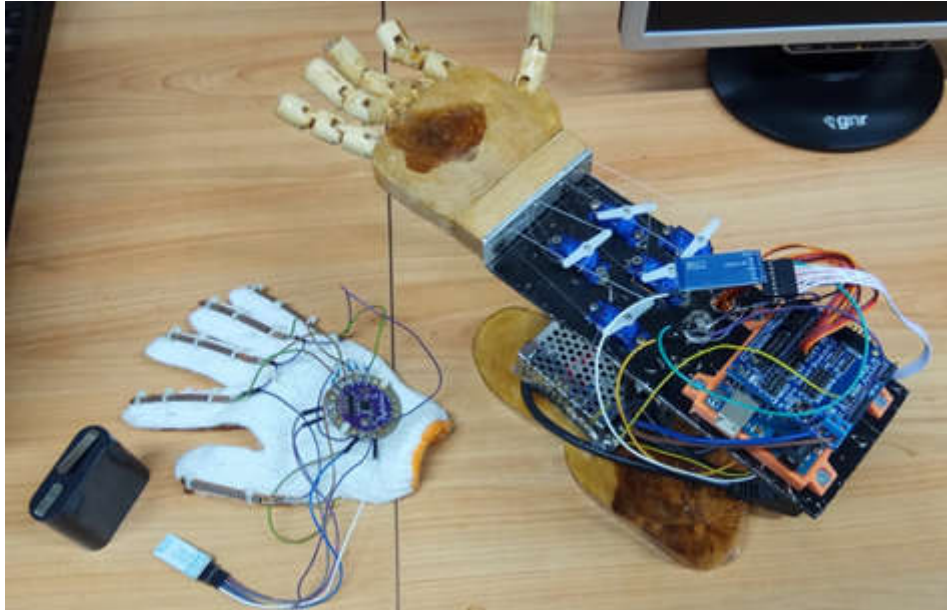


Figure 4 The complete system: Robotic hand and control glove

Arduino Uno board is based on ATmega328 microcontroller. It contains everything needed for microcontroller support. To start operation, it is simply connected to a power supply. It has 14 digital input/output interface pins (6 of which can be used as PWM output), 6 analog inputs, 16 MHz ceramic resonator, USB interface, 32 KB flash memory, 2 KB SRAM, 1 KB EEPROM, power supply connector, ICSP header and reset switch.

Arduino servomotor shield is an extension intended to be connected to Arduino UNO to simply add several servomotors, sensors, relays or potentiometers. The shield passes through supply, grounding, analog and digital input-output pins to the Arduino, and therefore Arduino does not need additional power connection.

Servo motor is a rotational or linear actuator that allows precision control of angular or linear position, speed, or acceleration. It consists of a suitable electro-motor linked to a feedback positioning sensor. This requires also a sophisticated regulator, often as a separate module designed especially for use with servo motors. Servo motors are not a specific motor class, although the term often refers to a motor suitable to be used in a closed feedback system. Servo motors are used in applications like robotics, CNC machines or automated manufacturing. All motors have three connecting wires, two of them for DC supply (positive and negative) while third is used to receive signal sent from the MCU. All small servo motors operate directly on + 5V, but we have to limit the current to be consumed by the motor. If more than two servomotors are to be used, it is advisable to make a dedicated servo shield. Since this application uses 5 servo-motors, 220V/5V 4A was used. Actual voltage is not that important as the current- 280mA per motor. Figure 5 shows these three main components of the robotic hand.

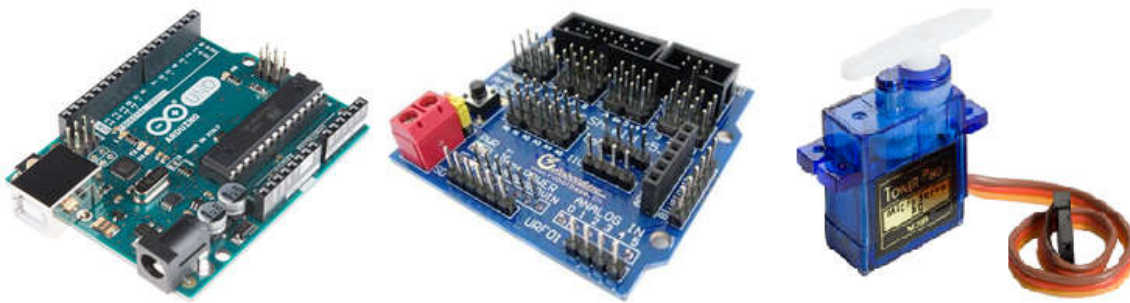


Figure 5 The robotic hand's main components: Arduino Uno, servomotor shield and servomotor

The robotic hand also contains a slave bluetooth module HC-06. This bluetooth module communicates with the HC-05 bluetooth master module on the glove. Figure 6 shows the complete system block diagram.

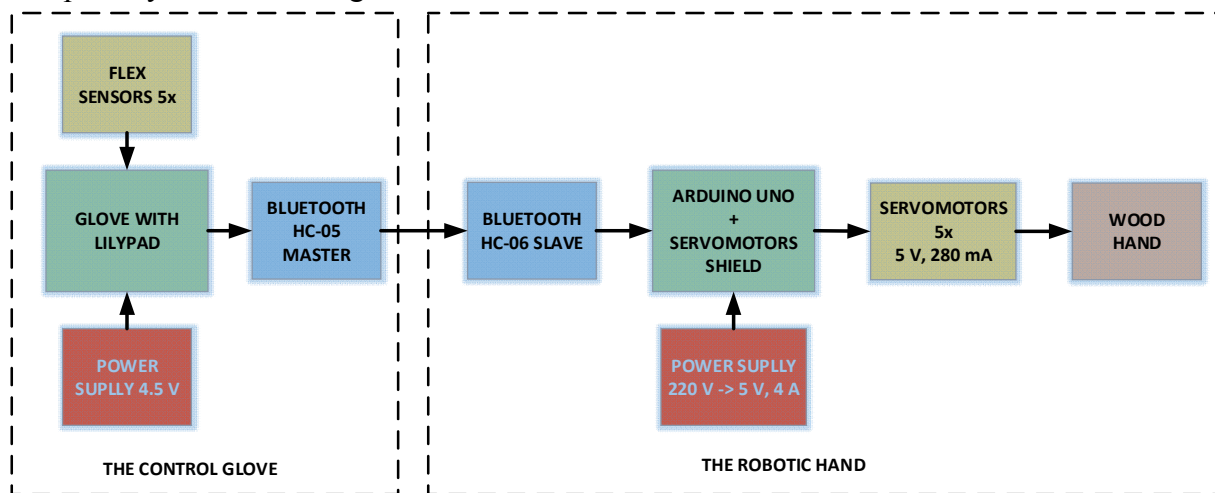


Figure 6 The system block diagram

4. Program Platform

Arduino Uno is an open-source platform based on a simple development PCB with input/output connectors, free software support and simple user interface. Programming of the device is performed within the development environment, which is available for multiple operational systems like Windows, Mac or Linux in C-like programming language. The main purpose of the whole system is communication with the hardware connected to it.

Figure 7 shows the flowchart of the control glove code. From this flowchart, it is apparent that the main program functions relate to readings of the analog flex sensor inputs according to the position of the fingers, and to transmitting the data to the robotic hand using bluetooth communication. Figure 8 shows the flowchart of the robotic hand code. From this flowchart, it is apparent that the current servomotor position is set according to the received data using bluetooth communication.

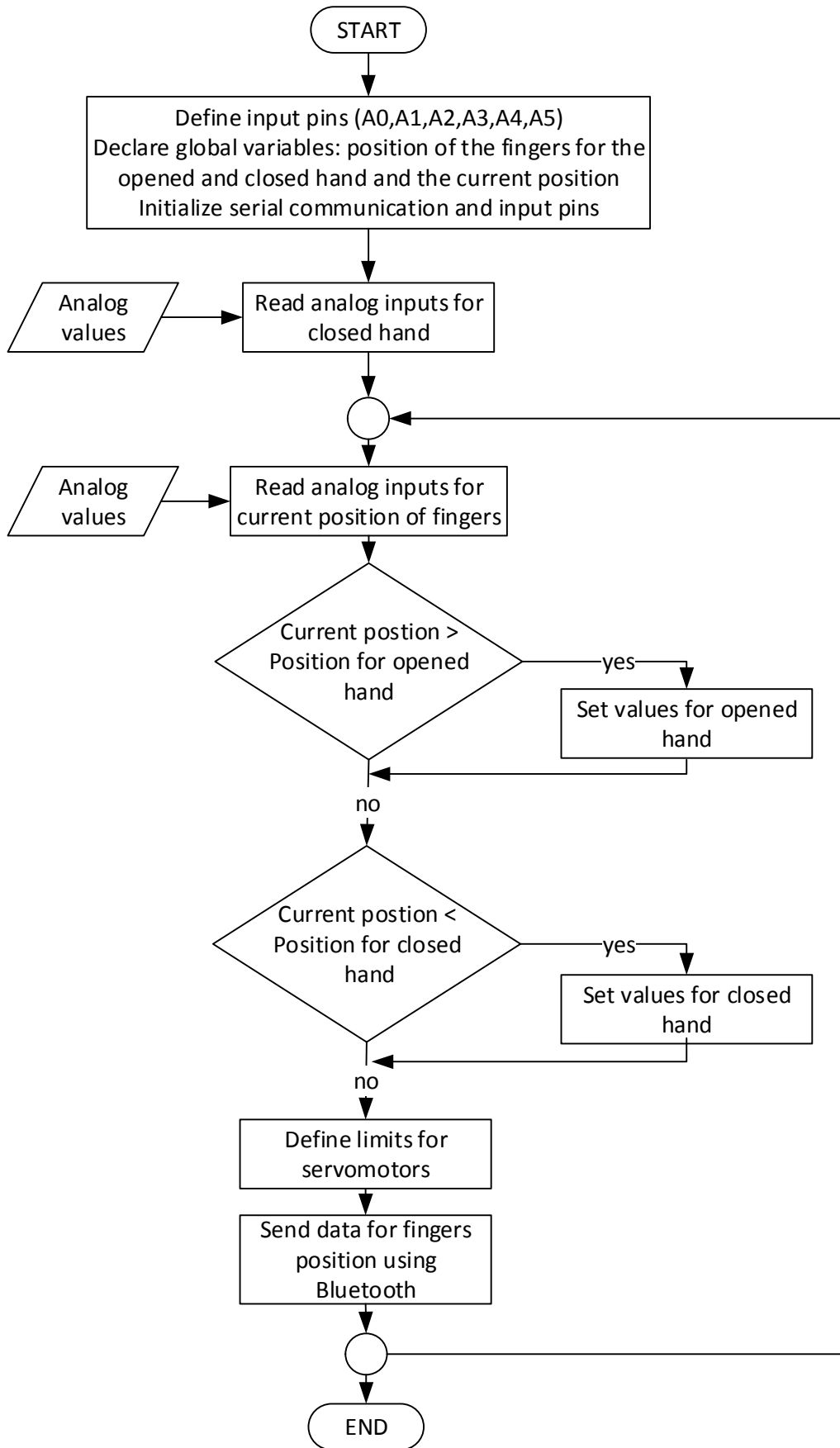


Figure 7 The functional scheme of the 3D printer

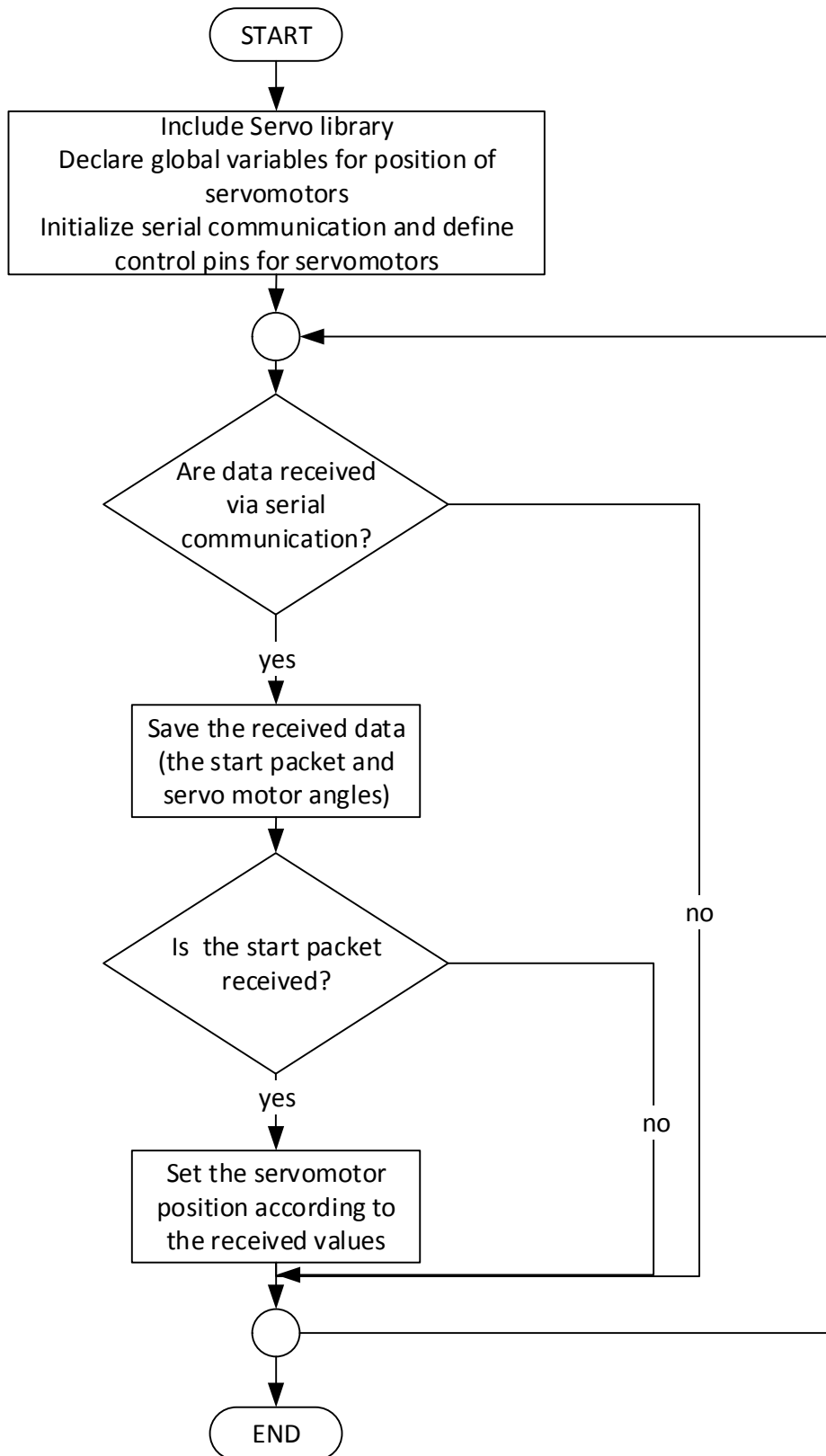


Figure 8 The electrical scheme of the 3D printer

5. Conclusion

In this paper we presented a successful design and manufacturing of a robotic hand with five degrees of freedom, using flex sensors and ordinary servo motors which are normally used for RC models. The robotic hand is simple, and allows basic movement of fingers, one DOF per finger. During the work on the project, a lot was learned about collection and transfer of real time movement data and mechanical challenges present in fabrication of parts. Problems were encountered and solved one by one, and the acquired knowledge is going to be used for the next project, including more complex design, with more degrees of movement freedom, to increase usability of the finished “product”.

REFERENCES

- [1] https://en.wikipedia.org/wiki/Robotic_arm (online, accessed 25.7.2017.)
- [2] <https://store.arduino.cc/usa/lilypad-arduino-main-board>
- [3] <https://www.sparkfun.com/products/10264>
- [4] <http://www.martyncurrey.com/hc-05-and-hc-06-zs-040-bluetooth-modules-first-look/>
(online, accessed 25.2.2018.)
- [5] <https://store.arduino.cc/usa/arduino-uno-rev3>
- [6] <https://www.arduinoocia.com.br/2014/09/arduino-motor-shield-l293d-servo.html>
- [7] <https://www.dfrobot.com/product-255.html>

Managing Distributive Transformers

Ante Kiso

University of Split, University Department of Professionals Studies, Split, Croatia
antekiso3@gmail.com

Vjekoslav Zrno

University of Split, University Department of Professionals Studies, Split, Croatia
vzrno@oss.unist.hr

Slobodanka Jelena Cvjetković

University of Split, University Department of Professionals Studies, Split, Croatia
sjcvjet@oss.unist.hr

Abstract. The power companies are aiming for the more cost-effective delivery of high-quality electrical energy. In order to increase the economy and the quality of the electricity supply, it is necessary to connect the substations to the system by means of which remote control and management of substations are carried out. The paper presents the solutions of communication paths, introduction of transformer stations into the remote control system. By designing the remote control system, voltage and load capacity measurements are provided, as well as signaling of the failure current. Thus, the automation and optimization of the key parameters of the substation is achieved. For less complex distribution substations, the classic solution that includes a SCADA cell computer with a monitor workstation will be replaced by a simple device designed as a communications control device. It can be concluded that the communication control device, the CCU without display, is the optimal solution. Remote monitoring and management significantly reduces interruptions in electricity supply as well as maintenance costs, and rapid adaptation to variable production and consumption is achieved. In view of the above, the need for remote-controlled secondary substations is inevitable.

Key words: *remote monitoring, management, Supervisory Control And Data Acquisition (SCADA), Remote Terminal Unit (RTU), communication subsystem*

1. Introduction

Given a large number of small distribution distributors, certain criteria must be set when selecting those that will be introduced into the remote control system RCS. The engineer must find a compromise between the number of objects introduced and total costs. Given the relatively low implementation cost of the system, the basic criteria for selecting a substation are first of all experienced - the executives and dispatchers are aware of the worst parts of the network in terms of frequent failures and the length of their repair. Therefore, their proposal should be given priority, but should also be considered from other standpoints as appropriate. Some of the criteria for such an experimental TS selection are:

- 1) the location of the object in the network and the number of failures in the same,
- 2) the possibility of network switching,
- 3) Acceptability of an existing MV block or replacement of the same,
- 4) building option to accept a new block,
- 5) the need to build a new facility for accommodating a remote controlled block.

Unlike TS 35/10 (20) kV automation, a large number of objects at 10 kV voltage level, and their geographic distribution, is a problem when selecting the mode of communication with the dispatch center. The problem is often compromised on the compromise between reliability and security on one and the investment level, response rate, bandwidth, and availability on the other. [3.]

2. Technical Structure of the Communication System

The system basically consists of three levels. The first makes the SCADA system installed in the dispatch center. In one variant, SCADA exchanges data with the Open Platform Communications OPC server over the so-called FEP manager. FEP is basically a protocol converter that, among other things, OPC DA 3.0 translates to SCADA-comprehensible IEC 60870-5-104 protocol. The FEP manager is an integral part of the ProzaNet SCADA application, KET Končar product, which, due to its advantages, is installed in several dispatch centers throughout Croatia and beyond.[3.] At the second level of the first variant there is a supervisory control device, which also serves as a mobile network modem. The device contains, depending on specification, a different number of digital, analogue and relay inputs and outputs that are connected via auxiliary relays or directly to the primary equipment.

The third level consists of primary equipment (MV switchgear in most cases) and monitoring and measuring devices. Almost all the switchgear blocks introduced into the RCS (remote control system network) also contain fault current flow indicators on each water field, which, as special signals, are introduced into the RCS. The monitoring device has the ability to connect to other devices communicating through various MODBUS protocol versions. In this way, the connection between the measuring terminals, which are a standard part of the low voltage switchgear, is realized and, as a rule, already exist in numerous transformer stations. The connection permits, in this variant via the OPC server, to send information about measured quantities such as voltage, transformer loads, and so on to the dispatcher center. Measurements that are sent to the OPC server can be stored directly in an arbitrary database and thus avoid unnecessary load on the SCADA system. Equally, there is the possibility of connecting to Utility Data Warehouse, UDW server that serves to store data from SCADA and their further analysis. These databases will become even more important in the coming period in order to achieve additional functionalities. The system scheme is shown in Figure 1.

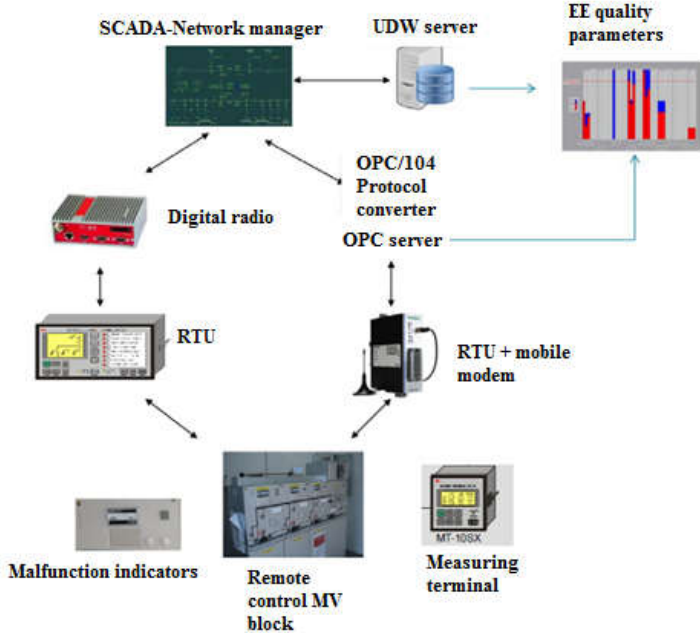


Figure 1 Diagram of the technical solution of the management system [3.]

The second option is, as a supervisory control element, a device communicating with IEC 60870-5 to 104 protocol and does not require additional protocol conversion its is directly associated with SCADA. Connecting a third-level device is almost the same as that of the previous variant. In the third variant, a digital radio modem is displayed as a means of communication between dispatch center and lower levels. It is important to note that it is possible, if the devices have the necessary capabilities, to combine any RTU and communication device, and that is only necessary to make minor changes in the configuration of the devices themselves.

3. Communication Channels

The largest number of remote controllable TS (10 / 0.4 kV) communicate with the dispatcher center over the mobile network owned by different telecommunications operators. The advantage of this type of communication is certainly the signal coverage - rare areas where no signal is available so there is no need to check the availability of the signal, as is the case for some other forms of communication. The cost of this kind of communication, especially when considering that any upgrade and maintenance of the system is a third party, is certainly a big advantage. But in the fact that we are left to the mercy and inability of telecommunications operators lies the biggest shortcoming of this kind of communication.

A certain number of stations that play a significant role in quicker detection of failures will be in the near future will be equipped with a digital radio connection, which is based on availability since its infrastructure is owned by Croatian Electric Power Distribution System Operator, HEP ODS . However, given the growing need to introduce more and more objects into the RCS, all due to the rapid development of new technologies such as electromagnetism and the increasing number of renewable sources on the network, it is certain that the mobile type of communication will gain its significance.

The transformer's communication path is realized via a 5 GHz Wi-Fi point-to-point connection. For the realization of this type of communication it is necessary to install the appropriate antennas and the corresponding network component. The advantages of this kind of communication are work in the unlicensed band, large bandwidth and low latency. The greatest disadvantage lies in the fact that the connection can be realized if the optic visibility of the two points that are the subject of the connection is fulfilled, although this is often not a sufficient condition. This problem can, on some occasions, be borne by the use of a repeater. Another disadvantage is certainly the risk from the security aspect because the equipment used is widely available and relatively inexpensive.

A small number of substations are connected by optics. This kind of communication medium, though the best features, will hardly be, given the price, to find wide application in automation at a 10 kV voltage level.

The digital radio link of the licensed spectrum is characterized by relatively low latency and the price of communication equipment itself, as well as robustness and availability. Potential obstacles to the rapid and wide implementation of the system are bureaucratic in terms of obtaining permits by HAKOM.

4. Measurements

When purchasing low-voltage switchgear, it would be necessary to buy measuring terminals capable of real-time communication, through some of the protocols that must then support the RTU. This raises the value of the entire system and sets the foundation for some of the more advanced functions in the future. Devices allow reading of various voltage parameters such as total harmonic distortion, decay, overvoltage etc. If the existing communication link was used

for the transmission of these and other parameters, and for the purpose of setting up a quality control system el. energy at least at the TS level, it should avoid transferring these parameters directly to SCADA. Data should be stored in separate database. Likewise, consideration should be given to the possibility of reading certain parameters on a monthly or weekly level, and allowing the signal processing to be left to the device itself, and the specific reports are transmitted to the database.

It is recommended that data on total voltage, working and reactive power is transmitted in real-time to SCADA. Sizes are what they will use for the first time to achieve more advanced functions. If a mobile network is used as a communication path, account should be taken of the time sampling of the measurements and the amount of data transfer, and thus, depending on the tariff model and the total cost payable to the telecommunications operator by the SIM card.

If there is no possibility of installing a measuring terminal in a particular object and measuring it real-time power would be worth it, you can always use the pulse outputs of the meters that can be connected to, for example, a digital input on the RTU device and with a smaller adjustment (constants, etc.) can get the amount of power in all directions.

5. Remote Management of TS with Device Based on Linux Platform

In a medium voltage distributive transformer station it is possible to realize a system remote control and communication control device-CCU. The major differences compared to the previous versions are the new Debian Linux OS operating system and the new standardized robust architecture. Other improvements compared to the previous version of the CCU's can be referred to as modernization of the internal architecture, support for modern cell protocols such as IEC 61850, greater conversion flexibility, better diagnostics, easier configuration, etc. Its basic functions are to collect process data using communication interfaces from the numerical devices of the supervised facility and for forwarding this data to the superintendent management center.

The basic functions of LCCU (Linux CCU) are the concentration of different cellular communications that the device collects process data and connect it to the superior SCADA / DMS system. Supporting a large number of communication protocols enables unmatched communication functionality as well as the classic cellular SCADA system. Compared to the classic solutions of the automation of the MV substation using the cellular SCADA system, the LCCU solution is considerably simpler in the engineering sense. Namely, LCCU does not have support for the graphical interface to the operator (HMI) because smaller installations have no need for this and engineering is less extensive because it is not necessary to produce graphical displays and detailed process models that are the basis of the SCADA system.

5.1 Launch of LCCU system

Unlike the SCADA system, LCCU is not designed to be connected to the screen and the configuration is loaded using SSH remote or SFTP remote file transfer.

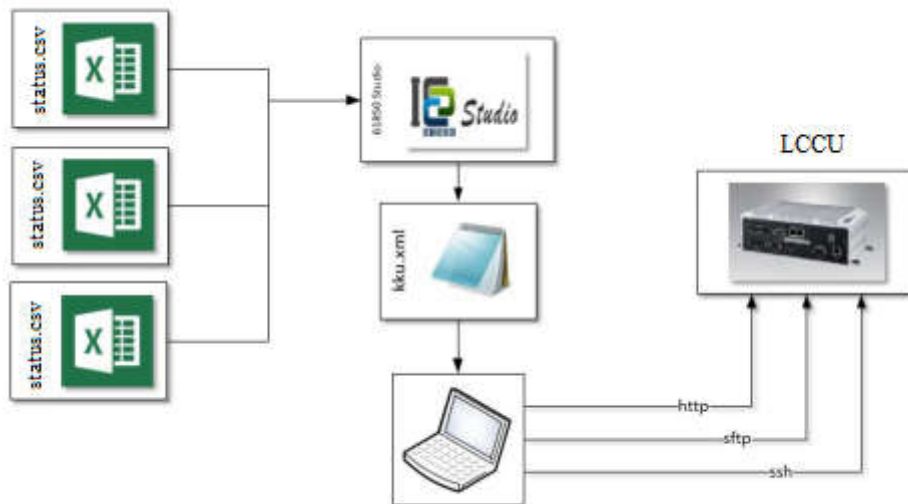


Figure 2 The process of creating and loading the configuration [1.]

For easier, more accurate, and more accurate process point inputs, it is desirable to use .csv files that are easiest to create in MS EXCEL. Separate files are according to Figure 3 of the process point of indications, measurements and commands. Each file has the standard columns needed to define specific process points. When importing a .csv file to IEC 61850 Studio, columns that are, depending on the protocol, are entered by default. This allows the use of additional columns in files that can later be used in faster and more accurate design documentation.

	A	B	C	D	E	F	G	H	I	J	K	L		
	Naponski nivo	Pojme	Naziv informacije	Objekt	Dogip[4]	Tip	Kanal (dolar)	(spondozhan)	IEC 61850 adresa (cond-adr)	Kanal (odlaz)	(act:group)	Tip 104 (act:stype)	IEC104 ASDU/CA (act:asdu)	IEC104
1	35kV	#H01	APU u tijeku	PREST/PROKAD	SPI	H01_RFX	H01_RFX	H01_RFX	H01_RFXRelay/ARREC151575prgIecSrv	CENTAR	M_SP_TB	30		
2	35kV	#H01	APU blokiran	PREST/PROKAD	SPI	H01_RFX	H01_RFX	H01_RFX	H01_RFXRelay/ARREC151575brkIecSrv	CENTAR	M_SP_TB	30		
3	35kV	#H01	APU definitivni isklp	PREST/PROKAD	SPI	H01_RFX	H01_RFX	H01_RFX	H01_RFXRelay/ARREC151575umIecSrv	CENTAR	M_SP_TB	30		
4	35kV	#H01	IRF kvar relea	PREST/PROKAD	SPI	H01_RFX	H01_RFX	H01_RFX	H01_RFXRelay/DiagPH0151575DevOpSrv	CENTAR	M_SP_TB	30		
5	35kV	#H01	Nadstrujna zaštita (>)	PREST/PROKAD	SPI	H01_RFX	H01_RFX	H01_RFX	H01_RFXRelay/DT50HPTDC151575OpSrv	CENTAR	M_SP_TB	30		
6	35kV	#H01	Nadstrujna zaštita (>)	PREST/PROKAD	SPI	H01_RFX	H01_RFX	H01_RFX	H01_RFXRelay/DT50HPTDC151575OpSrv	CENTAR	M_SP_TB	30		
7	35kV	#H01	ZIP	PREST/PROKAD	SPI	H01_RFX	H01_RFX	H01_RFX	H01_RFXRelay/Ext50HPTDC151575SndSrv	CENTAR	M_SP_TB	30		
8	35kV	#H01	Kvar iskljapanog kruga prekidača	PREST/PROKAD	SPI	H01_RFX	H01_RFX	H01_RFX	H01_RFXRelay/IT3ECCAG0151575SndSrv	CENTAR	M_SP_TB	30		
9	35kV	#H01	Struja Ia	MEAS	H01_RFX	H01_RFX	H01_RFX	H01_RFXRelay/IVPQFMMMU15MNSAA5phaAScvalSmagSf	CENTAR	M_ME_NC	30			
10	35kV	#H01	Salvna snaga	MEAS	H01_RFX	H01_RFX	H01_RFX	H01_RFXRelay/IVPQFMMMU15MNSAA5phaAScvalSmagSf	CENTAR	M_ME_NC	30			
11	35kV	#H01	Radna snaga	MEAS	H01_RFX	H01_RFX	H01_RFX	H01_RFXRelay/IVPQFMMMU15MNSAA5phaAScvalSmagSf	CENTAR	M_ME_NC	30			
12	35kV	#H01	Upravljanje pojmem	L/D	SPI	H01_RFX	H01_RFX	H01_RFX	H01_RFXRelay/LN05015LodSrv	CENTAR	M_SP_TB	30		
13	35kV	#H01	Zemljospojna zaštita is	PREST/PROKAD	SPI	H01_RFX	H01_RFX	H01_RFX	H01_RFXRelay/NDT504LPTDC151575OpSrv	CENTAR	M_SP_TB	30		
14	35kV	#H01	Stanje prekidača	Q0	ISK/UK	DP	H01_RFX	H01_RFX	H01_RFXRelay/Obj3ACSW151575PosSrv	CENTAR	M_DP_TB	30		
15	35kV	#H01	Stanje rastavljača	Q1	ISK/UK	DP	H01_RFX	H01_RFX	H01_RFXRelay/Obj3ACSW151575PosSrv	CENTAR	M_DP_TB	30		
16	35kV	#H01	Stanje rastavljača	Q2	ISK/UK	DP	H01_RFX	H01_RFX	H01_RFXRelay/Obj3ACSW151575PosSrv	CENTAR	M_DP_TB	30		
17	35kV	#H01	Stanje rastavljača	Q3	ISK/UK	DP	H01_RFX	H01_RFX	H01_RFXRelay/Obj3ACSW151575PosSrv	CENTAR	M_DP_TB	30		
18	35kV	#H01	Stanje rastavljača	Q8	ISK/UK	DP	H01_RFX	H01_RFX	H01_RFXRelay/Obj3ACSW151575PosSrv	CENTAR	M_DP_TB	30		
19	35kV	#H01	Vrata željeze etvorene	PREST/PROKAD	SPI	H01_RFX	H01_RFX	H01_RFX	H01_RFXRelay/UserrGG0251575SndSrv	CENTAR	M_SP_TB	30		
20	35kV	#H01	Isпад aut. EMP prekidača	PREST/PROKAD	SPI	H01_RFX	H01_RFX	H01_RFX	H01_RFXRelay/UserrGG0251575SndSrv	CENTAR	M_SP_TB	30		
21	35kV	#H03	CBF	PREST/PROKAD	SPI	H03_RFD	H03_RFD	H03_RFD	H03_RFDRelay/CB50BF8BF151575OpSrv	CENTAR	M_SP_TB	30		
22	35kV	#H03	IRF kvar relea	PREST/PROKAD	SPI	H03_RFD	H03_RFD	H03_RFD	H03_RFDRelay/DiagPH03151575DevOpSrv	CENTAR	M_SP_TB	30		
23	35kV	#H03	Nadstrujna zaštita (>)	PREST/PROKAD	SPI	H03_RFD	H03_RFD	H03_RFD	H03_RFDRelay/DT50HPTDC151575OpSrv	CENTAR	M_SP_TB	30		
24	35kV	#H03	ZIP	PREST/PROKAD	SPI	H03_RFD	H03_RFD	H03_RFD	H03_RFDRelay/Ext50HPTDC151575SndSrv	CENTAR	M_SP_TB	30		
25	35kV	#H03	Kvar iskljapanog kruga prekidača	PREST/PROKAD	SPI	H03_RFD	H03_RFD	H03_RFD	H03_RFDRelay/IT3ECCAG0151575SndSrv	CENTAR	M_SP_TB	30		
26	35kV	#H03	Nadstrujna zaštita (>)	PREST/PROKAD	SPI	H03_RFD	H03_RFD	H03_RFD	H03_RFDRelay/DT50HPTDC151575OpSrv	CENTAR	M_SP_TB	30		
27	35kV	#H03	Struja Ia	MEAS	H03_RFD	H03_RFD	H03_RFD	H03_RFDRelay/IVPQFMMMU15MNSAA5phaAScvalSmagSf	CENTAR	M_ME_NC	30			
28	35kV	#H03	Salvna snaga	MEAS	H03_RFD	H03_RFD	H03_RFD	H03_RFDRelay/IVPQFMMMU15MNSAA5phaAScvalSmagSf	CENTAR	M_ME_NC	30			
29	35kV	#H03	Radna snaga	MEAS	H03_RFD	H03_RFD	H03_RFD	H03_RFDRelay/IVPQFMMMU15MNSAA5phaAScvalSmagSf	CENTAR	M_ME_NC	30			
30	35kV	#H03	Upravljanje pojmem	L/D	SPI	H03_RFD	H03_RFD	H03_RFD	H03_RFDRelay/LN05015LodSrv	CENTAR	M_SP_TB	30		
31	35kV	#H03	Zemljospojna zaštita is	PREST/PROKAD	SPI	H03_RFD	H03_RFD	H03_RFD	H03_RFDRelay/NDT504LPTDC151575OpSrv	CENTAR	M_SP_TB	30		
32	35kV	#H03	Stanje prekidača	Q0	ISK/UK	DP	H03_RFD	H03_RFD	H03_RFDRelay/Obj3ACSW151575PosSrv	CENTAR	M_DP_TB	30		
33	35kV	#H03	Stanje rastavljača	Q1	ISK/UK	DP	H03_RFD	H03_RFD	H03_RFDRelay/Obj3ACSW151575PosSrv	CENTAR	M_DP_TB	30		
34	35kV	#H03	Stanje rastavljača	Q2	ISK/UK	DP	H03_RFD	H03_RFD	H03_RFDRelay/Obj3ACSW151575PosSrv	CENTAR	M_DP_TB	30		
35	35kV	#H03	Stanje rastavljača	Q3	ISK/UK	DP	H03_RFD	H03_RFD	H03_RFDRelay/Obj3ACSW151575PosSrv	CENTAR	M_DP_TB	30		
36	35kV	#H03	Vrata željeze etvorene	PREST/PROKAD	SPI	H03_RFD	H03_RFD	H03_RFD	H03_RFDRelay/UserrGG0251575SndSrv	CENTAR	M_SP_TB	30		
37	35kV	#H03	Isпад aut. EMP prekidača	PREST/PROKAD	SPI	H03_RFD	H03_RFD	H03_RFD	H03_RFDRelay/UserrGG0251575SndSrv	CENTAR	M_SP_TB	30		
38	35kV	#H03	Buchholz isklp	PREST/PROKAD	SPI	H03_RFD	H03_RFD	H03_RFD	H03_RFDRelay/UserrGG0451575SndSrv	CENTAR	M_SP_TB	30		
39	35kV	#H03	Buchholz alarm	PREST/PROKAD	SPI	H03_RFD	H03_RFD	H03_RFD	H03_RFDRelay/UserrGG0451575SndSrv	CENTAR	M_SP_TB	30		
40	35kV	#H03	Kontaktni termometar isklp	PREST/PROKAD	SPI	H03_RFD	H03_RFD	H03_RFD	H03_RFDRelay/UserrGG051575SndSrv	CENTAR	M_SP_TB	30		

Figure 3 File for indications, commands and measurements [1.]

Figure 4 shows an example of configuring communication. It is necessary to define communication between subordinate devices (red) and parent (black). The line and device settings to be communicated (green) are entered.

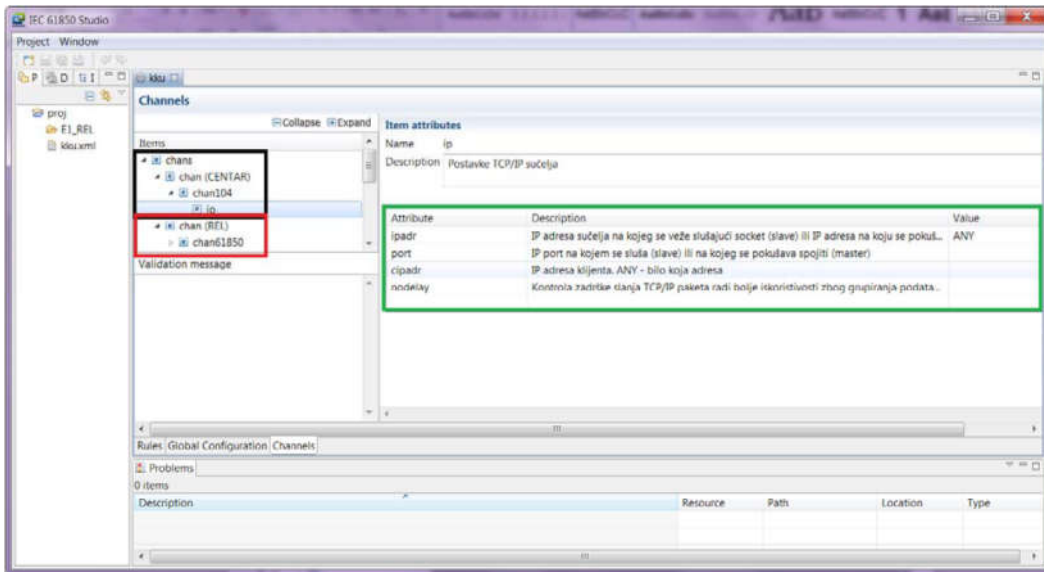


Figure 4 IEC 61850 Studio [1.]

LCCU has so far been built into medium and low voltage transformer stations, as a communication server in remote control centers and as a transducer converter. In 35/10 kV transformer stations, standard poles are integrated, which combine protective and control functions like KONČAR RFX and ABB REF, and one in each field. It is advisable to install the ARK2120F computer due to the need for communication with a large number of terminals. The communication scheme is performed depending on the type of protocol communicated with LCCU. According to experience, IEC 60870-5-103 or network IEC 61850 was used. In addition to the terminal, LCCU also needed devices such as rectifier control units, alarm units, measuring terminals and similarly installed in the remote control system, most commonly with MODBUS RTU or MODBUS network TCP protocols.

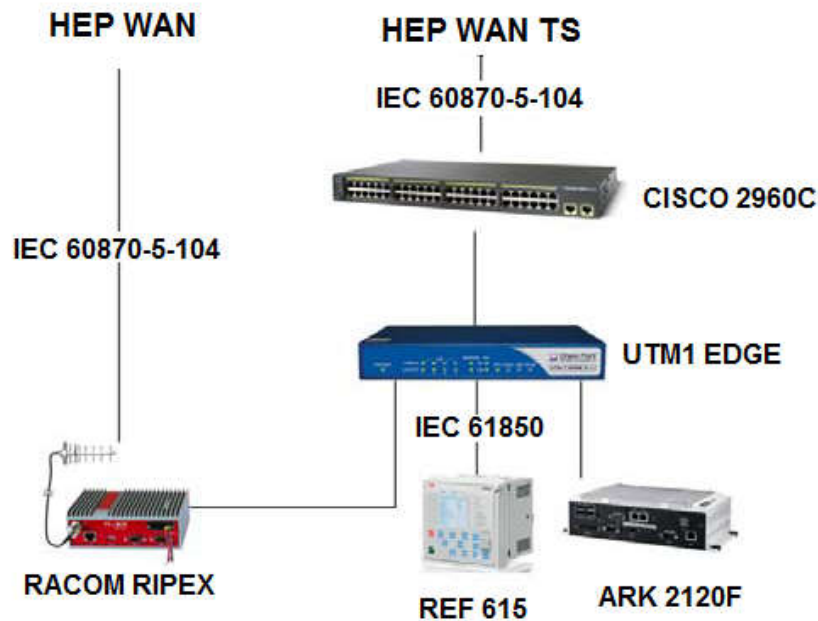


Figure 5 Communication link scheme in TS 20 / 0.4 kV [1.]

10 / 0.4 or 20 / 0.4 kV transformer stations are less complex, which often means a smaller number terminal fields of the already mentioned series. There usually one terminal field manages and protects the whole station, and besides it, there may not be other signaling devices. LCCU can also be used as an independent communication server in remote control centers. The benefits of such a distributed architecture can be seen at a faster initial proxy after the application servers are upgraded. Unlike the old CCU, the channels according to the process are completely independent of dropouts and transcripts from the channel center. The data center is always served from the LCCU's faster local base. Thus, there is no need to restart the channel according to the process of rebooting SCADA, which is significant in radio links that have a longer refresh rate. [1.]

6. Conclusion

At the time of the growing number of distributive sources and the emergence of the energy storage system, automation in the depth of the network will gain more meaning. Although today, due to the exceptionally rapid development of technology, it is difficult to assess whether the characteristics of a system meet future needs, yet it is necessary to think about setting up a foundation that could be used in the future. SCADA and LCCU systems have their own advantages and disadvantages. It is difficult to say which of the two solutions is technically advantageous for the accelerated development of the distribution network. But due to the adaptive programming structure of the Linux system and the trusted industrial computers, and simplicity with respect to SCADA systems is currently being made as a better choice.

REFERENCES

1. Brestovec B.; Išlić M.; Krajnović I.: *Daljinsko vođenje distribucijskih transformatorskih stanica komunikacijskim koncentratorskim uređajima baziranim na Linux platformi.*, CIREĐ 2016.
2. Northcote-Green J.; Wilson R.: *Control and automation of electrical power distribution systems.*, 2007.
3. Sinjeri T.; Kopač B.; Kolarek A.; Bolfek M.: *Iskustva elektre Koprivnica u uvođenju malih trafostanica u sustav daljinskog vođenja.*, CIREĐ 2016.
4. Zagorščak G.: *Uvođenje TS 20/0,4 kV Viševac u SDV - Projekt izvedenog stanja.*

CIET
2018

Split
Track 4

Interdisciplinary
Teaching and Learning

The Indicative and the Subjunctive Mood in Subordinate Adverbial Clauses in Italian and German

Petra Grgičević Bakarić

University department of professional studies, University of Split, Croatia
pgrgicev@oss.unist.hr

Katarina Krnić

University department of professional studies, University of Split, Croatia
katarina.krnic@oss.unist.hr

Abstract. This paper underlines the frequency and importance of either indicative or subjunctive use in subordinate adverbial clauses in both Italian and German. This is highlighted through a general comparative analysis of the linguistic terms in question. The introductory part provides a brief insight into the subordinate clauses, particularly adverbial clauses. Verb moods with an emphasis on the indicative and subjunctive are shortly distinguished. The main part of the paper revolves around a systematic presentation of adverbial clauses: clauses of place, time, reason clauses, result clauses, purpose clauses, concessive clauses, conditional clauses, comparative clauses, clauses of manner and exception. The following method of work is used: having explored the Italian language system with a detailed listing of verbs and verb phrases followed by conjunctions and conjunctive phrases introducing the indicative and subjunctive, the same analysis is carried out for the German language system. On the basis of the above mentioned, the two language systems are compared. Sources consulted and cited for the examples analysed are: grammar books, course books and dictionaries. Finally, this paper's conclusion provides an outline of the most important findings of this study: there is a high congruence in the use of the two verb moods in the conditional clauses and clauses of place. Furthermore, there is no record of the subjunctive being used in clauses of time, place, manner, exception and reason clauses in German. In the remaining adverbial clauses some major or minor differences are noticeable. There is a higher frequency of the subjunctive use in Italian.

Key words: *adverbial clause, the indicative, the subjunctive, conjunctions, comparison.*

1. Introduction

This paper's aim is to consider the use of the indicative and subjunctive mood in subordinate adverbial clauses of Italian and German through applying a ¹contrastive approach to the interpretation of the two linguistic terms and systems. A verb constitutes the main part of the predicate within a sentence. The sentence content may be presented in various ways.

1.1 Italian

There are seven verb moods; four finite (*modi finiti*) and three non-finite (*modi indefiniti*) verb moods. The former group comprises the indicative, the subjunctive, the imperative mood and the conditional, all four being distinguished by the grammatical categories of person and number, whereas the latter consists of the infinitive, participle and gerundive, all three lacking

¹Contrastive analysis represents a systematic description and comparison of two languages (a native and a target/second or foreign language) in order to pinpoint similarities and dissimilarities between them and thus to facilitate teaching and learning the target language. Its basic assumption underlies that fact that similarities should result in positive transfer and facilitated acquisition of the target language, whereas dissimilarities should cause negative transfer and possible emergence of transfer error on all lexical levels of the target language.

the properties of person and number with the exception of the participle being inflected by number. Verb tenses are variously deployed in certain verb moods. Thus eight (one present, five past and two future) tenses may be deployed in the indicative, four may be applied (one present and three past) in the subjunctive, two (one present and one past) may be attributed to the conditional, infinitive, participle and gerundive while only one (present) in the imperative.

1.2 German

As opposed to Italian, German is characterized by only three finite verb moods (*Modi*) consisting of the indicative, subjunctive and imperative and three non-finite verb moods (*infinite Verbformen*) comprising the infinitive, present participle and past participle. The participles in contrast to other non-finite verb forms may exceptionally be inflected as adjectives preceding nouns as attributes. Finite verb moods are marked by the categories of person, number, tense and voice excluding the imperative. All tenses (one present, three past and two future) can be applied in both the indicative and subjunctive mood, while merely one (present) can be used in the imperative.

1.3 General facts about verb moods and subordinate clauses

Each of the finite verb moods conveys a different speaker's viewpoint, a psychological attitude and /or a communicative relationship to the content that has been uttered; the indicative mood expresses statements of facts, objectivity and certainty. On the other hand, the subjunctive mood reflects a speaker's subjective attitude, uncertainty, unreality, possibility, affective participation, and doubt about the spoken content and is typically used for what is imagined, hoped for, demanded, or expected. The conditional is dominated by the aspect of eventuality, wish, whereas the imperative is used to express commands, requests and encouragement. The use of the subjunctive mood as a syntactic element introducing subordinate clauses has been the most frequent in all complex sentences including the ones indicating the reported speech. Complex sentences are sentences consisting of one main and one or more subordinate clauses that are dependent on the main clause. Subordinate clause complements the main clause in various ways and can be classified as nominal, relative and adverbial clauses. In relation to the main clause, nominal clauses can function as its subject, object, complement, attribute and appositive. Relative clauses generally function as restrictive or non-restrictive modifiers of noun phrases, are functionally parallel to attributive adjectives and are introduced by relative adverbs and pronouns. An adverbial clause is part of the main clause in the same way as other adverbials are, such as an adverb or prepositional phrase. Considering certain morphosyntactic disparities of the two languages and various classifications of both complex and subordinate adverbial clauses in consulted sources, we have opted for the aforementioned one due to its suitability for a systematic and well laid out comparison and analysis.

2. Adverbial clause

According to the semantic functions of adverbial clauses, we distinguish the following categories: clauses of place, time, reason, manner, exception, result, final, concessive, conditional and comparative clauses. They are regularly introduced by both distinguishable subordinating conjunctions and conjunctive phrases with or without the accompanying² correlatives that we shall point out in this paper.

2.1 Clause of place

A clause of place is a subordinate clause functioning as an adverbial of place to the main clause. It is introduced by interrogative adverbs with place meaning.

² *Grammar* (of words such as neither and nor) corresponding to each other and regularly used together. Correlatives may be, depending in large part on the predicate of the main clause, pronouns, adverbs, pronominal adverbs and prepositional phrases.

2.1.1 Italian

A clause of place is preceded by the following adverbs: *dove, ove, donde, onde, di dove, da dove*.

The **indicative** mood is the verb mood used in clauses of place.

“Andate *dove* volete“ (De Dominicis, 1997:805)

The **subjunctive** mood is not used in clauses of place.

2.1.2 German

The use of verb moods in either a clause of place or any other subordinate clauses of German is not determined and defined by any conjunctive phrase introducing the clause of place or any other subordinate clause. Conjunctive phrases for clauses of place are adverbs of place (position and direction): *wo, woher, wohin, soweit*.

The main clause usually contains correlatives as pronominal adverbs of place: *dort, dorthin*.

The **indicative** mood is introduced by all the conjunctions present in clauses of place.

“Ich habe ihn *dort* gesehen, *wo* ich ihn überhaupt nicht erwartet hatte.“ (Glovacki-Bernardi, 2001: 40)

Clauses of place do not contain any verbs in the **subjunctive** mood.

2.1.3 Comparison

Both languages use only the indicative mood due to the aspect of reality and objectivity attributed to the expressed verb action.

2.2 Clause of time

A clause of time functions as an adverbial of time for the main clause. It relates the time of the situation in its clause to the time of the situation the main clause. The time of the main clause can be previous to that of the adverbial clause, simultaneous with it, or subsequent to it.

2.2.1 Italian

In Italian, the verb mood to be used in clauses of time and all the other compared subordinate clauses is directly contingent on the conjunctive phrase introducing them. Conjunctions may convey:

- simultaneousness: *quando, come, mentre, allorché, allorquando, al tempo in cui, nel momento in cui, ogni volta che, ogni qual volta, tutte le volte che,*

- posteriority: *dopo che, appena, non appena, dacché, da quando, fin da quando, dal momento in cui, una volta che,*

- anteriority: *prima che, avanti che, anzi che, finché, fino a che, fin quando, fino a quando, fino al momento in cui, fintantoché.*

Conjunctions conveying the time relationship of simultaneousness and posteriority typically require the **indicative** use.

“*Quando* l’ho visto, gli sono corso intorno.“ (Dardano&Trifone, 1996:283)

“*Dacché* è arrivato, non ha smesso di lamentarsi.“ (Cattana&Nesci, 2000:298)

Conjunctions conveying the time relationship of anteriority certainly require the **subjunctive** mood. The sentence content has not been realized yet and thus has been considered uncertain.

“*Prima che* la sfortuna si accanisca contro di voi, comprate un cornetto.“ (La Grassa et al., 2013:97)

2.2.2 German

Conjunctions introducing clauses of time may indicate:

- simultaneousness: *indem, indessen, sobald, sooft, solange, während, wenn, wie, seit (dem), als,*
- anteriority: *als, nachdem, sobald, sowie, kaum dass, wenn, seit (dem,)*
- posteriority: *bevor, bis, ehe.*

All the conjunctions determining the relationship of simultaneousness, anteriority and posteriority are followed by verbs in the **indicative** mood as the feasibility of the main clause content is always considered real and certain.

“*Sobald* das Schiff anlegte, betrat ein Mann das Deck.“ (Glovacki-Bernardi, 2001:33)

“Dem Patienten ging es besser, *nachdem* er die Tabletten eingenommen hatte“. (Buscha et al., 2013:178)

“Du kannst noch im Garten spielen, *bis* das Abend fertig ist.“ (Glovacki-Bernardi, 2001:34)

The **subjunctive** mood is not used in any clauses of time.

2.2.3 Comparison

In Italian, the subjunctive mood is applied with the relationship of anteriority that is conveyed by its conjunctions, whereas clauses of time in German make exclusive use of the indicative regardless of the expressed time relationship.

2.3 Reason clause

Reason clause conveys a direct relationship with the main clause. The relationship may be that of cause and effect, reason and consequence, motivation and result and circumstance and consequence.

2.3.1 Italian

Conjunctions indicating a real reason are: *perché, ché (che), poiché, siccome, dal momento che, giacché, per il fatto che, per la ragione che, per il motivo che, tanto più che, dato che, visto che, considerato che, visto e considerato che, atteso che, posto che, essendo che, perocché, perciocché, imperocché, conciossiaché*, those indicating a possible, but a negated reason are: *non perché/non già che...ma perché, o perché... o perché, non che, non è che.*

The **indicative** mood is preceded by conjunctions indicating a real reason.

“*Visto che* non c’è, vado via.“ (Dardano&Trifone, 1996:299)

The use of the **subjunctive** mood is required after the conjunctions indicating a possible, but a negated reason.

“Suo figlio, signora, va male a scuola *non perché* sia poco intelligente, *ma perché* non si impegna seriamente.“ (Silvestrini et al., 2000: 130)

2.3.2 German

Conjunctive phrases of reason clauses are: *weil, da* (cause and effect), *zumal (da), um so mehr/um so weniger als* (an additional reason), *dass*, and prepositional phrases *auf Grund dessen, auf Grund der Tatsache.*

If the main clause is followed by the subordinate clause, it may contain the following correlatives *daher, darum, deshalb, deswegen, aus dem Grunde.*

All the conjunctions of reason clauses are exclusively associated with the **indicative** mood.

“Das Auto begann (*daher*) zu schleudern, *weil* die Strasse sehr glatt war.“ (Helbig&Buscha, 1996:689)

“Ich fahre im Januar sehr gern in die Oztäler Alpen, *zumal* die Alpen als besonders schneesicher gelten“. (Buscha et al., 2013:176)

Reason clauses do not contain any verbs in the **subjunctive** mood.

2.3.3 Comparison

In Italian, there is regular use of the subjunctive mood after conjunctions conveying a possible, but negated reason. However, German displays exclusive use of the indicative since there is no clearly expressed semantic distinction between a real and a possible, but still negated reason.

2.4 Result clause

A result clause complements the main clause by indicating the consequence of the situation in the main clause.

2.4.1 Italian

Conjunctions of result clauses can express either the manner or the intensity of the consequence conveyed.

The **indicative** mood is obligatory:

- after the conjunctive phrases conveying the intensity of the consequence: *si/così/tanto/talmente/tale/siffatto/simile...che*.

“La vita psichica è *talmente forte che* può dominare la nostra vita cosciente.” (Serianni, 1991:586)

- after the conjunctions conveying manner: *sicché, cosicché, in modo che, in tal modo che, di maniera che, a/al segno che, di/in guisa che, a tale che* and conjunctions expressing intensity, however, only if the consequence is considered an objective result of the main clause content.

“Era stanco *a tal punto che* non si reggeva più in piedi.” (De Dominicis, 1997:1087)

The use of **subjunctive** mood is required:

- after the locutions *troppo/poco/troppo poco/abbastanza...perché*.

“È *troppo* astuto *perché* lo si possa imbrogliare.” (De Dominicis, 1997:1087)

- when preceded by a negative or an interrogative main clause.

“Scherzava sulla penetrazione dell’ amico *non tanto* spensieratamente *ché* non si sentisse la voce rauca.” (Serianni, 1991:585)

- after the conjunction *senza che*.

“Posso andare da solo *senza che* io glielo chieda.” (Chiuchiù et al., 2002:388)

Conjunctions conveying manner (alongside with *senza che*) and conjunctions expressing intensity may be followed by the subjunctive use if there is a nuance of volition and eventuality reflected by the consequence.

“Gli parlerò *in modo che* non si faccia troppe illusioni.” (Dardano&Trifone, 1996:300)

2.4.2 German

Result clauses are introduced by the following conjunctive phrases: *so dass, dass* with the obligatory correlative *so* and *solch-, ohne dass, als dass* with the obligatory correlative *zu*.

Conjunctions conveying manner *so dass, ohne dass* and the conjunction expressing intensity *dass* with the correlative *so* require the use of the **indicative**.

“Er hinkt, *so dass* er nicht schnell gehen kann.” (Helbig&Buscha, 1996:693)

The use of both subjunctive and indicative is possible in unreal result clauses for present and past with the conjunctive phrase *als dass* and the correlative *zu*. The **subjunctive** mood is preferred if there is a minor possibility for the clause content to be realized in the present time, whereas both moods are equally suitable to express unfeasibility of past actions.

“Das Haus war *zu* teuer, *als dass* wir es hätten mieten können/mieten konnten.” (Glovacki-Bernardi, 2001: 38)

2.4.3 Comparison

Both languages use both verb moods, but a more frequent subjunctive usage may be noticed in result clauses of Italian due to interrogative and negative main clauses and certain locutions.

The indicative use in Italian is related to conjunctions conveying the manner and the intensity of consequences, in German it is linked with all the conjunctions and that of the subjunctive is associated exclusively with unreal result clauses.

2.5 Purpose clause

A purpose clause is a subordinate clause denoting a purpose or aim of the main clause content.

2.5.1 Italian

Purpose clauses are introduced by conjunctions: *perché, affinché, acciocché, a ché, a fare sì che*.

The **indicative** mood is not used in purpose clauses.

A purpose clause expresses an aim or a purpose that a speaker wants or does not want to be achieved. Thus the resulting consequence is uncertain and the **subjunctive** is the only suitable verb mood to be used.

“Ti dirò tutto, *affinché* tu capisca che l'errore non è stato mio. (Marin&Magnelli, 2013:78)

2.5.2 German

Purpose clauses are introduced by: *damit*, seldom *dass*

The **indicative** is mainly used in purpose clauses, particularly in everyday speech.

If the main clause is followed by the subordinate clause, it may contain correlatives: *darum, deshalb, deswegen, zu dem Zweck, in der Absicht*.

“Wir investieren *darum* viel Geld in die Qualität des Erzeugnisses, *damit* das Vertrauen des Verbrauchers erhalten bleibt.“ (Glovacki- Bernardi, 2001:37)

The **subjunctive** mood may be used in this type of subordinate clauses only when referring to past actions.

“Der Vater schickte Helene auf den Markt, *damit* sie Obst und Gemüse kaufe.“ (Medić, 1992:143)

2.5.3 Comparison

The indicative mood is not used in purpose clauses of Italian. In German, it is possible to use the subjunctive solely for past actions.

2.6 Concessive clause

A concessive clause indicates that the situation in the main clause is contrary to what one might expect in view of the situation in the concessive clause.

2.6.1 Italian

Conjunctions requiring **indicative** use are: *anche se* (with both concessive and conditional meanings) and *con tutto che*.

“L'Inter ha vinto *anche se* non ha giocato bene.“ (Marin&Magnelli, 2013:71)

The **subjunctive** mood is required:

- after the concessive conjunctions: *benché, sebbene, quantunque, nonostante (che), malgrado (che), per quanto, ancorché*.

“Ha una casa modesta *benché* guadagni molto denaro. (Chiuchiù et al., 2002:387)

- when preceded by conjunctions that are used both concessively and conditionally at the same time: *seppure (se pure), quand'anche*.

“*Quand'anche* l'avessi saputo, non avrei potuto far nulla.“ (Cattana&Nesci, 2000:1018)

- after the correlative sequence *per...che*.

“Qualunque dose, *per piccola che* sia, comporta un rischio. (Serianni, 1991:602)

- when preceded by adjectives and indefinite pronouns *chiunque, qualunque, qualsiasi, checché*, adverbs and adverbials *comunque, come se, ovunque, dovunque, da ogni parte*.

“*Dovunque tu vada, io verrò con te!* “ (Marin&Magnelli, 2010:69)

2.6.2 German

Conjunctive phrases introducing concessive clauses are *obgleich, obwohl, trotzdem, wenn auch, selbst wenn, sogar wenn*, in formal literary German *obzwar, obschon, wiewohl, wenngleich*, correlatives *doch* (combined with *so*), *dennoch, trotzdem*, conjunction *dass* and prepositional phrases *trotz der Tatsache, trotz des Umstandes* etc.

The **indicative** mood is used:

- when introduced by the abovementioned conjunctions and conjunctive phrases:

“*Obwohl es schon sehr spät war, so kam er doch.* “ (Glovacki-Bernardi, 2001:39)

- when the concessive meaning of the main clause content is conveyed by interrogative adverbs, adverbials, pronouns *wann, wie (immer), womit* and the particle *auch*, the conjunction *ob*, and the particle *so* with an adjective or adverb in the subordinate clause.

“*Womit sich der Junge auch befasst, ihm gelingt alles.* “ (Helbig&Buscha, 1996:692)

The **subjunctive** mood is used:

- in unreal concessive clause introduced by conjunctive phrases *auch wenn, sogar wenn, selbst wenn* with the strong conditional force. It is used to convey an unreal, imaginary concessive relationship between the clauses.

“*Auch wenn es geregnet hätte, hätten wir den Ausflug gemacht.* “ (Helbig&Buscha, 1996:204)

- in a real concessive clause with the phrase *wenn auch* and the modal verb *sollen* attaching to it an additional tone of eventuality.

“*Auch wenn er nicht kommen sollte, werden wir seinen Beitrag besprechen.* “

(Helbig&Buscha, 1996:691)

2.6.3 Comparison

Concessive clauses of both languages make use of both moods. However, there is a greater presence of the subjunctive in Italian rather than in German.

2.7 Conditional clause

A conditional clause conveys a direct condition in that the situation in the main clause is directly dependent on the situation in the conditional clause. A direct condition may be either an open condition expressing something that may be true or a hypothetical condition conveying something which is not true or is imaginary.

2.7.1 Italian

The **indicative** mood is indicated by conjunctions: *se, se pure, nella misura in cui*. It should be pointed out that the conjunction *se* introduces the indicative mood only within a real and true condition. This is type 1 conditional (*realtà*).

“*Se comincia a parlare, non la finisce più.* “ (Dardano&Trifone, 1996:303)

The **subjunctive** mood is employed:

- if the clause content indicated by the conjunction *se* is merely potential or absolutely unreal and unfulfilled These are type 2 (*possibilità*) and type 3 conditionals (*impossibilità*).

“*Se tu facessi attenzione, non avresti problemi.* “ (Chiuchiù et al., 2002:431)

- when preceded by conjunctions: *se, se anche, se mai, casomai, ove, dove, laddove, qualora, quando, purché, sempreché, ammesso che, concesso che, dato che, posto che, a condizione che, a patto che, solo che, per poco che, nel caso che, nell'eventualità che, nell'ipotesi che*.

“*Il cornetto funziona veramente, a patto che sia rigido.* (La Grassa et al., 2013:97)

2.7.2 German

Conjunctive phrases pertaining to conditional clauses are: *wenn, falls, insofern, im Falle dass*, correlatives *so, dann*. A condition related to the situation in the main clause may also be expressed by the subordinate *dass* clause and prepositional phrases *unter der Bedingung, unter der Voraussetzung, in dem Falle, gesetzt den Fall, vorausgesetzt* in the main clause.

All of the aforementioned conjunctive phrases indicate the **indicative** mood. However, the conjunction *wenn* is followed by the indicative mood only when conveying an open condition and thus forming type 1 conditional (*reale Konditionalsätze*).

“*Wenn* Eltern den Computer als Babysitter missbrauchen, *dann* entstehen oft Probleme.“
(Glovacki-Bernardi, 2001:35)

“*Gesetzt den Fall, dass* wir morgen frei haben, besuche ich dich.“ (Buscha et al., 2013:177)

The **subjunctive** mood is applied:

- if there is a hypothetical or unfulfilled condition expressed and introduced by the conjunction *wenn*, thus resulting in forming type 2 conditionals (*irreale Konditionalsätze*) and type 3 conditionals (*irreale Konditionalsätze*).

“*Wenn* die Haifischen Menschen wären, wären sie dann netter zu den kleinen Fischen?“
(Buscha et al., 2013:73)

- in a real conditional clause with the modal verb *sollen* with or without a conjunction to express an additional eventuality modification attached to it.

“*Falls* er die Arbeit nicht allein schaffen sollte, werde ich ihm helfen.“ (Helbig&Buscha, 1996:690)

2.7.3 Comparison

In conditional clauses in both languages the indicative use is required with an open condition expressed, whereas the subjunctive usage is requested when conveying a hypothetical condition.

2.8 Comparative clauses

A comparative clause compares a proposition expressed in the main clause with a proposition expressed in the subordinate clause. A comparison includes comparisons of equivalence, non-equivalence and proportionality or equivalence of tendency or degree between two situations.

2.8.1 Italian

The **indicative** use is required:

- after conjunctions introducing a comparison of equivalence *come, così...come, come...anche, nel modo in cui, (tanto)...quanto, (tale)...quale, (così)...come* and those introducing a comparison of proportionality *via via che, di mano in mano che, man mano che, a misura che, più...più, quanto più...tanto più, più...meno, meno...più*.

“Il diavolo non è *così* brutto *come* si dipinge.“ (Dardano&Trifone, 1996:302)

“*Più* l'umanità si fa grossa, *meno* diventa trasparente per sé stessa.“ (Serianni, 1991:617)

- occasionally when preceded by conjunctions introducing a comparison of non-equivalence *diverso...da/di come, differente...da/di come, altro da/di come, più/meglio/maggiore...di quanto, meno/peggio/minore... di quanto (non)/che (non)/ di come (non)/di quello che (non)/di quando (non)*.

“Si svegliò *più* stanco *di quanto* era andato a dormire.“ (Dardano&Trifone, 1996:303)

The **subjunctive** mood is generally introduced:

- by the abovementioned conjunctions introducing non-equivalence.

“Il fumo è *più* nocivo *di quanto* tu possa immaginare.“ (Marin&Magnelli, 2010:69)

• by conjunctions introducing a comparison of equivalence: *come se, quasi (che), secondo che, a seconda che*.

“Ci tratta *come se* fossimo dei ragazzini.” (Silvestrini et al., 2000:130)

2.8.2 German

The most common conjunctions for comparative clauses are: *wie, als, als ob, als wenn, je...desto/um so*.

The **indicative** mood is applied when preceded by conjunctions of equivalence *wie* with the obligatory correlative *so (genau)*, those of non-equivalence *als* and those of proportionality *je...desto/um so*

“Im Februar war es *genau so* kalt, *wie* es im Januar war.“ (Helbig&Buscha, 1996:685)

“Er weiss viel mehr, *als* ich dachte.“ (Medić, 1992:141)

“*Je* mehr ich lese, *um so* reicher wird mein Wortschatz.“ (Helbig&Buscha, 1996:687)

The **subjunctive** use is preferred to the indicative use in an unreal comparative clause expressing something that is not true, but imaginary. Conjunctions are: *als, als ob, als wenn*.

“Ann *tut so, als ob* sie nichts hörte/höre/hört.“ (Glovacki-Bernardi, 2001:39)

2.8.3 Comparison

Both linguistic systems apply both verb moods.

2.9 Clause of manner

A clause of manner functions as an adverbial of manner for the main clause.

2.9.1 Italian

The use of the **indicative** is required after conjunctions implying a relationship of equivalence and manner simultaneously, but only if expressing a statement of fact: *come, secondo che, nel modo in cui, nel modo che, come se, quasi che*.

“Comportati *nel modo che* ritieni più opportuno.“ (Dardano&Trifone, 1996:308)

The **subjunctive** mood is used:

• after the conjunction *senza che* with a restrictive meaning.

“Molti nonni italiani guardano crescere i nipotini *senza che* paghino un centesimo in più.“ (La Grassa et al., 2013:195)

• occasionally after conjunctions simultaneously introducing a relationship of equivalence and manner, if the expressed clause content is merely supposed or unreal.

“Si comporta *come se* la colpa fosse mia.“ (Serianni, 1991:611)

2.9.2 German

Conjunctive phrases for clauses of manner are conjunctions implying equivalence and manner at the same time: *indem, dass* with obligatory correlatives (*dadurch, damit*), conjunctions *ohne dass, anstatt dass* and *statt dass*.

The **indicative** use is introduced by all conjunctions of clauses of manner.

“Er verbesserte seine Leistungen, *indem* er regelmässig trainierte.“ (Helbig&Buscha, 1996:685)

Clauses of manner do not contain any verbs in the **subjunctive** mood.

2.9.3 Comparison

It may be noticed that Italian uses both verb moods. German, however, uses exclusively the indicative mood.

2.10 Restrictive clause

A clause of exception excludes a part of the main clause content from the main clause.

2.10.1 Italian

The **indicative** mood is indicated by the conjunction *se non che*.

“Ci conosciamo da molti anni, *se non che* ci vediamo raramente.” (Dardano&Trifone, 1996:309)

Other conjunctions introducing clauses of exception require the use of the **subjunctive**: *eccetto che, salvo che, tranne che, a meno che (non), fuorché*.

“Accetto tutto da te, *tranne che* tu sia falso.” (Silvestrini et al., 2000:130)

2.10.2 German

Conjunctive phrases for clauses of exception are: *ausser dass, ausser wenn*.

The use of the **indicative** is preceded and introduced by the aforementioned conjunctions.

“Er war geheilt, *ausser dass* er in der Aufregung manchmal ein wenig stotterte.” (Helbig & Buscha, 1996: 456)

The **subjunctive** mood is not used in any clauses of exception in German.

2.10.3 Comparison

In Italian, clauses of exception largely apply the subjunctive mood, whereas those in German do not.

3. Conclusion

Upon completion of the comparison of the two languages, the following facts should be pointed out:

- Clauses of place in both languages display identical use of both verb moods; both use only the indicative mood.
- Verbs in clauses of time in German are deployed solely in the indicative. Italian and its subjunctive use is related to conjunctions introducing the relation of anteriority
- Reason clauses in German use solely the indicative mood. In Italian, however, conjunctions of a possible, but negated reason are followed by the subjunctive mood.
- Result clauses in both languages display use of both verb moods, however, with prevalence of the subjunctive in Italian.
- Purpose clauses in Italian introduce exclusively the subjunctive mood. German is dominated by the indicative, with the exception of the subjunctive being possibly used for past actions.
- Concessive clauses of both languages make use of both verb moods, with the subjunctive being more frequently used in Italian.
- Identical use of both verb moods is evident in conditional clauses of both languages.
- Comparative clauses in both languages apply both verb moods.
- Clauses of manner in Italian use both verb moods as opposed to German and its only verb mood used; the indicative.
- Clauses of exception in Italian are dominated by the subjunctive use, while in those of German prevails the indicative use.

It should be pointed out that both linguistic systems display identical usage of the verb moods in their clauses of place and conditional clauses. Other adverbial clauses feature less or more noticeable distinctions. Thus, for example, clauses of place, time, reason, manner and exception in German use only the indicative, whereas purpose clauses in Italian apply solely the subjunctive mood. Result, concessive and comparative clauses in both languages deploy both moods. The subjunctive use is, however, more frequent in Italian due to abundance of conjunctive phrases explicitly introducing it. The aforementioned speaker's aspect of

eventuality adds to the frequency of its use. In German, on the contrary, the subjunctive use is not defined by any conjunctive phrases, but primarily by a speaker's attitude or the unfeasibility and unreality of the expressed clause content. It is these features of the subjunctive that considerably contribute to its obligatory appearance in unreal conditional clauses and possible use in other adverbial clauses.

Mention should also be made of the fact that the use of the verb moods is sometimes dependent on language styles or registers applied. In spoken and written language, there is a growing tendency to use the indicative mood more frequently. This tendency is even evident in type 3 conditional, where the imperfect indicative often replaces the pluperfect subjunctive in a subordinate clause and the past conditional in the main clause; (*Se studiavi molto, non ti bocciavano/Se avessi studiato molto, non ti avrebbero bocciato*). In German, in both speech and writing there is growing prevalence of the indicative use (*Der Tee ist zu heiß, als dass man ihn gleich trinken könnte/kann*). Even in negative result clauses, we encounter the present indicative more regularly than the past subjunctive, a formal reinforcement of the negative clause meaning (*Er hilft jedem bereitwillig, ohne dass man ihn besonders darum bitten muss/müsste*). This is due to the increased need for the simplification of a rather complex system of verb moods and more efficient information communication.

Similarities in the use of the two verb moods can be ascribed to their common Indo-European origin and ancestor, whereas their differences can be justified by the existence of various groups of Indo-European languages (Romanic and Germanic language) Italian and German belong to. Methodical and didactic implications of applying the contrastive approach to the verb mood interpretation are numerous, particularly in teaching German and Italian as second or foreign languages. An Italian and German teacher's familiarity with basic disparities and similarities in the mood use between the two languages can considerably contribute to successful teaching of the target language. Contrastive analysis may and should assume a significant role in teaching adult learners or native speakers of Italian and German the target German and Italian language respectively (with emphasis on lexical, grammatical and syntactic accuracy), as higher levels of instruction imply carrying out a comparison of the languages and retrieval of their translation equivalents. Contrastive analysis of transfer errors into German and Italian may prevent their emergence or at least mitigate their frequency in the target language.

REFERENCES:

- Buscha, A., Szita, S., Raven, S. (2013). *C Grammatik. Übungsgrammatik Deutsch als Fremdsprache*. Leipzig: Schubert-Verlag.
- Cattana, A., Nesci, M. (2000). *Dizionario compatto della lingua italiana*. Bologna: Nicola Zanichelli Editore S.p.A.
- Chiuchiù, A., Minciarelli, F., Silvestrini, M. (2002). *In italiano. Grammatica italiana per stranieri. Corso multimediale di lingua e civiltà a livello elementare e avanzato*. Perugia: Guerra Edizioni.
- Dardano, M., Trifone P. (1996). *La lingua italiana*. Bologna: Nicola Zanichelli Editore S.p.A.
- De Dominicis, F. (1997). *Dizionario Garzanti di francese*. Cernusco (Mi): Garzanti Editore.
- Glovacki-Bernardi, Z. (2001). *Osnove njemačke gramatike*. Zagreb: Školska knjiga.
- Helbig, G., Buscha, J. (1996). *Deutsche Grammatik*. Leipzig, Berlin, München: Langenscheidt Verlag Enzyklopädie
- La Grassa, M., Delitala M., Quercioli F. (2013). *L'italiano all'università 2. Corso di lingua per studenti stranieri 2*. Roma: Edizioni Edilingua.
- Marin, T., Magnelli, S. (2013). *Progetto italiano 2. Corso multimediale di lingua e civiltà italiana. Livello intermedio. Libro dello studente*. Zagreb: V.B.Z. d.o.o. i Edilingua.
- Medić, I. (1992). *Kleine deutsche Grammatik*. Zagreb: Školska knjiga.

Serianni, L. (1991). *Grammatica italiana*. Torino: Utet Università.

Silvestrini, M., Bura, C., Chiacchella, E., Giunti Armani, V., Pavese, R. (2000). *L'Italiano e l'Italia. Lingua e civiltà italiana per stranieri. Livello medio e superiore*. Perugia: Guerra Edizioni.

Making Mistakes is Absolutely Correct

Marijana Jurišić

University Department of Professional Studies, Split, Croatia
mjurisic@oss.unist.hr

Ivana Vodogaz

University Department of Professional Studies, Split, Croatia
ivodogaz@oss.unist.hr

Abstract. The subject of this paper is students' mistakes and the teacher as corrector in the EFL classroom. Helping students to learn how to communicate effectively with self-confidence is our objective and we need to detect those mistakes, determine their type and decide what to do. Correction is just one of the important oral functions of the teacher, and we are about to explain two basic stages: showing incorrectness and using correction techniques. There are many problems associated with error correction. Every student wants to improve the accuracy, but not all of them like being corrected. However, most students do want to have some of their mistakes corrected as it gives them a basis for improvement. Our decision of what and when to correct will depend on a number of variables. We attended certain number of each other classes, as well as our colleagues' classes to find out what are the most common techniques that we all use. Alongside, we interviewed our students to discover their opinion, fears and experience about the same matter. Providing feedback may serve not only to let learners know how well they have performed, but also to increase motivation and build a supportive classroom climate. Failure to provide correction may have a damaging effect on the learner's language development in the long term. On the other hand, providing only negative feedback may have a negative impact on their performance. Finding the balance between these two is a responsible work that we have to face.

Key words: *correction, errors, mistakes, teacher*

1. Introduction

"It has been suggested that learner errors can be seen as an evidence of learner achievement. Does this mean that they should not be corrected under any circumstances? If there are circumstances where error correction is legitimate, what are they, and how does the teacher set about it without inhibiting learner development?" (H. G. Widdowson).

This citation introduces us to the main subject of this paper which is the role of the teacher as corrector in the EFL classes.

No teacher can deny the fact that correcting the errors made by students when they speak or write is one of the most difficult tasks in language teaching. During the presentation stage the teacher acts as a controller, selecting the language the students are to repeat and insisting on accurate reproduction of the new item. This means that student's errors and mistakes will be dealt with when they occur. Most teachers believe that to ignore these mistakes might put at risk the learner's development. On hearing an incorrect form, teachers have to decide what to

do about it. However, this often means having to make a number of on-the spot decisions. What we decide to do may depend on any one or more factors. What kind of error is there? Does it have a major effect on communication? Is it one that the student could probably self-correct? What is the objective of the activity and what is the relationship of the incorrect form to that objective? Is the focus of the activity more on form or on meaning? What caused an error? Does it matter? Will the learner be discouraged or humiliated by correction? What are we going to do about it? There are so many questions, and so little time to deal with those questions because we are supposed to react immediately.

It seems that most of the researchers agree with the importance of teachers' role in error correction, while the amount, time, and type of corrective feedback differ in various situations. It is the teacher who evaluates how significant the error is, and takes necessary actions (Akhter, 2007). Therefore the roles of teachers are the key part of error correction process (Harmer, 1986).

2. The significance of making errors

There has always been much concern and discussion on errors and error correction in foreign language learning and teaching (Tomczyk, 2013). Making errors is an inevitable and natural process of language learning (Edge, 1989; Hendrickson, 1987). It has been accepted that errors and correction of errors play an important role in the learning process. In this sense, researchers view errors as evidence of the learner's positive contribution to foreign language learning rather than as a sign of learner's inability to master the new language as many teachers view it.

It has been suggested that feedback plays a major role in helping learners to test the acquired knowledge of the target language. The feedback is the response to efforts by the learner to communicate. Feedback can involve such functions as correction, acknowledgement, requests for clarification. However, feedback is more than just error correction, it is about providing learners with information on their performance. Effective feedback can motivate, support and encourage students as well as having a significant effect on their achievement. Without feedback students have no idea of how they are doing in class. At the same time over-correction and poor correction techniques can be demotivating for the learner and may lead to a reluctance to try out new language or even to speak at all.

Naturally, learners' errors and feedback to errors have been of great interest to foreign language teachers. Error correction is one of the most important and most difficult functions of the language teacher. As Shaffer (2008) mentioned, one of the questions every EFL teacher has to face is how to correct oral errors and how much to correct. Researcher opinions vary widely on this: from no correction to extensive correction, from immediate to delayed correction, and from implicit to explicit correction. The danger of over-correcting is that students will lose motivation and you may even destroy the flow of the class or the activity by correcting every single mistake. The other extreme is to let the conversation flow and not to correct any mistakes.

When treated effectively with constructive feedback, errors lead to better learning. Once teachers regard errors as a natural part of learning, learners feel more encouraged to speak. Effective oral correction works well if the teacher reacts positively to errors. Therefore the roles of teachers are the key part of error correction process (Harmer, 1986).

3. Types of errors

Once an error has occurred, the next step is to classify it.

Some linguists insist on making the difference between the error and the mistake. An error is the result of incorrect rule learning; language has been stored in the brain incorrectly. If the incorrect form is due to the lack of knowledge, for example, if the student is a beginner who has never met the present perfect tense, it is an error. A mistake is less "serious" since it is the retrieval that is faulty, not the knowledge. In other words the student knows the rule, but makes a "slip" when producing it. It is usually caused by the pressure of the communicative situation. Mistakes are a sign that the student hasn't yet fully acquired or assimilated the particular form. This difference between errors and mistakes can have important implications for the treatment of student incorrectness. In the case of an error, simple correction is unlikely to be helpful and it may even confuse the student. The form needs to be taught, or at least it needs re-teaching if it is misunderstood or simply forgotten. On the other hand, mistakes can be offered for self-correction.

As we are dealing here with the teacher as controller of spoken English, we have to say that there is often the greater pressure for written accuracy than there is for accuracy in speaking, but this doesn't depreciate this important role of the teacher as corrector and his ability to choose the right correction technique or to show incorrectness in the right time for the right mistake (or error).

According to Scott Thornbury, the following categories of errors have been identified:

- lexical errors
- grammar errors
- discourse errors
- pronunciation errors

Learners can make mistakes at the level of individual words, or at the level of whole text. At the word level, learners make mistakes either because they have chosen the wrong word for the meaning they want to express, or they have chosen the wrong form of the word. These are lexical errors. Grammar errors cover the area of verb forms and tenses, while discourse errors relate to the way sentences are organised and linked. In the case of spoken language we may also recognize some pronunciation errors.

Unfortunately, it is not always the case that errors fall neatly into the above categories.

Identifying the cause of an error can be equally problematic, and in this paper we didn't have enough time or space to cope with it as well, but it could be an interesting topic to write about.

4. Correction

According to Jeremy Harmer, the correction procedure takes place during the accurate reproduction stage, and it can consist of two basic stages: showing incorrectness and using correction techniques. There are many problems associated with error correction in the EFL classroom. For example, every student wants to improve their accuracy, but not every student likes being corrected. There are also students who want constant correction and others who don't. Another common problem is that students and teachers often disagree on the amount of error correction that there should be in class. For most teachers today it is not a case of deciding whether there should be error correction or not, but the much more difficult task of getting the amount of error correction just right for each individual level, age group, personality, etc. This way or another, the majority still believes that to produce proficient speakers of English, we must offer correction in the classroom.

4.1 Showing incorrectness

The teacher indicates to the student that a mistake has been made. If the student understands this feedback, he will be able to correct himself, and this will be helpful to him as part of his learning. It is probable that a student who can correct himself in this way has made a mistake rather than an error. With repeated self-correction students remember the right language better and their confidence increases. Self-correction should take place quickly, hardly affecting the flow of conversation. If they correct themselves too much, it can have the opposite effect. It can ruin fluency.

If the student cannot correct him/herself the teacher can encourage other students to supply correction. This technique is to be applied tactfully, so that the student who originally made the mistake will not feel humiliated. In the case of errors, it is useful if after peer correction the teacher goes back to the student who made the error and gets him/her to say it correctly. Edge (1989) mentions the following advantages of peer correction: it encourages cooperation, students get used to the idea that they can learn from each other, both learners (who made the error and who corrects) are involved in listening to and thinking about the language and the teacher gets a lot of important information about the learners' ability.

In this process, the teacher uses a variety of corrective feedback strategies.

4.1.1 Repeating

The teacher simply asks the student to repeat what he has just said by using the word like "again". This can indicate that the response was unsatisfactory, but can also be mistaken as a signal that the teacher didn't hear the student.

4.1.2 Echoing

The teacher may echo what the student has just said with a questioning intonation. Sometimes the teacher may echo the complete sentence, probably stressing the part that was incorrect, he may echo the response up to the point where the mistake was made or just the wrong part. This method can sound patronising if used too often or with the wrong tone of voice. Teachers should try to mix up the different versions of it and to alternate with other methods. Echoing is probably the most efficient way of showing incorrectness.

4.1.3 Denial

The teacher tells the student that his response was incorrect and asks him to repeat it. This is potentially discouraging in a way that the previous techniques are not. This is clearly negative feedback and it doesn't offer the student the clue of what was wrong. Positive ways of being negative include "nearly there", "getting closer", "just one mistake", so teachers are allowed to tell the students they are wrong but nicely. Sometimes students don't need much help at all but just a chance to do it again. This is likely to be true if we have trained them well in spotting their own errors. With lower level of students and new classes, teacher must balance the need to be nice with the need to be clear and not confuse them with feedback language that they don't understand.

4.1.4 Questioning

The teacher may say "Is that correct?" asking any student to answer this question. This technique has one disadvantage because the student who made the mistake could feel exposed in front of the whole class and disgraced.

4.1.5 Facial expression

The teacher may indicate that a response was incorrect by his expression- for example, raising an eyebrow. Most people will do this naturally, but there is a slight chance a teacher's expression will be too critical or too subtle for students to pick up on. This can be "dangerous" if the student thinks that this expression is a form of mockery.

4.1.6 Body language

The problem with using body language could also be that it is taken as very serious criticism or that is too vague. Possibilities include using hands (making a circle by moving the index finger to mean "one more time"), head (tilted to one side to mean "I'm not sure that sounds correct") or shoulders (hunched to reinforce "I don't understand what you mean").

4.1.7 Giving the rule

For example: "Since usually takes the present perfect". This works best if they already know the rule, and teacher at least needs to make sure that they will quickly understand what he/she is saying, for example by only using grammatical terminology they are familiar with. Otherwise, this terminology is just going to confuse them more.

4.1.8 Pointing at the correct language

If teachers have a correct form of the target word easily accessible on the whiteboard, in the book, or on a poster, just pointing at it can be helpful for students to use the correct language form. It can be the name of the tense, a word form they are using, a grammatical explanation etc.

Showing incorrectness should be handled with tact. The process of student self-correction is an important and useful part of the learning process. Also, showing incorrectness should be seen as a positive act.

It is often the case that showing incorrectness is insufficient for the correction of a mistake or an error and the teacher may have to use some correction techniques.

4.2 Using correction techniques

If the student is unable to correct himself, the teacher may use one of the following techniques

4.2.1 Student corrects student

If the student is not able to correct himself the teacher can encourage other students to supply correction. The teacher may ask if anyone else can give the correct response. If another student can answer correctly it will be very good for his self-esteem, but the student who originally made the mistake may feel exposed and humiliated. This technique is to be applied tactfully, so that the student who originally made the mistake will not feel humiliated. On the negative side, students could miss problems with the language, or even correct something that doesn't need correction. This type of correction can be used in any conversational activity and also has a tendency to eat up a lot of time.

After peer correction the teacher can go back to the student who made the error and get him/her to say it correctly. Edge (1989) mentions the following advantages of peer correction: it encourages cooperation, students get used to the idea that they can learn from each other, both learners (who made the error and who corrects) are involved in listening to and thinking about the language, the teacher gets a lot of important information about the learners' ability. However, it may happen that whenever the teacher asks for peer correction from the whole

class, it is always the same students who answer. In this case the teacher has to make sure that other students are involved as well.

4.2.2 Teacher corrects student

The most obvious and often used form tends to be the direct teacher to student type. Sometimes the teacher may feel that he should take care of the correction because the student can't give the right and correct response. In this case the teacher can re-explain the new language to the student or give some grammar rule. He can also directly correct the previous mistake. This kind of correction is probably the least desirable, especially if used often, because it can create a teacher-centered classroom. Correction from the teacher prevents students from noticing mistakes, and it can harm their ability to analyze why something is wrong. It would be inappropriate to say that this type of correction has no place in the classroom, especially in the early stages of the lesson when students first practice the target language. They haven't become familiar with the new language material, so they need direct feedback.

The aim of using correction techniques, of course, is to give the students a chance to get the new language right. It is important that when the teacher has used one of the techniques suggested above, he asks the student who made the mistake to give him the correct answer.

Errors have generally been attributed to cognitive causes, evidence of the learner's psychological process of rule formation. Also, the communicative demands result in error because the learner does not have enough time to access second language systemic knowledge.

There is no doubt that so-called errors are indeed evidence of learners' success in realising meaning potential, or any other potential. They are also evidence of limitations in the learners' knowledge. Learners therefore need to be provided with guidance in order to extend the range of the knowledge they can draw upon.

The stages of correction shown here are especially useful for accuracy work, where the main focus is grammatical correctness.

Another possibility for the immediate creativity stage and for practice activities is gentle correction. This involves showing the student that something is wrong, but not asking for repetition. Gentle correction is usually connected with the so-called communication output and we will see more about it in the next few pages.

4.2.3. Self-correction:

Error correction should not always be the responsibility of teachers or other students. Teachers should train their students to correct their own errors and give them the chance to do so. After the student recognizes what is incorrect in his/her response, s/he should be able to correct him/herself. Self-correction is a useful technique because the student will remember about the mistake he/she made.

5. Communication output and gentle correction

Communication output refers to activities in which students use language as a vehicle of communication, and where the students' main purpose is to complete some kind of communication task. The teachers' attitude to error and mistake will therefore be completely different. If he wishes the students to use language in any way, then control will have to be relaxed. This is also the theme elaborated by Harmer in his book mentioned before.

He thinks that if the teacher stops students every time they make a mistake, then he will be destroying the communication that he is supposed to be encouraging. Students will find it

frustrating and de-motivating. This doesn't mean that teachers should not be interested in accuracy. But it does imply that there are stages when the communicative efficiency must be the focus in the classroom.

Where students are involved in immediate creativity the teacher may still correct, but such correction should be "gentle". Gentle correction involves showing that incorrectness has occurred, but not making a big fuss about it.

In the accurate reproduction stage the teacher asked students who had made mistakes to say the sentence correctly. Gentle correction, on the other hand, involves the teacher in saying things like "Well that's not quite right... we don't say he goed, we say he went", but not insisting that the student then repeats the sentence in the same controlled way.

Where students are working in pairs or groups the teacher may inject this type of correction without completely destroying the atmosphere. The teacher can also wait until an activity or task has been completed and then tells the students how well they did.

Here we can make a distinction between two kinds of feedback: content feedback and form feedback. Content feedback tells students how well they performed the activity as an activity, rather as a language exercise. The teacher is reacting not to the students' accurate use of language, but to the result of their communication. Form feedback tells students how well they performed in terms of the accurate use of language.

The teacher should take great care not to make form feedback dominant after communication activities: content feedback should usually come first and the teacher must decide when form feedback is appropriate and when it is not. It is vital for the teacher to be sensitive to his students in his role as assessor and to realise when correcting is inappropriate.

6. Techniques of correction used by teachers

Teachers use different correction techniques in the classroom. Our aim in the following study was to give an account of the different ways of correcting errors, made by the students in their oral work. For the purpose of this research, teacher as corrector was analysed in three different settings: at our university department, the secondary school and in one private school for foreign languages. In other words we are dealing with three teachers, one at our institution (in future analysis, the teacher will be referred to as teacher A), one in the secondary school (teacher B) and one in the private school (teacher C).

We attended twelve hours listening to English classes in each of those schools in order to register every error or mistake made by the students, the way of correcting made by the teacher and to notice the mistakes that weren't corrected for different reasons.

The written exams and exercises are more frequent in all schools, and the oral examination is often strictly connected with the fluent lesson, so students don't make many mistakes.

The average number of students at our department as well as in the secondary school classrooms goes from 30 to 36. The obligatory programme and the plan of teaching are very strict and extensive, so we can conclude that we are dealing with rather hard and restrained conditions of work.

The situation in the private school is different because we are dealing with groups of 12 to 16 students. Their programme is not so strict, and the teacher is usually the one who makes the plan for the recent school year in the way he thinks is the most appropriate.

The analysis of this study shows us that only two techniques for showing incorrectness are used and these are echoing and questioning. When we speak about using correction techniques the situations when student corrects student or when the teacher corrects student are both present in their work.

The examples of gentle correction were found in the speech of the teacher C. Since we are dealing with the private school and the small groups of students we should not be surprised by the fact that the modern teaching techniques focused on the development of communicative skills find their place during their lessons.

During their work in pairs and all the other oral activities, where the students can express themselves, they were making a lot of mistakes in pronunciation. The teacher didn't correct them, and she didn't want to intervene. By "intervene" we mean telling students that they are making mistakes, insisting on accuracy and asking for repetition.

The teacher had waited until an activity or a task had been completed and then told the students how well they had performed it. She warned them of the wrong pronunciation of the words like: high, antique, curtain, researcher, psychologist, swallow etc. Of course, the teacher never tells the names of the students who made the mistakes and she repeats the mistakes for the whole class.

Here are the results shown and arranged in tables which show us how frequently is a particular technique used by the particular teacher.

Table 1 Correcting techniques used by three different teachers

TEACHER	TECHNIQUES			
	ECHOING	QUESTIONING	STUDENT CORRECTS STUDENT	TEACHER CORRECTS STUDENT
A	15%	-	15%	70%
B	16%	28%	-	56%
C	-	-	-	70%

The teachers use two techniques to show incorrectness and these are echoing and questioning. While echoing is present in the speech of the teacher A and B, questioning is used only by the teacher B. We can say that the self-correction isn't used much in any of these schools, so this first stage of correction is often passed over. The focus is almost always on the accuracy.

The situations when student corrects student are more frequent and they find their place in the speech of the teachers A and C.

The only technique that is present in the work of all the teachers is the direct correction, when teacher corrects his student, and it is also the most frequent one which is obvious from the table above.

7. Students' attitudes towards error correction

Language learners also have their own opinions on how and whether they wish to have their oral errors corrected by their teacher in the classroom. Nunan (1987) argued, "One of the most serious blocks to learning is the mismatch between teacher and learner expectations about what should happen in the classroom" However, if successful language learning depends largely on matching the expectations of teachers and learners, it would be useful for the teachers to know their students' opinion on error correction. For that purpose a questionnaire was developed to elicit information on students' attitudes regarding error correction practice. It examined attitudes and preferences for classroom oral error correction among our students. Data was collected from 120 first-year students of the Business Trade and Accounting and Finance enrolled at the University Department for Professional Studies in Split. The

participants' proficiency levels varied from low-intermediate to intermediate. Their ages ranged from 18 to 21 years old and they have been studying English for more than eight years on average. The following questions were addressed in the questionnaire:

1. What are the student's attitudes towards classroom error correction?
2. How often do you want to have your errors corrected?
3. What are your favourite error correction methods?

For question 1 the response options included a five-point scale with 1 representing strongly disagree and 5 representing strongly agree. For the second question, participants had the choice of three options (always, sometimes and never) for each item (grammar, pronunciation, vocabulary and inappropriate expressions). In the third question students had to rank different error correction methods in the order of their preferences, with 1 representing their favourite method and 4 representing the least favourite method.

7.1 Data analysis

In the first part of the questionnaire the students were asked whether or not they agreed with the statement, "I want teachers to correct my errors in speaking English." Adding together the numbers of students who agreed or strongly agreed, 68% of the students agreed with the statement (Table1). The students' strongly favorable attitudes towards receiving error correction in this study is consistent with the results of similar studies which clearly points out the need for error correction in EFL classroom. Nearly half of the respondents (47.3%) agreed with the following statement: "Teachers should correct all errors that learners make in speaking English". When asked whether or not they agreed with the statement, "Teachers should correct only the errors that interfere with communication," 16% expressed agreement, 35% disagreed, and 29% neither agreed nor disagreed. This indicates that most students believe that correcting only errors that interfere with communication is insufficient. A total of 17% agreed with the following statement: "I want my classmates to correct my oral errors in group work" Students may have negative attitudes towards peer correction which indicates that they do not expect to have their oral errors corrected by their classmates.

Table 1 Student's attitudes towards error correction

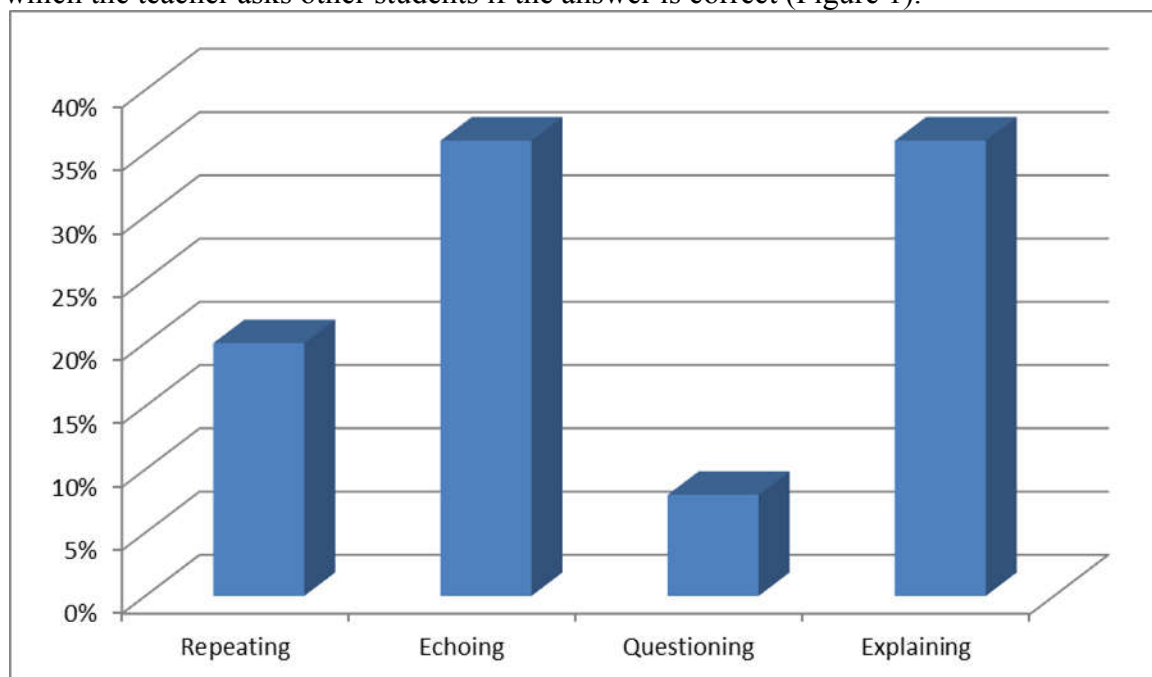
Item	N	Strongly disagree 1 (%)	Disagree 2 (%)	I'm not sure 3 (%)	Agree 4 (%)	Strongly agree 5 (%)	Mean
I want teachers to correct my errors in speaking English	120	4%	16%	12%	32%	36%	4,20
Teachers should correct all errors that learners make in speaking English.	120	8%	16%	16%	12%	46%	3,80
Teachers should correct only the errors that interfere with communication	120	35%	20%	29%	16%	0%	2,16
I want my classmates to correct my oral errors in group work.	120	8%	25%	50%	17%	0%	2,29

The second part of the questionnaire addressed students' preferences regarding the frequency of error correction, the majority of the students (72%) said they wanted to have their errors in grammar always corrected. It is not surprising that the students in this study showed high interest (44%) in correction of vocabulary errors too (Table 2).

Table 2 Types of errors students want to have corrected

Item	N	Never (%)	Sometimes (%)	Always (%)
Grammar	120	4%	24%	72%
Pronunciation	120	24%	64%	12%
Vocabulary	120	8%	48%	44%
Inappropriate expressions	120	48%	36%	16%

The last section of the questionnaire addressed the students' preferences for particular types of error correction methods. The students were asked to choose which method they like most and which they like the least, rating the methods from 1, the most favoured correction methods to 4, the least favoured method. Among the four types of correction, the most popular were echoing, the one in which the teacher points out the part that is incorrect and provide the correct answer (38%) and an equally popular method explaining, in which the teacher explains why the student's answer is incorrect (38%). 20% of students chose repeating as favourite method while the least favoured method (8%) was questioning, the method in which the teacher asks other students if the answer is correct (Figure 1).



Fig

Figure 1 Student's favourite error correction methods

8. Conclusion

No matter how perfect the teaching methods are, errors will always accompany every foreign language learning. The reasons why the teachers analysed in this research use only few kinds of techniques have to be very different. The teacher himself is maybe the most important factor, and he chooses the methods which he thinks are the most appropriate and would give the best possible results.

The findings of the study on students' attitudes towards error correction provide information that may contribute to a clearer understanding of students' perceptions of classroom error correction. It is very clear that individual students differ from each other in their attitudes towards errors and error correction. Before starting the process of correction, it is necessary to find out their preferences and attitudes. It is not surprising to see that the majority of students like to be corrected by their teachers because they believe that frequent correction would improve their knowledge of the language they are learning. On the other hand, some students find continuous correction very annoying, distracting and discouraging. They do not like being corrected and some of them would even stop participating in the classroom interaction or lose confidence and interest for learning English. Due to these different attitudes, both teachers and students should adopt a reasonable approach to handle the error-correction problem effectively and appropriately. Teachers should be careful about error correction in order to help learners improve their speaking skills without damaging their confidence.

The information from this study may be useful for teachers and help them decide how to treat students' errors and subsequently to choose the appropriate method of correction. In a typical class some combination of teacher-to-student and self-correction probably provides the most benefit. We have to be very careful because not all errors matter equally: nor do they all respond to the same kind of treatment. Failure to provide correction may have a damaging effect on the learner's language development in the long term; on the other hand, using only negative feedback may be ultimately demotivating. Providing the balance between these two is a difficult and responsible work that we all have to face.

REFERENCES

- Akhter, N. (2007). *Giving feedback and correcting errors in ESL classroom*. Dhaka, Bangladesh: BRAC University.
- Amora, N., (2015). Error correction in English language teaching. *The Online Journal of New Horizons in Education*, Volume 5(3).
- Edge, J. (1989). *Mistakes and correction*. London, UK: Longman.
- Harmer, J. (1986). *The practice of teaching English*. London, UK: Longman.
- Hendrickson, J. (1987). Error correction in foreign language teaching: Recent theory, research and Practice. *Modern Language Journal* 62, 387-398.
- Nunan, D. (1987). Communicative language teaching: Recent theory, research and practice. *ELT Journal*(41), 136-145.
- Shaffer, D.. (2008). Error correction: student preferences and research findings. *Journal of Bibliographic Research*, 5, 117-123. Retrieved May 18, 2009, from [http:// www.linref.com/cpp/casp/7/paper1285](http://www.linref.com/cpp/casp/7/paper1285).
- Thornbury, S. (1999). *How to teach grammar*. London, UK: Longman.
- Tomczyk, E., (2013). Perceptions of oral errors and their corrective feedback: teachers vs. students. *Journal of Language Teaching and Research*, Volume 4 (5), 924-931.
- Widdowson, H. G. (1990). *Aspects of language teaching*. Oxford, UK: Oxford University Press.

Organization Identity in Higher Education Institutions in The Republic of Croatia

Linda Martić Kuran

Veleučilište Marko Marulić, Knin, Republika Hrvatska
linda.martic@veleknin.hr

Katarina Blažević Miše

Sveučilište u Splitu,
Podružnica - Sveučilišni odjel za stručne studije, Split, Republika Hrvatska
katarina@oss.unist.hr

Slobodan Brezak

Bauernfield, Zagreb, Republika Hrvatska
slobodan.brezak@bauerfeind.hr

Nikola Blažević

Šibensko kninska županija, Šibenik, Republika Hrvatska
nikola.blazevic@skz.hr

Abstract. Business interaction between managers, employees, institution encirclement and other institution stakeholders results in creating organizational identity. Organizational identity has a significant impact on different types of organizational behaviours, and thus on the institution's functioning, as well as on achieving institutional goals as a whole. Organizational identity is a strategically planned and operational self - presentation of a company, based on long term company goals, combined with the desire to use all the instruments of the company as one unit achieved by means of behaviour and communication. Employee perception toward the workplace has significant impact on institutional reputation and is a part of the features of the institution and also includes emotional reactions and stakeholders' knowledge about the institution's identity. It is indisputable to articulate these concepts as key factors in the success of institutions in competitive markets, respectively their importance as intangible assets that provide companies with competitive precedence on the market. The aim of the paper is to examine conceptual and strategic relations between organizational identity and organization's reputation perception on the example of the higher education institutions in the Republic of Croatia. The paper also discusses possible directions for further research in this relevant and interesting field of research.

Keywords: *higher education, business interaction, organizational identification, organizational reputation, organizational identity.*

1. Introduction

Higher education institutions in the Republic of Croatia, despite the process of reform in recent years endeavour developing their own identity that would enable them in better communication with their stakeholders. National government and regional associations are focusing upward on education, as the global competition and the pursuit of competitive economics are increasingly strengthened. The Republic of Croatia recognizes education and science as its developmental

priorities as they can provide the Republic of Croatia with long - term social stability and economic development, as well as safeguard its cultural identity¹.

Education is seen as a service that could be marketed worldwide (Melewar and SibelAkel, 2005). Adoption of concepts such as organizational identity and reputation are becoming increasingly important, as organizations and managers alike are eager to develop distinctive university identities, understand multiple meanings held by stakeholders, improve images, and enhance reputation in this highly competitive global environment (Hemsley - Brown and Oplatka, 2016). Competition in higher education institutions is not only regional but already within countries and even global, especially since the acceptance of multilateral Bologna Process toward creating unified higher education architecture in Europe. In the Republic of Croatia there are²: 119 institutions of higher education of which: eight public universities, two private universities, 68 faculties and art academies, one university centre within public university, four private polytechnics, eleven public polytechnics, 22 private high schools and three public high schools.

Most of the higher education institutions in the Republic of Croatia are still in need of developing and implementing corporate identity program as a part of their strategic growth and expansion. Van Knippenberg and van Schie (2000) see strong organizational identity as a lead for individuals to take the organization's perspective and to act in the organization's best interest. Bendixen and Abratt (2007) define corporate identity as how the organization goes about its business, and how it behaves, thinks, feels, and interacts with the external world through their employees. Although organizational identity creation in higher education institutions has been studied (Balmer and Liao, 2007; Celly and Knepper, 2010), there is a lack of studies related to employees of higher education institutions especially in the Republic of Croatia researches. University marketing employees emphasize the importance of understanding and managing the corporate identity of their institutions (McAlexander et al., 2002). Curtis et al. (2009) see an important aspects of higher educational institutions in clear corporate identity combined with strong leadership.

The aim of the paper is to examine conceptual and strategic relations between organizational identity and organization's reputation perception and compatibility of organizational identification and organizational culture in organization just on the example of the higher education institutions in the Republic of Croatia.

2. Literature Review

Albert and Whetten (1985) define organizational identity as the central and recognizable character of the organization. Organizational identity ("who we are as an organization") is the result of a long-term process in which attitudes, beliefs and behaviour of employees are gradually formed, and are ultimately representing the personality of the organization.

Along with the strategy, structure, process and system, organizational identity is one of the fundamental organizational elements. Building an organizational identity is also fundamental in understanding the phenomena of organizational identity (Corley et al., 2006).

Organizational identity classifies the organization in terms of "what kind of organization it is about" and "how this organization differs" from other similar organizations (Gioia, 1998). According to Suddaby et al. (2016) creating an organizational identity is considered a process that requires continuous management of the perception of organizational identity in the past, the present, and the future.

¹StrategyofEducation, ScienceandTechnology (2014).

²www.azvo.hr (2016)

Organization identity includes three components: feelings of solidarity with the organization, attitudinal and behavioural support for the organization and perception of shared characteristics with other organizational members (Patchen, 1970).

When it comes to changing organizational identity, Fiol (2002) emphasizes organizational identification as a tool that can serve as a key process for maintaining organizational competitiveness. Organizational identification is defined as a sense of unity or a sense of belonging of an individual within the organization where he is employed (Ashforth and Mael, 1989; Mael and Ashforth, 1992). Higher organizational employee identification often leads to greater involvement and thus commitment toward the institution. The interest in identifying within institutional settings is increasing precisely because the implications are of great importance for the organization (Kreiner and Ashworth, 2004). Haslam et al. (2003) even claim that without organizational identification there is no effective organizational interaction, interconnection, significant planning as well as leadership.

The degree of organizational identification can change due to the nature of the relationship between employees and the organization, respectively, the more employees communicate with each other and spend time within the organization there is a greater tendency of identifying with it (Basar and Basim, 2015). According to Berelson and Steiner (1964) the perception is a process by which an individual receives stimuli and gives them a meaning based on a previous learning, memory, expectations, fantasies, beliefs and personality. Creating an environment in which positive perceptions of an individual create additional positive perceptions leads to greater identification with the institution.

The perception of the individual about the institution in which he is employed is one of the key criteria for organizational identification (Carmeli et al., 2006). Since the perception of an individual about the institution in which he is employed is highly influential, it is important to understand the relationship between individual perception and strength of organizational identification, and all with the goal of improving the performance of the institution. Organizational identity is by that: central, enduring or distinguishing identity attributes which can be analysed as part of the culture and beliefs of the organization (Whetten, 2006). The importance of understanding the organizational culture is reflected in the thesis that individuals are more effective when their personal competences are aligned with the culture of the organization where they are employed (Abbet et al., 2010). Organizational identity is built within the company, based on the culture of the organization, and the degree of identification affects the performance of the employee. Respectively, a sense of organizational identification creates a degree of perception to which an employee associates himself with the organization's goals and values (Miller et al., 2000). The attractiveness of organizational identity is strongly associated with the intensity of identification of employees in the organization (Dukerich et al., 2002).

It is very important to identify the level of compatibility of identification and organizational culture in organization, which is one of the accents of this empirical study. There are four types of organizational culture popularized by Handy (1999): power culture, role culture, task culture and people or existential culture. The classification of organizational culture is a prerequisite for a relatively quick but easy assessment of a specific organizational culture in the organization (Delić and Nuhanović, 2010). People culture is strongly oriented towards personality as well as on the needs and the values of an individual, unlike other three cultures where the individual is subordinated to the organization (Bako, 2010). People culture and determinant factors leading to cultural fit and success of both are freedom, actualization, individual growth and power from autonomy (Jittaruttha, 2010), and it is assumed that people's organization culture can promote the highest achievement of organization and its member. Although the number of employees may not affect organizational identification, this empirical research has linked organizational identification and number of employees in organization. As mentioned before, positive

identification decreases turnover and reduces conflict within an organization (Van Dick et al., 2004). When employees identify with organization, they are more likely to exert effort and avoid any kind of conflict situation especially because the team's success or failure becomes their own personal interest (Tyler and Blader, 2000). While small organizations are faced with greater challenges than larger organizations in retaining and attracting key employees (Marchington, et al. 1999), according to Petrakis and Kostis (2012) employees in small organizations have better interpersonal trust, less encounters and hence stronger identification. Based on the above discussion, the following set of hypotheses regarding relationships between employees' perceptions toward their workplace, organizational identification, organization culture and number of employees in higher education institutions in the Republic of Croatia were considered:

H1. The employee perception toward his workplace is going to be positively correlated with the intensity of organizational identification.

H2. Organizational identification will be higher in organizations with people's organization culture.

H3. Institutions with smaller number of employees are more inclined to have higher organizational identification.

3. Research Methodology

a. Data collection

For the purpose of this paper, a primary research was conducted on a sample of 164 respondents between the ages of 18 to 65 years, employed in higher education institutions in the Republic of Croatia. Data collection took place through January and February 2018. The random sampling method was used and the survey questionnaire was distributed over the Internet (500 of them are distributed). A self-administrated questionnaire was used for data collection. The questionnaire consisted of two parts and fifteen questions based on the review of available literature as well as the researches on a similar topic. The first part of the questionnaire included five closed questions regarding demographic characteristics of respondents: gender, age, education and questions about the typology of the organizational culture and the size of the organization where the respondents are employed. The second part of the questionnaire included seven questions regarding the employee perception toward his workplace and three questions about the organizational identification of employees with the organization where they are employed. All collected questionnaires, 164 of them, were originally inserted in Microsoft Excel and then transferred to statistical package "SPSS 20" which was used for processing the collated data.

b. Demographic analysis of respondents

A total of 164 people participated in the study, with 336 either declining participation or failing to return the questionnaire. Most of the respondents were females (66, 5%), middle aged, 36 – 45 years old (56, 1%) and highly educated (46, 3%). Most of them work in higher education organizations in the Republic of Croatia which by Handy's³ typology of organizational culture have team work oriented, rational and focused on the goal culture. The majority of respondents (34, 1%) are working in organizations with the number of employees from 21 employees to 100 employees. Precise demographic characteristics of the respondents can be seen in *Table 1*.

³Charles Handy (1932) – philosopher who has specialized in organization culture.

Table 1 Demographic characteristics of the respondent

Demographic characteristics of the respondents (N=164)	N	Percentage %	Cumulative percentage
Gender			
Male	55	33,5	33,5
Female	109	66,5	100,0
Age			
18 – 25	10	6,1	6,1
26 – 35	24	14,6	20,7
36 – 45	92	56,1	76,8
46 – 55	32	19,5	96,3
56 – 65	6	3,7	100,0
Education			
SSS	24	14,6	14,6
VSS	45	27,4	42,1
VSS	76	46,3	88,4
VSS or higher	19	11,6	100,0

Typology of organizational culture	N	Percentage %	Cumulative percentage
Development, adhocracy or the culture of power	13	7,9	7,9
Hierarchical, bureaucratic or the culture of roles	50	30,5	38,4
Rational, goal oriental or the culture of tasks	59	36,0	74,4
Group, team or directed to individuals	42	25,6	100,0
Number of employees per organizations			
20 or less	33	20,1	20,1
21 – 100	56	34,1	54,3
101 – 200	46	28,0	82,3
201 or more	29	17,7	100,0

c. Employee perception and organizational identification

Employee perception toward his workplace was measured with seven items: five adapted from the Feldman et al. (2014) and Rekom and Riel (2000) and two items created by the author.

The organizational identification of the individual with the institution where he is employed was measured with three items adapted from the Moksness (2014).

The responses were taken on a five-point Likert scale with responses ranging from 1 to 5, with 5 denoting strongly agree and 1 strongly disagree (*Table 2*).

Table 2 Perception of institution and identification with the institution

Institution where I work:	Strongly disagree		Disagree		Neither		Agree		Strongly agree	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Is socially responsible (Feldman et al., 2014)	22	11,2	88	44,9	559	336	774	445,1	221	112,8
Generates positive feelings in people (Feldman et al., 2014).	111	66,7	227	116,5	552	331,7	667	440,9	77	14,3
Has a positive and pleasant working environment (Feldman and others, 2014).	113	77,9	119	111,6	445	227,4	666	440,2	221	112,8
Has a top management with a strong sense for the institution history (Rekom and Riel, 2000).	99	55,5	335	221,3	556	334,1	550	330,5	114	88,5

Have well – defined goals (Rekomand Riel, 2000).	99	55,5	335	221,3	556	334,1	550	330,5	114	88,5
I feel insulted if the media is talking negatively about the institution I am employed in (Moksness, 2014).	44	22,4	226	115,9	444	226,8	771	443,3	119	111,6
I feel insulted if other people criticize the institution I am employed in (Moksness, 2014).	112	77,3	224	114,6	441	225	770	442,7	117	110,4
Has workers who are strongly associated with the institution (own research).	88	44,9	228	117,1	556	334,1	550	330,5	222	113,4
The success of the institution I am employed in I see as my own success (Moksness, 2014).	66	33,7	222	113,4	447	228,7	665	339,6	223	114
Is innovative and has a good leadership (Feldman et al. 2014).	88	44,9	330	118,3	660	336,6	449	229,9	117	110,4

From the total of 164 respondents, 74 of them (45,1 %) agrees that the one of the higher educational institutions in the Republic of Croatia where respondents are employed is socially responsible, and 67 respondents (40,9 %) replied that the institution where they work generates positive feelings in people.

66 respondents (40,2%) believe that their institution has a positive and pleasant working environment and 56 of the respondents (34,1%) do not agree nor disagree with the claim that the institution where they work has top management with a strong sense for their institutional history.

71 respondents (43,3%) say that their institution has well defined goals, 60 of respondents (36,3%) agree that it has workers who strongly associate themselves with the institution where they work and 65 respondents (39,6%) agree that their institution is innovative and with good leadership.

49 respondents (29,9%) say that they feel uncomfortable when they see negative comments in the media about the institution they work in. 56 respondents (34,1%) do not agree with the claim that they feel insulted when other people criticize their institution and 70 respondents (42,7%) consider the success of their institution like it is their own.

d. Reliability of scales

The reliability of this scale was evaluated by calculating Cronbach's alpha (α) coefficient, which measures the internal consistency of an individual factor. Cronbach's alpha is the most common measure for checking reliability (Field 2005). Higher value of Cronbach alpha coefficient indicates greater reliability; respectively it shows that the attributes of the same factor measure the same appearance.

According to George and Mallery (2003) categories of reliability values are: > 0.9 "Excellent", > 0.8 "Good", > 0.7 "Acceptable", and > 0.6 "Questionable", > 0.5 "Poor".

Cronbach's alpha (α) coefficient $\alpha = 0,838$ (Table 3) shows very good consistency between answers about the respondents' perception of the institution where the respondents are employed and Cronbach's alpha coefficient $\alpha = 0,854$ (Table 4) also suggests very good consistency between answers of the respondents about organizational identification.

Table 3 The reliability results

Cronbach's Alpha	No. of Items
,838	7

Table 4 The reliability results

Cronbach's Alpha	No. of Items
,854	3

e. Research analysis

After testing the reliability of used variables, we begin to analyze data in order to test the hypotheses where the Pearson's coefficient of correlation and t – test are used. There are some traditional criteria for measuring agreement between two rating approaches, such as Pearson's correlation coefficient and paired t-test (Li and Chow, 2005). Pearson's coefficient of correlations is used for variables and interval scales which are in a linear relationship (Udovičić et al., 2007). Rozga (2009) considers the correlation coefficients values in the following way: $r = -1$; $r = 1$ (functional negative / positive correlation), $-1 < r \leq -0,8$; $0,8 \leq r < 1$ (strong negative / positive correlation), $-0,8 < r \leq -0,5$; $0,5 \leq r < 0,8$ (medium strong negative / positive correlation), $-0,5 < r < 0$; $0 < r < 0,5$ (weak negative / positive correlation) and $r = 0$ (there is no correlation). Student's t – test is a statistical procedure to determine statistically significant differences between two independent samples, respectively, two arithmetic means. That is only applicable when there are two independent samples. Correlation coefficient between the employee perceptions toward his workplace is 0,582 and it is shown in Table 5. That coefficient is considered to have a medium strong positive correlation as well as statistically meaningful level of significance ($p \approx 0,000$). With that in mind, the hypothesis *H1* is confirmed respectively and it is confirmed that employee perception toward his workplace correlates positively with the organizational identification.

Table 5 Pearson's correlation

		Employee perception toward his workplace	Organizational identification
Employee perception toward his workplace organization he works in	Pearson's Correlation	1	,582**
	Sig. (2-tailed)		,000
	N	164	164
Organizational identification	Pearson's Correlation	,582**	1
	Sig. (2 tailed)	,000	
	N	164	164

Table 6 Group statistics

	Group, team or directed to individuals org. culture	N	Mean	Std. Deviation	Std. Error Mean
Organizational identification	YES	42	3,4603	0,93110	0,14367
	NO	122	3,2732	0,99587	0,09016

Table 7 T- test

		Levene's Test		T - test	T - test			T - test		
		F	Sig.	t	df	Sig.	Mean D.	Std.Err.D.	95 % Low	95% Upp
Organizational identification	Assumed	0,546	0,461	1,067	162	0,287	0,18709	0,17530	- 0,1590	0,53327
	Not ass.			1,103	75,676	0,274	0,18709	0,16962	- 0,1507	0,52494

Although the average organizational identification in the observed sample is higher in organizations that are group – based, team – specific and targeted to individuals ($\bar{X} = 3,46$, $SD = 0,93$, (Table 6.), T – test for independent samples (Table 7.) shows that there is no statistically significant difference ($p = 0,461$) between organizations directed to individuals and organizational identification, so the hypothesis *H2* in this research is rejected.

Table 8 Group statistics

	The size of organization (by the number of employees)	N	Mean	Std. Deviation	Std. Error Mean
Organizational identification	Small	89	3,3858	0,95200	0,10091
	Large	75	3,2444	1,01392	0,11708

Table 9 T- test

		Levene's Test		T - test	T - test			T - test		
		F	Sig.	t	df	Sig.	Mean D.	Std.Err.D.	95 %	95%
									Low	Upp
Organization identification	Assumed	0,224	0,636	0,919	162	0,359	0,14132	0,15373	-	0,44490
	Not ass.			0,914	153,536	0,362	0,14132	0,15456	-	0,44667

Even though in the observed sample there is a higher organizational identification in organizations with a smaller number of employees ($\bar{X} = 3,39$, $SD = 0,95$) (Table 8.), T- test for independent samples (Table 9.) shows that there is no statistically significant difference ($p = 0,636$) between the size of the organizations (by the number of employees) and organizational identification, and so the hypothesis *H3* is rejected in this research.

Correlations				
			Employee perception toward his workplace	Organizational identification
Spearman's rho	Employee perception toward his workplace	Correlation Coefficient	1,000	0,554**
		Sig. (2-tailed)	.	0,000
		N	164	164
	Organizational identification	Correlation Coefficient	,554**	1,000
		Sig. (2-tailed)	,000	.
		N	164	164

** . Correlation is significant at the 0.01 level (2-tailed).

The correlation coefficient is statistically significant (p approx. 0) and $p = 0.554$ which shows that the correlation between organizational identification and employee perception toward his workplace is positive and medium strong.

Mann-Whitney Test

Ranks				
	People's organization culture	N	Mean Rank	Sum of Ranks
Organizational identification	YES	42	89,63	3764,50
	NO	122	80,05	9765,50
	Total	164		

Test Statistics ^a		Organizational identification
Mann-Whitney U		2262,500
Wilcoxon W		9765,500
Z		-1,137
Asymp. Sig. (2-tailed)		0,255
a. Grouping Variable: People's organization culture		

Mann-Whitney test showed that there is no statistically significant difference in organizational identification between those who are focused on the individuals and those who are not - because the empirical level of significance is greater than 5% ($p = 0.255$).

Ranks				
	Size of the organization (Higher education institution)	N	Mean Rank	Sum of Ranks
Organizational identification	Small	89	85,29	7590,50
	Big	75	79,19	5939,50
	Total	164		

Test Statistics ^a		Organizational identification
Mann-Whitney U		3089,500
Wilcoxon W		5939,500
Z		-,825
Asymp. Sig. (2-tailed)		0,409
a. Grouping Variable: Size of the organization		

Mann-Whitney test showed that there was no statistically significant difference in organizational identification between small and large organizations because the empirical level of significance was greater than 5% ($p = 0,409$).

One-Sample Kolmogorov-Smirnov Test			
		The employee perception toward his workplace.	Organizational identification
N		164	164
Normal Parameters ^{a,b}	Mean	3,3605	3,3211
	Std. Deviation	,70695	,98030
Most Extreme Differences	Absolute	,092	,115
	Positive	,045	,080

	Negative	-,092	-,115
Kolmogorov-Smirnov Z		1,179	1,478
Asymp. Sig. (2-tailed)		0,124	0,025
a. Test distribution is Normal.			
b. Calculated from data.			

One variable is normally distributed, but the other is not, so despite the large sample it is better to do non - parametric tests (Mann-Whitney and Spearman), although the results are similar and the conclusions are the same.

4. Conclusion and Limitations

In this study, the relations between organizational identity and institutional reputation were investigated among 164 employees from higher education institutions in the Republic of Croatia. Organizational identity has a profound impact on organizational behaviour, the organization's functioning and the achievements of the organization. It is the articulation of what an organization is and how it works. The reputation of the organizations evolves over time, especially as a result of an effective communication. No organization can survive without communication with all key participants, and communication can be seen as a key element of the organizational climate. An important aspect of organizational culture in academic institution is represented by relationship between superiors and subordinates, who should, according to the principles of "academic culture" be collegial. This is a great challenge; it brings in itself the risk of unequal treatment of these two groups of employees; from their different roles in achieving the mission of these institutions, and also in different terms of status and social reputations. Reliable and timely transparent communication creates the reputation of the organization and builds organization identity. The study outcomes indicate that creating a good reputation can produce notable beneficial effects to the organization. The results of the current study suggest that in order to cultivate committed employees the perception of the individual about the institution is a very important part, in which employees are positively correlated with the intensity of organizational identification. Further, the link between organizations focused on individuals, respectively, where individuals are the focal point in the organization, have not been found correlated with organizational identification, although the average organizational identification in the observed sample in this study is higher in organizations which are group – based, team – specific and targeted to individuals. Even though there is a higher organizational identification in organizations with a smaller number of employees, in this study this hypothesis was not verified. Even a respectable number of respondents still represents a limited test on corporate identity and corporate reputation, and future research should consider a larger number of respondents. Nevertheless, this paper represents initial efforts to identify a corporate identity that will affect the corporate reputation of the higher education institution in the Republic of Croatia. The research is also the first to focus on corporate identity research in a specific area of higher education institutions, and at the same time, the results of the research suggest the higher education institution to consider incorporating a corporate identity program into its long-term institutional future planning. To address the limitations of the current study, further, future research should explore possible influences of other possible variables which would be identified as potentially influential in the relationship between organizational identity, organizational identification, organizational reputation and employee engagement observed in this study. Possible variables for following future researches could be detected through a focus group with employees of various higher education institutions in the Republic of Croatia. Clear higher education institution identity combined with a strong leadership is one of the important aspects of being successful, as well as having a good reputation.

REFERENCES

- Abbett, L., Coldham, A. & Whisnant, R. (2010). Organizational culture and the success of corporate sustainability initiatives: An empirical analysis using the Competing Values Framework. *Master thesis*. University of Michigan.
- Albert, S. & Whetten, D. A. (1985). Organizational identity. *Research in Organizational Behavior*, 7, 263 – 295.
- Ashforth, B. E. & Mael, F. (1989). Social identity theory and the organization. *Academy of Management Review*, 14, 20 – 39.
- Bako, R. K. (2010). Organizational Discourses as Status Symbols. *Acta Universitatis Sapientiae. Philologica*, 2 (1), 151 – 160.
- Balmer, J. M. T. & Liao, M. N. (2007). Student corporate brand identification: an exploratory case study. *Corporate Communications: An International Journal*. 12 (4), 356 – 375.
- Basar, U. & Basim, N. (2015). Effects of Organizational Identification on Job Satisfaction: Moderating Role of Organizational Politics. *Economic and Administrative Sciences Journal*, 22, 663 – 683.
- Bendixen, M. Bukasa, K.A. & Abratt, R. (2004). Brand equity in the business-to-business market. *Industrial Marketing Management*, 33, 371 – 380.
- Berelson, B. & Steiner, G. A. (1964). *Human behavior: An inventory of scientific findings*. Oxford, England: Harcourt, Brace & World.
- Carmeli, A., Gilat, G. & Weisberg, J. (2006). Perceived external prestige, organizational identification and affective commitment: A stakeholder approach. *Corporate Reputation Review*, 9, 92 – 104.
- Carmeli, A., Meitar, R. & Weisberg, J. (2006). Self - leadership skills and innovative behavior at work. *International Journal of Manpower*, 27 (1), 75 – 90.
- Celly, K. S., & Knepper, B. (2010). The California State University: A case on branding the largest public university system in the US. *International Journal of Nonprofit and Voluntary Sector Marketing*, 15 (2), 137 – 156.
- Corley, K. G., Harquail, C. V., Pratt, M. G., Glynn, M. A., Fiol, C. M. & Hatch, M. J. (2006). Guiding organizational identity through aged adolescence. *Journal of Management Inquiry*, 15, 85 – 99.
- Curtis, T., Abratt, R. & Minor, W. (2009). Corporate brand management in higher education: the Case of ERAU. *Journal of Product and Brand Management*. 18(6), 404 – 413.
- Delic, A. & Nuhanovic, S. (2010). The Organizational Structure and Organizational Culture Interdependence Analysis with a Special Reference to Bosnian and Herzegovinian Enterprises. *Economic analysis*, 43 (3 / 4), 70 – 86.
- Dukerich, J. M., Golden, B. & Shortell, S.M. (2002). Beauty is in the eye of the beholder: The impact of organizational identification, identity and image on physician cooperative behavior. *Administrative Science Quarterly*, 47 (3), 507 – 533.
- Feldman, P. M., Bahamonde, R.A. & Bellido, I.V. (2014). A new approach for measuring corporate reputation. *Revista de Administracao de Empresas*, 54 (1), 53 – 66.
- Field, A. (2005). *Discovering statistics using SPSS* (2nd ed.). London: Sage.
- Fiol, C.M. (2002). Capitalizing on Paradox: The Role of Language in Transforming Organizational Identities. *Organization Science*, 13(6), 653 – 666.
- George, D. & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference*. Boston, MA: Allyn & Bacon.
- Gioia, D. A. (1998). *From individual to organizational identity*. Identity in organizations: Building theory through conversations: 17 – 31. Thousand Oaks, CA: Sage.
- Handy, C. (1999), *Understanding organizations*, Penguin Books, London.
- Haslam, S. A., Postmes, T. & Ellemers, N. (2003). More than a metaphor: Organizational identity makes organizational life possible. *British Journal of Management*. 14, 357 – 369.
- Haslam, S. A., Postmes, T. & Ellemers, N. (2003). More than a metaphor: Organizational identity makes organizational life possible. *British Journal of Management*, 14, 357 – 369.

- Hemsley - Brown, J. & Oplatka, I. (2015). University choice: what do we know, what don't we know and what do we still need to find out? *International Journal of Educational Management*, 29 (3), 254 – 274.
- Jittaruttha, C. (2010). *Cultural - Fit Management in Expensive Cultural Organization: An Exploratory Case Study of Professional Organization on Advertising Agency*. The Institute of Vocational Education and Adult Education, East China Normal University, China. 37 – 38.
- Kreiner, G. E. & Ashforth, B. E. (2004). Evidence toward an expanded model of organizational identification. *Journal of Organizational Behavior*, 25, 1 – 27.
- Kreiner, G. E. & Ashforth, B. E. (2004). Evidence toward an expanded model of organizational identification. *Journal of Organizational Behavior*. 25, 1 – 27.
- Mael, F. & Ashforth, B. E. (1992). Alumni and their alma mater: A partial test of the reformulated model of organizational identification. *Journal of Organizational Behavior*, 13, 103 – 123.
- Marchington, M., Wilkinson, A., Ackers, P. & Dundon, T. (2001). *Management Choice and Employee Voice*, London, CIPD Publishing.
- MartićKuran, L. & Mihić, M. (2014). Primjenateorijeplaniranogponašanja u kupoviniekološkehrane. *Tržište*, 26, 179 – 197.
- McAlexander, J. H., Schouten, J. W., Koenig, H. F. (2002). Building brandcommunity. *Journal of Marketing*. 66 (1), 38 – 54.
- Melewar, T. C. & SibelAkeli, 2005. The role of corporate identity in the higher education sector. *Corporate Communication: An International Journal*. 10 (1), 41 – 57.
- Miller, V., Allen, M., Casey, M. & Johnson, J. (2000). Reconsidering the Organizational Identification Questionnaire. *Management Communication Quarterly*, 13, 626 – 658.
- Moksness, L. (2014). Verbal Measure, or Graphic Measure, or Both? Psychometric Study of Organizational Identification. *Master thesis*. UiTNorway's Arctic University.
- Petrakis, P. & Kostis, P. (2015). The Role of Knowledge and Trust in SME's. *Journal of the Knowledge Economy*, 6 (1), 105 – 124.
- Rekom, J. R. & Riel, C. B. M. (2000). Operational Measures of Organizational Identity: A Review of Existing Methods. *Corporate Reputation Review*, 3 (4), 334 – 350.
- Rozga, A. (2009). *Statistikaekonomiste*. Ekonomskifakultet, Split. (monografija).
- Suddaby, R., Foster, W. M. & Trank, C. Q. (2016). Remembering: Rhetorical History Identity Work. *The Oxford Handbook of Organizational Identity*, 297 – 316.
- Tyler, T. R. & Blader, S. L. (2000). *Cooperation in groups: Procedural justice, social identity, and behavioral engagement*. Philadelphia: Psychology Press.
- Udovičić, M., Baždarić, K., Bilić – Zulle, L. & Petrovečki, M. (2007). Štotrebaznatikadaizračunavamokoefficientkorelacije? What we need to know when calculating the coefficient of correlation? *Biochemia Medica*, 17(1), 10 – 15.
- van Dick, R. (2004). My job is my castle: identification in organizational contexts. *International Review of Industrial and Organizational Psychology*, 17, 171 – 204.
- Van Knippenberg, Daan & Els C. M. Van Schie (2000). Foci and correlates of organizational identification. *Journal of Occupational and Organizational Psychology*, 73 (2), 137 – 147.
- Whetten D. A. (2006). Albert and Whetten Revisited: Strengthening the Concept of Organizational Identity. *Journal of Management Inquiry*. 15, 219 – 234.

Empathy – Is It Measurable and Teachable?

Nataša Uzelac

Zagreb University of Applied Sciences, Croatia
nuzelac@tvz.hr

Marta Alić

Zagreb University of Applied Sciences, Croatia
malic@tvz.hr

Abstract. This paper offers the findings of a review regarding the term empathy and its two dimensions – measurement and education. The main question that is discussed through the paper is the definition of the term, as well as its measurability and possibility of being taught. Empathy is a critical interpersonal and societal role, which enables cognitive and emotional understanding of others' feelings and experiences. In business processes, empathy is the key indicator for improving customer satisfaction and revenue growth and as such was analyzed in 2014 by the Harvard Business Review. The Global Empathy Index was established and analysis on a sample of companies with major financial indexes was conducted. Over the years, the criteria were adjusted and the data sources were expended. Even though the conducted research revealed that top 10 companies in the 2015 Global Empathy Index increased in value more than twice, in comparison to the bottom ten and generated 50% more earnings, the problem that still persist is empathy implementation as well as the negative connotations and its quantify issue. The purpose of this article is to provide a review of larger scale empathy indicators and to define empathy as a discipline that can be learned with the proper education and promotion among the leaders.

Key words: *empathy, quantify, implementation, education, indicators*

1. Introduction

In the past people operated in a different mode with very structured routine and little expectations. They would buy the same product from the same supplier, or they would join a company, staying with the same employer for decades. As the generations are shifting, the expectations are also completely different. If we analyze the Z generation, the demographic group with birth dates in the mid-1990s to mid-2000s, who grew up with Information and Communication Technology (ICT) from the earliest age, their requirements and habits are becoming an essential segment of study in today's user-centric business. To this intensely "connected" generation, social media is a key element in shaping their worldview, providing them the transparency of the experience and feedback of other users. The experience and the feedback of others is a ground for making a decision. According to Harry Wallop (Wallop, 2014), journalist of The Daily Telegraph, the generation Z is, compared to the previous, millennials: "smarter, safer, mature and want to change the world".

Due to the growing customer connectivity, sales research has advanced, focusing on achieving unique and personalized user experiences across all sales channels. Today's users are no longer looking for products as much as experience through added value during their purchase. A quality product is no longer sufficient, while competition is becoming more and more global.

As business processes are becoming more automated and artificial intelligence over-consuming, organizations need to become more human than ever. In a world where technology

change is constant and unpredictable, those organizations that make the fullest use of uniquely human skills will win. (Dearborn, Judge, Raftery, & Ungerleider, 2018).

While humanness is a goal, empathy is metric.

2. In Search of (Corporate) Empathy

The definition of empathy varies but, from Merriam-Webster dictionary, empathy is “the action of understanding, being aware of, being sensitive to, and vicariously experiencing the feelings, thoughts, and experience of another of either the past or present without having the feelings, thoughts, and experience fully communicated in an objectively explicit manner”¹.

Although it has been studied from the various disciplines, psychology has developed scales to measure empathy as a personality trait (Lee, 2016a) and it is commonly accepted that empathy has both, cognitive and emotional components (Davis, 1994). While cognitive empathy (CE) represents the ability to understand others' on mental level, predict their next moves and detect when others are lying, emotional empathy (EE) motivates individuals to behave altruistically toward others and provides the fundamental basis for social bonding (Smith, 2006). It can vary widely across individuals, ages, and personalities (Eisenberg & Morris, 2001).

However, in terms of wider communities, such as corporations, the question that imposes itself is: can empathy be validated or even measured?

Empathy is a main component of SERVQUAL scale, the most widely used, validated and generally accepted instrument in service quality measurement. The model was introduced in 1988 (a Parasuraman, Zeithaml, & Berry, 1988) and it is composed of 22 Likert-type items in five dimensions. The dimensions are: Tangibles which encompass physical facilities, equipment and appearance of personnel; Reliability reflects the ability of the provider to perform the service which was promised as accurately as possible; Responsiveness reflects service to customers; Assurance trust and confidence of employees; Empathy to customers.

By using elements of SERVQUAL, research by Cho et al. (Cho, Lee, Ahn, & Hwang, 2012), questioned the relationship of measures and metrics which are used in Service Supply Chain Performance Management. The research used empathy as a customer service metric, along with tangibles, including physical facilities, equipment, appearance of personnel and assurance represented in performance metrics (range of services, service capacity customer satisfaction and their loyalty). Results showed that customer service has the most impact (0.56/1) on performance, with empathy scoring (0,38), same as assurance element.

Therefore, empathy factor is two-dimensional; not only as perceived service, but also as affective evaluation in behavioral/conative responses (Chiu, 2002) (Edwards, 1990) (Edvardsson, 2005).

Analyzing the brand image, as marketing goal for building positive perception of product/company, a wide range of business metrics can be found but in terms of emotional attributes of building corporate image new metrics need to arise.

Linking products and services to emotional attributes (such as sincerity, trustworthiness) is beneficial and vital to enhance a brand's corporate image (Azoulay & Kapferer, 2003) (Davies et al., 2004) (Patterson, 1999). Balmer (Balmer, 2009) explains that corporate brand refers to stakeholder's image of the organization that is gained from brand values, a synthesis of key values built-in within the corporate identity. Empathy is such value.

¹ <https://www.merriam-webster.com/dictionary/empathy>

For example, in higher education sector, where emotional and affective branding is highlighted by the reputation of the institution and building loyalty through the “alma mater”, research by Alwi and Kitchen (Syed Alwi & Kitchen, 2014) places empathy in relation to brand image and behavioral response in business schools. As such, empathy has a significant role in recommendation process; because students’ positive recommendations are depended largely on the affective rather than upon the cognitive brand attributes of the school. Empathy was quantified in terms of concern, support, reassurance and trustworthiness of communication. By facing two distinctive attributes: corporate cognitive and affective brand images, it was established that the attribute that is more affective is brand attribute, and as such is considered to be more important in an institutional context and in terms of metrics. Its emotional component needs to be emphasizes while designing brand management. Empathy scored the most in validity and reliability of proposed model.

On the other hand, in automotive industry, a very competitive, innovation demanded and brand oriented sector, research by Loureiro et al. in Portugal has put empathy as a metric in conjunction with relationships that customers build with brand. These relationships included brand's willingness to help, to mind best interest and to understand the needs of customers, as well as customer's feeling of safety in relationship with brand. As in previous research by Cho et al., in their structural equation model constructed using Partial Least Squares method, empathy composite scored highest in reliability to perceived value for customer. However, this research also reveals empathy in greater context of social responsibility. By testing influence of other constructs on customer satisfaction and perceived value of a brand, authors have questioned other social factors that can be also identified as signs of empathy; care for others, labor practices (working conditions in factories, children employment), environment (recycling policies, CO and CO2 emissions, overall environmental damage), community (positive effect on society, sponsorships of worthy causes).

In reference to communities, corporations as a subject and society as an environment, this social responsibility could be an answer, a metric for corporate empathy. In 2001, the European Commission defined Corporate Social Responsibility (CSR) as “a concept whereby companies decide voluntarily to contribute to a better society and a cleaner environment” (European Commission, 2001).

As studies already have shown, customers may exhibit positive attitudes toward socially responsible products (Loureiro & Lotade, 2005) encouraging them to behave altruistically toward products with social claims (Smith, 2006). Nevertheless, consumers who score high in emotional empathy show greater willingness to pay a premium price for a pro-social product as a opposed to a conventional product (Lee, 2016b). But empathy also leads to an increased loyalty (A. Parasuraman & Grewal, 2000), and it can be used as lever in building corporate strategies.

In this customer-centric world, it is more important than ever, to obtain and retain customers. Customer equity, usually a marketing KPI (Key Performance Indicator), which provides financial return of individual customer's lifetime relationship with a brand, is spreading it's boundaries, not only to sales and customer care, but to the top management. The essence of customer equity is building relationships with a consumer and as such has a direct connection to customer's lifetime value (CLV), (Gupta et al., 2006), as “the present value of all the expected future profits obtained from an individual customer over his or her lifetime of a relationship with a firm”.

Back to the Z generation. Research Do CSR actions in retailing really matter for young consumers? A study in France and Norway on 16 business students (8 in each country) describe and compare social responsibility practices of retailing sectors in France and Norway “through the eyes” of male and female undergraduates aged 18–25. The study (Loussaïef, Cacho-

Elizondo, Pettersen, & Tobiassen, 2014) suggests that young people show high awareness of the social responsibility issues and that CSR actions can positively affect consumer attitudes and their relationships with retailers, but the retailers are sometimes failing to communicate their CSR efforts through branding.

3. Methods and Results

After the development of the Global Empathy Index, a Lady Geek consultancy conducted a research in 2014, 2015 and 2016. The Lady Geek 'Empathy Quotient' was inspired by Simon Baron Cohen's 'Empathizer' and 'Systemizer' model (Parmar, 2015b). The purpose of the model was to measure levels of empathy in large consumer-facing companies with a significant presence in the UK. In this methodology, three components defined empathy: customer, employee and social media and all three were combined to generate each individual company ranking.

The combination of these components, with equal weighting, across the following channels: internal channel-employees, external channel-customers, and social channel - public via social media, were the core of the "empathy quotient" (Parmar, 2015b). Source for employee and customer perspective in 2015 research were nationally statistically representative samples in the UK and publicly available data. The social media data was extracted from public communications made by the company and the algorithm classified empathic and unempathic interactions on Twitter. The most significant part in this research was a standardization of the measures with a purpose of collecting and recording data with the unique technique. Data partners included Glassdoor and Survation. All surveys in 2015 were conducted online with the sample of 1000 nationally representative customers and each employee review was based on at least 25 employee reviews. The social media algorithm performed a textual analysis that extracted data on behavior such as frequency of complaints and use of repetitive language. In total, half of million tweets were analyzed during the period October 6 and October, 31 2015. This data was scaled to give each company a score between zero and one for each metric, with the worst performing companies getting a score of zero and the best performing companies getting a score of one. On a sample of 160 companies, the highest empathy score was given to Microsoft, Facebook, Tesla Motor, Alphabet (Google) and Procter & Gamble. Also the results showed that the top five companies make up for 15% of the index's total market capitalization and their market capitalization has grown in 2015 by 23.3% compared to weighted average of 5.2% of all the companies in the index (Parmar, 2015b).

In 2016, the Empathy index was conducted on a sample of 170 companies and the top five companies with highest score were: Facebook, Alphabet (Google), LinkedIn, Netflix and Unilever. The analysis included the internal culture, CEO performance, ethics and social media presence. The index was built on the methodology in 2015, only updated to reflect a deeper understanding of empathy. The empathy fragmented into following categories: ethics, leadership, company culture, brand perception and public messaging through social media. Publicly available metrics included CEO approval rating from staff, ratio of women on boards, and number of accounting infractions and scandals. The carbon metric was also added in 2016 and the source for financial information was S&P Capital IQ and Glassdoor for the employee information. Research analyzed 2 million tweets between September 27 and October 16 2016 (Parmar, 2016). The results in 2016 revealed that top 10 companies in the 2015 Global Empathy Index increased in value more than twice as much as the bottom ten and generated 50% more earnings. Comparing all the results from 2014, 2015 and 2016 the company that was through all three years at the top five was LinkedIn. The company had a strong presence on the rival platform Twitter, a little bit unexpected, but they made an effort to follow their customers, even

with the risk of negative connotations. This move showed that LinkedIn empathizes with customer's interests and choices.

Even though the companies are aware of the empathy impact, the problem that still persists is implementation of empathy, as well as the misconception that empathy is intangible and soft good, and as such is hard to quantify. In 2014 at the World's Economic Forum, the CEO of a British bank, said that empathy is important, but that most of his people think that empathy is for "wimps" (Parmar, 2015a). This point of view is not an isolated case, as Belinda Parmer mentions, many CEO's see empathy as an intangible quality and as such hard to quantify.

This misconception of empathy needs to change with the proper education of leadership and employees.

4. Empathy – Is It Teachable?

According to the results from a series of studies in 2009 and 2010 ineffective managers make up half of the today's organizational management pool (W. A. (Bill) Gentry, Logan, & Tonidandel, 2014).

This fact implies that it is not possible to let go 50% of managers but then, on the other hand, this group of underperforming managers is very expensive, so it is recommendable to establish the educational tool to improve their chances of success. Center for creative Leadership (CCL) implies that one of those tools is empathy and defines it as the ability to experience and relate the thoughts, emotions, or experience of others. They define empathy as a construct that is fundamental to leadership (W. A. Gentry, Weber, & Sadri, 2007).

CCL states that to improve performance and effectiveness of managers, they need to develop the capability to demonstrate empathy. Goleman defines empathy as a key part of emotional intelligence and critical discipline for effective leader. In one company for biotechnology, the president proudly explained that his organization is modern and not a single employee has an office. Instead, they all had laptops and connection to others. People are very satisfied and they are working 70 and 80 hours per week. On the contrary, the employees said that they are feeling deprived of their personal life, drained and exhausted. They felt as nobody is listening and they had a strong need for empathy and connection with other people (Goleman, 2008).

The result from CCL study, conducted on the group of 6,371 leaders from 38 countries with 360° instrument, shows that the ability to understand what others are feeling is a necessary skill for effective leadership. Empathetic leaders are able to effectively build and maintain relationships that are a critical part of leading organizations (W. A. Gentry et al., 2007). To provide a more empathetic culture that nurtures the improvement of manager's empathy, organizations and employees, need to:

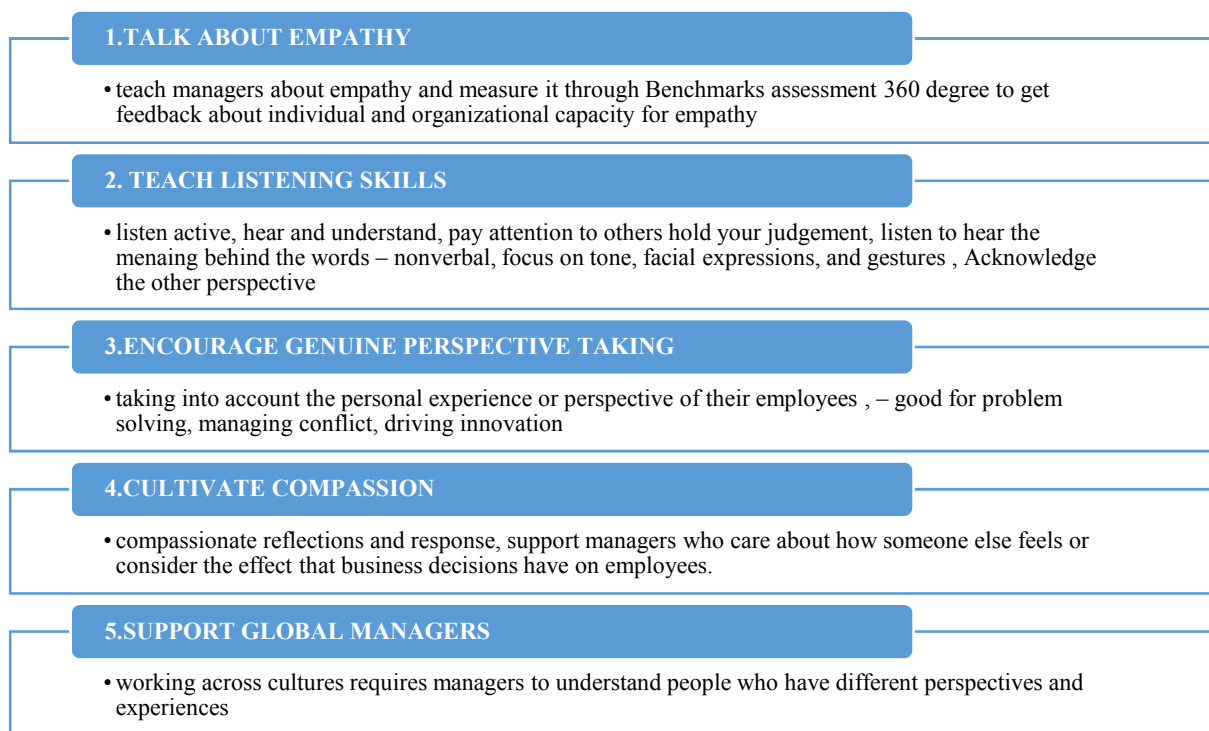


Figure 1 Guidelines to empathy

The fact that empathy as a discipline is teachable is emphasized by Parmer "not only can large consumer-facing organizations be empathetic, but it is a hard skill that should be required from the boardrooms to the shop floor" (Dishman, 2015). Shapiro also states that empathy is not a fixed trait and it can be learned and also that leaders can develop and enhance their empathy skills through coaching, training and developmental opportunities and initiatives (Shapiro, 2002).

Shapiro and Parmer are implying that empathy is teachable, but its implementation is necessary from the top. Primarily obligation is to teach the board and the middle management about the values of empathy on intern procedures and processes as well as on the external public – consumers. Than the board needs to educate the employees and create the organizational climate that supports empathy. This is not an easy task because it requires the right mindset of the entire organization, commitment and time. If there is a will to learn, it is necessary to take time to learn it and to teach others across the organization.

Table 1. shows the positive and the negative results of empathy practice in a various organization's, as well as the purpose and the effect. As it is shown, the purpose is to understand customers and their needs so organizations can achieve increased sale and profit. The organization that did not understand their customers and that did not act through empathy had a negative effect – like bankruptcy.

Table 1 Positive and negative practice and their effect on the company's business

Source	Company	Positive/ Negative practice	The purpose	Effect
10 companies that are great at empathy (Thompson, 2016)	Facebook	Empathy lab – provides Facebook Empathy lab – provides Facebook engineers the chance to experience how customers will use the products – even if they are visually impaired or hard of hearing	To understand what customers are experiencing	The desired effect of the Empathy lab is to : <ul style="list-style-type: none"> a. <i>To build product on the needs of the customers</i> b. <i>To build empathy into engineering</i>
The Most Empathetic Companies, 2016 (Parmer, 2016) 10 companies that are great at empathy (Thompson, 2016)	Ryanair	Always Getting Better program – is about listening to customer feedback	Making the policies that people don't like- unallocated seating, draconian luggage rules, hidden charges...	After this program, in 2016, Ryanair increased net profits and climbed 13 places in the Empathy Index
The Role of Empathy in Social Enterprise (Brinker, 2017)	Pacific Southwest Airlines	Company that tried to expand into the car rentals and hotel business – that was outside of the company's expertise .but at the time this sectors offered profit.	The company wanted more profit and this sectors offered enticing profit potential	Bankruptcy - the airliner that emerged from the bankruptcy: Southwest Airlines

Source	Company	Positive/ Negative practice	The purpose	Effect
The Role of Empathy in Social Enterprise (Brinker, 2017)	General Motors	The company focused on building a large gas guzzlers, including SUVs and pickup trucks	Profit through empathy	By 2009 GM was bankrupt because when oil prices spiked from 2004 to 2008 people slowed their purchase of big trucks. GM emerged from this state with new understanding – short terms profit isn't everything. GM offers the all electrical Chervolet Volt, and they became a leader in climate change action
Can empathy really work in a business world dominated by testosterone? (Parmar, 2014)	L'Oréal	The best empathizers in sale sold nearly \$ 100,000 more per year than their colleagues	Profit through empathy	Increased sale
The Most Empathetic Companies, 2016 (Parmar, 2016)	European bank	Empathy fund- a small pot of money put to use from the retail staff to engage with its own customers – sending a sympathy card to a bereaved client	To engage with customers	Increased sale

5. Discussion

In the beginning of the article, the definition of empathy is set as individual action of understanding, being aware and being sensitive to other feelings and thoughts. This is an ability to understand the position of others and the other's point of view in order to gain a deeper insight into their perspective.

Contrary to this approach the definition of the empathy through the organization's eyes, is a different concept. As it was mentioned before, there is obvious correlation between empathy and commercial success. Business organizations are more profitable and productive when they act ethically and treat their staff with respect and communicate better with the customers. The concept "Empathy" is used in business for a specific goal, and that is to improve sales – so that

companies are more profitable and productive (see Table 1). This is actually very similar to the definition that professor Philip Kotler explained about marketing “meeting the needs of your customer at a profit” (Kotler, 1973). Rene Schuster, former CEO of Telefonica Germany, said: ” Empathy is not a soft nurturing value, but a hard commercial tool that every business needs as a part of their DNA, our aim is to make every interaction our customers have with us an individual one” (Parmar, 2015a). Schuster implemented a Germany wide Empathy training program that led to an increase in customer satisfaction of 6% just in 6 weeks (Parmar, 2015a).

But again we can see that Schuster defines empathy as a hard commercial tool that is used for improving a customer satisfaction (Parmar, 2015a). In today's world, organizations are listening to their consumers, but not in order to be sensitive, but rather to achieve the sales and make a product that fits the needs and desires of the customers. Organizations are also modifying the products by different price range so that various groups of people with different financial possibilities can buy the product. If all the organizations acted empathetically in business and if all managers would take time to be sensitive to the needs of their employees and consumers, what would really happen?

Being empathetic to some point is reasonable, but if the deeper empathy would be recommended, that could have a negative turn, not only in business but in a real world. If people would really consume their time with the feelings of others, could they go forward? For example if one of the employees is seriously sick and all the other employees spend time thinking and dwelling about his condition, business would probably suffer and on the other hand "feeling sorry" and "feeling someone pain and their emotions" is not helpful neither to organization nor to this person. Is empathy really the way? Or do organizations and people just need to be more responsible, professional and ethical? It is important to approach the definition of the concept in the way that is stated and call it by the real name.

All the discussion about the concept of empathy is about acting in professional and ethical way, and educating people within our organization how to become more professional and ethical, and to some point "empathetical". People need to develop their listening skills so they could learn how to communicate with others and how to acknowledge the other point of view. But all of that should be done in a productive way. The real question is are the organizations and employees ready to learn, are they really mature enough to understand each other and to communicate and relate on a deeper level so they could accomplish more for themselves and for the entire organization. Also, the more relevant question should be considered: Are organizations ready to listen to their employees, to thrive for better results and effective and healthy organizational climate? Can the board be taught how to listen so they can teach the employees?

6. Future research guidelines

In order to implement empathy as a tool for revenue growth and customer and employee satisfaction, it is necessary to establish preliminary actions. Foremost, the empathy that arrived from the cited bibliography is corporate empathy and as such provides different definition and purpose. Before the next research, the definition should be clearly established and pointed in all questionnaires. The SERVQUAL scale (a Parasuraman et al., 1988) can be used in order to measure the leadership efficiency in employee satisfaction in five dimensions modified to fit the needs and the purpose of the research. The five dimensions are: Tangibles which encompass physical facilities, equipment and appearance of leadership; Reliability reflects the ability of the leaders to perform as promised and accurately as possible; Responsiveness measures willingness of leadership to interact with employees; Assurance reflect trust and confidence and Empathy to employees. At the same time, the 360-degree instrument can compare the self-perception of the leaders with an observation of their subordinates, as well as the superiors and

colleagues in order to gain perspective of leader's competencies, communication skills and insight in their emotional intelligence and empathy quotient. In order to do all this research in a company, trust among employees should be established and anonymity should be guaranteed. The anonymity of the process can be guaranteed only through an independent platform that is not internal and in the possession of a company that is conducting research.

Foremost the research should be conducted on the current situation and then on the basis of the results, methods for improvement should be established. In a year period, the research should be revised so the progress in empathy implementation can be measured. Leadership should also have empathy as a key performance indicator, for example: providing the accurate education of empathy to the employees, on quarterly basis with the intention of increasing their awareness for 60%. This KPI can be measured before the learning process and after the learning process is finished. This KPI can also be cascaded down on a per employee basis, improving the empathy skills for 60%.

More important is the selection criteria, if the purpose is leadership with empathy quotient, than the selection process should observe their behavior in stress situation, as well as their managerial skills. In this process, the Success Insights method (TTI Success Insights, n.d.) should also be included due to its behavioral component, and with the purpose to provide assessments. The Insight method is a behavioral assessment tool and consist the TTI Success Insights® DISC with four behavioral styles: Dominance, Influence, Steadiness and Compliance. DISC measures how a person behaves and reveals insights into how members of staff, management and leadership are likely to respond in certain situations. In addition, the method consist driving Forces (motivators) and reveals how each person is uniquely motivated at work and in life.

The important part of the method is Emotional Quotient™ (EQ) (TTI success insights, 2013) that accurately measures a person's emotional intelligence, the ability to understand and effectively apply the power of overall emotional well-being to facilitate higher levels of collaboration and productivity and is commonly used to develop leaders, engage teams, coach and in succession planning.

When the empathy is established and implemented in all internal processes in the organization than it can be transferred to external public – customers, with the purpose of satisfying their needs and bringing profit to a company.

7. Conclusion

If organizations want to have an organizational culture that understands and promote listening, ethical and professional skills, as well as the 'empathy concept', then it's their responsibility to educate the employees.

But there is one more step before the empathy implementation into business process: organizations should establish the right criteria for the process of selection and hiring employees. The most important step towards "healthier society and healthier business environment" is the selection of right people for the individual organization. Employees should be able to connect and align with organizations values and in this way, they can adopt faster to the new rules, as well as the new principles and methods.

This concept of "Empathy" is new approach to business, because in the past few decades with the attempt of implementing the market economy, all of the elements of this concept were abandoned. In this attempt people started to neglect each other, not only the feelings and understanding of one other, but also the professional and cultural behavior that has a strong ground in business ethics.

More than half a century ago the Russell-Einstein Manifesto (Russell; Bertrand & Einstein, 1955) called to “remember your humanity and forget the rest!” Now, has come a time to retrieve those words and shift the perspective and to enter in business with touch of humanity, respect for each other, understanding and compassion, because only through the sum of intellectual capital, organizations are moving forward.

REFERENCES

- Azoulay, A., & Kapferer, J.-N. (2003). Do brand personality scales really measure brand personality? *Journal of Brand Management*, 11(2), 143–155.
- Balmer, J. (2009). Corporate marketing: apocalypse, advent and epiphany. *Management Decision*, 47(4), 544–573.
- Brinker, B. (2017). The Role of Empathy in Social Enterprise. Retrieved March 31, 1BC, from <https://changecreator.com/the-role-of-empathy-in-social-enterprise/>
- Chiu, H.-C. (2002). A study on the cognitive and affective components of service quality. *Total Quality Management*, 13(2), 265–274.
- Cho, D. W., Lee, Y. H., Ahn, S. H., & Hwang, M. K. (2012). A framework for measuring the performance of service supply chain management. *Computers and Industrial Engineering*, 62(3), 801–818.
- Davies, G., Chun, R., da Silva, R. V., Roper, S., Vinhas, R., Roper, S., ... Roper, S. (2004). A corporate character scale to assess employee and customer views of organization reputation. *Corporate Reputation Review*, 7(2), 125–146.
- Davis, M. H. (1994). *Empathy: a social psychological approach* (Social Psy). Westview press.
- Dearborn, J., Judge, D., Raferty, T., & Ungerleider, N. (2018). The Human Angle. Retrieved March 27, 2018, from <http://www.digitalistmag.com/executive-research/the-human-angle>
- Dishman, L. (2015). These Are The Most Empathetic Companies In The World. Retrieved April 9, 2018, from <https://www.fastcompany.com/3054098/these-are-the-most-empathetic-companies-in-the-world>
- Edvardsson, B. (2005). Service quality: beyond cognitive assessment. *Managing Service Quality: An International Journal*, 15(2), 127–131.
- Edwards, K. (1990). The interplay of affect and cognition in attitude formation and change. *Journal of Personality and Social Psychology*, 59(2), 202–216.
- Eisenberg, N., & Morris, A. S. (2001). The Origins and Social Significance of Empathy-Related Responding. A Review of Empathy and Moral Development: Implications for Caring and Justice by M. L. Hoffman. *Social Justice Research*, 14(1), 95–120.
- European Commission. The Green Book—Promoting a European framework for corporate social responsibility (2001).
- Gentry, W. A. (Bill), Logan, P., & Tonidandel, S. (2014). Understanding the Leadership challenges of first-time managers. strengthening your leadership pipeline. *Center for Creative Leadership*, 18.
- Gentry, W. A., Weber, T. J., & Sadri, G. (2007). Empathy in the Workplace. *Centre for Creative Leadership*, (April), 1–13.
- Goleman, D. (2008). *Emocionalna inteligencija u poslu*. Mozaik knjiga.
- Gupta, S., Hanssens, D., Hardie, B., Kahn, W., Kumar, V., Lin, N., ... Sriram, S. (2006).

- Modeling customer lifetime value. *Journal of Service Research*, 9(2), 139–155.
- Kotler, P. (1973). Atmospherics as a Marketing Tool. *Journal of Retailing*, 49(4), 48–65.
- Lee, E. J. (2016a). Empathy can increase customer equity related to pro-social brands. *Journal of Business Research*. <https://doi.org/10.1016/j.jbusres.2015.05.018>
- Lee, E. J. (2016b). Empathy can increase customer equity related to pro-social brands. *Journal of Business Research*, 69(9), 3748–3754.
- Loussaïef, L., Cacho-Elizondo, S., Pettersen, I. B., & Tobiassen, A. E. (2014). Do CSR actions in retailing really matter for young consumers? A study in France and Norway. *Journal of Retailing and Consumer Services*, 21(1), 9–17.
- Parasuraman, A., & Grewal, D. (2000). The impact of technology on the quality value loyalty chain: A research agenda. *Journal of the Academy of Marketing Science*, 28(1), 168–174.
- Parasuraman, a, Zeithaml, V. a, & Berry, L. L. (1988). SERQUAL: A Multiple-Item scale for Measuring Consumer Perceptions of Service Quality. *Journal of Retailing*.
- Parmar, B. (2014). Can empathy really work in a business world dominated by testosterone? Retrieved April 10, 2018, from <https://www.theguardian.com/women-in-leadership/2014/jun/18/empathy-secret-revolutionise-business>
- Parmar, B. (2015a). Corporate Empathy Is Not an Oxymoron. Retrieved March 30, 2018, from <https://hbr.org/2015/01/corporate-empathy-is-not-an-oxymoron>
- Parmar, B. (2015b). The Most (and Least) Empathetic Companies. Retrieved April 9, 2018, from <https://hbr.org/2015/11/2015-empathy-index>
- Parmar, B. (2016). The Most Empathetic Companies, 2016. Retrieved March 31, 2018, from <https://hbr.org/2016/12/the-most-and-least-empathetic-companies-2016>
- Patterson, M. (1999). Re-appraising the concept of brand image. *Journal of Brand Management*, 6(6), 409–426.
- Russell; Bertrand, & Einstein, A. (1955). Russell–Einstein Manifesto. Retrieved April 9, 2018, from <https://pugwash.org/1955/07/09/statement-manifesto/>
- Shapiro, J. (2002). How do physicians teach empathy in the primary care setting? *Academic Medicine*, 77(4), 323–328.
- Smith, A. (2006). Cognitive Empathy and Emotional Empathy in Human Behavior and Evolution. *Psychological Record*, 56(1), 3–21.
- Syed Alwi, S. F., & Kitchen, P. J. (2014). Projecting corporate brand image and behavioral response in business schools: Cognitive or affective brand attributes? *Journal of Business Research*, 67(11), 2324–2336.
- Thompson, S. (2016). 10 companies that are great at empathy. Retrieved from <https://www.weforum.org/agenda/2016/11/empathy-index-business/>
- TTI success insights. (2013). Emotional Quotient Sample.
- TTI Success Insights. (n.d.). Home. Retrieved May 10, 2018, from <https://www.ttisuccessinsights.com/>
- Wallop, H. (2014). Gen Z, Gen Y, baby boomers – a guide to the generations. Retrieved March 27, 2018, from <https://www.telegraph.co.uk/news/features/11002767/Gen-Z-Gen-Y-baby-boomers-a-guide-to-the-generations.html>

Use of the optical mouse in teaching experimental Physics

Stjepan Knežević

University Department of Professional Studies, Split, Croatia
sknezev52@gmail.com

Zlatko Norac

University Department of Professional Studies, Split, Croatia
znorac@gmail.com

Jelena Ružić

University Department of Professional Studies, Split, Croatia
jruzic@oss.unist.hr

Natko Bajić

University Department of Professional Studies, Split, Croatia
natko.bajic@yahoo.com

Abstract: We are surrounded by cheap measuring instruments that can be used to teach physics. The goal of every professor today is too cheaply and simply prove the laws physics using measuring devices. Optical mouse can be easily turned into a stopwatch. It captures a large amount of data in a short period of time, using programs such as the Cronocomando, Stopwatch, zap_ura or Mouse Motion. Optical mouse can be used to study various types of movements and positions in real time with greater accuracy than a ticker timer. In this work we will determine the acceleration of an object in free fall using an optical mouse.

Keywords: *acceleration, STEM, optical mouse*

1. Introduction

Determine is it possible to use computer and its existing peripheral devices (mouse, web camera, microphone, speakers) as a measuring device for collecting and processing physical quantities to be used in physics education. Therefore, our goal is to make a cheap device using existing or slightly modified hardware, along with customized software, to be used in physics classroom.

We will try to answer the following questions:

1. How to determine dimensions of a desk or any other real life object?
2. How to determine speed of an object in movement?
3. How to calculate its acceleration?
4. How to represent physical quantities in a table?
5. How to represent mouse movement on a desk graphically?
6. How correct are these measurements compared to traditional methods of measurement?
7. Can we use a mouse to record real movement, even outside of screen boundaries?

To answer these questions we'll use a computer mouse, as the pointer on the screen shows the mouse position in a plane. We need to add a stopwatch to our measurements (ref.4).

2. Desktop computer peripheral devices



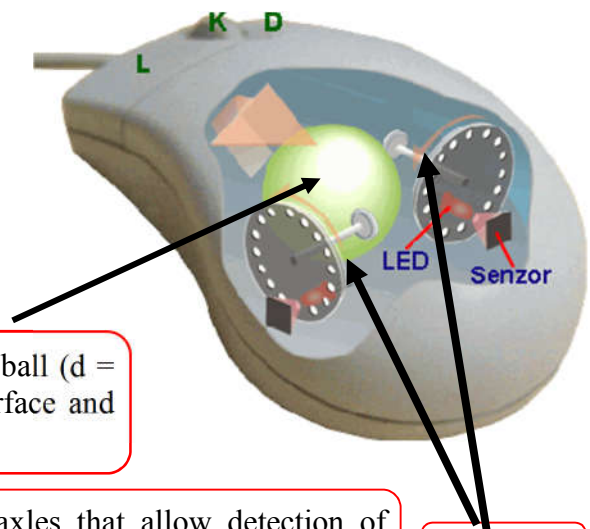
Figure 1 Computer with all components

COMPUTER MOUSE BASICS:

- Input pointer device
- Main task: to convert hand movement to electrical impulses readable by the computer
- Detects only relative movement – offset to the current position
- Sends information about quantity and direction of movement to the computer
- Resolution – number of impulses a mouse can generate in linear movement
- Resolution – smallest offset a mouse can register
- Connecting - PS/2, USB or wireless
- There are different types of a mouse upon signal processing type or connecting type

3. Optomechanical mouse

Works based on converting mechanical movement to a series of electrical impulses.



A rubber coated metal ball (d = 21mm) touches the surface and spins.

The ball, by its rotation friction forces two axles that allow detection of movement in horizontal and vertical direction.

Axles

Processor

Processor reads impulses received from sensor and converts them to binary data which are then being sent to the computer.

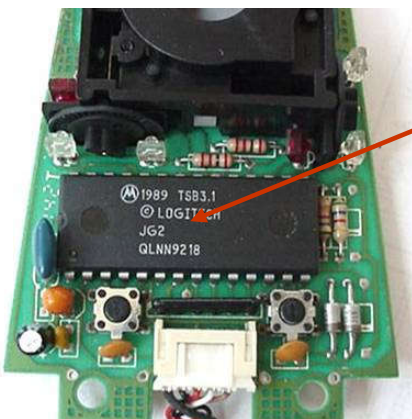


Figure 2 Mouse interior

4. Optical mouse

Optical mouse we use today was developed by Agilent Technologies and publicly released in 1999. With the advancement in technology, optical mice also advanced and gradually displaced usage of rubber mice.

Optical mice have a small camera that records 1600 images per second.

Red LED diode lightens the surface, while the reflected beam is detected by a CMOS (Complementary metal–oxide–semiconductor) sensor in a mouse. CMOS sensor sends every image to DSP (Digital signal processor) for the analysis.



Figure 3 Optical mouse with USB connection (ref.2)



Figure 4 Interior of an optical mouse (ref.1)

Interior of an optical mouse is consisted of series of devices like a microcontroller, LED, optical prism, photoelectric element (CMOS), electrical switch etc. These devices altogether make an optical mouse and assure external control of a cursor position on the computer screen.

Optical mouse can be used as a photogate which help to measure gravitational acceleration up to second decimal point. Source of the microwaves (router) can be used to study wave properties of these waves which can be detected using a microwave antenna built in every newer laptop. Using a sound card in education to convert natural sound to digital form is a well-known practice.

Older optical mice used an obsolete technology where the beam reflected from a special, highly reflective surface pad, which consisted of narrow dark line grid.

With every mouse movement beam was interrupted as it moved over a dark line where it couldn't be reflected. Sensor then sent a signal to the computer that a mouse moved by some quantity.

Therefore, losing or damaging a mouse pad would mean the mouse can't be use until the new pad is bought.

The advantages of the optical mouse:

- No moving parts: more robust to failures
- Inability of dust entering the mouse interior
- Increased resolution and precision
- Does not require special surface: the mouse works on any surface except glass and mirrors
- Possibility of having wireless connectivity is important in physical experiments in which the mouse is a measuring instrument.
- Wireless connection of mouse and computer is appropriate for physical experiments where mouse is used as a measuring device.

4.1 How to use a mouse for the measurement?

In the majority of the physical quantities measurements dependence on time is considered. Thus, a stopwatch was added in the code to enable us to use mouse as a measuring device. Next problem was turning the stopwatch on and off and defining the time interval.

The program is written in Python.

```
import struct, os, time, sys
from ctypes import windll, Structure, c_long, byref

file2=open("data.csv","w");

point_x = 0;
point_y = 0;

class POINT(Structure):
    _fields_ = [("x", c_long), ("y", c_long)]

def getMouseEvent():
    dis = POINT();
    windll.user32.GetCursorPos(byref(dis))
    return dis;

collection_time=float(input("time of measurement (s)"))
sample_rate=float(input("sample time (microseconds)"))/1000000
if collection_time>0:
    duration=collection_time
else:
    duration=float(1000)

start=time.time()
calculate=0
while( calculate<duration ):
    dis = getMouseEvent();
    point_x = int(dis.x);
    point_y = int(dis.y);
    point=time.time()
    calculate=point-start
    print (" %f,%d,%d" % (calculate, point_x, point_y));
    file2.write(" %f,%d,%d\n" % (calculate, point_x,
point_y))
    time.sleep(sample_rate)

file2.close()
```

Data is being sent to comma-separated value table (CSV) file, where time, x and y coordinate (in pixel) measurements are written. This file can be used by any software used for table manipulation, such as Microsoft Excel, where it can be imported or opened as a three-column table.

4.2 Optical mouse coordinates calibration

Pixel: a smallest graphical element of a digital image. It is consisted of red, blue and green subpixels. Larger the number of pixels in a digital image, closer to the original it is. Name “p” for pixel is often used as a measure of image resolution, for instance 300 ppi (pixel per inch) for images or 640x480p or 0.3 Mp (megapixels) for screen resolution. These numbers represent number of horizontal and vertical pixels, so 800x600 resolution has 800 horizontal and 600 vertical pixels. Pixels are also used as a resolution measure for light sensors in a digital camera, e.g. 10Mp.

Diagonal of a screen 39,4 cm Monitor resolution: 1366x768

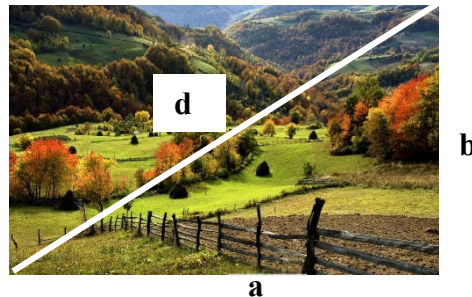


Figure 5 An example for computing a resolution (ref. 3)

Example shown in Figure 5 (next formulas apply to any image). In the excel program we records the data of the monitor **a** and **b**, a is the length of the monitor in pixels, b is the height of the monitor in pixels. From this data, the pixel size in the py column and the pixel size in the px column is calculated for the used monitor. Px and py program excel accounts by written formulas, px and py are equal.

For example:

$$a = 1366px, \quad b = 768px$$

$$d = \sqrt{a^2 + b^2}, \quad \frac{a}{b} = \frac{1366}{768} = 1,778, \quad a = 1,778b$$

$$a = 42,05cm, \quad b = 23,64cm$$

$$1px = \frac{42,05}{1365} = 0,031cm$$

Smallest distance between points in a column or a row for this monitor is 0,031 cm. What looks like in Excel can be seen in the Figure 6.

dijagonala monitora	45
a	1366
b	768
a/b	1.778646
b	22.05358
a	39.2255
px	0.028716
py	0.028716

Figure 6 How get pixel size in centimeters in Excel

The process of data collection takes place as follows:

- a) Light sensor (CMOS) has its response rate. Response rate is the time needed for the sensor to read an image and get ready for accepting the new one. It's dependent on a specific mouse. The information shown in the picture was obtained by moving the mouse on the screen. Data with time and x and y coordinates in pixels are displayed in Excel.
- b) Entering the following data in the table (Figure 6):
 - Monitor size (diagonal in centimeters)
 - Screen resolution from its settings

We get the pixel size in centimeters.

Figure 7 shows the final data we get when we apply the formula to convert the pixel position to centimeters.

vrijeme- dt(s)	položaj x/ cm	položaj y/ cm
0.015625	21.96742842	19.38302507
0.015628	22.59917146	19.41174067
0.015597	23.23091449	19.58403422
0.015604	23.80522635	19.75632778
0.015617	24.32210702	19.98605252
0.015644	24.92513446	20.33063963
0.015625	25.21229039	20.70394234
0.015605	25.49944632	21.19210741
0.015662	25.61430869	21.47926334
0.015593	25.75788665	21.96742842
0.015679	25.81531784	22.0248596
0.015601	25.75788665	22.0248596
0.015593	25.5568775	22.0248596
0.01568	25.21229039	22.0248596
0.015626	24.63797854	22.0248596
0.015624	23.94880431	22.0248596
0.015627	23.17348331	22.0248596
0.015571	21.30696978	22.0248596
0.01566	19.75632778	21.88128164
0.015596	17.83238307	21.36440097
0.015621	15.93715395	20.73265793
0.015622	13.86963127	19.38302507
0.015633	13.72605331	19.06715355
0.015615	14.27164957	18.11953899
0.015679	15.21926413	17.7175207
0.015627	21.45054775	17.11449325
0.015605	32.19017942	18.37797933

Figure 7 The results obtained: the first column shows the time t (s), the second position of x (cm), and the third position of the y (cm)

5. How to use a mouse for measurement?

First application

In the first application we use one of the two mouse buttons (left or right), which represent the switches upon which the mouse state is activated. That state is then sent to mouse controller, which sends data to the computer, where the software runs the desired action.

Mouse switch can be switched over to a photoresistor to get the fast switch reacting to lighting level. Cutting the light from the optical pointer we can quickly turn on or off the switch. It can be used to record the time in a given moment. (Figure 8)

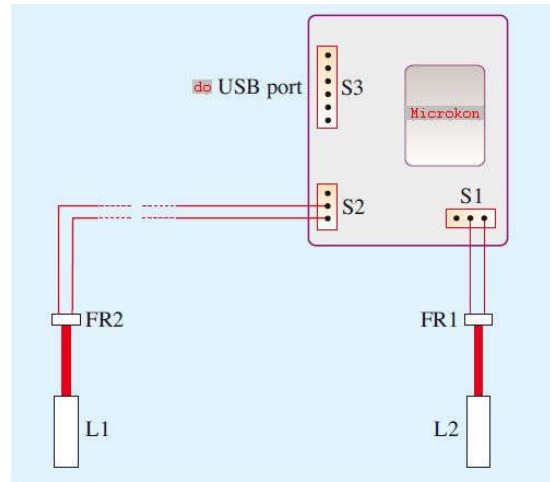


Figure 8 Optical mouse switches

When photoresistor is lightened, its resistance is several $k\Omega$. That mouse state is equal to a pressed mouse button. Photoresistor in dark has resistance close to $1 M\Omega$, which is equivalent to released mouse button. We can achieve the unlighted photoresistor state with a ball that falls in front of laser beam. Software stopwatch registers that moment. Resistance changes as well when a ball falls in front of other photoresistor, which can be connected to the same mouse button as the first one. Stopwatch registers that moment in time, too. From time interval corresponding to passage of a ball that falls between two photogates gravitational acceleration can be determined. (Figure 10, Figure 11).

We can also imagine a series of photogates in front of which a tape with black stripes at the end of which the ball was hanged falls. In that case we would have more couples of time-position measurements which would provide fitting a curve that approximates the measured points very well, with minimal deviations.

On the following image Figure 9 an optical mouse modified for usage in measurements is shown.



Figure 9 The picture shows an optical mouse that has been modified so that it can be used to measure the interval of the time

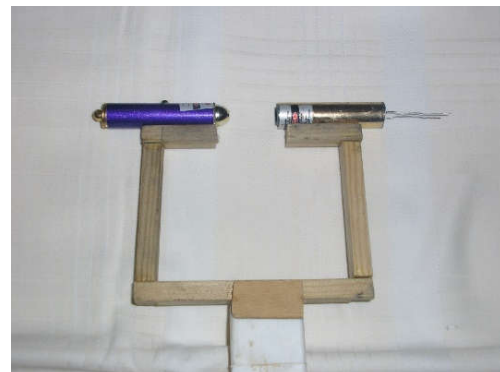


Figure 10 Photogate

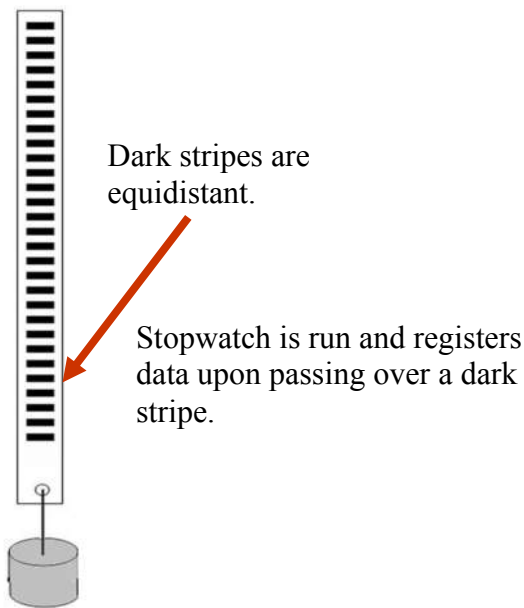


Figure 11 Transparent tape with black stripes at the end of which the ball was hanged

Figure 11 shows a black striped strip that allows us to measure the accelerated acceleration of an optical mouse display that has been modified so that it can be used to measure the time.

Possibility of optical mouse application on a smart pulley.

Second application – a promising one

Second approach uses the optical properties of the computer mouse. It's basically a camera with a frame rate of 1600 images per second working on a principle of offsets between two images in consecutive time instants. Upon the data provided, instructions where to position the cursor on the screen is forwarded. Similar as in the first application, we have to use a stopwatch but to define intervals of time offsets we need to define position offsets to force cursor to follow instructions from the environment. E.g. force cursor to follow the free fall of the body.

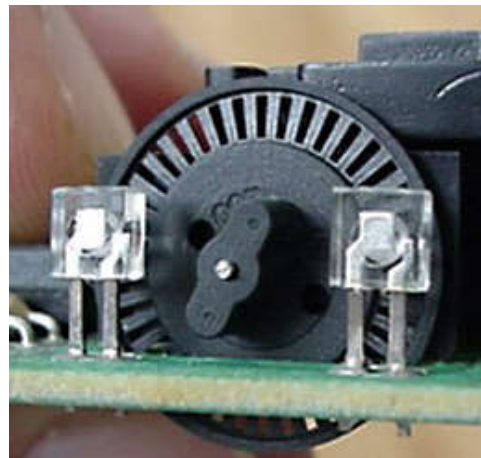


Figure 12 The ability to use an optical mouse on a smart pulley

The wireless mouse is tied by a thread through the collapse and the smart pulley on the pretension that drops accelerating the optical mouse. The smart pulley associated with the logger provides the data shown in Figure 13.



Figure 13 Optical Mouse Acceleration Motion Imaging Device with Smart Collage on One Side and Optical Mouse on the other side

	Time (s)	Latest Distance (m)	Velocity (m/s)
1	0,000000	0,0000	
2	0,095901		
3	0,137301	0,0150	0,184
4	0,178501		
5	0,205214	0,0300	0,262
6	0,234520		
7	0,256402	0,0450	0,313
8	0,282302		
9	0,301827	0,0600	0,355
10	0,324721		
11	0,341622	0,0750	0,400
12	0,361714		
13	0,377203	0,0900	0,439
14	0,396031		
15	0,410104	0,1050	0,485
16	0,427004		
17	0,439503	0,1200	0,529
18	0,454904		
19	0,466926	0,1350	0,548
20	0,482117		
21	0,494204	0,1500	0,568
22	0,508504		
23	0,519806	0,1650	0,605
24	0,533308		
25	0,543853	0,1800	0,648
26	0,556450		
27	0,566206	0,1950	0,683
28	0,578209		
29	0,587806	0,2100	0,696
30	0,599806		
31	0,609306	0,2250	0,699
32	0,621306		
33	0,630704	0,2400	0,707
34	0,642614		
35	0,651727	0,2550	0,741
36	0,662907		
37	0,671307	0,2700	0,796
38	0,681608		
39	0,689524	0,2850	0,833
40	0,699508		
41	0,707318	0,3000	0,842
42	0,717222		
43	0,725146	0,3150	0,834
44	0,735153		

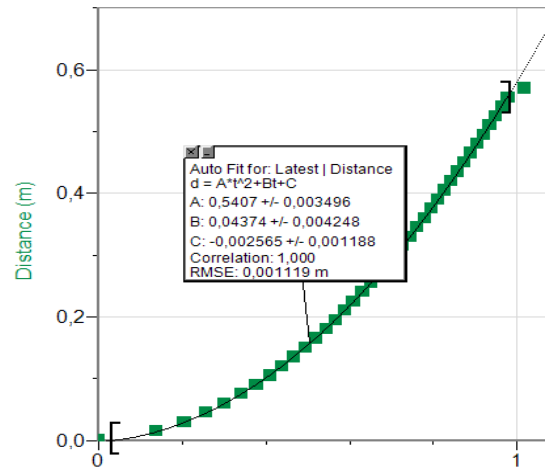


Figure 14 Measurement results using LoggerPro devices and smart pulley. Graphic illustration of a sudden accelerated motion of a mouse shot by a smart pulley.

Graphic view of the function:

$$f(x) = At^2 + Bt + C$$

A = 0,5407 so the acceleration is the same

$$a(t) = 2A = 10,814 \text{ms}^{-2}$$

Using the optical mouse, results are obtained that deviate from measurements obtained with Smart Column and LoggerPro.

Table 1 Optical Mouse Movement Submissions obtained with Optical Mouse, some results.

Time t/s	Distance x/m
0.000502	0.14357796
0.001004	0.14357796
0.001506	0.14357796
0.00201	0.14357796
0.00251	0.14357796
0.003011	0.14357796
0.003514	0.14357796
0.004018	0.14357796
0.004519	0.14357796
0.005024	0.14357796
0.005527	0.14357796
0.00603	0.14357796

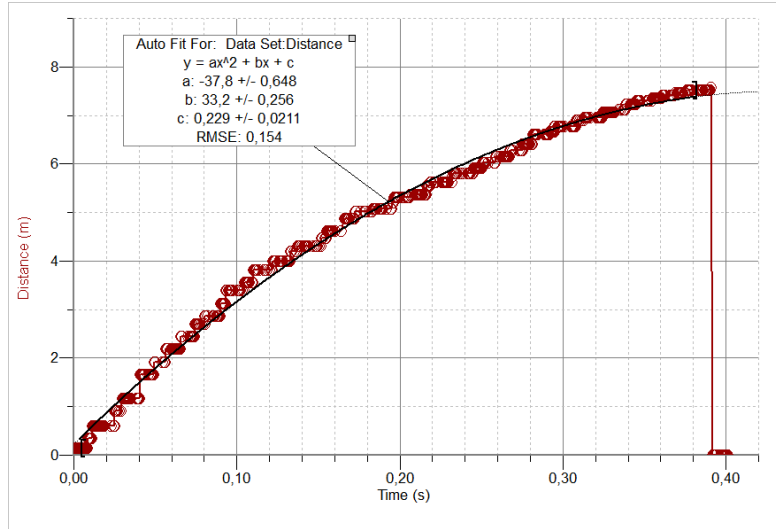


Figure 15 Graphic illustration

5.1 Optical mouse as a device for measuring oscillator position

a) Body on a spring. Optical mouse uses a tiny camera that fetches 1500 or more images per second. Red LED sends light that is being reflected from almost every surface to CMOS. Sensor sends signal for each individual image to DSP microcontroller which analyses it. Performing 20 million or more operations per second it finds patterns in surface and their change upon mouse movement. From these changes DSP calculates mouse displacement and sends them to computer as (x-y) coordinates. Computer moves cursor on the screen in accordance to these coordinates. That function is used to follow position change of oscillator mass related to static optical mouse. For data collection Dynamic Mouse Coordinate Tracker (ref.5) software is used. Collected data can be copied and imported in data table software, like Microsoft Excel.

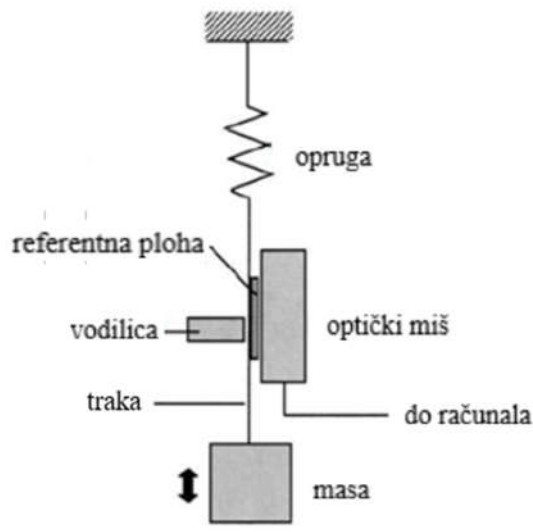


Figure 16 The ability to use an optical mouse on a smart cube

b) The optical mouse uses a tiny camera that captures 1500 or more images in one second. The red LED emits light that is refracted from virtually any surface to the corresponding semiconductor photoelectric sensor (CMOS). The sensor sends a signal (each individual image) to the microcontroller (DSP) that performs the analysis. Specifically, performing

20 million or more operations per second, it finds surface shapes and their change when the mouse is moving. From these changes the DSP account moves the mouse and sends it to the computer in the form of (x; y) coordinates. The computer moves the cursor on the screen according to these coordinates. This function is used to monitor the change in the oscillator mass position relative to the silent optical mouse. Dynamic Mouse Coordinate Tracker (ref.5) is used for data collection. The data is processed using excel or some other similar program. The figure 17 shows a circuit by which we can experimentally check the measurement results obtained with the optical mouse and LoggerPro. We are checking the accelerated acceleration of the optical mouse that is scorched by the weight as shown in the picture. Recording a weigh that weighs on a spring using an optical mouse.



Figure 17 Oscillator motion recording device

Table 2 Optical mouse motion data obtained with an optical mouse

Time t/s	Distance x/m
0.000502	0.14357796
0.001004	0.14357796
0.001506	0.14357796
0.00201	0.14357796
0.00251	0.14357796
0.003011	0.14357796
0.003514	0.14357796
0.004018	0.14357796
0.004519	0.14357796
0.005024	0.14357796
0.005527	0.14357796
0.00603	0.14357796
0.006531	0.14357796
0.007036	0.14357796
0.007541	0.14357796

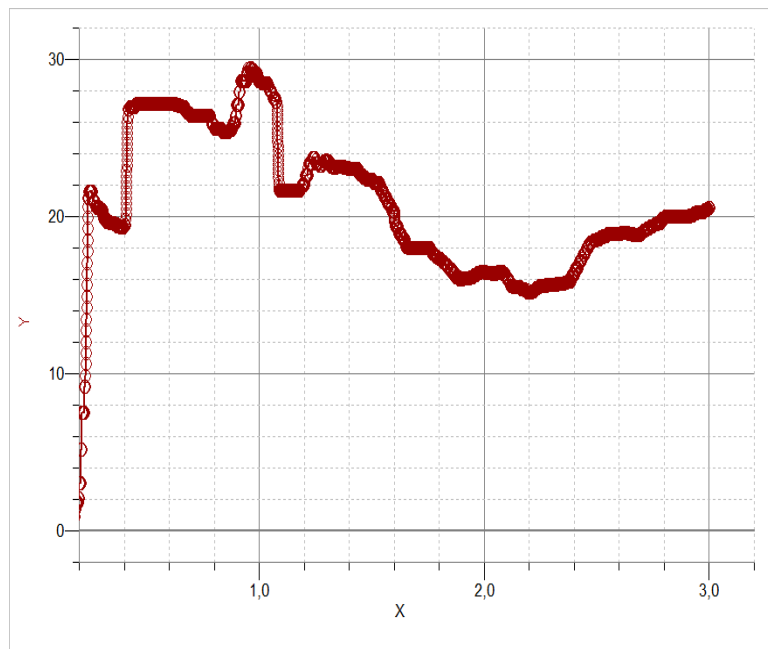


Figure 18 Graphic illustration, y is distance in meter, x is time in microseconds.

The graphic representation of the motion is not a good correction to be made in the code of Python. Namely, the starting point is at the top left of the monitor (Figure 18). What needs to be changed to get an overview of the periodic motion will be done in further work.

6. Conclusion

The optical mouse application is large. These are just some of the examples of how an optical mouse can be used as a cheap instrument in teaching physics for a better understanding of physical laws. Of course, the error when measuring exists, it is sometimes negligible. That is why it is necessary to continue to work and strive to find new and better methods of work.

We have not fully met the default goals set for optical mouse measurements. The reason for this is the imprecise time spent on the operating system of the computer. These errors could be avoided by using the optical mouse in combination with Arduino. Arduino is a simpler device that does not have an operating system and measures the right time.

REFERENCES:

1. <http://www.dansdata.com/images/moremouses/newexpguts440.jpg>
2. <http://tehton.covermagazin.com/wp-content/uploads/2013/05/opticki-laserski-mis.jpg>
3. <https://pejzazisrbije.weebly.com/planinski-i-morski-pejza381i.html>
4. Luketin Ivica, Begović Nedeljko, Stjepan Knežević, Buljubašić Mladen (2009, March). Optical mouse as a measuring device. Paper presented at the meeting on IX. Croatian Symposium on Physics Education. Interactive Physics Classes. Primosten, Croatia
5. <http://biofuturex.com/mouse/mousetrackerdynamic.htm>

The Interconnection between Pedagogical Principles and Accounting Principles in the Accounting Teaching and Learning

Sofia Capatina

Trade Co-operative University of Moldova, Chisinau, Republic of Moldova
capasofia@yahoo.com

Nicolae Silistraru

Tiraspol State University, Chisinau, Republic of Moldova
nsilistraru@gmail.com

Abstract: The theoretical basis of the economical higher education pedagogy is represented by certain pedagogical and economical concepts: teaching theories, accounting and pedagogical principles, pedagogical factors and conditions, accounting convention; their knowledge being essential to the analysis of the initial vocational training of the accountant student. The initial vocational training of the economic professionals in the context of expertise is a problem of the economical higher education that qualifies into the comprehensive diagram of the actual economic education's politics. In this regard, the vocational training curricula aims to promote the knowledge, capacities and attitudes transfer in the practical training of the accountant. These are focused on the interconnection of the following principles: general principles of pedagogical design; pedagogical knowledge; pedagogical communication; pedagogical, economical and operational creativity of education/training accomplishment (positive formative orientation; essentiality; systematization; efficient participation; accessibility of the education/training activity).

Keywords: *pedagogical principles, accounting principles, design principles.*

1. Introduction

The pedagogical principles represent the strategic and operational norms that have to be followed in order to ensure efficiently the activities projected at the system's level and the educational process. These principles are designed to meet legally the essence of the educational process; regulatory thesis, general ideas within the organization and the management of the educational-informative activities; norms or didactical rules that apply in the teaching-learning activity.

The aim lies in the capacity of designing and optimally achieving activities of instructive and educational nature (formulation and indication of objectives, selection of content, development of instructive strategies, setting up appropriate situations of learning, establishment of assessment methods and instruments etc.), that involve the development through the following manners:

- The capacity of objectively assess training programs and activities, preparing students as well as their chances to succeed;
- The capacity of preparing students regarding self and permanent education.

The principles serve as a basis of the research approach and of the development of scientific theories.

2. Classification of the Principles

The classification is achievable based on the assumed level of regulatory compliance, identified especially in the microstructural territory of the educational process.

From this perspective, there can be identified two categories of pedagogical principles:

A) General principles of pedagogical design. These principles are designed epistemologically based on the *functional structure of the education and the instruction*, respectively, that sets the *regulatory benchmarks* that are necessary in any activity of pedagogical design. The benchmarks can be identified at different levels, i.e. physiognomy of the educational/pedagogical message, mechanism of reception, innerness and improvement of the educational/pedagogical message, continuous regulation-automatic regulation circuit of the educational/pedagogical message:

A-1) Principle of pedagogical knowledge. It aims the necessity of converting the specialist knowledge into knowledge with *positive* educational value at the level of the *pedagogical message*. It is oriented mainly to the primary improvement of the student's judgment with regard to the memory, the *internal motivation* as compared with the *external motivation*, the *positive emotionality* towards the education/training in relation to the *negative emotionality* etc.

A-2) Principle of pedagogical communication. It aims the efficient achievement of the pedagogical message at *commonly repertoire* level between the *teacher* and the *student*. It is built by the teacher not only in a cognitive manner, but also in a non-cognitive way for the reception, the innerness and the improvement of the educational/pedagogical message by each student, individual, in *micro-clusters* and in *groups* (students groups etc.).

A-3) Principle of pedagogical creativity. It aims the continuous regulation-automatic regulation of the products/results of the education/training activity, at the level of *continuous/formative – auto formative* evaluation-self-evaluation action, achievable on different circuits of external conversely connection (initiated by the teacher) and internal (initiated by the student), with the purpose of correction, adjustment, improvement, enhancement of the educational/pedagogical message.

B) Operational principles of education/training achievement. These are promoted as *educational principles* that prioritise especially the training activity. Operationally, they translate the *general regulatory requirements* expressed as *design principles* that form explicit *regulatory criteria* necessary for the evaluation of any concrete activity (course etc.). They aim all pieces of the education/training activity, separately and within their interdependency approached at the level of: objectives (specific and concrete) – basic contents – efficient methods – evaluation (initial, continuous, final), organisational forms that ensure the customization of the education/training activity etc.

B-1) Principle of positive regulatory orientation of the education/training activity;

B-2) Principle of knowledge essentiality within the education/training activity;

B-3) Principle of knowledge systematisation within the education/training activity;

B-4) Principle of efficient participation of the students at the education/training activity;

B-5) Principle of the education/training activity's accessibility;

B-6) Principle of interdependency between intuitive and logical knowledge within the education/training activity;

B-7) Principle of interdependency between theory and practice within the education/training activity;

B-8) Principle of continuous regulation-automatic regulation of the education/training activity (Cristea, S., 2016).

The accountancy principles are conceptual elements that guide accountancy regulations in a normalised way, starting with the accountancy postulates. These are useful both for those who produce and diffuse accounting information and for those who supervise the quality of the accounting information (auditors). The accountancy principles have a reduced general degree compared to the postulates and an enhanced level than the accounting standards.

Among fundamental accounting principles, the following ones are distinguished:

- ✓ *Activity continuity*. The information has to be registered in accounting and in the financial situations starting from the hypothesis that the entity operates and it will continue its activity in a predictable future. In this case, it is assumed that the entity does not have either the intention or the necessity to significantly reduce or to phase out its activity;
- ✓ *Constant methodologies*. The accounting methods and rules chosen by the entity have to be consequently applied from a management period to another. In this case, usually, it is taken into consideration the constant methodologies adopted regarding the reflection upon economical operation, the evaluation of the assets and reliabilities, the calculation of the fixed resources' wear and the amortisation of the non-material assets within the current management year, as well as from a management year to another;
- ✓ *Accrual accounting*. The revenues and the expenses are concluded and reflected upon in the accounting and in the financial situations in the period of time in which they were produced, regardless the effective moment of the collection or the resources payments;
- ✓ *Principles of prudence*. When taking decisions under uncertainty conditions, it is necessary that the precaution means to be respected, aiming that the assets and the revenues not to be overrated and the liabilities and the expenses not to be underrated. According to this principles, the revenues are concluded only when they are gained and the expenses directly when incurred. Nevertheless, prudence does not justify the establishment of latent reserves;
- ✓ *Principles of substance over form*. The economical operations and other phenomena have to be reflected in accounting and presented within the financial situations, first of all according to their content and financial reality, but not only suitable for their juridical form. For example, the fixed resources received on financed lease have to be reflected in the leaseholder's balance sheet, even though the property rights belong to the lessor;
- ✓ *Relative importance (essentiality)*. In accounting and financial situations there has to be revealed all the important positions for evaluations and decisions making by the users. In the case in which the position (or its degree of accuracy) does not have too much importance for the users of the financial report, this thing is considered as non-essential. For instance, the financial situations published by large entities may be expressed in thousands of euro due to the fact that small amount of money do not influence the decision making process;
- ✓ *The no-netting principle*, according to which the elements from the active and the passive have to be evaluated and registered in accounting separately, the netting between active and passive balance sheet positions and between revenues and expenses being not admitted, even though the economic logic imposes some reciprocal substitutions (Standardul Național de Contabilitate „Prezentarea situațiilor financiare”, 2013).

Pedagogical rules. They are simple procedural and operational constructions, with instrumental character, utilised as elementary regulatory criteria in the process of applying the design and concrete education/training activity realisation principle. There might interfere as *general pedagogical rules* or *specific pedagogical rules*, operable in the case of a specific

design and education/training activity realisation principle or general design and education/training activity realisation principles (Cristea, S., 2016).

In order for the elucidated requirements to be successfully achieved, it is required that the focus should be especially on the research methodology specific to accounting.

3. Research Methodology Specific to Accounting

The research methodology specific to accounting corresponds to the research object specific to the domain that has to be approached globally, profoundly, dynamically according to the specified legislative, alleged at different levels:

- a) *Macro-structural*, through *axioms* and *laws*;
- b) *Microstructural*, through design and accounting realisation *principles*.

From this perspective, in the accounting domain there can be identified two types of *research*: fundamental research and applied research (Ionaşcu, I., 1997).

The fundamental research in accounting focuses on the accounting analysis as historical, social and organisational phenomenon. The results of this research type contribute to the increase of the knowledge level in accountancy due to the fact that it argues and realizes the definition of accounting concepts, methods and functions. This type of research does not provide a direct answer to the accounting practices' needs, but ensures their support, advancement and direction.

The applied research in accounting follows the improvement of the accounting instrument based on the context in which the practices operates through results, new accounting methods being proposed as a response to these activity needs.

The availability of these two sides of accounting research has been identified also by some Romanian authors, e.g. Demetrescu C., Puchiţă V., Possler L., Voica V., Feleagă N., Ionaşcu I., who named accountancy "fundamental and applied science" (Demetrescu C., & Puchiţă, V., & Possler, L., & Voica, V., 1979). On account of the accounting particularities, B. Colasse proposes the identification of a regulatory accounting research (Bernard, C. 2005). This research type is explained through the fact that the accounting practices are based on regulations and accounting rules.

Based on the above information, it can be concluded that accounting shall be established as a science, with a great number of paradigm, open to fundamental and applied research.

According to Léo-Paul Lauzon (Lauzon, L-P. 1985), accounting "represents concurrently a social and applied science". Therefore, accounting is a *social science* because of the following reasons:

- It is a creation of the human being;
- It reflects phenomena, activities; events and social facts;
- It is addressed to different groups of users that form part integrally of the society;
- It provides financial situations that have an impact on the society and which modifies the individuals' behaviour. These financial situations generate social changes that are in the same time dependent on or influenced by social phenomena (Ionaşcu, I. 1997).

Accounting is an *applied science* due to the below facts:

- It operates in a real and concrete medium, therefore it mirrors real phenomena;

- It assumes applying the acquired knowledge. The theoretical knowledge is applied in real or concrete world (Horngren CH., & Datar, S., & Foster, G. 2006).

The administrative science are formed by a heterogeneous assembly of practical and theoretical knowledge. This heterogeneity results from different domains of administrative knowledge application. Some domains aim to structure the entity administration on specialised functions: production function, accounting-financial function, commercial function, research and development function that are also responsible of the entity approach.

The heterogeneity of the administrative knowledge arises also from different levels of elaboration and systematisation of the subjects that constitute this domain, as well as the norms and validation criteria of the knowledge.

As a result from the research methodology, the administrative sciences are both theoretical and applied, as they incorporate theoretical knowledge that applies to a concrete reality – entity, in the most extensive way. Accounting, as scientific subject, is located nowadays within the administrative sciences domain, after many decades in which it has been frequently considered as a subject of the economical sciences. The new position derives from the practical role of accounting, which has become an administrative instrument of businesses, but also from the manner in which accounting problems are addressed within the American business schools.

The administrative sciences include not only the traditional subjects, e.g. accounting, but also the newest subjects, e.g. marketing or management. It follows that, accounting is not identified as a scientific subject just once with its affiliation in the administrative sciences, but also with its reposition in the social sciences' assembly. Therefore, the newer accounting domains are not new subjects, but hybrid subjects. In order to understand this process, it is important to establish a certain classification of the various subjects that constitute accounting.

The research of psycho-pedagogical implications of the educational communication around the emotional intelligence of teenagers emphasises the impact of the communication based on emotional intelligence towards the harmonious evolution of teenagers and their need to speak up about emotional experiences through which the positive personal identity is formed, as well as the importance, in this context, of the level of the professors/adults' emotional culture which the educational efficiency depends on.

The efficient communication – “true art of human relationships – implies the formation of two emotional talents: auto-administration and empathy” (Goleman, D. 2008), necessary skills not only for teenagers, but also for professors/adults. The systematic analysis of the newer educations proves their convergence within emotional development for communication of teenagers, supporting the educational integrative character for the emotional development in the educational system of new dimensions. In this way, it can be observed that the values promoted by the educational new dimensions (axiological education, education for communication, education for change and development, education for family life, education for health, education for tolerance, education for professional career, literary-artistic education) achieve a synergy for the emotional intelligence development through communication at teenagers.

The working principles within the class:

1. Part of the teaching tasks will be proposed in small groups through co-operation. Even though, the learning activity will be a collective one, the marks for the tasks achievement will be individual. The tasks presentations will be accompanied by a mutual evaluation of the subgroup members in order to identify each ones' contribution towards the final result.
2. The class calendar (presentation deadlines of the proposed tasks, evaluation moments, etc.) is correlated to other subject calendars. Therefore, the tasks presentations after the specified deadlines is not welcomed, and the students who frequently postpone the presentations will form an unfavourable image of themselves.
3. The class delays are not welcomed.
4. The student active position is highly welcomed, which implies studying new contents on their own initiative, proposing solutions (applications, web based instruments), asking questions during lectures and practical hours.
5. Within the subject, an enhanced attention will be offered to the compliance with the ethical principles. Presenting of solutions taken over from colleagues or other sources, taking over information from various sources without references will be considered plagiarism and will be penalised through marks of "1" (Cabac, V. 2014).

Efficiency and effectiveness – as performance dimensions – are actions extremely complex to obtain, thus it is necessary to base them on a series of principles, such as: principle of defining objectives, principle of prioritisation, principle of deadlines establishment, principle of time management, principle of synergy.

The performance management is hereby established as a dynamic and evolutionary process which determines the starting point in the identification of changing needs, which imposes a new prospective paradigm that implies conscious elaborations, forward-looking and participative, taking into account the gap between slow changes at the level of personality and fast changes from society.

The performance motivation is in a significant positive correlation between certain personality variables, enhanced through energy, and the function of performance motivation, oriented towards wishes determination, argumentation of own value feelings and living of pride regarding the obtained performance through improvement of one's own capabilities (Cojocaru, V. 2016).

The formative-educational valences that recommend these interactive methods as successful practice for both teaching and evaluation are the following ones:

- Stimulating the active implication within the tasks, the students being aware of the assumed responsibilities;
- Practicing the analytical and the decision making capabilities at the right moment, stimulating the initiative of all students involved within the task;
- Ensuring a better implementation of knowledge, exercising the capabilities and the skills within different contexts and situations;
- Ensuring a better conceptual clarification and an easier integration of the assimilated knowledge within the national system, thus becoming operational;
- Some of them, e.g. portfolio, offer an overall view toward the student activity on a longer period of time, overcoming the shortcoming of the traditional evaluation methods with survey and material character among the students;

- Ensuring an interactive approach of the teaching-learning-evaluation act, adapted toward the individual needs of the working tasks for each student, building on and stimulating the creative potential and his originality;
- Discouraging speculation practices or learning only for the mark (*Interacțiunea metodelor în învățământul superior*, 2010).

An interactive training method utilized is the **case study**, which consist of analysing and debating a case represented by a particular situation in which an individual, a social group or an institution may be facing.

The case study methodology assumes the methods and procedures integration in *superior operational structures*, within which operational hierarchies are established.

Learning based on case study is an active teaching method because:

- It motivates the students intrinsically and involve them in activities, succeeding to get closer the university to everyday life, while offering the students the opportunity to *face genuine real problem-situations*, extracted from contents that are representative for a certain category of situations, events, phenomena, etc.;
- It puts the students in a position to use their knowledge, their *capabilities of extrapolation, generalisation, particularisation, acquisitions transfer*, as well as their *disciplinary and transversal competencies* in order to establish deductive and inductive approaches in the context of acquiring and discovering new skills;
- It helps the students to get involved with good results, actively and interactively in the analysis and understanding other “cases”, as it represents an authentic exercise of research in an active and interactive manner along with the development of discoveries, settlement and arguments;
- It determines the students to conduct researches, to collect information in different manners, to systemise, structure and operationalise them, contributing to the development of several settlement options of the “case” and, consequently, taking the decisions;
- It determines the students to adopt a critical attitude and spirit towards different types of “case” settlement and related strategies by comparing the situations, prioritise them and choosing the optimal option, arguing it in a rational manner;
- It implies collective debates, within which intellectual exchanges are made, as well as engagements of points of view, hypothesis formulations, arguments, predictions, synthesis, assessments, conclusions, selecting the optimal options, elaborating argued and relevant decisions;
- It implies the participation of all students during the debating and the settlement of the case, allowing them, through co-operative working, to achieve the most complex and taxonomic levels of thinking and active learning, passing from applicability to analysis, synthesis and assessment;

Taking into account the above mentioned consideration, it can be said that this type of teaching has valences that are application-oriented, formative, playful and special heuristic [15, p. 286-287].

The training is more formative, active and interactive, based on the students’ initiative and their knowledge interest. The exploration in co-operative activities of a “case” with educational potential, noticed by the students in everyday life and relevant to them, may create favourable assumptions of an interactive training. However, in most cases, the

professor is the one choosing and exposing the “case”, the students being the ones who contribute at its resolution through cooperation.

4. Conclusion

From the above information, it can be concluded that there is a great contribution of the processes through connecting the principles within the activity of teaching and academic performance, in the context of teaching and learning. Teaching not only that implies these kind of processes, but also by its means is realized the processes’ enhancement and development that shape, in a distinguished way, the student’s personality.

Therefore, the principles form a unitary system with values oriented towards the professor’s activity, with open and dynamic character, their compliance with ensuring an equilibrium of the educational process. The educational principles are general oriented requirements of the teaching process that are continuously reconsidered based on the results of scientific researches and on the ones provided by the accounting and pedagogical practice.

REFERENCES

- Bernard, C. (2005). *Comptabilité générale - 9 édition* (pp. 26-27). Paris: Éditeur Economique.
- Cabac, V. (2014). *Proiectarea formării în învățământul superior. Ghid pentru cadrele didactice universitare* (pp. 48). Chișinău.
- Cojocaru, V. (2016). *Competență. Performanță. Calitate. Concepte și aplicații în educație* (pp. 168). Chișinău.
- Cristea, S. (2016). *Pedagogia. Științele pedagogice. Științele educației. Vol. I* (pp. 71-73). București.
- Demetrescu C., & Puchiță, V., & Possler, L., & Voica, V. (1979). *Contabilitatea știință fundamentală și aplicativă* (pp. 113). Craiova: Editura Scrisul românesc.
- Goleman, D. (2008). *Inteligența emoțională. Ediția a III – a* (pp. 132). București: Curtea Veche.
- Horngren CH., & Datar, S., & Foster, G. (2006). *Cost Accounting: A Managerial Emphasis, 9th Edition* (pp. 26). Chișinău: Editura ARC.
- Interacțiunea metodelor în învățământul superior. Ghid metodologic* (pp. 59-60). (2010). Chișinău.
- Ionașcu, I. (1997). *Epistemologia contabilității* (pp. 8, 23). București: Editura Economică.
- Lauzon, L-P. (1985). *Le cadre théorique de la comptabilité financière*. Paris: Éditeur Gaétan Morin.
- Standardul Național de Contabilitate „Prezentarea situațiilor financiare”, aprobat prin ordinul ministrului finanțelor nr. 118 din 06.08.2013. Standard nr. 1533 din 22.10.2013, Monitorul Oficial al Republicii Moldova nr. 233-237 din 22.10.2013.* (2013). Chișinău: Monitorul oficial al Republicii Moldova.

Researching Plagiarism in Higher Education – Case of First-Year Students at Selected HEIs

Gorana Duplančić Rogošić

University of Split, Faculty of Economics, Business and Tourism, Split, Croatia
gduplanc@efst.hr

Sonja Koren

University of Split, University Department of Health Studies, Split, Croatia
sonja.koren@ozs.unist.hr

Abstract. The fast development of the Internet provided students with easy access to the abundance of electronic resources for academic writing, thus increasing the chances of plagiarism. Therefore, the awareness of the importance of academic integrity should be developed from an early stage of education. By the time students enrol into a university, they should be aware that plagiarism, as an element of academic dishonesty, is a serious issue at all levels of education.

The aim of this paper is to investigate the level of students' awareness of academic dishonesty. First-year students at two institutions at the University of Split were given a questionnaire to assess their attitudes, beliefs and practices related to academic dishonesty. The paper reveals how often students resort to plagiarism, what resources they mainly use, and what reasons they consider acceptable for plagiarism.

Finally, it is suggested that students' acquisition of academic writing skills should be improved since many of them plagiarize because they are not familiar with citing or paraphrasing nor are they aware that plagiarism is not acceptable.

Key words: *academic dishonesty, plagiarism, students' attitudes, tertiary education.*

1. Introduction

Plagiarism is unauthorized appropriation of other people's ideas, processes or text without giving correct credit and with intention to present it as own property (Baždarić et al, 2009). A simpler definition by Cambridge English Dictionary is that if you plagiarize, you “use another person's idea or a part of their work and pretend that it is your own” (Walter, 2008). Plagiarism is unethical, dishonest and prohibited. Nevertheless, the scientific and academic community, plagiarism is undoubtedly present (Marušić, 1997 as quoted in Bilić-Zulle,2006). The unacceptability of plagiarism, which includes various forms, is built into the Code of Ethics of the University of Split. By enrolling into the University, students automatically become parties to this agreement.

Students can cheat on tests and examinations and on written assignments. Cheating on tests and examinations can refer to, among other: a student copying from another student on a test without their knowledge, copying from another student on a test with their knowledge, helping another student cheat on a test, using cheat notes, or using an electronic device (usually a mobile phone) as an unauthorized aid during a test. Cheating on written assignments can refer to, among other: paraphrasing and /or copying several sentences from any written source without giving credit to the actual author, paraphrasing and /or copying several sentences from the Internet source without giving credit to the actual author, receiving unpermitted help from someone on an assignment, copying material almost word for word from a written source without citation,

turning in work copied from another student, turning in work done by another student, or obtaining paper from term paper mill. The listed examples of academically unacceptable behaviour are certainly not exhaustive as students, with the advancement of technology, invent new ways of cheating. They are, however, a good starting point for the analysis of academically unacceptable behaviour.

The remainder of the paper is organized as follows. Section 2 addresses the theoretical grounds of the research. Section 3 explains the research problem, the methodology, and presents descriptive analysis of research findings. In section 4, results are discussed and directions for future research are offered. Finally, section 5 is the conclusion.

2. Plagiarism

Plagiarism is a burning issue in the academic circles and the problem of plagiarism, its causes, forms and knowledge about it are researched by various authors. The offenses usually researched are related to fabrication or falsification of scientific data, self-plagiarizing, and the like, but more attention should be devoted to “lower” levels in academic circles, i.e. students and their plagiarism since it is important to promote academic integrity and to point out the danger of plagiarism at schools at any early level. Good practice will then be continued later in professional life. The issue of plagiarism has been studied and viewed from different angles. Many authors tried to explain the reasons which led students to plagiarise. Some researchers see the reason for plagiarism in students’ personalities, such as student age, sex, study program, and study level as well as their ambitions, self-esteem and motives, ignoring the external factors that might contribute to plagiarizing (Rettinger & Kramer, 2009; Williams, Nathanson, & Paulus, 2010). Other researchers blame the teachers for not giving enough attention to checking student work, thus focusing on the factors outside the students (Barnas, 2000). Engler, Landau, & Epstein (2008) claim the plagiarism happens due to social norms according to which students learn certain behaviours by observing the others’ generally accepted behaviour. They often justify plagiarism by pointing out that since their peers plagiarize, they are allowed to do the same (Turnitin.com and Research Resources). Moreover, the other reason which motivates students to plagiarize is their wish to get good grades and to achieve the same success as their peers (Songsriwittaya, Kongsuwan, Jitgarum, Kaewkuekool, and Koul (2009) as quoted in Šprajc et al, 2017). As stated in Fish and Hura (2013) plagiarism has more chance to arise if students have vague perception of it and have not been taught how to avoid plagiarism and improper citing and paraphrasing. They need instruction and practice in order to be able to use correct citing and paraphrasing methods, to choose suitable material, and recognize what is accepted as common knowledge (Barrett & Cox, 2005). Blum (2009) suggests that “students must learn that if they wish to succeed, they must grasp the concept of authority and its rules so that they can perform according to them.”

The fast development of the Internet provided students with easy access to the abundance of electronic resources for academic writing, thus increasing the chances of plagiarism. The simple cut-and-paste cheating has been replaced by more sophisticated high-tech teaching, and students are more proficient in the use of modern technology, especially computers (Jones, 2011). The process of copying and pasting the electronic text has become ever so easy. Online resources are available around-the-clock, and often without apparent authorship, which makes some students believe that they can use them legitimately in their course assignments (Fish, & Hura, 2013). Besvinick (1983) stated that self-centred and immoral students may threaten the integrity of the higher education institution, and that in order to preserve academic integrity the problem of academic misconduct has to be tackled.

Some authors claim that plagiarizing is not a universal problem, but a culture specific. Plagiarism exists because “In many Asian, Middle Eastern, African, and First Nation

cultures...knowledge is believed to belong to society as a whole, rather than an individual...” (Hu, 2001 as quoted in Abukhattala, 2012). Abukhattala (2012) confirms that plagiarism among students exists in Lybia, and gives the potential causes and declares that plagiarism is not inherent in any culture. Rusikoff, Fucaloro & Salkauskiene (2003) performed a research on plagiarism among student population in the USA, Lithuania and China. The results showed that there was less plagiarism in the USA where social sanctions are stronger, while in China and Lithuania students did not recognize the moral implications characteristic for the Western notion of plagiarism. According to the authors, the issue of plagiarism must be approached in terms of both culture and pedagogy in order to modify students’ understanding, attitude and practice.

The method and results of the research on plagiarism among Croatian students are presented in the next chapter.

3. Research

3.1. Research problem

The impetus for the research came from practical experience of teaching. All first-year students at both Faculty of Economics and University Department of Health Studies take ESP courses in the first year (Business English 1&2 at the Faculty of Economics and English language 1&2 at the Department of Health Studies). The Economics students have three 45-minute lessons per week and the students of Health Studies have two 45-minute lessons per week in one semester. There are between 40 and 60 students per group which challenges developing all four skills, i.e. speaking, listening, reading, and writing. It is practically impossible to explain a writing assignment to students, to have them write it, assess it and provide a feedback in class. At the Faculty of Economics, students are required, as a prerequisite to take the final test at the end of the semester, to upload to Moodle (an open source e-learning platform) a written assignment related to their field of study every two weeks. The tasks include e.g. writing a CV, a cover letter, an e-mail, placing an order, and replying to an order, a business report. The purpose of the tasks is to teach students relevant vocabulary and structures needed in relevant types of business communication. At the Health Studies, before taking written and oral exam, the students are required to prepare a short seminar paper and make a PowerPoint presentation related to their future field of work, thus verifying they have mastered the professional vocabulary.

Students who enrol in both Faculties have passed English at the state Matura exam and should be at the B1/B2 level of the Common European Frame of Reference for Languages. One of their tasks at the Matura is writing an essay in English which would imply, as they have passed the Matura, they should not have significant problems in doing written assignments having done them extensively in high school when preparing for the Matura. In addition, the assignments they have to do as a part of the courses are related to topics and tasks that are well explained in class. Finally, the timeframe is usually two weeks so they have enough time to write and upload the task.

The procedure with the assignments at the Faculty of Economics is as follows. Case studies are explained in class where students also do a number of speaking, reading and listening tasks which provide them with the frame of the case study presented in the course book *Market Leader*. They are given a written assignment which they have to upload on moodle, open source e-learning platform. Each moodle assignment has an *available from* and *due date* clearly written at the bottom of the task. The task is available to students 24 hours a day. When the assignment is closed for submitting, the teacher downloads the files and checks them giving brief written feedback to students online. Feedback is brief because of the number of students and usually refers to whether the task meets the necessary criteria or not. A more constructive and elaborate

feedback is given to the class as a whole as students usually make the same type of mistakes, from the simple one of not signing an e-mail to a complex one of not following the structure of a report.

Students at both institutions are told it is unacceptable to copy the assignment either from a colleague or from the Internet, either partially or in full. In addition, it is emphasized to them that teachers are open for questions during office hours, immediately after class or via e-mail for any problems or difficulties students might have when writing assignments. In spite of all aforementioned, some students copy the task from another student or the Internet, either partially or in full.

Shi (2004:178) developed three major categories of textual borrowing which were expanded by Jahić (2011:176):

1. *textual borrowing with no reference*: a) exact copy b) near copy c) close paraphrase d) special paraphrase
2. *textual borrowing with reference to the author or the source text*: a) exact copy b) near copy c) close paraphrase d) special paraphrase e) appropriate textual borrowing (with appropriate or inappropriate reference)
3. *textual borrowing with quotations*: a) with appropriate reference b) with inappropriate reference c) without reference
4. *miscellaneous*

The most common type of borrowing in students' writings are textual ones with no reference to the author(s) of the text, exact copy and near copy being most used methods. Exact copy refers to a string of exactly copied words from the original text and near copy refers to a string of words modified slightly by adding or deleting words or using synonyms for content words (Shi 2004: 178).

Students copy entire tasks from the Internet word-for-word, as illustrated by the example in table 1.

Table 1 Textual borrowing with no reference: exact copy from the Internet

<p>Dear Mr Graham,</p> <p>I would like to introduce myself as a candidate for the Hotel Operations Managers position that your company advertised yesterday on the Monster.com website.</p> <p>As a seasoned professional, I feel I will be more than able to ensure that your guests are treated in a prompt, and friendly manner whilst at the same time making sure that the highest standard of Hotel cleanliness, comfort, and safety are always adhered to. For the last three years I have been working as a Bartender, Receptionist and Waiter where I developed lot of communication, organization and serving skills also i learned lot about drinks entertainment food and marketing which you will find useful. I come to you from an experienced background, and will bring an assortment of knowledge and skills to every area of your business.</p> <p>Aside from my technical abilities, my pleasant manner and adaptive skills allow me diplomatically bring to a conclusion any guests' issues that may arise. I have an authentic style, natural curiosity and a warm way with people.</p> <p>The enclosed CV provides a more detailed description of my education, interests, and work experience.</p> <p>Right now I am ready to take the next step in my career and to be challenged in all areas of hospitality and guest service. For me it would be an honour to be a part of and contribute to a company like yours which concentrates on building loyalty and value for its guests.</p> <p>Yours sincerely, Student's name</p>

Students also sometimes copy entire tasks from colleagues, as illustrated by the example in table 2. The task is copied word for word with all the mistakes in punctuation, spelling, and/or grammar.

Table 2 Textual borrowing with no reference: exact copy from another students

To:	Country	D
From: Taka Shimizu Cycles		
Dear country D,		
Our company Taka Shimizu Cycles (TSC) is based in Nagoya,Japan. The company sells four models of bicycle: road bicycles, touring bicycles, racing bicycles and mountain bicycles. TCS plans to expand in Asia so that becomes a global company. We decided to expand in your country because we need a perfect geography location, a place with low business and import taxes. What is also important to us, the government has a five-year programme to improve transport systeme. You have a large supply of unskilled workers who are used to working long hours and if necessary workers will be recruite locally and trained at a special school set up for that purpose. The factory will have approximately 2000 workers,who will produce the frames for the cycles locally. Other components , such as saddles,gears,chains,tyres,..will be imported. We would like to invite you to participate in our annual meeting, which is taking place this year in Nagoya,Japan, June 3-10 to discuss the proposal further.		
I hope this will be possible. Let us know.		
Best wishes, TSC		
		STUDENT'S NAME

Sometimes students copy strings of words from another student, as illustrated by the example in table 3. The strings of words copied were underlined by the authors of the paper. No mistakes were corrected.

Table 3 Textual borrowing with no reference: near copy (from another student)

Dear Mr Wright I have just received your email in which you asked me to help you to expand your sales in Europe and Middle East. <u>As a CEO of Hudson Corporation, I can confirm you that</u> we are serious company and with our working experiences of <u>expanding businesses in foreign country countries</u> , we will definitely how and what to do to get your sales expanded. <u>Path to the succesful business is to promote what you do, so I recommend you to sho, show up at the main fair here in Paris. There will be many important persons from all over the Europe which can help you to become more popular at the European market.</u> Second good thing you can do is to <u>offer discounts to your customers</u> and provide them throughout the newspapers, magazines or online advertising. <u>If you're interested in those marketing</u>	Dear Mr. Wright, I just recieved your email in which u want me to help you to expand your sales in Europe. <u>As a chief executive officer of Hudson Corporation i can confirm you that</u> you have contact right company which will help you, because we have experiences in <u>expanding job in foreign countries</u> . I believe that the <u>path to a successful bussines is</u> primarily related to the promotion of what you do, so <u>i recommend you to show up at the main fair here in Paris, because there will be many important persons from all over the Europe which can help you to become more popular in the European market.</u> Also true path to sucess is to offer discounts to your customers through the most widely read magazines or newspapers, because it is easy and cheap way to promote your products. <u>If u are interested in those marketing strategies we invite you</u>
--	--

<p><u>strategies, I suggest a meeting here in Paris in April 15. with paid travel expenses.</u></p> <p><u>We hope that you will answer soon</u> so we can discuss some more important things. Looking forward to see you again, Mr Wright.</p> <p>Best Wishes</p> <p>Student A's name</p>	<p><u>to the meeting with us, on 15th April here in Paris with paid travel expenses.</u></p> <p><u>We hope u will answer as soon</u> as possible so we can book travel tickets.</p> <p>Kind regards,</p> <p>Student B's name</p>
---	--

The three examples are most common types of students' plagiarizing written tasks which illustrate the fact that students usually borrow texts without any reference. The reasons are researched in the following sections.

3.2. Research method

In order to find out the reasons students' attitudes to plagiarizing which would reveal why students copy their written tasks, a questionnaire is designed (available in the appendix). The questions in the questionnaire can be divided into several sections, namely general questions about the student (five questions that differ slightly for the two groups of students), the notion of plagiarism (two questions), plagiarism in general (three questions), copying from colleagues (seven questions), copying from the Internet (nine questions), reasons for plagiarizing (seven questions), and attitudes towards plagiarizing (six questions). The questionnaire is available in the appendix. The questionnaire was designed using google docs and was available to students from February 1st to February 24th, 2018. Economics students were invited to participate in the research via a link posted on moodle, whereas the Health Studies' students were invited to participate in the research during class as no moodle is available at this institution. Students who participated did so voluntarily.

3.3. Research participants

The research participants were first-year, first-semester students at two faculties at the university of Split, namely the Faculty of Economics, Business and Tourism (hereinafter The Faculty of Economics) and University Department of Health Studies (hereinafter Health Studies). The questionnaire was administered to a total of 82 full-time first-year students at The Faculty of Economics (24.4% male and 75.6% female) and 45 students (6.7% male and 93.3% female) at the University Department of Health Studies. At the Faculty of Economics, there were 20 undergraduate (24.4%) and 62 professional degree students (75.6%). At the Health studies, there were 34 undergraduate (75.6%) and 11 professional degree students (24.4%). Most participants at both institutions were female students (75.6% and 93.3% students at the Faculty of Economics and Health Studies respectively) who are between 19 and 21 years old (75% and 84.4 % at the Faculty of Economics and Health Studies respectively).

The last question in the first section briefly addressed the reasons for studying Economics / Health Studies. Slightly over 50 % of students study Economics because they are interested in it (54.9%), whereas slightly more Health Studies students are interested in their field of study, i.e. 62.2%. A total of 30.5% and 24.4% of students are studying Economics and Health studies respectively because they could not enrol into the university program which was their first choice.

3.4. Research findings

An important starting point in a research into plagiarism was determining whether the students were familiar with the concept. According to the results, the notion of plagiarism has been explained to 60% of Economics and 53.3% of Health Studies students. Over 70% of both Economics and Health Studies students have never been warned they have plagiarized

someone's work. About 1/4 of Economics students have never plagiarized anything in elementary or high school, whereas the same is true for 1/3 of Health Studies students in elementary and 1/4 in high school. Slightly under 20% of Economics students state they have often, very often or often plagiarized in both elementary or high school. On the other hand, 15.5% of Health Studies students claimed to have plagiarized often, very often or often in elementary school and slightly under 30% of them state to have plagiarized often, very often or often in high school. Finally, slightly under 5% of Economics students have often, very often or often plagiarized and 64.6% of them have never plagiarized at university. A total of 11.1% of Health Studies students have plagiarized often, very often or often and 44.4% never.

The results show that Economics students are often, very often or often (36.5% of them) willing to let their colleagues copy their entire paper, whereas the same is not true for Health Studies students as 17.8% do the same. Economics students are often, very often or often (53.7% of them) willing to let their colleagues copy parts of their paper, whereas 31.1% Health Studies do it often, very often or often.

To find out whether they were ever warned for having plagiarized parts of entire papers from other authors, 84.% of Economics and 93.3% of Health Studies students never copy entire papers from colleagues. More than half, i.e. 51.2% of Economics and 64.4%, also never copy entire sentences or paragraphs from colleagues nor do they change a few words from their colleague's assignment (54.9% Economics students and 66.7% Health Studies students).

Economics and Health Studies students never buy papers from their colleagues (as stated by 92.7% and 100% students respectively). Students (93.9% Economics and 88.9% Health Studies ones) also never buy papers from the Internet. Finally, 93.9% of Economics and 97.8% Health Studies students state they have never submitted other person's paper as their own.

A total of 80% of Economics and 93.4% of Health Studies students use sources from the Internet when writing their papers. However, Economics ones rarely or never copy entire papers from the Internet and 6% of Health Studies ones do it often, very often or often. Around one third of both groups of students copy entire sentences and paragraphs from the Internet often, very often or often. About one fifth of students of both groups change only a few words from the text they find online while copying the rest of the text. Finally, a total of 28.8% Economics and 22% of Health Studies students paraphrase the text and present it as their own. Students also state that it is necessary to quote Internet sources, as stated by around ¾ of research participants. A total of 20% Economics and 17.1% of Health Studies students are not certain whether internet sources need to be stated. Finally, around three-quarters of both groups of students think it is not acceptable to buy papers online and almost 20% are not sure. Only one person per group has ever bought a paper online and submitted it as his/her own.

The following sections analyses what reasons students believe are acceptable ones for plagiarizing.

Table 4 Reasons considered acceptable when plagiarizing

Item	Economics	Health Studies
In your opinion, a good reason for plagiarizing your colleague's entire paper is	<ul style="list-style-type: none"> • Not being able to do the task on my own to meet the criteria - 23.2% • Lack of time to write the paper yourself - 23.3% • Not being interested in the topic of the paper - 17.1% 	<ul style="list-style-type: none"> • Lack of time to write the paper yourself - 24.4% • Not being familiar with the rules for avoiding plagiarism - 13.3% • Not being interested in the topic of the paper - 6.7%
In your opinion, a good reason for plagiarizing parts of your	<ul style="list-style-type: none"> • Not being able to do the task on my own to meet the criteria - 25.6% • Lack of time to write the paper yourself - 20.7% 	<ul style="list-style-type: none"> • Not being able to do the task on my own to meet the criteria - 24.4% • Not being interested in the topic of the paper; Not understanding the

colleague's paper is	<ul style="list-style-type: none"> Not being interested in the topic of the paper - 13.4% 	topic of the paper due to the lack of preparation in class - 11.1% (each)
In your opinion, a good reason for plagiarizing an entire paper from the Internet is:	<ul style="list-style-type: none"> Not being able to do the task on my own to meet the criteria - 24.4% Lack of time to write the paper yourself - 20.7% Desire to appear better than you really are; Not being interested in the topic of the paper; Not understanding the topic of the paper due to the lack of preparation in class. - 11% (each) 	<ul style="list-style-type: none"> Lack of time to write the paper yourself - 28.9% Not being able to do the task on my own to meet the criteria - 20% Not being familiar with the rules for avoiding plagiarism - 13.3%
In your opinion, a good reason for plagiarizing parts of the paper from the Internet is:	<ul style="list-style-type: none"> Not being able to do the task on my own to meet the criteria - 28% Lack of time to write the paper yourself - 20.7% Desire to appear better than you really are - 14.6% 	<ul style="list-style-type: none"> Not being able to do the task on my own to meet the criteria 28.9% Desire to appear better than you really are; Not being interested in the topic of the paper; Not understanding the topic of the paper due to the lack of preparation in class. - 11.1% (each)

As can be seen from the table, the main reasons students believe it is acceptable to plagiarize an entire assignment or parts of it from a colleague are: *not being able to do the task on one's own that would meet the necessary criteria, lack of time to write it on my own, and not being interested in the topic of the assignment*. Students state that *the lack of time to write the paper yourself and not being able to do the task on my own to meet the criteria* are good reasons for plagiarizing an entire paper or parts of it from the Internet.

In the last section of the questionnaire, the students were given a number of statements they had to agree or disagree with. A five-point Likert scale was used to measure students' level of agreement with six statements, where 1 is strongly disagree and 5 is strongly. Students' attitudes are shown in table 6 in a simplified manner, i.e. data obtained for *agree* and *completely agree* are presented together as well as *disagree* and *completely disagree*.

Table 6 Students' attitudes to plagiarizing

Statement	Dis/agreement in percentages	Economics			Health Studies	
		dis-agree	neither agree nor disagree	agree	dis-agree	neither agree nor disagree
When plagiarizing, the person who plagiarizes is not fair to oneself because he/she pretends to be something they are not.	7.3	28	64.6	2.2	35.6	62.2
When plagiarizing, the person who plagiarizes is resourceful.	20.7	37.8	41.5	33.4	35.6	31.1
When plagiarizing, the person who plagiarizes is not honest to the University because with this behaviour they do not accomplish the educational tasks.	13.4	19.5	67.1	4.4	28.9	66.7
When plagiarizing, the person who plagiarizes saves his/her time.	12.2	34.1	53.7	13.3	28.9	57.8

When plagiarizing, the person who plagiarizes is not fair to the author of the paper since they take over their merits.	2.4	18.3	79.3	2.2	22.2	75.5
When plagiarizing, the person who plagiarizes is not fair to the rest of his/her fellow students who write on their own and earn their grades.	3.6	17.1	79.3	8.9	17.8	73.3

Table 6 shows that Economics and Health Studies students (64.6% and 62.2% respectively) believe that when plagiarizing, the person who is plagiarizing is not honest to oneself because he/she pretends to be what he/she is not. Then, 41.5% of Economics and 31.1% Health Studies students believe that when plagiarizing, the person who is plagiarizing is resourceful, but 20.7% of Economics and 33.4% Health Studies disagree with this statement. Slightly over 65% of both Economics and Health Studies students agree that when plagiarizing, the person who is plagiarizing is not fair to the university where he/she is studying because with such a conduct he/she does not achieve the educational mission of the Faculty. Over 50% of students (53.7% and 57.8% of Economics and Health Studies student respectively) believe that when plagiarizing, the plagiarist saves their time. Slightly under 80% of both groups believe that when plagiarizing, the plagiarist is not fair towards the actual author as he/she takes his / her credit. Finally, slightly under 80% of both groups believe that when plagiarizing, the plagiarist is not fair to the rest of their group of students who do their own assignments and earn their grades.

4. Discussion and Direction for Future Research

It has been shown that academic integrity is an aspect of tertiary education that needs to be worked on. As can be seen from the examples in section 3.1., students breach several guidelines to academic honesty, i.e. they copy assignments from their colleagues or from the Internet (either partially or in full), and, in later case, they do not cite their sources.

Overall, the main reasons students consider acceptable for plagiarising are: *not being able to do the task on their own to meet the criteria*, *lack of time to write the paper yourself*, and *not being interested in the topic of the paper*. These reasons suggest that students might not have received adequate explanation on how to write tasks and have not been given enough time to do it. It can, however, also mean that students are not willing to ask for help from teacher and that their time management skills are limited. The reason stated as *not being interested in the topic of the assignment* takes us back to the motivation for studying Economics and Health Studies. It can be presumed that when a student is not particularly interested in the course of study, that they will be less willing to put effort into doing assignments. Future research into these reasons is required.

If we compare whether students copy more from colleagues or from the Internet, it can be concluded that they equally rarely copy entire assignments, but usually copy only sentences and/or paragraphs and occasionally paraphrase parts of the assignment. It can be presumed that they do as they are less likely to be caught copying only parts of an assignment. It is also very likely that only a small number of students who actually copy paragraphs or sentences from colleagues are caught as it is easier for the teacher to see when the entire assignments are copied. Therefore, it would be advisable to use plagiarism-detection software not only for Business English courses but by the entire University. An important aspect in analysing academic dishonesty are not only the plagiarists, but also the students who let plagiarists copy assignments from them. Students are more willing to let their colleagues copy parts of their assignments rather than entire assignments. It can be presumed that it is because of the fear of being caught cheating by the teacher. On the other hand, it can be presumed that plagiarism

largely depends on the cultural characteristics of a community. It is relevant how the community, i.e. society in general, university and etc., views plagiarism and to what extent it accepts it. It is important whether the aforementioned forms of plagiarism are considered acceptable if done for “good” reasons, where a “good” reason might be helping a colleague do the task as *not being able to do the task on one’s own that would meet the necessary criteria* is one of the top three reasons why plagiarism is seen as acceptable by students. Although a student might seek and provide help to colleagues, it would be advisable to stimulate students to help others do their assignment rather than just let them copy–paste their own ones. It could be researched whether there are differences between cultures in terms of attitudes to plagiarism and consequences plagiarist face when caught.

The advent of Internet and the ease of downloading text in electronic form from the Internet have enabled new forms of plagiarism, i.e. *cyber-plagiarism*, which is a type of academic dishonesty that consists of reusing whole electronic documents, or parts of them, composed by another author without proper acknowledgment of the original source, and *web plagiarism*, which is a specific type of cyber-plagiarism that consists of copying texts (Kakkonen & Mozgovoy, 2012:1168). It, therefore, becomes necessary to teach students that texts on the Internet have their authors who must be acknowledged and that they must properly cite their online sources as well.

Finally, a longitudinal research could be conducted to see whether students’ attitudes to plagiarism change through the course of their studies, how they change and why they change (or do not change).

5. Conclusion

As the amount of cheating appears to be increasing, it is increasingly important that students and their unethical behaviour are studied more in order to acquire new knowledge that could then be applied in practice. It is not only important to reduce and prevent plagiarism at tertiary level but it is of increased importance to develop responsible and honest individuals who will continue to be such when they graduate from college and start their professional careers.

At Croatian universities there are rules of academic integrity and honesty which are woven into the statutes of universities. More emphasis should be put on the one hand on educating students on the importance of academic honesty and on the other hand on developing and imposing stricter penalties for students who commit plagiarism.

REFERENCES

- Abukhattala, I. (2012). Plagiarism And Culture: Are They Closely Related To Each Other? *IPEDR*. 54 (28), 145-149.
- Barnas, M. (2000). “Parenting” students: Applying developmental psychology to the college classroom. *Teaching of Psychology*. 27, 276-277.
- Barrett, R., Cox A.L. (2005). ‘At least they’re learning something’: the hazy line between collaboration and collusion. *Assessment & Evaluation in Higher Education*, 30 (2), 107–122.
- Baždarić, K., Pupovac, V., Bilić-Zulle, L., & Petrovečki, M. (2009). Plagiranje kao povreda znanstvene i akademske čestitosti/ Plagiarism as a violation of scientific and academic integrity. *Medicina Fluminensis*, 45(2), 18-117.
- Besvinick, S. L. (1983). Integrity and the future of the university. *The Journal of Higher Education*, 54(5), 566-573.
- Bilić - Zulle, L. (2006). *Pojavnost i stajališta o prisvajanju autorskog vlasništva među studentima medicine*. Unpublished doctoral dissertation. University of Rijeka, Rijeka, Croatia.
- Blum, S.D. (2009). *My word! Plagiarism and college culture*. Ithaca, NY: Cornell University Press.
- Engler, J.N., Landau, J.D., & Epstein, M. (2008). Keeping up with the Joneses: Students’ perceptions of academically dishonest behaviour. *Teaching of Psychology*. 35, 99-102.

- Fish, R., & Hura, G. (2013). Students' perceptions of plagiarism. *Journal of the Scholarship of Teaching and Learning*, 13(5), 33-45.
- Hu J. (2001). An Alternative Perspective of Language Re-use: Insights from Textual and Learning Theories and L2 Academic Writing. *English Quarterly*, 33 (1), 52-62.
- Jahić, A. (2011). An Insight into Textual Borrowing Practices of University-Level Students in Bosnia and Herzegovina. *Journal of Academic Writing*, 1(1), 173-179.
- Jones, D. L. R. (2011). Academic dishonesty: Are more students cheating? *Business Communication Quarterly*, 74(2), 141-150.
- Kakkonen, T., & Mozgovoy, M. (2012). Students' Cyber-plagiarism. In Zheng, Y. (Ed). *Encyclopedia of Cyber Behavior. Volume 1*. Hershey, PA: Information Science Reference.
- Rettinger, D.A., & Kramer, Y. (2009). Situational and personal causes of student cheating. *Research in Higher Education*, 50(3), 293-313.
- Russikof K., Fucaloro L., & Salkauskiene D. (2003). Plagiarism as a Cross-Cultural Phenomenon. *The CATESOL Journal*, 15 (1), 127-142.
- SHI, L. (2004). *Textual Borrowing in Second-Language Writing*. Written Communication. 21(2), 171-200.
- Songsriwittaya, A., Kongsuwan, S., Jitgarum, K., Kaewkuekool, S., & Koul, R. (2009). *Engineering Students' Attitude towards Plagiarism a Survey Study*. Korea: ICEE & ICEER.
- Sveučilište u Splitu. (2015). *Statut Sveučilišta u Splitu*. Split: Sveučilište u Split.
- Retrieved January 27th, 2018, from:
<http://www.unist.hr/sveuciliste/dokumenti/propisi?EntryId=55#file-list>
- Šprajc P., Urh M., Jerebić J., Trivan D., & Jereb E. (2017). Reasons for Plagiarism in Higher Education. *Organizacija*, 50 (1), 33-45.
- Turnitin.com and Research Resources. (n.d.). Why students plagiarize, Retrieved March 3, 2018, from <https://www.aub.edu.lb/it/acps/Documents/PDF/WhyStuPlagiarize.pdf>
- Walter, E. (Ed). (2008). *Cambridge Advanced Learner's Dictionary with CD-ROM*. Cambridge: Cambridge University Press.
- Williams, K.M., Nathanson, C., & Paulus, D.L. (2010). Identifying and profiling scholastic cheaters: Their personality, cognitive ability and motivation. *Journal of Experimental Psychology Applied*, 16 (3), 293-307.

Appendix 1:

QUESTIONNAIRE

Please read the short instructions before completing the questionnaire. The questions you will be asked are about plagiarism. You will need up to 10 minutes to complete the questionnaire.

Your participation in the survey is voluntary and your responses will have no consequences for your grade or getting signatures in your student transcript book. The purpose of this questionnaire is to explore students' attitudes on plagiarism.

Your responses will be anonymous and confidential.

Thank you for your time!

Your teacher

GENERAL QUESTIONS (please circle)

Sex	M	F	
Age	19-21	22-25	26 and more
Student status	Full-time	Part-time	
Study:	professional study	university	

Reason for studying at the Department of Health Studies:

- A. I am interested in the health studies
- B. I will easily find a job after graduation
- C. I did not succeed in enrolling in other study programme I wanted to
- D. I did not succeed in enrolling in the School of Medicine
- E. Other (specify)

Reason for studying at the Faculty of Economics, Business and Tourism:

- A. I am interested in economics/business
- B. I will easily find a job after graduation
- C. I did not succeed in enrolling in other non-economics study programme I wanted to
- D. I did not succeed in enrolling in other economics study programme I wanted to
- E. Other (please specify)

PLAGIARISM

Before enrolling in the university, did anybody at school (primary or secondary) explain to you what plagiarism was?

Yes No

A simple definition of plagiarism is that it is "a bad habit of taking over the ideas or words of other authors and incorporating them into your own work and presenting those ideas and words as your own." How many times have you been warned in writing or orally about having made such a mistake in your work?

- A. never B. once C. twice D. more than twice**

In your opinion, how often have you used the ideas or words of another person as your own without crediting the source during elementary school education?

- A. always B. very often C. often D. rarely E. never**

In your opinion, how often have you used the ideas or words of another person as your own without crediting the source during secondary school education?

- A.** always **B.** very often **C.** often **D.** rarely **E.** never

In your opinion, how often have you used the ideas or words of another person as your own without crediting the source during tertiary education?

- A.** always **B.** very often **C.** often **D.** rarely **E.** never

COPYING FROM COLLEAGUES

How often do you copy your colleague's entire paper in order to present it as your own?

- A.** always **B.** very often **C.** often **D.** rarely **E.** never

How often do you copy complete sentences or paragraphs from your colleague's papers, but not the entire paper?

- A.** always **B.** very often **C.** often **D.** rarely **E.** never

How often do you change a few words from your colleague's paper so that it appears to be your own?

- A.** always **B.** very often **C.** often **D.** rarely **E.** never

How often do you allow your colleagues to copy an entire paper from you?

- A.** always **B.** very often **C.** often **D.** rarely **E.** never

How often do you allow your colleagues to copy parts of your paper?

- A.** always **B.** very often **C.** often **D.** rarely **E.** never

How often have you bought the paper written by your colleague?

- A.** always **B.** very often **C.** often **D.** rarely **E.** never

How many times have you submitted someone else's paper as your own during the study?

- A.** never **B.** once **C.** twice **D.** more than twice

COPYING FROM THE INTERNET

How often do you use Internet sources when writing your papers?

- A.** always **B.** very often **C.** often **D.** rarely **E.** never

How often have you copied the entire papers from the Internet so that they appear as your own?

- A.** always **B.** very often **C.** often **D.** rarely **E.** never

How often have you copied complete sentences or paragraphs from the Internet, but not the whole paper?

- A.** always **B.** very often **C.** often **D.** rarely **E.** never

How often have you changed only a few words in the paper you've found on the Internet so that it appears as your own and copy the rest of it?

- A. I did not know how to write the paper.
- B. I did not have time to write the paper.
- C. I did not understand what I had to do.
- D. I did not think it was wrong to copy someone else's work.
- E. I did not know that copying someone else's work was a violation of intellectual rights.
- F. I have never done it.
- G. Other (please specify)

In your opinion, a good reason for plagiarizing your colleague's entire paper is:

- A. Desire to appear better than you really are
- B. Lack of time to write the paper yourself
- C. Not being interested in the topic of the paper
- D. Not understanding the topic of the paper due to the lack of preparation in class.
- E. Experience from previous levels of education
- F. Peer competition
- G. Not being familiar with the rules for avoiding plagiarism
- H. Family pressure to be as successful as possible at the course of studies
- I. Not being able to do the task on my own to meet the criteria
- J. Desire to prove that you can cheat the system
- K. Other (please specify)

In your opinion, a good reason for plagiarizing parts of your colleague's paper is:

- A. Desire to appear better than you really are
- B. Lack of time to write the paper yourself
- C. Not being interested in the topic of the paper
- D. Not understanding the topic of the paper due to the lack of preparation in class.
- E. Experience from previous levels of education
- F. Peer competition
- G. Not being familiar with the rules for avoiding plagiarism
- H. Family pressure to be as successful as possible at the course of studies
- I. Not being able to do the task on my own to meet the criteria
- J. Desire to prove that you can cheat the system
- K. Other (please specify)

In your opinion, a good reason for plagiarizing an entire paper from the Internet is:

- A. Desire to appear better than you really are
- B. Lack of time to write the paper yourself
- C. Not being interested in the topic of the paper
- D. Not understanding the topic of the paper due to the lack of preparation in class.
- E. Experience from previous levels of education
- F. Peer competition

- G. Not being familiar with the rules for avoiding plagiarism
- H. Family pressure to be as successful as possible at the course of studies
- I. Not being able to do the task on my own to meet the criteria
- J. Desire to prove that you can cheat the system
- K. Other (please specify)

In your opinion, a good reason for plagiarizing parts of the paper from the Internet is:

- A. Desire to appear better than you really are
- B. Lack of time to write the paper yourself
- C. Not being interested in the topic of the paper
- D. Not understanding the topic of the paper due to the lack of preparation in class.
- E. Experience from previous levels of education
- F. Peer competition
- G. Not being familiar with the rules for avoiding plagiarism
- H. Family pressure to be as successful as possible at the course of studies
- I. Not being able to do the task on my own to meet the criteria
- J. Desire to prove that you can cheat the system
- K. Other (please specify)

ATTITUDES FROM PLAGIARIZING

Circle a number to show how much you agree with the following statements. Numbers 1 to 5 indicate as follows:

- 1 = Strongly disagree
- 2 = Disagree
- 3 = Neither agree nor disagree
- 4 = Agree
- 5 = Strongly agree

When plagiarizing, the person who plagiarizes is not fair to oneself because he/she pretends to be something they are not.

1 2 3 4 5

When plagiarizing, the person who plagiarizes is resourceful.

1 2 3 4 5

When plagiarizing, the person who plagiarizes is not honest to the University because with this behaviour they do not accomplish the educational tasks.

1 2 3 4 5

When plagiarizing, the person who plagiarizes saves his/her time.

1 2 3 4 5

When plagiarizing, the person who plagiarizes is not fair to the author of the paper since they take over their merits.

1 **2** **3** **4** **5**

When plagiarizing, the person who plagiarizes is not fair to the rest of his/her fellow students who write on their own and earn their grades.

1 **2** **3** **4** **5**

Detecting and Solving Unfair Working Schedule Using Math

Siniša Zorica

University Department of Professional Studies, University of Split, Split, Republic of Croatia
szorica@oss.unist.hr

Bože Plazibat

University Department of Professional Studies, University of Split, Split, Republic of Croatia
bplazibat@oss.unist.hr

Arijana Burazin Mišura

University Department of Professional Studies, University of Split, Split, Republic of Croatia
aburazin@oss.unist.hr

Nada Roguljić

University Department of Professional Studies, University of Split, Split, Republic of Croatia
nmaroevi@oss.unist.hr

Abstract. In this work we have analyzed working hours for employees in a local company. Different statistical criteria consistently demonstrate that excessive workload is carried by the same employee. The lack of knowledge about organizing working schedules can cause uneven and unfair workload and this is one of the important causes of mobbing. There are different approaches in trying to design a fair schedule. One approach of choice uses linear programming, which can be a powerful tool in workload management.

Key words: *working hours, schedule, linear programming problem*

1. Introduction

It is well known that job satisfaction depends on many factors and a fair working schedule is one of them. Employees who work irregular shift times, in contrast to those with a more standard schedule, experience greater work or family conflicts and work-related stress. Irregular scheduling is most prevalent in retail trade, agriculture, personal services, entertainment industry, transportation etc. Usually the lowest income workers face the most irregular and unfair work schedules. [1] Work hour schedules are not uncommonly posted no more than one week in advance. A common consequence is that such practices limit employees' opportunity to balance work, social, and family responsibilities [2] Most of the employees in such industries are women. That makes it very difficult to make ends meet and to care for their families. Repeated unfair workload could cause employees to feel bullied by the management responsible for the workload scheduling. Awaiting better labor legislation framework, managers should also try to improve their systems for balancing the employee workload. In order to create a fairer and more balanced workload scheduling we propose the methods of linear programming as very beneficial.

2. Analysis

In this study the working hours for employees in a local shoe retail store are analyzed. On the beginning of each week the store manager usually had presented the work schedule for all employees. One of the employees was collecting available work schedules and putting them together like it is

shown on Figure 1. The authors obtained those data sheets and organized them in order to analyze them further.

Date		RO	PR		Employee1	Employee2	Employee3	Employee4	Employee5	Employee6	Employee7	Employee8
01/07/17	sat			22	free	09-15	15-22	16-22	free	bo	10-15	go
02/07/17	sun			22	09-17	16-21	18-22	10-15	free	-	15-22	-
03/07/17	mon	+		22	09-17	16-22	free	15-21	09-15	bo	free	go
04/07/17	tue			22	free	15-22	09-14	free	16-22	bo	10-15	go
05/07/17	wed	+		22	09-17	15-22	free	09-15	10-16	bo	16-22	go
06/07/17	thu			22	14-22	15-22	09-14	free	free	bo	10-15	go
07/07/17	fri	+		22	09-17	free	07-15	15-22	09-15	bo	15-22	go
08/07/17	sat			22	09-17	free	10-15	16-22	free	bo	15-22	go
09/07/17	sun			22	free	09-14	15-22	10-15	16-22	-	free	-
10/07/17	mon			22	free	free	15-22	go	09-15	bo	16-22	10-15
11/07/17	tue	+		22	09-17	16-22	free	go	09-15	bo	15-21	09-15
12/07/17	wed			22	14-22	10-15	free	go	free	bo	09-14	15-22
13/07/17	thu	+		22	09-17	07-15	15-21	go	09-15	bo	16-22	free
14/07/17	fri			22	free	09-14	16-22	go	15-22	bo	free	10-15
15/07/17	sat			22	09-17	16-22	10-15	go	free	bo	free	15-22
16/07/17	sun			22	09-17	free	09-17	-	10-15	-	15-22	free
17/07/17	mon	+		22	09-17	16-22	free	go	09-15	bo	free	15-22
18/07/17	tue			22	free	16-22	10-15	go	free	bo	09-14	15-22
19/07/17	wed	+		22	09-17	free	09-15	go	10-16	bo	15-21	16-22

Figure 1 Work schedule for shop employees for July 2017.

Data for the workload shifts for 3 consecutive years (2015, 2016, and 2017) were collected. The focus was placed on 8 full time employees. Part time workers and apprentices were not considered. Among 8 employees there was one shop manager and two deputy shop managers. A workday schedule could be: full day, morning (day shift), afternoon or late afternoon (closing store included with extra working duties). As in most retail stores employees' schedule includes Saturdays, Sundays and public holidays. A weekly day off is mandated for all employees and two consecutive days off are occasionally possible. As the total annual workload for employees is not uniform we have analyzed proportions instead of absolute frequencies. Excel was used as a tool for descriptive statistics of the data.

2.1 Distribution of working schedule per employee

Distribution of morning, afternoon, and full day shifts in the total workload of employees for three consecutive years is presented using stacked bar charts. Employees 2, 3 and 8 were omitted due to maternity leave or sick leave. Replacement employees were not taken into consideration. Employee 1 is a shop manager and mostly scheduled morning shift. Employees 4 and 5 are deputy shop managers. In their working schedule structure morning shift exceeds afternoon shift. In the working schedule it is evident that working hours of employees 6 and 7 are mostly afternoon. Similar schedule structure is observed for all three consecutive years. Employees 2, 3 and 8 also seem to have dominantly afternoon working hours. Occasionally full day work is present especially at the store manager and deputy store managers working schedules.

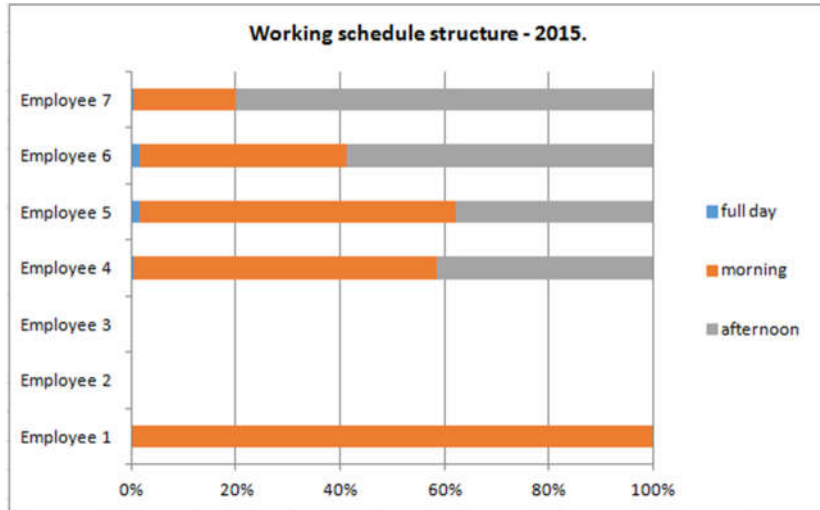


Figure 2 Distribution of shifts in the total workload of employees during 2015.

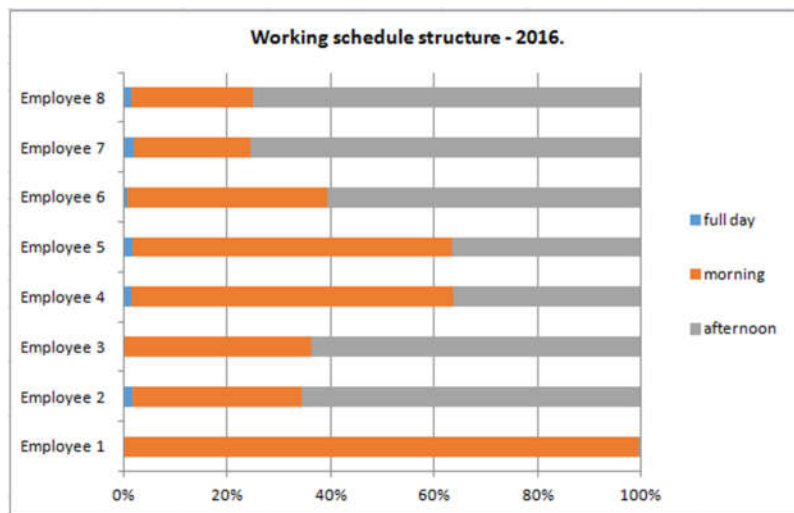


Figure 3 Distribution of shifts in the total workload of employees during 2016.

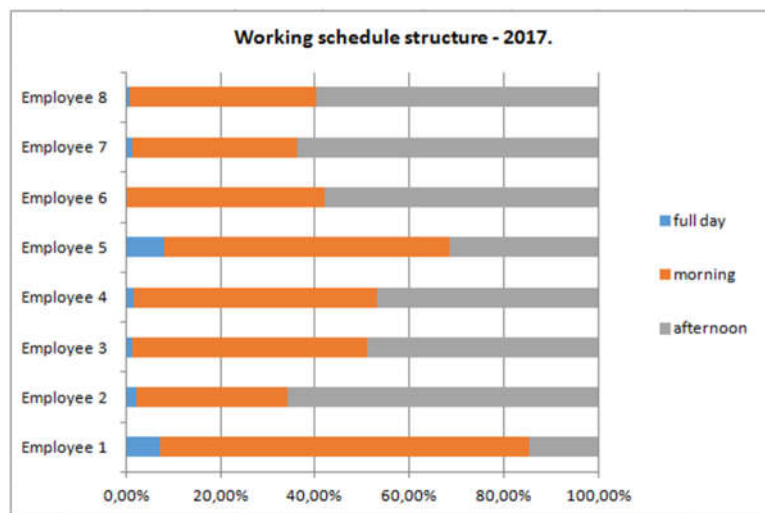


Figure 4 Distribution of shifts in the total workload of employees during 2017.

2.2 Distribution of morning and afternoon shifts per employee

Distribution of morning and afternoon shifts for 2017 is presented using radar chart.

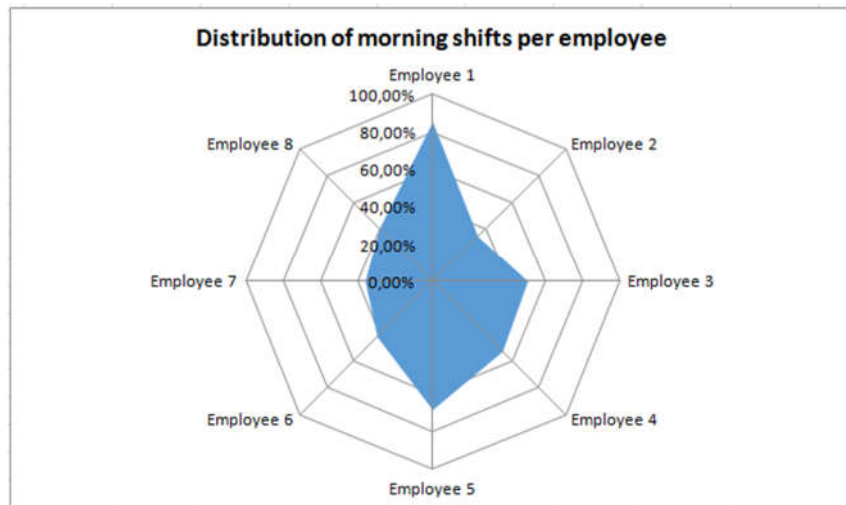


Figure 5 Distribution of morning shifts during 2017.

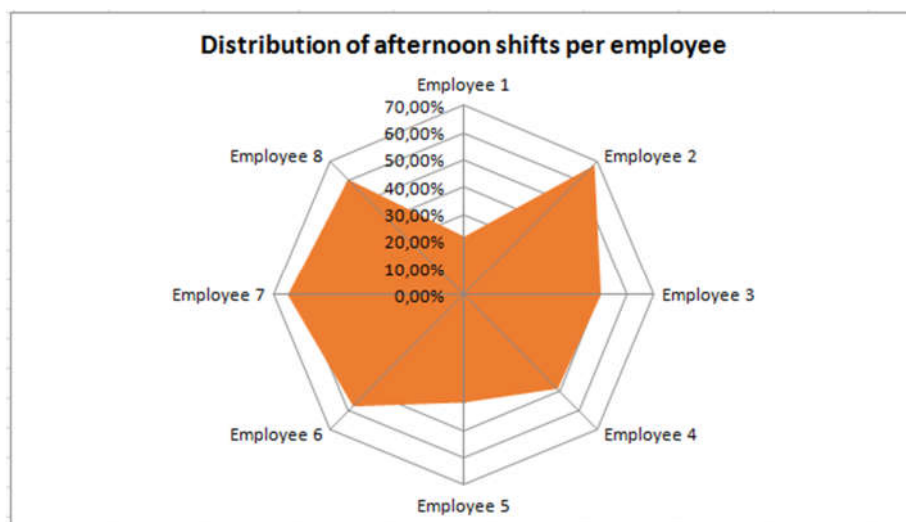


Figure 6 Distribution of afternoon shifts during 2017.

It is evident that Employees 1 and 5 predominantly work morning shifts and Employees 2, 7 and 8 have less than 30% of morning shifts in their workload schedules. Employees 3, 4 and 6 have more balanced schedules.

2.3 Distribution of days off

Data on off days for 2017 were analyzed and presented by stacked column chart. Data for the other two years show similar structure.

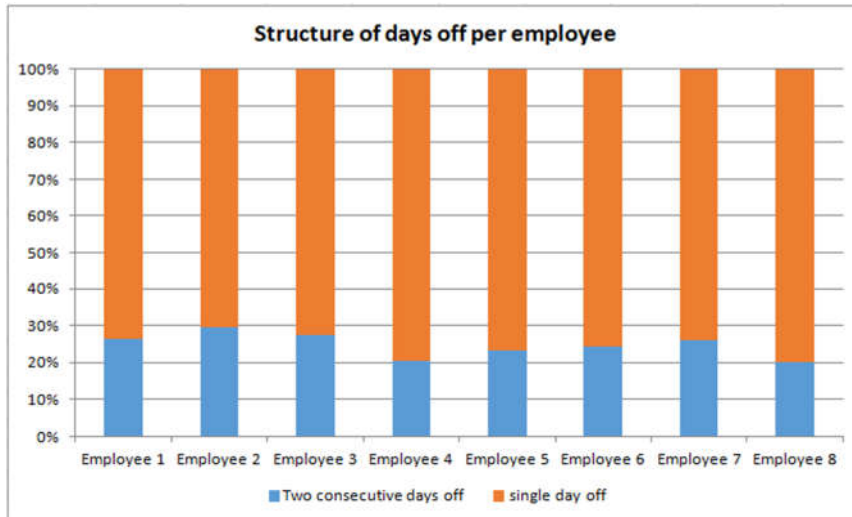


Figure 7 Distribution of afternoon shifts during 2017.

In total number of off-days the two consecutive off-days occurrence varies from 20% (Employee 8) to 30% (Employee 2). There are no great differences, yet the distribution of occurrence is not uniform for all employees. In the long run, this can also be the cause of employee dissatisfaction.

2.4 Work on Saturdays, Sundays and public holidays

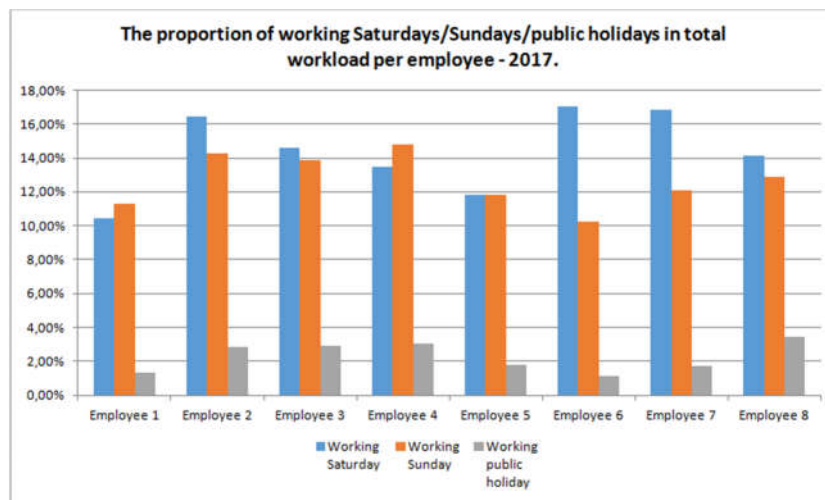


Figure 8 The proportion of working Saturdays/Sundays/public holidays per employee 2017.

Data for working Saturdays, Sundays and public holidays for 2017 were analyzed and presented by clustered column chart. Data for the other two years show similar structure. It is evident that the proportion of working Saturdays in employees' schedules is not equal. Employees 2, 6 and 7 have a noticeably higher proportion. Additionally, we can notice that Employees 2, 3 and 8 have a higher proportion of working Sundays. A similar difference is present in proportion of working public holidays. Employees 2, 3, 4, and 8 have a few percent higher proportions. Employees are especially sensitive to unequally distributed work on Saturdays/Sundays and public holidays due to family nature of these days.

3. Solving the Problem

Having described statistically the uneven workload, something could be done: a new work schedule. It is obvious that a poorly arranged schedule can cause discontent and impact the production. A new

work shift plan should satisfy business requirements and additionally take care of a well-balanced workload. Unreasonable amount of overwork, lack of breaks between shifts, lack of days off; the new and improved schedule should prevent it all. Considering all these requirements, it is clear that scheduling of employees can be a complex and time-consuming task [4,5].

3.1 Defining the workforce scheduling problem

First, we will define what we are doing: there is a certain number of employees, and we want to assign them to day/time intervals. It has to be done in a way that the demand for staff is fulfilled, all other constraints have to be regarded and the objective should be achieved. If we consider “all other” constraints, according to importance (of implementation) we could split them in two categories [4]:

- hard constraints – their satisfaction is mandatory; here belong legal restrictions like maximum working hours, maximum numbers of shifts, not to work in two following shifts
- soft constraints represent the constraints we want to achieve (but only if it is possible), for example not to have overtimes, to try and have a fair distribution of workload to the personnel. Non fulfilment of soft constraints can be penalized, usually in goal function.

There are different types of objectives often used to model the staff scheduling problem. Some of them are time oriented, e.g. sum of overtimes should be minimised, others are more concerned about workforce size and distribution. But all of them finally have one thing in common: costs should be minimised. So, it is simply a matter of implementation on which aspects of cost we will concentrate. Objective, or goal function, as the result gives a numerical value, so it is simple to compare two different schedules. Therefore, the goal functions can give us an impression of the schedule quality.

3.2 Technique used for solving the workforce scheduling problem: Integer Mathematical Programming

There are several different techniques for modelling staff scheduling problem and one of the most widely used is the Integer Mathematical Programming (type of Linear Programming). It is a mathematical optimization technique which restricts variables to integers. The general structure of linear programming model contains three main components [6]:

- decision variables, they are representation of activities
- objective function, optimization of mathematical (quantitative) representation of objective, such as profit, costs, etc.
- constraints are set of linear inequalities (and/or equalities) which presents restrictions of resources

General mathematical model of linear programming problem:

Optimization of (min or max) $Z = c_1x_1 + c_2x_2 + \dots + c_nx_n$ (where x_i are decision variables and c_i are parameters that give contribution to decision variables) with set of constraints

$$\begin{aligned} a_{11}x_1 + a_{12}x_2 + \dots + a_{1n}x_n (<, =, >) b_1 \\ a_{21}x_1 + a_{22}x_2 + \dots + a_{2n}x_n (<, =, >) b_2 \\ a_{m1}x_1 + a_{m2}x_2 + \dots + a_{mn}x_n (<, =, >) b_m \end{aligned}$$

and $x_1, x_2, \dots, x_n > 0$.

3.3 Staff scheduling model formulation in linear programming

Now we will present the major constraints for our case: All together there are eight employees, four of them are supervisors/deputies. Each person should work five days per week. It is preferable to have days off in a row. There are two types of shifts: morning shift (09:00-15:00) and afternoon shift 15:00-21:00 (in the summer time 15:00-22:00). There must be at least 2 persons in shift, on Saturday and Sunday afternoon 3. In each shift there has to be a supervisor (shop manager) or his deputy. Each employee works 30 hours per week, while supervisors/deputies work 40 hours.

3.3.1 Notation

In our model we will try to determine if there are enough workers to cover all shifts, if we put focus on demand for 5 working days per week with 2 days off in a row. Decision variables x_i where $i=1,2,\dots,7$ represent number of employees who start to work on Monday ($i=1$), Tuesday ($i=2$) etc. and work five consecutive days, as it is shown in the table 1 [7].

Table 1 Explanation of decision variables

variable	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
x_1	working day	working day	working day	working day	working day	day off	day off
x_2	day off	working day	working day	working day	working day	working day	day off
x_3	day off	day off	working day	working day	working day	working day	working day
x_4	working day	day off	day off	working day	working day	working day	working day
x_5	working day	working day	day off	day off	working day	working day	working day
x_6	working day	working day	working day	day off	day off	working day	working day
x_7	working day	working day	working day	working day	day off	day off	working day

3.3.2 Model constraints and objective function

Using given notation, we will model constraints defined on the beginning of the previous chapter. Shifts requirement and worker category are skipped for the moment as we want just to determine the number of employees needed to cover all days/shifts. The staff requirement for each day of the week:

$$\begin{aligned}
 x_1 + x_4 + x_5 + x_6 + x_7 &\geq 4 \\
 x_1 + x_2 + x_5 + x_6 + x_7 &\geq 4 \\
 x_1 + x_2 + x_3 + x_6 + x_7 &\geq 4 \\
 x_1 + x_2 + x_3 + x_4 + x_7 &\geq 4 \\
 x_1 + x_2 + x_3 + x_4 + x_5 &\geq 4 \\
 x_2 + x_3 + x_4 + x_5 + x_6 &\geq 5 \\
 x_3 + x_4 + x_5 + x_6 + x_7 &\geq 5
 \end{aligned}$$

Business demands are primary goal (also in our simplified version) therefore objective function is minimisation of the labor costs/number of employees:

$$\min Z = x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7$$

3.3.3 Results

For a given linear programming problem, Excels' add-in "Solver" (using template file from [8]) gives the solution shown in Figure 9.

	Minimum number of required employees:	6						
value of var. Xi		Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0	Monday	1	1	1	1	1	0	0
1	Tuesday	0	1	1	1	1	1	0
1	Wednesday	0	0	1	1	1	1	1
1	Thursday	1	0	0	1	1	1	1
1	Friday	1	1	0	0	1	1	1
1	Saturday	1	1	1	0	0	1	1
1	Sunday	1	1	1	1	0	0	1
	Total Number	4	4	4	4	4	5	5
		>=	>=	>=	>=	>=	>=	>=
	Number Needed	4	4	4	4	4	5	5

Figure 9 Excel Solver results

According to Solver, six employees are enough to cover all the working days. Our optimal solution requires no employees to start to work on Monday, and for each other day of the week one employee should start to work five consecutive days. If we check the same but including distinction between supervisor (shop manager) and “ordinary” employees, the Solver presents the same conclusion for the required number of workers. The obtained schedule is still not optimal, as some employees will never be free on weekends. In order to satisfy that requirement and to ensure equality to the extent possible, the work schedule should be spread across several weeks [7], sometimes called a roster [3]. One example of a fairer schedule would be:

- After the first week, the employee with the working schedule corresponding to x_i is taking schedule x_{i+1} for $i=1, \dots, 6$, and the x_7 is taking the schedule for the x_1 .
- Next week the process repeats.
- After six weeks, all the employees would have the same number of weekdays off.

This method of scheduling treats each employee equally. The requirement that is not covered yet is the morning/afternoon shift equality. A recommended solution for that requirement would be to have alternating shifts: a person works one week in the morning and the next one in the afternoon, and so on.

4. Conclusion

The working schedule for 8 employees of a local retail shoe store during the last three years was analyzed. Unequal distribution of morning and afternoon shifts among employees was noticed. The structure of days off (single or two days in a row) was shown not to be uniform for all employees. Finally, there is no uniformity in proportions of working Saturdays, Sundays and public holidays. In section 3, using Excel Solver, we have shown that the number of employees who work for this company is more than enough to handle the day-to-day business. Therefore, it was demonstrated that unfair schedule is a consequence of lacking management skills in this regard. We proposed a fairer roster where each employee is treated equally.

REFERENCES

[1] Golden, Lonnie (2015), Irregular Work Scheduling and Its Consequences, *Economic Policy Institute Briefing Paper No. 394*, Retrieved in April 2018, from <http://dx.doi.org/10.2139/ssrn.2597172>

[2] Zeytinoglu, I, W. Lillevik, M. Seaton, J. Moruz (2004), Part-Time and Casual work in Retail trade: Stress and Other factors Affecting the Workplace, *Relations Industrielles*, vol. 59, no.3, 516 - 542

[3] Hast J. (2017), Optimal work shift scheduling: a heuristic approach, Master’s Thesis Espoo, Aalto University School of Science, Retrieved in March 2018, from http://sal.aalto.fi/publications/pdf-files/thas17_public.pdf

- [4] Sauer J., Schumann R.: Modelling and Solving Workforce Scheduling Problems , Retrieved in March 2018, from publications.hevs.ch/index.php/attachments/single/352
- [5] Soares Ferreira da Silva Rocha M.: The staff scheduling problem: a general model and applications , A Thesis submitted to Faculdade de Engenharia da Universidade do Porto for the doctoral degree in Industrial Engineering and Management, Retrieved in March 2018, from https://sigarra.up.pt/feup/pt/pub_geral.show_file?pi_gdoc_id=335854
- [6] Mr. B.Satheesh Kumar, Ms. G. Nagalakshmi, Dr. S. Kumaraguru (2014): A Shift Sequence for Nurse Scheduling Using Linear Programming Problem; IOSR Journal of Nursing and Health Science (IOSR-JNHS) e-ISSN: 2320–1959.p- ISSN: 2320–1940 Volume 3, Issue 6 Ver. I (Nov.-Dec. 2014), PP 24-28, Retrieved in March 2018, from www.iosrjournals.org
- [7] Introduction to LP formulations, Retrieved in April 2018, from https://ocw.mit.edu/courses/sloan-school-of-management/15-053-optimization-methods-in-management-science-spring-2013/tutorials/MIT15_053S13_tut01.pdf
- [8] Yan Z., Schedule Your Workforce using Excel Solver [4 Case Studies], Retrieved in April 2018, from <https://www.excel-demy.com/schedule-your-workforce-using-excel-solver/>

Challenges in Teaching Business English – Understanding Media Messages

Elena Ciortescu

Alexandru Ioan Cuza University of Iasi, Romania
elena.cojocaru@uaic.ro

Abstract. Business English Teaching is primarily focused on understanding students' needs and, consequently, on creating a curriculum targeted at enabling them to communicate successfully, both in writing and orally, in business contexts and not only. It has long been argued that the main purpose of business English teaching is fluency acquisition rather than language accuracy. Sooner or later, depending on a number of factors, Business English learners generally succeed in acquiring both linguistic and intercultural communication skills. However, one of the greatest challenges for Business English learners occurs when they are actually immersed in a genuine English communication context. One of the most eloquent examples of such a context is the media, particularly headlines in English which very often prove quite difficult to understand due to their extensive use of jargon, wordplay, word omission. Undoubtedly, proficiency may be assumed to have been acquired once learners are able to grasp the meaning of headlines in English newspapers. This paper will discuss the major challenges that learners of Business English have to deal with in general and, based on our practical experience with second-year Economics and Business students, will further debate on how media headlines could become more accessible both to them and to the general public.

Key words: *Business English, Education, Media, Communication*

1. Introduction

ESP – English for Specific Purposes deals with teaching and learning the specific skills and language required for a particular purpose. Therefore, business communication skills are undoubtedly included within the broad area of ESP. It is thus essential to understand the differences between Business English and General English teaching, particularly those regarding context importance and skill-acquisition. It has long been argued that fluency is by far more important than accuracy in the Business English teaching and learning processes and the main reason for this resides in the stress on learners' needs. Consequently, learners' needs define the trainer's choice of syllabus and learning material. The decision will ultimately depend on a number of factors such as: who the learners are (i.e. are they university students or professionals?), who pays for the course (are they paying themselves or are they sponsored?), are they homogenous in their skills or are they a mixed ability group?, which aspects of professional language they actually need to acquire or improve; moreover, will self-study be an option to take into account as part of the learning process?, and which is the extent to which the trainer is familiar to the subject matter? Regarding this aspect, it is perhaps worth mentioning that thorough knowledge of the subject matter is not compulsory on behalf of the trainer. Most specialists argue that an interest in the field, constantly fuelled by enthusiasm, may actually enhance knowledge in time. Specialists like Jeremy Day and Mark Krzanowski consider that learners' specific needs may be met by using a blended learning platform (e.g. www.english360.com) and other online courses. Also, it is important to supplement teaching materials with *realia* (objects or activities which relate classroom teaching to the real life). It is this particular aspect which determined me to use economic and

financial newspapers in the business English class. Students react positively to real-life information and their motivation for understanding and using content is increased. In terms of relevance, newspaper articles prove extremely useful due to the fact that learners have to read and further exploit the information discovered in their daily lives (both professional and personal).

Jason Anderson (2017: 4-5) rightfully notes that the importance of context is crucial in teaching foreign languages. He points to the fact that most language teaching approaches nowadays (CLT – communicative language teaching, TBLT – task-based language teaching, CLIL – content and language integrated language learning, TBI – text-based instruction) extensively rely on context use. He further describes the changes in contextualization trends in ELT (English Language Teaching) books which occurred between 1986 and 2016. Four patterns of contextualization have been identified through his extensive analysis:

- *Image-supported* – learners use images or images and text to understand context.
- *Text-integrated* – learners complete or manipulate text to raise awareness.
- *Extensive text* – students read/ listen to complete texts (e.g. newspaper articles) and then, language is noticed and analysed.

- *No clear context* – example sentences or very short dialogue without clear indication of why or by whom the text was produced.

Jason Anderson noticed “a clear change in the late 1990s, when image-supported and text-integrated contextualisation largely disappears and *extensive text* contextualization begins to dominate. Since 2000, almost all the coursebooks examined have followed the same pattern: reading or listening skills are first practiced through texts that integrate the new language features, after which these features are extracted, analysed and (almost always) practiced, usually using both controlled (for example, cloze exercises) and freer (for example, communicative tasks) practice exercises. (...) Thus, while context has always been an important part of the introduction of new language in global coursebooks, the recent trend has been towards more extensive, receptive skills contexts, possibly under the influences of text-based instruction (Burns 2012).”(2017: 4)

The author proposes a model comprising three stages in language lessons – CAP, i.e. *context*, *analysis* and *practice*. The model will be further practically applied in our paper by using an economic newspaper article as a content provider for a Business English class.

Table 1. Jason Anderson’s CAP Model

Context	The context for learning is established through a text (listening, reading or video), a presented situation (in the classroom or through audio-visual resources), or the involvement of learners. May be accompanied by activities that raise background schemata, check comprehension, or engage learners meaningfully in the text.
Analysis	Language features are noticed and analysed explicitly for meaning, form, pronunciation and usage as appropriate. This may include grammatical, functional, lexical or textual aspects of the language.
Practice	Learners practice using the language. This may include controlled and freer practice of the language analysed and independent text construction or a communicative task.
Evaluation (optional)	When practice involves text construction, self-, peer- and teacher-evaluation of the text are possible.

2. The Media

Media messages – written or oral - encompass a wide range of *idioms, jargon, wordplays*, etc. Our aim is to discuss these elements as quintessential in the language learning process in the particular context of Business English teaching. The definitions provided by the *Cambridge Advanced Learner's Dictionary* (2006) for these key terms will be used as a starting point in dealing with the topic of our paper:

- *The Media*: “newspapers, magazines, radio and television considered as a group: can be followed by a singular or plural verb.” (788)

- *Idiom*: “a group of words in a fixed order that have a particular meaning that is different from the meanings of each word understood on its own.” (633)

- *Jargon*: “special words and phrases which are used by particular groups of people, especially in their work”. (681)

- *Wordplay*: “when you joke about the meaning of words, especially in a clever way”. (1495)

As their definitions suggest, the acquisition of *idioms, jargon, wordplay* requires both thorough knowledge of English and peculiarities of Business communication. While *jargon* can be assimilated while learning the subject as such (some terms are common in different languages) by paying attention to *false friends* (further illustrated), *idioms* prove more difficult to understand and, more importantly, to actually use spontaneously. *Wordplay* requires good knowledge of English as well as minimum awareness of cultural issues. Due to the high complexity which these three elements imply and to the fact that newspaper articles intensively rely on their use, understanding media messages beyond the headlines – whose meaning is sometimes the most difficult to grasp – can prove quite a challenge for non-native speakers of English.

Our students sometimes think that learning a lot of words guarantees a good level of English and ignore the fact that knowing words is one thing and actively using sets of phrases and word combinations could turn out quite difficult. As Raciél Martínez Cisneros stresses, “it is important to make it clear that the key to understanding these expressions (i.e. idioms) is never to look at them or read them in a literal sense. This is not a pointless warning, since most students tend to translate idioms into their mother tongue word for word – an ineffectual process because of the differences in the forms of expression between the two languages. (...) Teaching idioms (...) has proved effective, contributing as it does to the development of their (students’) communicative competence, particularly regarding their oral skills. Not only do they have the opportunity to build up their vocabulary, they also gain the fluency and confidence to enable them to interact easily with native speakers in their professional field.” (2017: 8-9)

It is for all these reasons that I have chosen to use Business newspaper headlines and articles in devising activities for undergraduate Business students: they are a genuine source of relevant context, the language used (though apparently simple) is complex and challenging, and thus, students are enabled to achieve multi-level improvement – reading, speaking, cultural awareness. Some examples of idioms, jargon and wordplay will be illustrated in the following part of this paper.

3. Understanding Media Messages: Idioms, Jargon, Wordplay

In an article published in *Business Spotlight* in 2014, Deborah Capras carries out an extremely interesting analysis of newspaper headlines and points to the fact that, most often, newspaper headlines are more difficult to understand as compared to other messages in English. She identifies some golden rules that journalists apply when creating headlines: they should be

short and snappy, make use of drama and monosyllabic words, and last but not least, they should exert the idea of fun; the editor also identifies some key terms used in headlines and provides a list:

- slam – generally a word which illustrates the action of a door being shut; in headlines: to criticize;

- blast – drama is amplified: to criticize strongly;

- axe – something is reduced; to be given the axe = to be sacked;

- crunch – a severe financial crisis;

- mull – to *consider* things;

- spark – to cause;

- splurge – in newspapers, people who spend a lot *splurge (greed)*;

- urge – the term is preferred in newspapers instead of *strongly recommend*. (Deborah Capras, 2014: 48-49)

One example of *wordplay* occurring in a *Financial Times* headline is given below:

“*Butt hang on a minute*”

The article deals with the tobacco industry and the headline urges readers to stop and think a little about the fact that anti-smoking campaigns are not as successful as expected. The wordplay is centred on the use of “butt” instead of “but” – *butt*: the part of a finished cigarette which has not been smoked; *but*: preposition, conjunction meaning except. (Business Spotlight 1/2014: 21)

The use of *jargon* raises the risk of *false friends*. Let us consider three English terms related to business and the media: *advertisement* (noun), *current* (adjective), *staff* (noun). Romanian students are tempted to use *announcement* instead of *advertisement*, *actual* instead of *current* and *personal* instead of *staff* (or *personnel*). The Romanian equivalents are: *anunț* for *advertisement*, *actual* for *current* and *personal* for *staff*. It is thus obvious that confusion may easily occur. The experience is similar with that of learners of English from other countries.

As for *idioms*, in the example below the idiom *corner the market* is the equivalent of *dominate the market*, i.e. there is no reference to space as such.

e.g. *I have just heard that XEROX have just bought three of their main competitors.*

Obviously, they are going to corner the market.

I agree: they will soon monopolize the market actually.

4. Conclusions: Media Messages in the Classroom

The 23rd of February 2018 issue of *Financial Times* provides a range of headlines which prove a rich source for classroom activities: “Latvia central bank chief hits at lenders”, “Frugal four take aim at Brussels’ plans”, “Macron in French farming shake-up”, “Angry Birds maker’s market cap slumps”, “Why KFC’s Chickens failed to cross the road – Shocking logistics slip sparks KFC’s great chicken run”, etc. All these headlines share common characteristics: they are short and snappy and make extensive use of idioms, wordplay, jargon; moreover, rhetorical techniques are employed, i.e. repetition of sound. Not only that all these catch readers’ attention but they also prove an endless source of teaching material for Business students, providing linguistic, professional and cultural input.

Jason Anderson’s CAP (context, analysis, practice) model will be used to illustrate how business newspapers content can be a resource for teaching Business English students by integrating multiple skills: reading, speaking, vocabulary-building and intercultural. The *context* for learning is set up through a text published in *Financial Times* on the 23rd of February, 2018 – “*Frugal four*” *mobilise to tame EU largesse* (Jim Brunsten, Mehreen Khan, Alex Barker: 4). This is accompanied by activities that raise background schemata, check comprehension, and engage learners meaningfully in the text. Language features are noticed

and analyzed explicitly for meaning and usage as appropriate during the *analysis* stage. Finally, learners *practice* using the language introduced and analysed during the previous stages. This includes independent text construction. Some representative fragments of the article will be quoted below:

“Talks over 2021-27 spending kick off with richer states trying to rein in ambitions
(*subtitle*)

Brussels’ master plan for preserving the EU’s joint spending power after Brexit is facing its most tenacious adversaries: four frugal countries determined not to foot the bill.

EU leaders launch the mother of all budget battles today as the bloc decides on plans for 2021-27. Negotiations promise to be even bloodier than past wrangles over money, as a group of Europe’s smaller and richer members try to shield tax payers from underwriting Brussels’ grand ambitions.

Britain’s departure from the EU is a double blow for the <frugal four> – the Netherlands, Denmark, Austria and Sweden that are losing both a fellow net contributor and a traditional ally in the fight against EU largesse.

The four are the most hawkish of the 10 EU countries that, in accounting terms, contribute more in budget funds than they receive in EU subsidies.

<The British will be dearly missed in this debate>, Wopke Hoekstra, Dutch finance minister, told the FT. <The UK has been one of our core anchors.>

(...) The frugal four are determined to keep the EU’s next seven-year budget like the current one, capped at 1 per cent of gross national income, meaning that it will shrink in real terms after Brexit.

(...) The commission will present its budget proposal in May but is expected to call for an overall pot of at least 1.15 per cent of GNI, in the hope that, whatever final number emerges from the talks, it will still be larger than the current 1 per cent.

Countries including Poland, Italy, Ireland, and the Baltic states want the existing budget of €1,000bn to be maintained after the UK leaves, which would require an increase in gross contributions by the remaining 27 members.

(...) Hawkish governments are preparing to dig in. Hartwig Loger, Austria’s finance minister said <there was no room for negotiation> over members paying more into the common pot.

Despite Germany’s apparent willingness to increase contributions, it still wants to toughen up the conditions attached to EU money, ranging from rule of law compliance to the welcoming of migrants.

(...) When a deal is agreed, EU diplomats expect it may hinge on the sensitive issue of rebates – mechanisms that reduce budget contributions and from which all of the frugal four benefit.” (Brunsden, Khan & Barker, 2018, p.4)

The lesson plan based on the above FT article is illustrated below.

Time: 50 minutes

Level of students: B2

Aims: at the end of the lesson students will have acquired:

- the ability to understand how written media messages are created and conveyed
- the ability to understand and use idioms, vocabulary related to budget and finance,

i.e. jargon, and wordplay in new contexts

- new information related to current EU affairs
- intercultural communication skills

STAGE 1: Introducing the Context – C 15 min.

Teacher writes 5 key terms on the whiteboard and asks students to anticipate the topic of the newspaper article: frugal four, GNI, budget battles, hawkish governments, EU.

Students try to anticipate and come up with ideas.

Teacher explains the terms: what the expression *frugal four* refers to - the Netherlands, Denmark, Austria and Sweden, *GNI* – Gross National Income; *hawkish* – from *hawk* - type of a large bird which catches small birds for food, a person who strongly supports the use of force in political relationships rather than discussion – *hawkish* - adjective; verb: to sell goods informally in public places.

STAGE 2: Analysis – A 20 min.

Students are given the text and are asked to read it in silence while identifying unknown words and expressions. At the end of the reading session, teacher explains new terms and expressions, among which:

- *cap* – limit; a very small amount of explosive powder in a paper container, used especially in toy guns to produce a loud noise;
- *to foot the bill* – to pay an amount of money;
- *hinge on* – if one thing hinges on another, the first thing depends on the second thing or is very influenced by it;
- *to kick off* – to get something started;
- *rebates* – an amount of money which is returned to you, especially by the government, for example when you have paid too much tax;

• *to tame* – to control something fierce or powerful. During this stage, i.e. C, teacher draws attention to the fact that the vocabulary used is predominantly military (“bloodier than past wrangles”), idiomatic and metaphorical (“to foot the bill”, “core anchor”), based on wordplay (“capped at 1 per cent” – see the meaning of *cap*) and jargon (“GNI”, “rebates”). During the same stage, teacher makes sure that students fully comprehend the text by asking questions related to its content.

STAGE 3: Practice - P 15 min

During this stage, teacher asks students to discuss the underlined terms in the text with a stress on the cultural aspects (e.g. “The British will be dearly missed in this debate” – typical British statement). Then, students are asked to work in pairs and rewrite a fragment of the newspaper article by replacing the underlined terms with simple words. At the same time, they are asked to suggest a new title for the article which should not exclude the use of wordplay, idioms, jargon. At the end of the activity, students report to the whole class.

Finally, conclusions are drawn and some key aspects related to reading and understanding media messages are emphasized: first of all, newspaper headlines are the most difficult to deal with in media communication due to their extensive use of idioms, jargon, wordplay and general lack of visual support; secondly, newspaper articles are easier to understand once knowledge of context is ensured (in our case, EU policy) and thirdly, newspaper articles can prove a valuable resource for intercultural as well as for language skills development.

REFERENCES

- Anderson, Jason (2017). Context, Analysis and Practice. *VOICES*, Issue 256, 4-5
- Brunsdon, Jim, Khan, Mehreen, Barker, Alex (2018). “Frugal four” mobilise to tame EU largesse. *Financial Time*.
- Cambridge Advanced Learner’s Dictionary (2006). Cambridge University Press.
- Capras, Deborah (2014). Comic Headlines. *Business Spotlight*, 5, 48-49
- Martinez Cisneros, Raciél (2017). Idioms in Context. *VOICES*, Issue 256, 8-9

Data Science in Social Context – Help from Physics and Statistics

Ivica Luketin

Faculty of Science, University of Split, Split, Croatia
lukeetin@gmail.com

Nada Roguljić

University Department of Professional Studies, Split, Croatia
nmaroevi@oss.unist.hr

Abstract. In this article we remind the users of data in social, economic or political settings how physicist (astrophysicists, meteorologists, urban physicists) used mathematical notions seeking correlation between variables. This lessons can help practitioners in social contexts (tourisms, merchandise, health) to sharpen distinction between datum and information (sense making), develop criticisms on predictions based on algorithmic reasoning and wonder about model of human cognition (cognition as emergent phenomena or predictable chain of “if- than” pattern).

Key words: *data, physics, social context, algorithmic reasoning, model of cognition*

1. Introduction

“The ability to take data—to be able to understand it, process it, to extract value from it, to visualize it, to communicate it—that’s going to be a hugely important skill in the next decades.” - Hal Varian, Google’s Chief Economist.

In academic context, this ability H. Varian highlighted is domain of data science, emergent field of notion roots from intersection of, coarsely, mathematics, computation and domain expertise presented at Figure1.

In the past, the craft of using data systematically was limited on few natural scientist, engineers and merchandize. Development of scientific method (observation, building model –theory, testing in practice), invention of printing, mathematical, computational and technological tools made collecting, analyzing and visualizing data important in whole society, promising to guarantee ecologically sustainable life (renewably energy, modern technology, quantum computers, big data) in global mega police.

In our paper, we shall remind reader on three examples of useful collecting data and effort to distill deeper knowledge about investigated phenomena (from physics and engineering domain). The first encompasses long history of astronomical observations climaxed in Kepler Laws and Newton universal law of gravitation. The second is concerned with universality of scaling laws in nature and human society, from Kleiber's power law [1] on animal's metabolic rate to some cities characteristics dependent on population, explained by Geoffrey West and Louis Bettencourt [2, 3, 4]. The third is essential enterprise of David Keeling [5] to collect meteorological data helping make correlation of actual earth climate trend with past earth climate deduced from geological paleo data.

Finally, we shall shortly describe one demography study, inspired from book An Introduction on Data Science [6], as clear example of collecting and analyzing data in social context, using statistical tools prepared in programming language R, well suited for working with data.

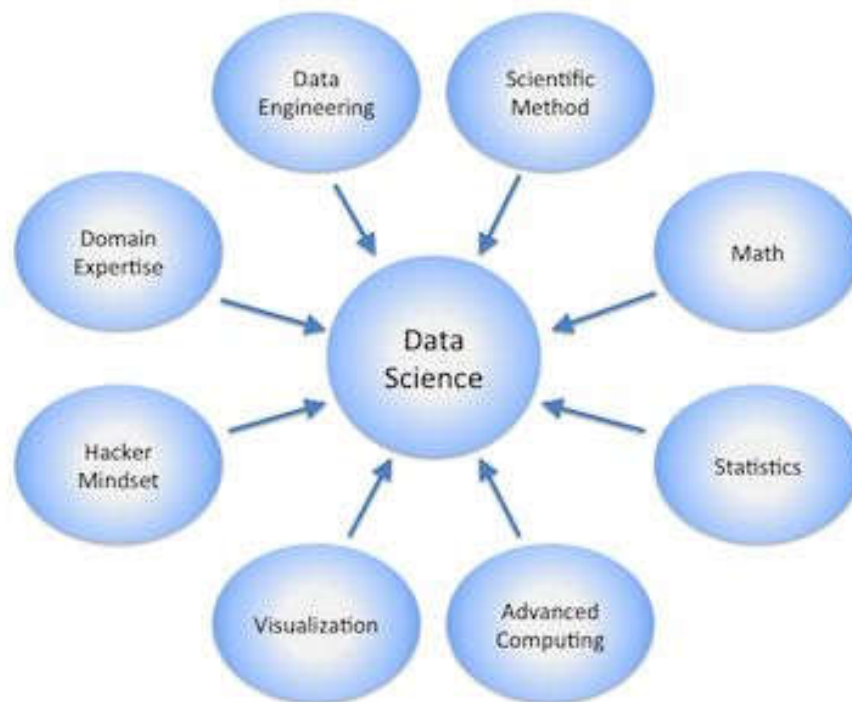


Figure 1 Domains of data science

2. Collecting data and distilling deep knowledge about phenomena

2.1 Fictive Kepler Law - guessing a rules with few experimental data

Most accurate data concerning planetary motion until 17th century collected Tycho Brache (1546-1601): positions of five known planets during annual movement. For this epoch it was huge, unstructured data collection scribed in Braches private notes, inaccessible to other scientists. Johannes Kepler (1571-1630), in spite of enormous difficulties, arrived in Prague, achieved Brahe belief and used his data to deduce 3 mathematical laws, describing planetary motions in precise and simple form:

- 1) planets trajectories are ellipses with Sun in one focus
- 2) vector connecting planet and Sun sweeps, during annual motion, equal areas in equal time intervals
- 3) ratio of planets mean distance from the Sun (R) power to the three with annual motion period (T) power to two is constant for all planets, algebraically $\frac{R^3}{T^2} = const$

Suppose you know Kepler 3rd low and ask volunteer who don't know low (in this fictive case it is ratio $\frac{R^2 + 2}{T} = const$) to deduce it equipped with data frame for 3 planets:

Table 1 Data on distance from Sun and annual period for 3 planets

Planet	Distance from Sun (R)	Annual period (T)
A	1	3
B	2	6
C	4	18

In the meantime, new planet D is discovered with measured mean distance from the Sun equals 5 and

$$T = 5^2 + 2 = 27 \quad (1)$$

Volunteer, using data for three planets from table, has trying various combinations of ratios R to T. For example, ratio of T/R is same for first two planets (3/1 and 6/2) but is not same for planet C (18/4) so we have to discard this combination as possible law of this fictive Kepler problem. He has trying new rule,

$$\frac{8}{R} + 7 * R = T \quad (2)$$

It looks perfect for all three planets giving number 12, but, you are giving him now data for 4th planet, D, with R=5 and T= 27, which, inserted in his rule gives number 9.6. Disappointed, volunteer is trying new rule and discovers correct rule

$$\frac{R^2 + 2}{T} \quad (3)$$

which is constant for all four planets, namely one. Finally, new, 5th planet E is discovered, with R=3 and T=11. Suppose that planet E has been discovered earlier, before planet D. According rule (2), volunteer would have gotten number 12.67, what is not too different from 12, and cause of difference is possible explain as experimental errors in measurement of distance and period. What is critical point in this fictive history of searching for mathematical law connecting two measured observables? In data analyze with very few data, caution is necessary not to permit firm conclusion about possible correlation between observables. Happily, as real history of physics confirmed, Kepler generalized motion of planets in mathematically correct laws using Braches data for five planets, only known in 17th century, which was foundation for Newton universal gravitation law.

2.2 Universality of scaling laws in nature and human society

“Scale invariance is a feature of laws that do not change if scales of length (or other variables) are multiplied with some parameter. Examples of power law are: Newton’s law of gravitation

$$F(\lambda r) = const \cdot (\lambda r)^{-2} = const \cdot \lambda^{-2} \cdot r^{-2} = \lambda^{-2} \cdot F(r), \text{ for any } \lambda > 0 \quad (4)$$

or Kleiber's law [1]

$$B = aM^b \quad (5)$$

that for animal's metabolic rate (B) scales to the

$$b = 3 / 4 \pm 0.1 \quad (6)$$

power of animal's mass (M) for 7 orders of scale (*a* is normalization factor)”- Luketin & all [7].

2.2.1 Universality of scaling laws in biology

Figure 2. is graph Kleiber published 1947, but referring to data appeared in [1]. Reminder for readers not accustomed on logarithmic scale: 1 kg is distanced from 10 kg for same length on horizontal axes as 10 kg from 100 kg because 1 kg=10⁰ kg, 10 kg=10¹ kg, 100 kg=10² kg so the powers 0 and 1 are equal distanced as powers 1 and 2, and so forth.

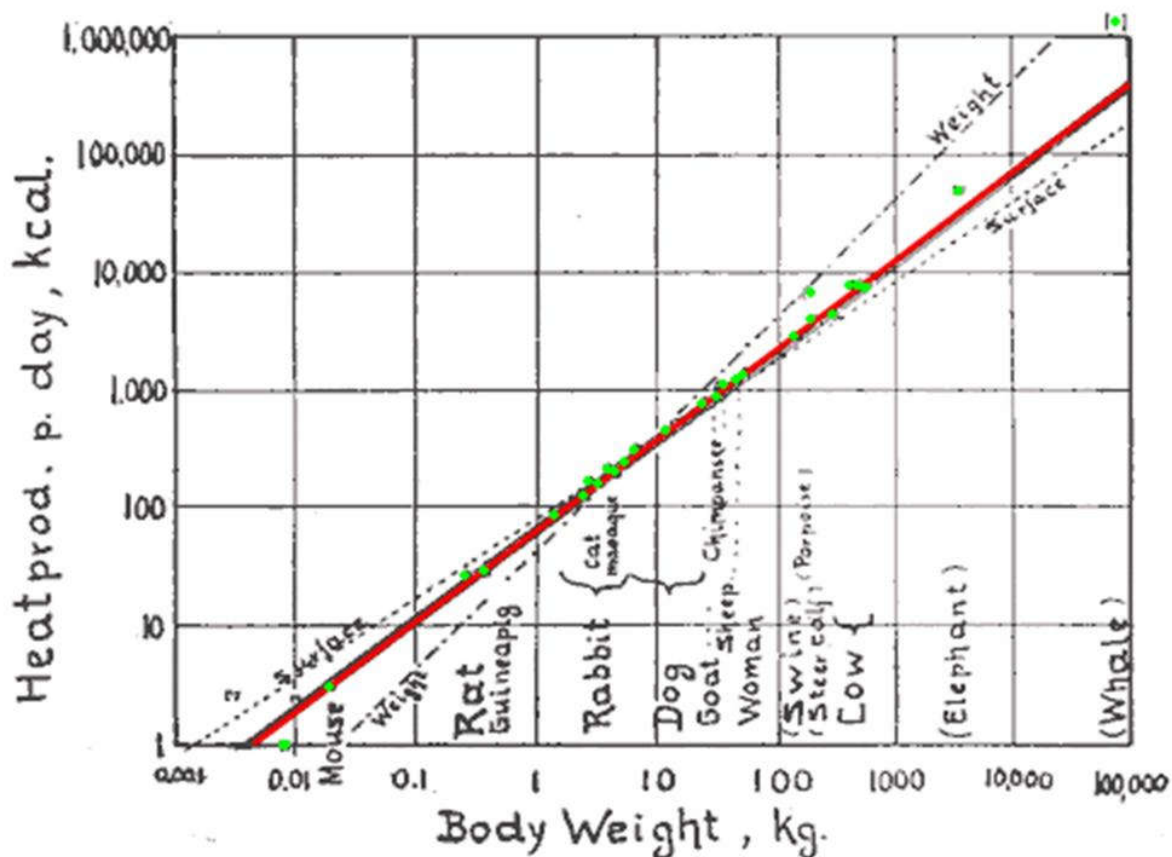


Fig. 1. Log. metabol. rate/log body weight

Figure 2 Metabolic rate vs. Mass log-log graph [1]

While this law was established for warm-blooded animals with masses from 10 grams to 100000 kg, Geoffrey West, in famous but controversial paper [8], encompassed data (basal metabolic rate versus mass) for wider span of biological organisms extending validity of $\frac{3}{4}$ power from the largest mammals to the mitochondria – masses scales to almost 27 order of magnitude. Key finding of his paper was building mathematical model based on notion of fractal network justifying $\frac{3}{4}$ power in Kleiber's law. Rephrasing in simpler way, animal with double more mass will not need double food (equivalent of energy needed for metabolisms) for survival, but only 75% more food. This is economy of scale created in nature owing to evolution. West hypothesized that this economy was achieved own to dense, fractal packing of blood vessels or cells responsible for some function in other organs in living organisms.

2.2.2 Digression with Galileo's scaling of leg wide with body weight

Animals with greater mass are constrained with gravitation. Galileo reasoned that animal with double more mass would have more than double wider legs not to collapse under own weight (proportional to mass) what limits the animal growth. Prove is adapted from Galileo's book Two New Sciences.

If body weight is pictured as cube of volume L^3 , which is posted on supports (pillars) of cross section area d^2 , than pillars, not to collapse, have to sustain pressure proportional to ratio L^3/d^2 . Doubling body weight, cube grows to $(2L)^3=8L^3$. If pillars has to sustain same pressure (building material has similar structure), wide of pillars has to grow for k time, so area grows as $(k \cdot d)^2$. Little algebra gives

$$\frac{L^3}{d^2} = \frac{(2L)^3}{(kd)^2} \Rightarrow k = 2\sqrt{2} \quad (7)$$

2.2.3 Universality of scaling laws in human society

This idea of universality of scales was used by West and Bettencourt [4, 5, 6], like metaphor (analogy) of cities as living organisms, to analyze correlation of urban infrastructure (according to analogy, cities blood vessels) with human population (in same analogy, has role of mass). Bettencourt with collaborators collected huge amount of data about some macroscopic aspects of cities and concluded that all cities realize, as they grow, some spatial economies of scales: volume of infrastructure-roads, pipes, and cables per capita is smaller. Doubling of city population, city don't need to double volume of infrastructure facilities, but crudely 80% more. City contains about 10-20 % less infrastructure volume per capita. An origin of this economy of scale in cities, according West and Bettencourt, is fractal filling of volume, similar like in nature. Figure 3 is graph which show sublinear (less than linear) growth per capita road miles in USA metropolitan areas.

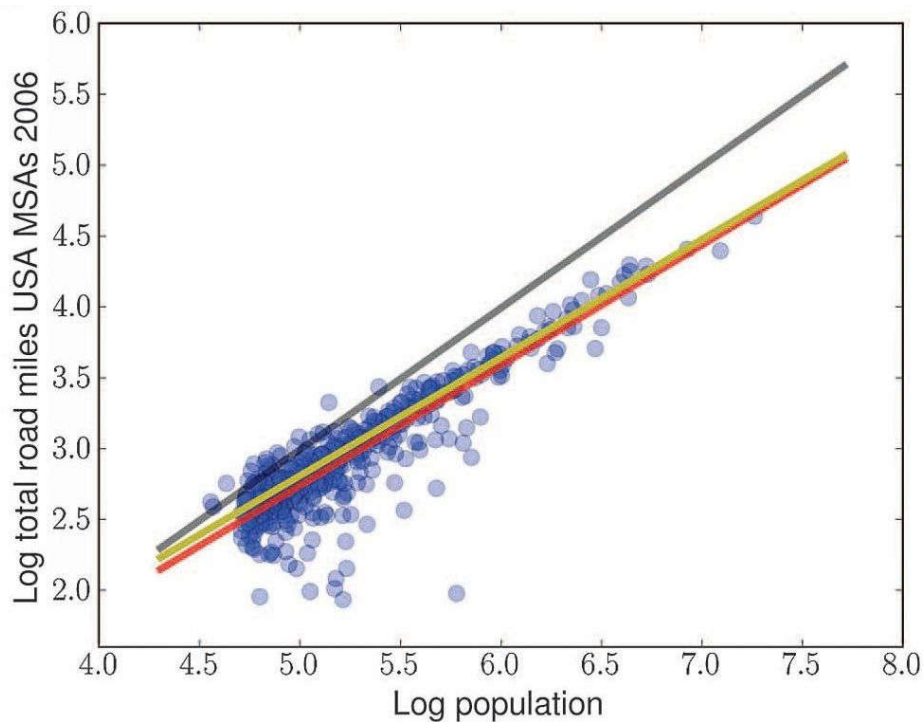


Figure 3 Scaling of urban infrastructure. Total lane miles (volume) of roads in U.S. metropolitan areas (MSAs) in 2006 (blue dots). Lines show the best fit to a scaling relation, $Y = Y_0 \cdot N^\beta$, $\beta = 0.85 \pm 0.04$ (red); theoretical prediction $\beta = 5/6$ (yellow); linear scaling $\beta = 1$ (black). [4]

Critical point in this example of collecting and analyzing data is which amount of data allows building reliable mathematical models. Opposite to a huge amount of data introduced in [3], justifying reporting power in universality law as $\beta = 0.85 \pm 0.04$ (significant number on the second decimal place meaning that β can vary between 0.8 and 0.9 with great confidence), determining power in power law using small data set is near to pure guessing.

Google data on question about number of gas stations in bigger Croatia towns are shown in log-log graph in Figure 4 and fitted with line with slope 0.75 and -0.699 intersection on y axis.

Although is visible trend of economy of infrastructure data with scale (doubling the number of population city can satisfied citizens need with less than double gas station), prediction model is inaccurate and lack rigour compare with big enough data set inhabited mainly with big cities.

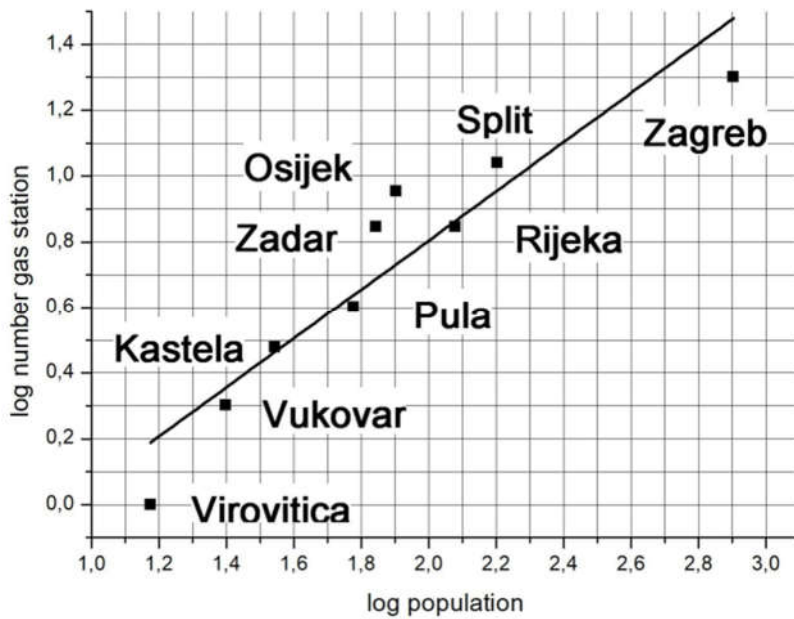


Figure 4. Logarithm population (normalized by 10000) versus logarithm number of gas stations in nine Croatian towns

Finally, not because of illuminating some new critical point teaching caution user of data in social domain, but as curiosity from urban physics, we give data in Figure 5 visualising correlation between cities population and some socioeconomic characteristic. Correlation is superlinear (greater than linear)-as cities grow, wages, patents and crime rate per capita are bigger. This means that employ, working in twofold bigger town can expect, on average, 10-15 % bigger wage for same job.

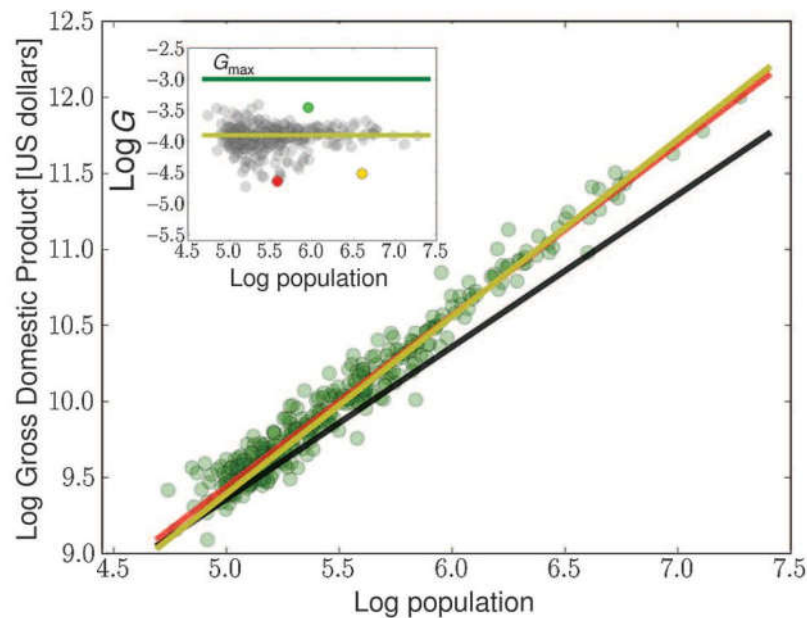


Figure 5 Scaling of socioeconomic variable. Gross metropolitan product of MSAs in 2006 (green dots). Lines describe best fit (red) to data $\beta = 1.13 \pm 0.02$; theoretical prediction $\beta = 7 / 6$ (yellow); linear scaling $\beta = 1$ (black). [4]

2.3 The Keeling curve, paleo data and supercomputers-prediction of future Earth climate

This example is short review on climate science, systematic study of climate, weather conditions averaged over period of time [9], part of earth science which is subfield of physics. One of founder of this field of knowledge was John von Neumann (1903-1957), whose insight in mathematics, physics and computer scientist nominated him as role model for highest standard of data scientist, although his brilliance in mathematics and quantum physics inclined him more on theoretical strand than as master of application of knowledge, which is nowadays stereotype of data science expertise. Climate science envelopes data collecting (measurement, cleaning, storage and analysing data), mathematical modelling and computer simulations using most fastest supercomputers or distributed computing to predict future climate. An interesting story from climate science is discerning deterministic chaos in simple climate model by E. Lorenz [10], who discovered that long-term prediction of weather is not possible if beginning conditions (temperature, pressure, air convection ...) are in chaotic regime of values.

Here, from extreme wide and important field of climate science, we pick two instances: continuous measurement of CO₂, with same method, taken at the Mauna Loa Observatory in Hawaii, from 1958. until now and obtaining content of CO₂ molecules in air from the past (in last 800000 years) using air bubbles trapped in snow, frozen in ice and excavated from almost 3000 on Antarctica (so cold paleo data).

Measurement data from Mauna Loa Observatory are accessible from [5].

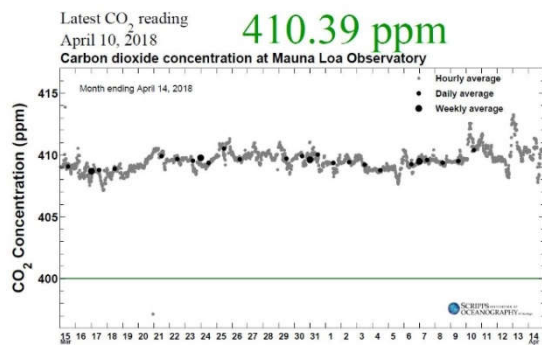


Figure 6 CO₂ conc.14.May -14.April 2018

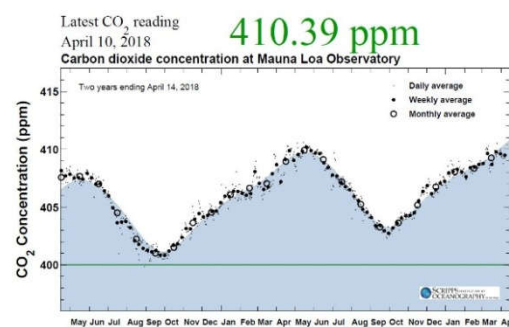


Figure 7 CO₂ concentrations for last two years

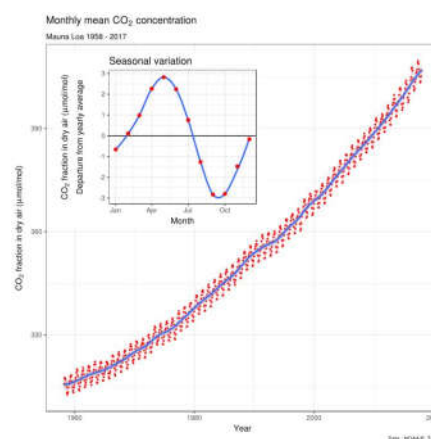


Figure 8 CO₂ concentrations – full record 1958-2017

Growth of CO₂ concentration from 316 (parts per million-ppm) measured 1958 year to actual 410 ppm is striking. Full meaning of this continues growth is more terrifying when compared with concentration of CO₂ in atmosphere deduced from paleo data:

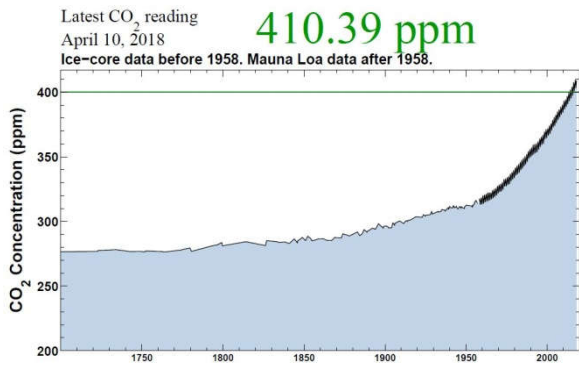


Figure 9 CO₂ conc. from 1750 till now

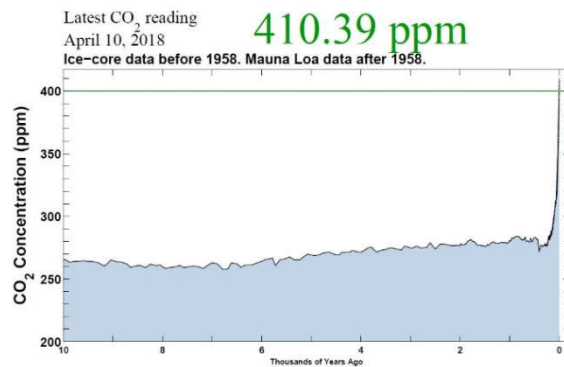


Figure 10 CO₂ conc. last 10 000 years

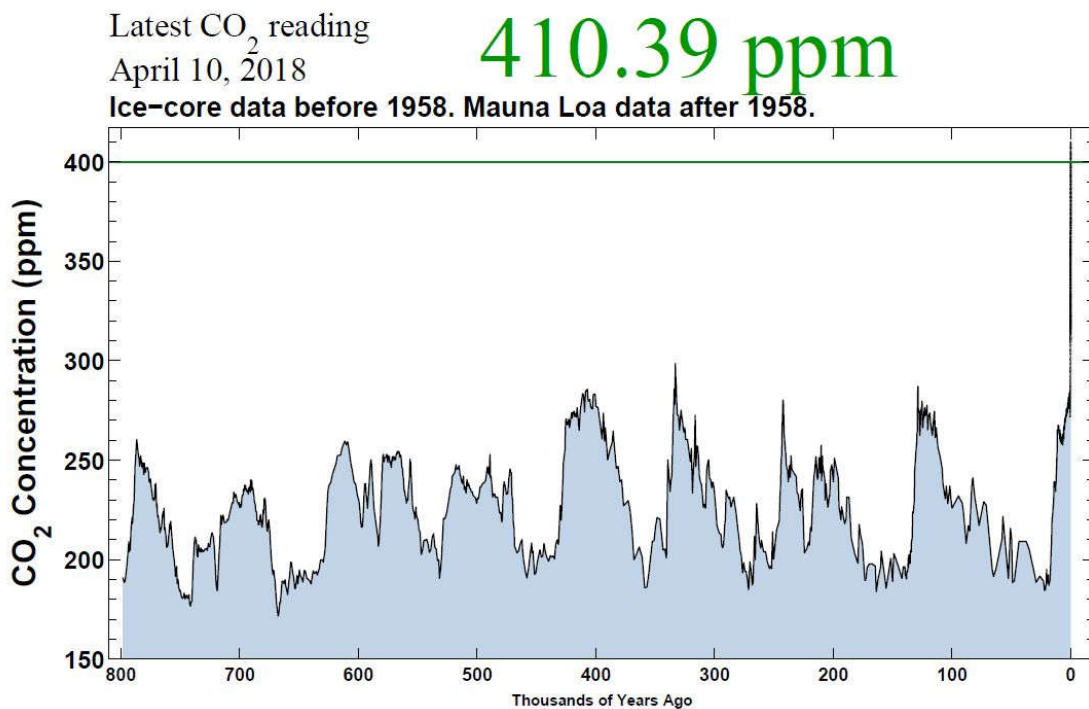


Figure 11 CO₂ concentrations last 800 000 years

Figures 9, 10 and 11 give graphs of CO₂ for period from 1750 (beginning of industrial revolution), last 10000 years (Holocene, geological era coincide with development of our civilisation) and last 800 000 years, deduced from deep ice layers on Antarctica.

It's obvious that CO₂ concentration in last 800 000 years never exceeded preindustrial level of 300 ppm, not to mention today level of more than 400 ppm. With great confidence is possible to assert that most influential cause of this abrupt rise is human activity, i.e. burning CO₂ contained in fossil fuels. The temperature rise and all consequences of climate change (sea level rise, extreme weather events and droughts) are in positive correlation with growth of CO₂ concentration.

Prediction of climate change is huge scientific task. Mathematical models with more than hundred variables are executed on supercomputers or distributed on thousands of smaller computers around world. We shall present simple exercise on data from Keeling's measurement contained in data file "monthly_in_situ_co2_mlo" [5]. Aim was observing trend in data shown in graph on Figure 8.

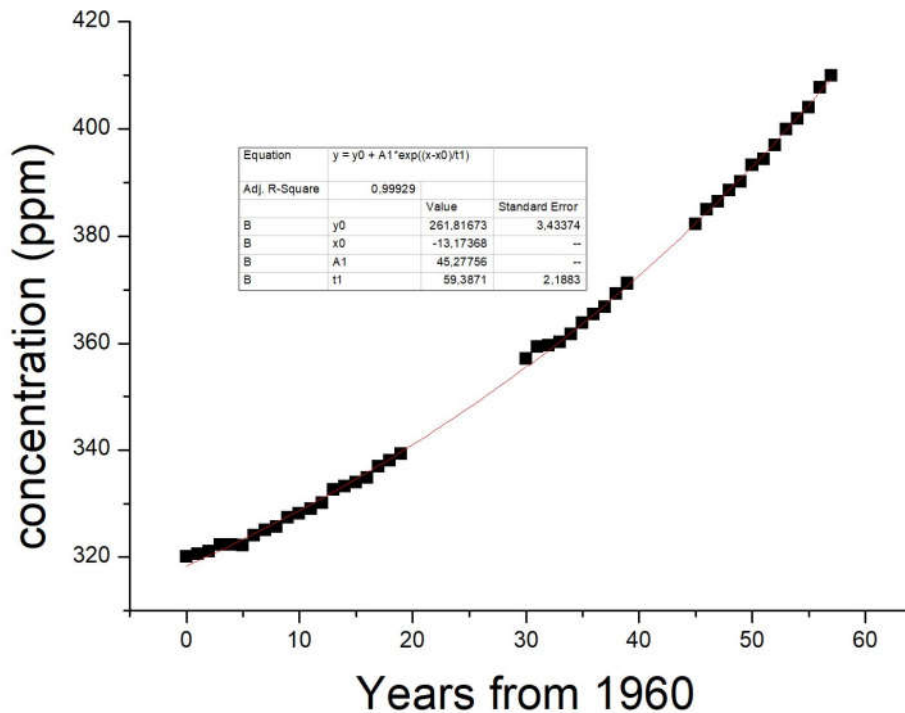


Figure 12 Fitted data on CO₂ concentrations from 1960 until now

Figure 12. is graph of fitted data collected on Mauna Loa from 1960 until now. Fitted function is exponential

$$c = 261.09 \text{ ppm} + 45.6 \text{ ppm} \cdot e^{\frac{t+13.17}{59.39}} \quad (8)$$

t denotes year after 1960

If Keeling curve continue to rise exponentially according upper low, concentration of CO₂ will be about 673 ppm in next 59 years, i.e.263 ppm bigger than today concentration of 410 ppm. As comparison, in last 59 years concentration is risen threefold smaller, 94 ppm, from 316 ppm till 410 ppm in this year.

3. Programming tools for data science-demographic example with R

So far in this paper we focused on two facets of data science: collecting data in some domain and applying mathematical knowledge seeking correlation between observables. This task- “to process it [data], to extract value from it, to visualize it, to communicate it” (Hal Varian)-would be impractical without computational technology in similar measure as assignment to count number of sand particles contained in a beach.

R is programming language widespread as computational tool because data can be easily packed as objects and achieve tasks Varian requested for. Basic object in R is vector. For example, five member family (father, 43 age, mother, 42 age, son, 12 age , daughter, 8 age, younger daughter, 5 age) can be collected in vector of integers with function c () which means combine objects inside bracket to get new object, vector.

Snippet of code written in command window (console) shows in first line creating of vector, second line is list of integers R has generated, third line is command to storage vector in definite memory place named myFamilyAges Less than (<) symbol, followed by minus (-) form assignment sign (<-) . Next several lines show commands to execute simple statistical operations on our object (vector): sum (), mean (), range (). Result generated by R is written after every command.

```

> c(43,42,12,8,5)
[1] 43 42 12 8 5
> myFamilyAges<-c(43,42,12,8,5)
> sum(myFamilyAges)
[1] 110
> mean(myFamilyAges)
[1] 22
> range(myFamilyAges)
[1] 5 43
> |
<

```

Figure 13 Snippet of R code in console

Next important object is dataframe (matrix), consisting of several vectors. They form rows and columns of dataframe and usual ordering is that data in rows are cases or instances and in columns attributes or variables. In first row are not data, there are names of variables. Each column has same kind of data, and same number of entries so dataframe is rectangular.

With command `>myFamilyNames<-c("Father","Mother","Brother", "Daughter", "Younger D")` R creates new vector with string kind of data and assign it to memory location `myFamilyNames`. Similarly R creates vectors for gender and weight of family members. In R, dataframe is list of columns, and each element of list is vector. `Data.frame()` is command to make dataframe, arguments are vectors. Command, after prompt sign, form new object and storage it in memory location named `myFamily`: `> myFamily<-data.frame(myFamilyNames, myFamilyAges, myFamilyGenders, myFamilyWeights)`. Output of dataframe `myFamily` shows what that new object contains:

```

> myFamilyNames<-c("Father","Mother","Brother", "Daughter", "Younger D")
> myFamilyGenders<-c("Male","Female","Male", "Female", "Female")
> myFamilyWeights<-c(88,70,40,22,12)
> myFamily<-data.frame(myFamilyNames, myFamilyGenders,myFamilyWeights, myFamilyWeights)
> myFamily
  myFamilyNames myFamilyGenders myFamilyWeights myFamilyWeights.1
1      Father      Male           88           88
2     Mother     Female           70           70
3    Brother     Male           40           40
4   Daughter     Female           22           22
5 Younger D     Female           12           12
> |

```

Figure 14 R code for creating dataframe maFamily

Commands `str()` and `summary()` has name of dataframe as argument and give figurative information about them.

Besides typing, what was done for uppermost vectors, input data can be imported, in form of dataframe, from web location or local computer. Cleaned data can be plot in some type of diagram. We adapted example from [6] reading real data, namely US census file, `nst-est2011-01.csv` (population of federal states) downloaded via URL `www2.census.gov/programs-surveys/popest/tables/2010-2011/state/totals/`. CSV extension means that file format is comma-delimited text.

```

> urlToRead <- "http://www2.census.gov/programs-surveys/popest/tables/2010-2011/state/totals/nst-est2011-01.csv"
> testFrame <- read.csv(url(urlToRead))
> |

```

Figure 15 R code for reading CSV file via URL

Command behind prompt sign > urlToRead <-“http://.... “ load file, command read.csv() read that file while assignment sign ensure storage file in memory location named testFrame.

But, for didactical reason, we shall proceed differently: first approach web location inside browser, downloading nst-est2011-01.csv file on local computer and then prompt R to read that file and storage it in testFrame dataset. Command str (testFrame) displays content of dataframe:

```
> urlToRead <- "C:/Users/iluketin/Documents/nst-est2011-01.csv"
> testFrame <- read.csv(urlToRead)
> str(testFrame)
'data.frame': 66 obs. of 10 variables:
 $ table.with.row.headers.in.column.A.and.column.headers.in.rows.3.through.4..
 $ X
 $ X.1
 $ X.2
 $ X.3
 $ X.4
 $ X.5
 $ X.6
 $ X.7
 $ X.8
> |
```

Figure 16 R code for reading CSV file from local computer

Skipping essential work on cleaning dataframe and preparing for visualisation, one get population of 50 US federal states sorted from most to less populated (from California with more than 37 million inhabitants, Texas with 25 millions, some modest inhabited states and much states with very small numbers -15 states with less than 2 million). Data is easy to comprehend globally (to notice relative relation between states population) shown in histogram what is simple task for R with command hist ():

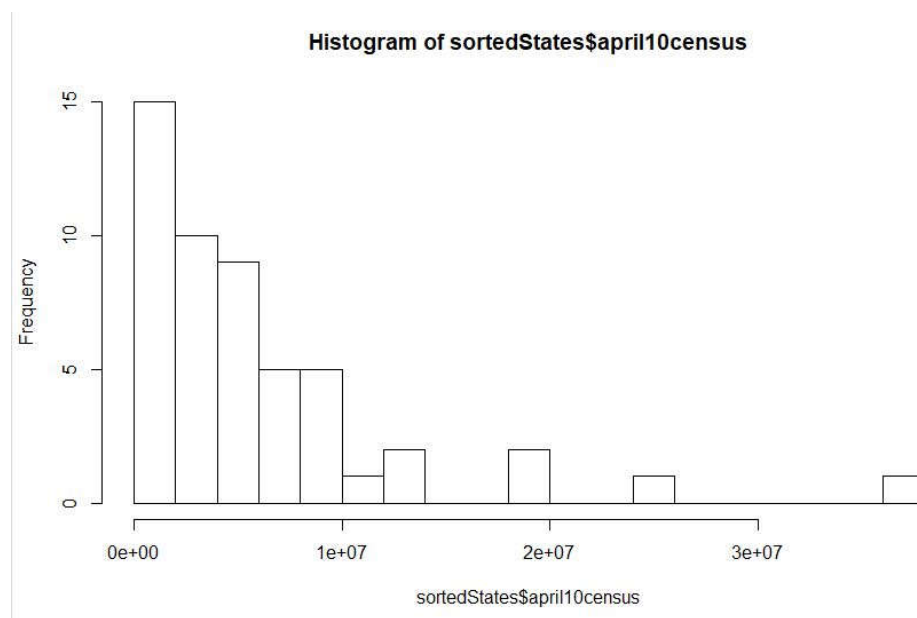


Figure 17 Distribution of US states from most to least populated using R

We shall not elaborate further analyses, but from histogram is obvious power law distribution of state population in US. Interested demographic analyses will seek cause of population misbalance, build model and suggest answer if aim is more balancing development.

4. Conclusion

Describing three cases from natural (astronomy, biology, climatology) and artificial context (rising of cities as living organisms) through lenses of data science can help practitioners in social domains to avoid some drawbacks if lean too much on sole algorithmic (machine) procedure. Premature reasoning based on few data Kepler compensate by deep belief in geometrical reasoning, encouraging him to accept ellipse as planets trajectory, better fitted with Brahe's data, instead of ancient prejudice in circle as planets trajectory as perfect, divine choice, but not supported with observation. Universality law, from biology context to cities, explained on fractal, network assumption, is supported by data in enormous range of scale, by have to permit sub linear power (bigger than one) for socioeconomic feature not observed in nature. Example from climate science can teach, yet, importance how data had been measured, frequency of articles in data series, uncertainty which can hinder predictions in long run and importance of modern technology in collecting and analysing data.

We didn't tackle model of human cognition (cognition as emergent phenomena or predictable chain of "if- than" pattern) in our paper. Underlining message was our conviction that human creativity is not possible to model with algorithmic reasoning, even give excellent prediction when apply on some collective human behavior (Google browsing, preferences when buying products, behavior in traffic, different services and so forth). Proponent of this attitude Douglas Hofstadter describe mind as eruptive, emergent analogy-making waterfall which is impossible mathematically bound, similar to Mitchell Feigenbaum failure to precisely describe turbulent stream. This is domain where data science (working with numbers) has difficulties.

REFERENCES

- [1] Kleiber, M. (1932). *Body size and metabolism*. ENE, 1,
- [2] Bettencourt, L. M., Lobo, J., Helbing, D., Kühnert, C., & West, G. B. (2007). Growth, innovation, scaling, and the pace of life in cities. *Proceedings of the national academy of sciences*, 104(17), 7301-7306.
- [3] Bettencourt, L.M., West G. (2010). A unified theory of urban living. *Nature* 467
- [4] Bettencourt, L. M. (2013b). The origins of scaling in cities. *Science*, 340(6139)
- [5] The Keeling curve, Scripps Institution of Oceanography. Retrieved 13.04.2018. from <https://scripps.ucsd.edu/programs/keelingcurve/>
- [6] Saltz, J., Stanton, J. (2018). *An Introduction to Data Science*. Sage
- [7] Luketin, I. and all (2016). Limits of mathematical model of cities - example from Mediterranean region. *Conference Proceedings Ciet 2016*, Split.
- [8] West, G. (1999). The Origin of Universal Scaling Laws in Biology. *Physica A* 263
- [9] Climatology. <https://en.wikipedia.org/wiki/Climatology>
- [10] Lorenz, E. (1963). Deterministic Nonperiodic Flow, *Journal of the Atmospheric Sciences*