

IDIMT-2016**Information Technology, Society and Economy
Strategic Cross-Influences****24th Interdisciplinary Information Management
Talks**

The 24th annual IDIMT conference is continuing in its tradition as an interdisciplinary forum for multi-disciplinary, multi-national, and future-oriented research. It deals with current and future challenges caused by Information and Communication Technologies (ICT) which structure and modify our environment, our society and economics.

We interact with ICT in multiple ways; the interdependence between Society and Technology is increasing. This leads to a permanent transformations of business processes which are also reflected in changes in everyday life.

In addition to having accepted 11 invited papers we have also accepted, based on a blind review process, 36 submitted papers. The authors come from 10 different countries: Austria, Belgium, Croatia, Czech Republic, Denmark, Germany, Italy, Luxembourg, Slovakia and Slovenia.

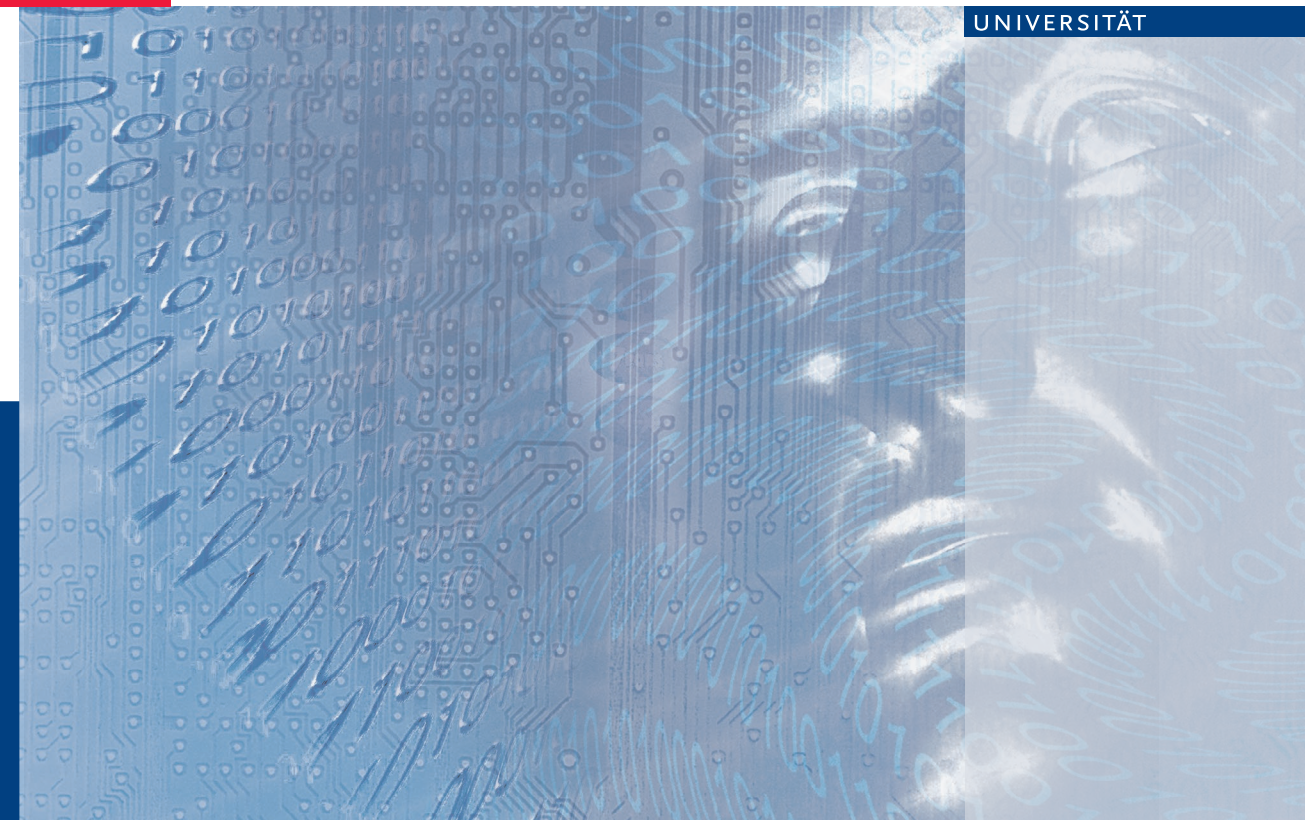
The papers have been grouped into the following themes:

- Social Media for Information Management
- The Multiple Roles of the Public in Crisis Management
- e-Health: ICT- Supported Health Management
- Innovation and Strategic Policies
- Open Innovation and New E-business Models
- ICT Impact on Business, Economy & Society
- Corporate and ICT Performance Management
- e-Sourcing and e-Procurement
- Cyber Security
- Highly Autonomous Systems and Vehicle



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24th Interdisciplinary
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Sept. 7-9, 2016
Poděbrady, Czech Republic

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24th Interdisciplinary Information Management Talks

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Janie Chroust: Spa in Poděbrady

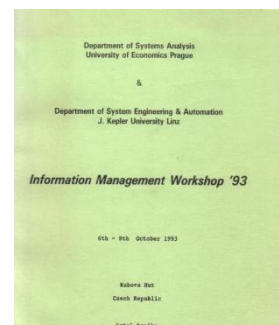
Welcome to IDIMT 2016!

A hearty welcome to the 24th IDIMT Conference!

We have come a long way from the first IDIMT Conference in 1993 in Kubova Hut¹, which then was not even called IDIMT! Improvements have been made each year: Last year (2015) we were surprised by the flood of submitted papers which – for the first time – forced us to run IDIMT along two parallel streams. This year we are confronted with the same situation, but we were prepared and were even able to make some good use of it: On the first two days we introduced two streams of sessions, one stream essentially devoted to business and computers in a broad sense, the other one devoted mainly to all aspects being more concerned with society, humans and their well-being.

We were also able to provide ample discussion time: after 3, 4 or maximal 5 papers a discussion will take place concerning the presented papers.

The overall orientation of our conferences changes slightly every year and thus reflects changing interests and challenges of the outside world. Information and Computer Technologies, however, are at the basis of most of the papers. On the ‘business side’ we typically have papers concerned with ICT’s impact on all levels of society and business, but also on the labor market. Questions of innovation and emerging new business models are raised, but also as far as cyber security is concerned. This establishes a link between business and issues of autonomous systems in relation to the second stream.



**First conference in
Kubova Hut**

¹Chroust, G. and Doucek, P., editors (1993). *Information Management Workshop 93, Kubova Hut, Czech Republic*.

The second stream shows the growing interest and concern with respect to Social Media and e-Health, both directly related to human welfare and well-being. A new trend is the discussion of the relationship between Social Media and Crises, even including refugee issues and marginalized groups.

Christian's Loesch lecture always offers an often surprising view on the new developments in technology, often also pointing out its limits. This year a special focus will be on modern communication technology like glass fibers.

We must not forget to express our thanks for the afternoon/evening excursion, this year to Kutna Hora, which is always perfectly organized by Petr Doucek!

A look at the list of authors shows familiar names of many people who loyally return year after year. We are a big family! This friendly atmosphere and the ample discussion time are one of IDIMT's greatest assets.

This year's conference will offer topics which have a greater diversity than those in the past years as the list of sessions shows:

- Social Media for Information Management
- The Multiple Roles of the Public in Crisis Management
- e-Health: ICT- Supported Health Management
- Innovation and Strategic Policies
- Open Innovation and New E-business Models
- ICT Impact on Business, Economy & Society
- Corporate and ICT Performance Management
- e-Sourcing and e-Procurement
- Cyber Security
- Highly Autonomous Systems and Vehicles

In my opinion the IDIMT-conferences act as a regional indicator of current trends in ICT. The headings of the individual sessions and the number of accepted papers reflect the current interest of participants.

Employing a blind review process we have accepted 36 plus 11 invited papers. The authors have come from 10 different countries: Austria, Belgium, Croatia, Czech Republic, Denmark, Germany, Italy, Luxembourg, Slovakia and Slovenia.

Each session is organized by a Session Chairperson. Traditionally a session starts with a keynote, the other papers providing additional points of view. The papers are followed by intense discussions. We believe that these discussions are one of the attractions of the IDIMT- Conferences, due to the interdisciplinary exchange of thoughts.

The preparation and realization of IDIMT 2015 would not have been possible without the support of diverse organizations and persons. Therefore we would like to thank for providing the organizational infrastructure:

- the University of Economics Prague for the grant IGA 409015,
- the Faculty of Informatics and Statistics of University of Economics, Prague, and
- the Johannes Kepler University Linz.



**Podebrady,
coat-of-arms**

Our further thanks go to:

- Petr Doucek for chairing the Organizing Committee, for arranging the conference location, the hotels and the greatly appreciated evening event,
- Antonín Pavlíček for organizing the program, the reviews, keeping contact with all involved speakers, especially reminding the authors,
- Václav Oškrdal who took over the work of arranging and assembling the selected papers into the proceedings,
- Lea Nedomová, Conference Secretary, for her support in performing the necessary administrative tasks,
- all Keynote Speakers, speakers and contributors of papers,
- all members of the Programme committee and the Session Chairpersons for establishing contacts and soliciting contributors,
- all reviewers providing critical remarks for improving the papers,
- the Trauner Verlag for acting as the publisher of our conference, and
- all other unnamed persons contributing to the success of this conference.

Looking forward to a successful and interesting conference!

A handwritten signature in dark ink, appearing to be 'G. Chroust', written in a cursive style.

Gerhard Chroust, July 2016

We want to express our special thanks to the reviewers of the IDITM 2016 Conference:

Georg Aumayr	Radek Němec
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SESSION A: ICT IMPACT ON BUSINESS, ECONOMY & SOCIETY

ICT AND ITS IMPACT ON ECONOMY AND SOCIETY – QUEST FOR DATA

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Keywords

ICT, productivity, national accounts, sectoral analysis, data sources

Abstract

Paper analyzes and points out approaches and methods being discussed in the previous five years of “ICT and its impact on economy and society” sessions of IDIMT conferences. Focus is given on data sources being used for these analyzes and their suitability for world-wide comparative studies. Paper is finalized by recommendation for future calls and discussions in IDIMT conferences.

1. Introduction

First IDIMT Session “ICT Impact on Economy and Innovation” has been included into the conference program in 2011. Since that time this topic has been appearing on the list of IDIMT conference sessions.

In the keynote paper Doucek, Fischer, Novotny (2012) we have been discussing issues connected with financial crisis and its impact on the economy as a whole and in particular on ICT sector. Even though the financial crisis is nowadays over, issues connected with strong pressure on effectiveness and efficiency of partial industries as well as the whole economics remain. We have also noted, that “empirical analyses of the impact of ICT on the economy and the entire society show that this impact is multidimensional. ICT have an impact on economic growth, productivity, usefulness and efficiency from many different points of view”. We came to conclusion, that without a detailed evaluation of ICT impact on the Czech economy, any thoughts about increasing investments in ICT are unfounded.

Situation has changed and today we can discuss a number of approaches to ICT sector impact evaluation being presented and discussed during last years. They have been categorized by summarizing keynote Doucek, Fischer and Novotny (2015), where also the future challenges have been identified. We have divided these approaches to the following categories:

- Impacts of ICT on production and productivity.
- ICT impacts on human capital and labour market.
- Impacts of ICT Usage.
- Mixed approaches.
- Other economic and societal impacts of ICT.

This time we have decided to concentrate on data sources related issues. Our paper is structured as follows. First we identify relevant papers from previous sessions of IDIMT conferences (years 2011-2015) where analysis of detailed data sources is used as an input for models of ICT impact analyses. Then data sources are categorized and analyzed from the perspective of their suitability for world-wide comparative studies. Paper is concluded by discussion of future challenges in data collection and recommendation for future IDIMT sessions.

2. ICT impact analysis IDIMT papers and their data sources

Following papers were identified in previous sessions of IDIMT conferences (years 2011-2015) as relevant for our analysis:

Fischer and Vltavská (2012) show possibilities of ICT impact analysis based on the input-output tables. From the input-output tables one can get the data on the structure of intermediate consumption in the industries and compare the share of ICT and non-ICT products which are used as an intermediate consumption in individual industries. Key data source is the database of the System of national accounts CZSO (2015).

Mand'ák and Nedomová (2014) evaluate the efficiency of ICT sectors (manufacturing, trade, service). Two output-oriented DEA models were used in this context - model with constant returns to scale and model assuming variable returns to scale. Obtained results are based on data from EUKLEMS (2011).

In subsequent paper Mand'ák (2015) estimates a translog stochastic production frontier with timevarying efficiencies. The performance is evaluated based on Malmquist productivity index. This study is based on data from the OECD (2015).

Hančlová and Doucek (2012) explores labor productivity growth in ICT and non ICT sectors. It also addresses the differential impact of the use of ICT capital intensity on labor productivity growth in sectors of the Czech economy. The proposed model is estimated using panel generalized least squares method with pool dummies and period specific effects. Applied data source is EUKLEMS (2011).

Hančlová (2015) estimates a translog stochastic production frontier using Corrected Ordinary Least Squares (COLS) method. Also compares the distribution of the Malmquist productivity index and its decomposition into technical and technological changes. This study is based on data from the ESA (2010).

Matějka and Vltavská (2013) try to find the best fitted wage distribution for ICT sector and compare it with the results for the business sphere of Czech economy in the year 2011. Afterwards the role of wage distribution in the process of economic modelling using the Meyer-Wise model is being examined. The applied data source is ISPV (2015). On the contrary Doucek, Nedomová and Maryška (2015) apply analysis of time series. They identify groups of job positions of ICT professionals based on the CZ-ISCO classification and analyses the average wage of ICT professionals in terms of the trend of the average wage in the Czech Republic and inflation rate. Key applied data source is ISPV (2015).

Šimpach and Langhamrová (2014) utilize cluster analysis and apply it on the latest available data from the Czech Statistical Office. Selected measures from CZSO (2014) are used for this analysis.

Above analysis is summarized on Table 1.

IDIMT Session paper	Data application	Data source
Fischer, J. & Vltavská, K. (2012)	Czech Republic	CZSO (2015)
Mandřák Nedomová (2014)	Selected EU countries	EUKLEMS (2011)
Mandřák (2015)	Selected EU countries	OECD (2015)
Hančlová and Doucek (2012)	Czech Republic	EUKLEMS (2011)
Hančlová (2015)	Selected EU countries	ESA (2010)
Matějka, Vltavská (2013)	Czech Republic	ISPV (2015)
Doucek, Nedomová, Maryška (2015)	Czech Republic	ISPV (2015)
Šimpach and Langhamrová (2014)	Czech Republic	CZSO (2014)

Table 1: Analysis of data sources being used in IDIM Session papers Source: (authors)

3. IDIMT conference ICT impact analysis papers and their data sources

Let us characterize key data sources being used for above analyses.

National accounts based data sources

National accounts or national account systems (NAS) are the implementation of complete and consistent accounting techniques for measuring the economic activity of a nation. On the national level of the Czech Republic, we can use Database of national accounts CZSO (2015).

On the level of EU exist s database “The European system of national and regional accounts” ESA (2010) which is the newest internationally compatible European Union's accounting framework for a systematic and detailed description of an economy. It is implemented as from September 2014.

On the level of OECD there is an STAN Structural Analysis Database – OECD (2015). It includes annual measures of output, labour input, investment and international trade which allow users to construct a wide range of indicators to focus on areas such as productivity growth, competitiveness and general structural change. STAN is primarily based on Member countries' annual national accounts by activity tables and uses data from other sources, such as national industrial surveys/censuses, to estimate any missing detail. Unfortunately, OECD 2015 is still missing data from a large number of countries.

EU KLEMS Database

Another source was elaborated as the result of the EU project “Productivity in the European Union: A Comparative Industry Approach” It aimed to create a database on measures of economic growth, productivity, employment creation, capital formation and technological change at the industry level for all European Union member states from 1970 onwards. The database facilitates the sustainable production of high quality statistics using the methodologies of national accounts and input-output analysis. EUKLEMS (2011).

Unfortunately, there is the problem with update of the database when the project has been finished. Last partial update has been done in 2011 and not for all the countries. Therefore, new initiative World KLEMS has been established to promote and facilitate the analysis of growth and productivity patterns around the world, based on a growth accounting framework. Until the date of elaboration of this article there are no results published yet.

Earnings based data sources

In the Czech Republic, The Average Earnings Information System (ISPV) provides accurate and comparable data on earnings and hours paid of employees in the Czech Republic. The ISPV contains data from regular statistical survey called the Quarterly Survey of Average Earnings that is included in the Program of Statistical Surveys maintained by the Czech Statistical Office (CZSO) and published every year as a Decree on the Program of Statistical Surveys - ISPV (2015).

This is an excellent data source allowing for analysis on the detailed levels of Subgroups and Units based on CZ-ISCO - CZSO (2010) in the Czech Republic. On the level of EU or world-wide does not exist summarized data source with the same quality and detail.

Household surveys based data

The EU-SILC is an instrument aiming at collecting timely and comparable both cross-sectional and longitudinal data on income, economic activity, poverty, material deprivation, social exclusion and living conditions. Nationally, the data from the survey could serve as a basis for social and family policy – both for its creating and checking its consequences in society. CZSO (2014)

This data source could be used for comparison among the EU member states. Unfortunately, there is no methodically comparable survey on the world-wide level.

4. Conclusion

We have been concentrated on data sources related issues connected with papers published in previous sessions of IDIMT conferences (years 2011-2015). We have found, the majority of papers have been using these data sources mainly for the Czech Republic based analysis or for analysis on the level of selected EU states. This is caused by the fact, that on the world-wide level does not exist unified data source comprising relevant economic indicators.

Most promising data source for such analysis is the STAN Structural Analysis Database on the world-wide level, which is based mainly on the national accounts data of OECD member states (even though there is still a large number of countries with missing data). In the future it can form very good base for application of IDIMT papers developed models on the larger scale.

For the future years of IDIMT would be also very good to invite papers from Asian countries, where new approaches and data sources could also appear. This paper was not meant to be exhaustive but rather explanative in a way to facilitate rich discussion in relevant IDIMT 2016 conference session.

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DOES HIGHER EDUCATION GENERATE HIGHER WAGES IN THE CZECH ICT?

*"Education is the most powerful weapon
which you can use to change the world."*

Nelson Mandela

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Keywords

ICT Professionals, Wages in Czech Economy, Levels of Education, Gini Index

Abstract

The aim of this article is to compare the wages of IT professionals in the Czech Republic by education and to compare these salaries with the rest of the Czech economy. The source of data for our analysis is the sample ISAE (Information System on Average Earnings). Specifically, we will compare the average wages of workers of ICT by educational attainment. The first category is 'Specialists in the field of information and communication technologies', the second 'Technicians in the field of information and communication technologies'. When comparing the level of education will consider the following six categories: primary, specialised school, high school, bachelor, master, PhD. The wages will be compared over time as we have the average wages for the period 2000 - 2014. As the benchmarks we will use basic statistical data - number of observations, average, standard deviation, some quantiles (10%, 25%, 50%, 75%, 90%), and available working time. All comparisons and analyses are made in MS Excel. The results are presented in the form of tables and graphs. Because this is a comparison of time series, we will also be interested in the growth rate and its trend.

1. Introduction

Appreciation of the work in a particular field represents one of the criteria with which society expresses its appreciation to those skilled in these areas (Marek and Vrabec, 2013). Changes in the political system and economic development are in keeping with the respect for and recognition of the professions. Traditionally, the most respected profession is the physician. Development of the current economy, which is based on a significant proportion of work with information, suggests that this trend should also reflect the important work of experts in the field of information and communication technologies (ICT). In 2014 there were in the Czech economy in all its sectors a total of 148,000 ICT professionals, accounting for approximately 3% of the employed population. Development of ICT workers and their structure largely determines the development of the information society in countries and regions and the integration of ICT into the everyday life of the people (Nedomova, Doucek and Maryska, 2015). This has resulted in an increasing number of

innovations in the economy and, consequently, in increasing labour productivity and competitiveness (Hanclova and Doucek, 2012; Hanclova et al, 2015; Fischer et al, 2013; Mand'ák and Nedomova, 2014). The number of workers is, however, only one of the sides of a coin (Ministr and Pitner, 2015). The other is the knowledge that they are the informatics specialisations and professions (Maryska, Novotny and Doucek, 2010). Know-how in ICT professions is closely related to the nature and level of experts' education (Bartosova and Longford, 2014).

The aim of this article is to analyse the wages of ICT Professionals by education attainment. Educational categories are college education, bachelor's, master's, and PhD. For each category we calculated the average growth tempo for the entire period and average absolute annual wage rise (Marek, 2010; Marek 2013).

The research is a follow-up to the work done during a project funded by the Czech Science Foundation and completed at the Faculty of Informatics and Statistics, University of Economics in Prague in 2009-2011, and work on project P402/12/G097 'DYME – Dynamic Models in Economics'.

2. Data Collection and Methodology

We work with a data set in the form of a time series for the period 2000-2014. The source of the data is the firm Trexima, s.r.o. (Trexima, 2016), which conducts statistical surveys on wages for the Ministry of Labour and Social Affairs and the Czech Statistical Office – see 'Sample Set ISPV' (ISPV, 2015) – Information System on Average Earnings.

We have payroll data for the entire Czech Republic, and payroll data broken down by education and by CZ-ISCO category. In terms of education we identify the following categories: elementary, vocational, secondary, bachelor, master and PhD (by PhD we also mean college education with scientific qualifications, including CSc.). According to the CZ-ISCO methodology, we focused on two groups, namely 'Specialists in the field of information and communication technologies' (CZ-ISCO 25) and 'Technicians in information and communication technologies' (CZ-ISCO 35) (Doucek, Nedomova and Maryska, 2015; Nedomova and Doucek, 2015). We were also interested in nominal wage developments of ICT Professionals overall. Since in those two categories, ICT specialists and ICT technicians, there are hardly any employees with elementary and vocational education, we limited ourselves in our comparisons to secondary and tertiary education.

For each group we have the basic statistical characteristics - mean, median, other quantiles (10%, 25%, 75% and 90%) and degree of variability (standard deviation and coefficient of variation). The data are presented in the form of annual time series with figures for the second quarter of each year. The second quarter was chosen because it is the most stable working time. We compare average wages in each group and their evolution over time. We are equally interested in quantile measure of wages. Because this data is in the form of time series, we examine the trend rate of growth and absolute growth. All the comparisons and analyses were performed using MS Excel. Growth rates are calculated on an annual basis.

3. Results

First, we compared the situation of ICT with the entire Czech economy. It should be noted at the outset that the average salary for the entire Czech Republic, which of course includes ICT, was adjusted for the influence of ICT. When comparing the wage developments between the Czech economy as a whole and the wage developments of ICT Professionals, we see that in 2000 the

initial value of the average wage in the Czech economy (CZK 12,525) was significantly lower than the average wage of ICT Professionals (CZK 19,692). The average wage for the whole economy accounted for only 63.6% of the wages of ICT Professionals. In 2014, the average wage in the Czech economy amounted to CZK 25,390 (which was 62.62% of the wages of ICT Professionals), while the average wage of ICT Professionals in the same year was CZK 40,544. Thus, the ratio changed to the detriment of the average wage in the Czech economy by almost one percentage point. We described the development of both time series with a linear trend function. In both cases, the trend equation and the determination index (as indicator of the quality of the model) was inserted directly into the graph. As the course of the data for the entire Czech Republic is stable course, the determination index is slightly higher. However, both values are higher than 0.9, demonstrating a very good quality of the estimate. Although the straight line for both series did not appear to be the best trend curve (the trend was expressed better with a parabola), given the evolution of the GDP and the expected wage growth, a straight line characterises the expected future development better. It is evident that the development over time is different as the series grows more rapidly for the ICT Professionals and moreover, the gap between the two series is widening, as shown by the line gradient in both categories under review (Czech economy 914.92, ICT Professionals 1491.3).

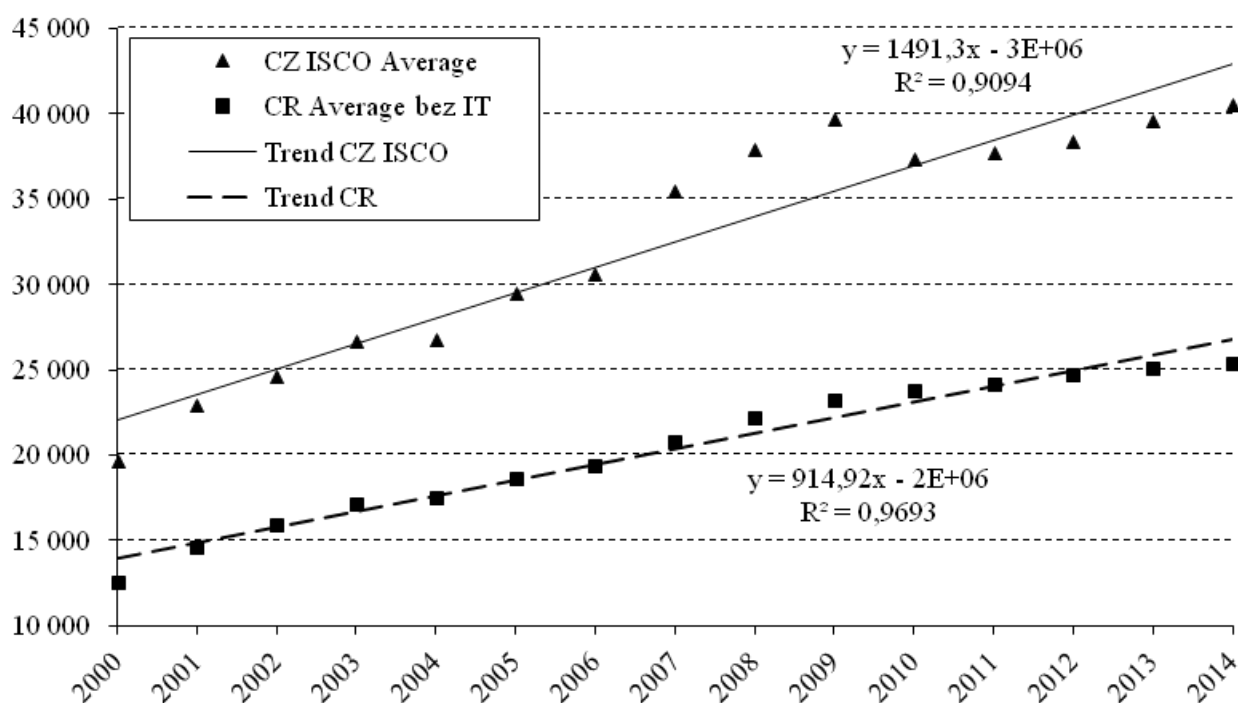


Figure 1: Comparison of Development of Wages of ICT Professionals and in Czech Economy Adjusted for the Influence of ICT Professionals.

Concerning the ICT Professionals, there was special year, 2010, with a marked decline as against the year 2009. The decline was caused by a change of the classification of professions in the Czech economy from K-ZAM to CZ-ISCO. The change resulted in exclusion of professions which were classified in K-ZAM among the ICT Professionals.

3.1. Wage Growth Tempo

Let us look at the wage growth tempo and absolute wage rises in the entire Czech economy and ICT professions.

Year	Growth rate (index)		1st difference	
	ICT Professionals	Czech Republic	ICT Professionals	Czech Republic
2000	-	-	-	-
2001	1.167	1.164	3 291	2 059
2002	1.073	1.090	1 668	1 310
2003	1.084	1.077	2 073	1 220
2004	1.001	1.026	26	449
2005	1.104	1.063	2 779	1 108
2006	1.038	1.040	1 108	754
2007	1.159	1.071	4 868	1 388
2008	1.068	1.065	2 410	1 351
2009	1.046	1.048	1 733	1 064
2010	0.942	1.025	-2 282	576
2011	1.008	1.017	313	398
2012	1.018	1.020	694	490
2013	1.032	1.017	1 246	426
2014	1.023	1.011	925	271

Table: 1 Annual Wage Growth Tempo in Czech Economy and ICT Professionals

The average growth tempo is almost identical and it equals 1.052, for the category of ICT Professionals it equals 1.053. It did not reach such values in the last few years when the growth tempo slowed down considerably as a result of the economic crisis. The average absolute rise for the entire Czech economy is CZK 1,489 and for the group of ICT Professionals it is CZK 919. Both average growth tempo and the absolute increase for the group of ICT Professionals is very much affected by the decline in 2010.

The data for the entire the Czech Republic did not reflect the decline. The reason is again the change from the CZSO K-ZAM methodology to the CZ-ISCO methodology and the ICT professions excluded managerial positions which were transferred to Group 1 with managerial positions in the economy.

3.2. Influence of Education on Wages, ICT Comparison

If we follow in more detail the dependence of the wage amount in the economy we will find that one of the decisive factors is the educational attainment. This is why we focused on this factor in the following analysis.

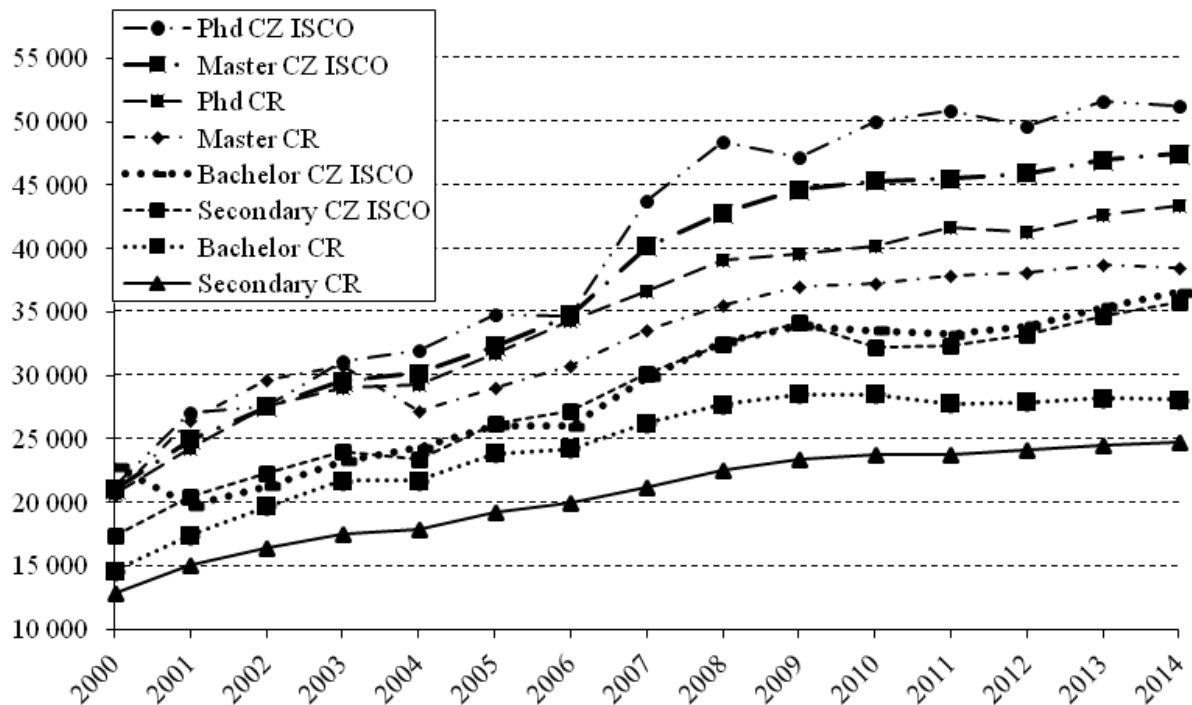


Figure 2: Development of Wages by Educational Attainment in Czech Economy and that of ICT Professionals

Note on Figure 2: The time series are displayed in the graph from top to bottom in the same order as in the legend.

Fig. 2 shows that the lowest wages in the Czech economy are received by workers with secondary and bachelor's education. Wages of ICT workers in these categories are very similar with respect to the amount. It follows that the division of professions between bachelor's and secondary education is not complete although the classification of professions was introduced in 2010. Overall, the Czech economy does not distinguish between the wage amounts received by ICT Professionals in these two categories.

Other groups that have higher wages are those with master's and PhD education in the whole Czech economy. Even these two categories are farther from the same categories for ICT Professionals. The highest wages are received by ICT Professionals with a PhD, are followed by those in the category of master's degree. The amount of their wages is approximately 25% higher than for similar categories of education outside the ICT sector.

3.3. Comparison between Gini Indices of ICT Professions and the Czech Economy

Evolution of the Gini index shows us what equality is in the distribution of wages in an economy (index for entire economy) and in selected groups of ICT Specialists and ICT Technicians. In the entire economy we see that the growth between 2000 and 2001 was followed in the subsequent year by a decline, which increased slightly after 2004 to a value very close to that for 2001. In the last reference year, 2014, the index value declined to 0.256. This value classifies the Czech economy among the most egalitarian economies of the planet. The development of the Gini index of ICT Technicians shows that from the value 0.219 in 2001 the value rose to 0.238 in 2014. This shift demonstrates the growing inequality of wages in this category of professionals. The Gini index followed a very similar development in the category of ICT Specialists. It began in 2000 with the value 0.219, then it increased to 0.270 in 2007, and then it fell again to 0.247 in 2014. The

development indicates an increasing inequality in wages. The ICT professionals reached this inequality in 2007 and the differences in wages were gradually lowered in the subsequent years.

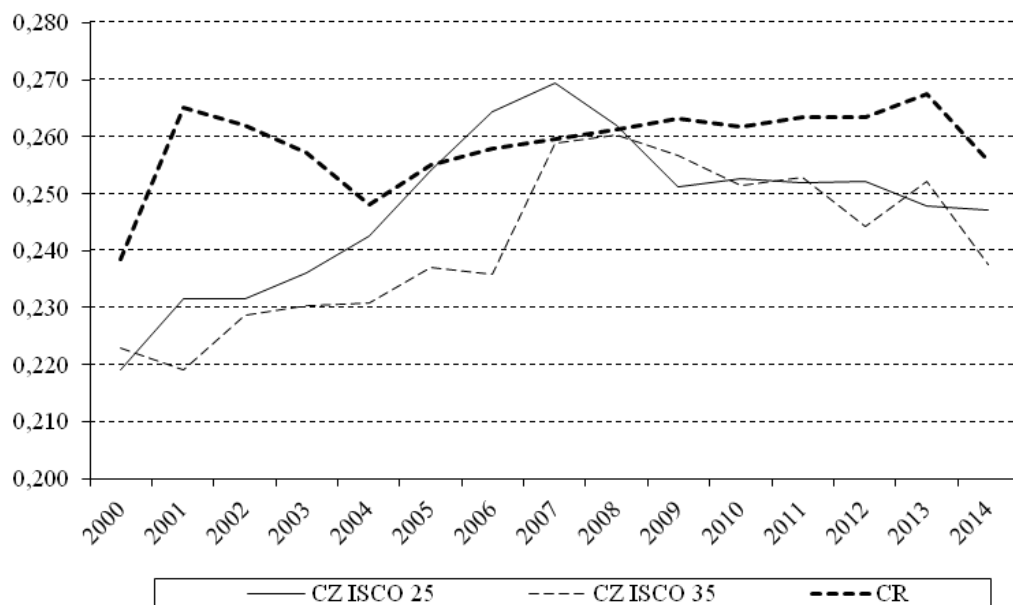


Figure 3: Evolution of Gini Indices of ICT Specialists and ICT Technicians in Comparison with Entire Czech Economy

4. Conclusions

When analysing the wages we came to the following conclusions:

- The average trend in wages received by ICT Professionals is growing faster than the average wage development trend in the entire Czech economy.
- The average wage in the entire economy accounted for only 63.6% of the wages of ICT Professionals. In 2014, the average wage in the Czech economy amounted to CZK 25,390 (which was 62.62% of the wages received by ICT Professionals), while the average wage of ICT Professionals in the same year was CZK 40,544. Thus, the ratio changed to the detriment of the average wage in the Czech economy by almost one percentage point.
- In the analysis of wages by education we identified the fact that average salaries of ICT professionals in the categories of secondary and bachelor's education are practically identical during the whole period under review. It follows that the Czech ICT professions do not differentiate professions the levels of education.
- The Gini index for the whole category of ICT Professionals is lower for most (except for the years 2006-2009 for ICT Specialists) of the period under review than the value of this index for the entire Czech economy. At the end of the period the value of this index for both ICT Professionals and the entire economy decreased, narrowing the gender wage gap.

The answer to the title of this article is yes and not only in the field of ICT. Let us therefore invest in our education and in education in general. A higher level of education, particularly of higher quality, offers the potential to earn a higher wage.

5. Acknowledgements

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REGIONAL INPUT-OUTPUT TABLES AS A DATA SOURCE FOR ICT ECONOMIC IMPACT ANALYSIS

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Keywords

Regional input-output tables, ICT impact, ICT sector, output, intermediate consumption, input-output analysis

Abstract

ICT impact on the national economy can be analysed by different approaches using national accounts. The more common way of analysis is based on the data on supply side (structure of gross value added, share of ICT industry and ICT services on gross value added) but very important data can be retrieved from the uses side of input-output tables (structure of intermediate consumption regarding usage of ICT products and ICT services as intermediates). As a special tool we can use the input-output analysis. The aim of the paper is to present the regional input-output tables as a useful data source for the input-output analysis of impact of ICT on regional economy. The first estimates of regional impact of ICT are computed and presented within the paper. The effect of the investment in ICT services is approximately five times higher than the effect of the investment in ICT manufacturing at the national level and four times higher at the level of Central Bohemia region. Econometric modelling of ICT impact on economy based on regional input-output tables remains the challenge for future research.

1. Introduction

Analysis of ICT impact on economy is a subject of several research papers in recent years and some important progress has been achieved for the Czech economy. Fischer et al. (2015) review the key recent findings and among others point out the analyses based on data from national accounts. They are three main approaches to estimating the direct and indirect impacts of ICT on economy: analysis of the supply side presented by Vltavská and Fischer (2010), Fischer and Vltavská (2011), Pavlíček et al. (2011), Sixta et al. (2011), Fischer et al. (2013) or Mand'ák and Nedomová (2014), analysis of the usage side by Fischer and Vltavská (2012) or a mixed approach selected by Hančlová and Doucek (2012). By the supply side analysis the direct impact of ICT on economy could be quantified, the usage side analysis leads to the indirect ICT impact quantification and by the mixed approach both direct and indirect impacts could be estimated. As an advanced method, based on usage side, we consider the input-output analysis which allow us to quantify the impact of change in final use (consumption, investment or export) on production side (output and value added).

Some basic analysis of the indirect impact of ICT on the Czech economy has been realized. Fischer and Vltavská (2012) analysed relation between share of ICT products on total intermediate consumption of individual industries and on total output of individual industries. Therefore, they compared these shares with labour productivity, total factor productivity and changes in value added at constant prices. The positive correlation between the share of ICT products on intermediate consumption and gross value added (0.66) and weak positive correlation between the share of ICT products on intermediate consumption and labour productivity (0.34) have been estimated (Fischer et al., 2015). When the indirect impact of ICT has been confirmed, the advanced tools such as input-output analysis could be applied to achieve more accurate estimates of the indirect ICT impact.

In 2015, the 3-year process of experimental regional input-output tables (RIOTs) compilation has been finished and RIOTs have been experimentally estimated for all 14 regions of the Czech Republic (Sixta and Vltavská, 2016). RIOTs availability and their usage at the input-output analysis lead to more relevant results at the regional level.

The aim of the paper is to present RIOTs as the useful data source for analytical purposes and to estimate the effect of increase in government investment in ICT at the regional economy. As Fischer and Vltavská (2011) strongly recommend to distinguish between ICT Manufacturing and ICT Services within the ICT Sector, our analysis is also broken down according to this division. The rest of the paper is organized as follows. In the section 2 the regional input-output tables and the input-output model are described. Section 3 contains main results of regional analysis, section 4 put these results to the current knowledge of ICT economic impact. Concluding remarks mainly present challenges for future research.

2. Data and Methodology

2.1. Regional input-output tables

Regional analysis represents one of the most demand researches' output. It describes relations within individual region or between regions. For this purpose researchers can use officially published data with limited detail. From the point of view of macroeconomic analysis researchers can use newly compiled regional input-output tables (hereafter RIOTs) of 2011 which were prepared by the Department of Economic Statistics. These tables are prepared based on the European System of Accounts ESA 1995 (Eurostat, 1996) as the project which was focused on the compilation started in 2013. Meanwhile, the Czech Statistical Office prepared revision of national accounts with the implementation of the newest standard ESA 2010 (EU, 2013). Nevertheless, the methodology of RIOTs first released by Sixta and Vltavská (2016) is completely transferable into ESA 2010. RIOTs present detail look into the structure of individual region from the point of intermediate consumption, final consumption expenditures, gross value added, import and export etc. using the Classification of Products CPA (2 digits level).

2.2. Input-output model

The analysis is based on simple static input-output model and Leontief inversion (Eurostat, 2008) which is used for the modelling of the partial impact in individual region

$$\Delta \mathbf{x} = (\mathbf{I} - \mathbf{A}_D)^{-1} \Delta \mathbf{y} , \quad (1)$$

where

$\Delta \mathbf{x}$ vector of the production change,

$\mathbf{I}$ identity matrix,

$\mathbf{A}_D$ matrix of technical coefficients which is derived from the matrix of the usage of domestic products under the intermediate consumption,

$\Delta \mathbf{y}$ vector of partial change of final consumption,

$(\mathbf{I} - \mathbf{A}_D)^{-1}$ Leontief inversion.

This model records the investment of government into the renovation of ICT in the public sector in the Czech Republic. The investment is investigated separately for ICT manufacturing and ICT services as these two parts of ICT have different impact on economy. We estimated that total investment would be 5 bn. CZK. It is recorded as the change in gross capital formation.

3. Results

Fischer et al. (2013) determined which products belonged to ICT manufacturing and which to ICT services. As ICT manufacturing products they stated products (CZ-CPA) 26.1, 26.2, 26.3, 26.4 and 26.8. ICT services represent products 61, 62, 58.2, 63.1 and 95.1. Since RIOTs are prepared only on 2 digits level classification we approximate this division as follows:

- ICT manufacturing – all products of 26 Computer, electronic and optical products,
- ICT services – products 61 Telecommunications services and 62 Computer programming, consultancy and related services.

As an example of region where we investigate the impact of the investment and compare the same impact for the Czech Republic. We chose the Central Bohemia Region, the largest region in the Czech Republic. This region is quite specific. It surrounds Prague, the country's capital, which is not a part of the region. The Central Bohemia region is the supporting region for Prague in terms of labour force. The overall impact of the investment separately into ICT manufacturing and ICT services represents table 1. The results indicate that the highest impact is achieved in gross capital formation as the investment is recorded in this indicator. The impact is more significant in the Central Bohemia region (4.3%) than on national level (0.5%). Moreover, this investment notably influences import of goods and services and intermediate consumption.

		ICT manufacturing		ICT services	
		Czech Republic	Central Bohemia	Czech Republic	Central Bohemia
P.1	Output (basic prices)	0.1	0.5	0.1	0.6
D.21- D.31	Net taxes on products	0.0	0.1	0.0	0.3
P.7	Import	0.1	0.8	0.0	0.3
Resources		0.1	0.6	0.1	0.5
P.2	Intermediate consumption (purchasers' prices)	0.1	0.7	0.1	0.5
P.3	Final consumption expenditures	0.0	0.0	0.0	0.0
P.5	Gross capital formation	0.5	4.3	0.5	4.3
P.6	Export	0.0	0.0	0.0	0.0
Final use		0.1	0.6	0.1	0.5

Table 1 The total impact of the investment into ICT, %; Source: own calculation

3.1. ICT manufacturing

Different impact of the investment at regional and national level depicts Figure 1. Results show impact on different products based on the aggregate classification as it is used in regional accounts. Significant impact is achieved within industries where ICT manufacturing belongs (B to E). This impact represents more than the primary investment 5 bn. CZK. Change of output is more significant on national than on regional level.

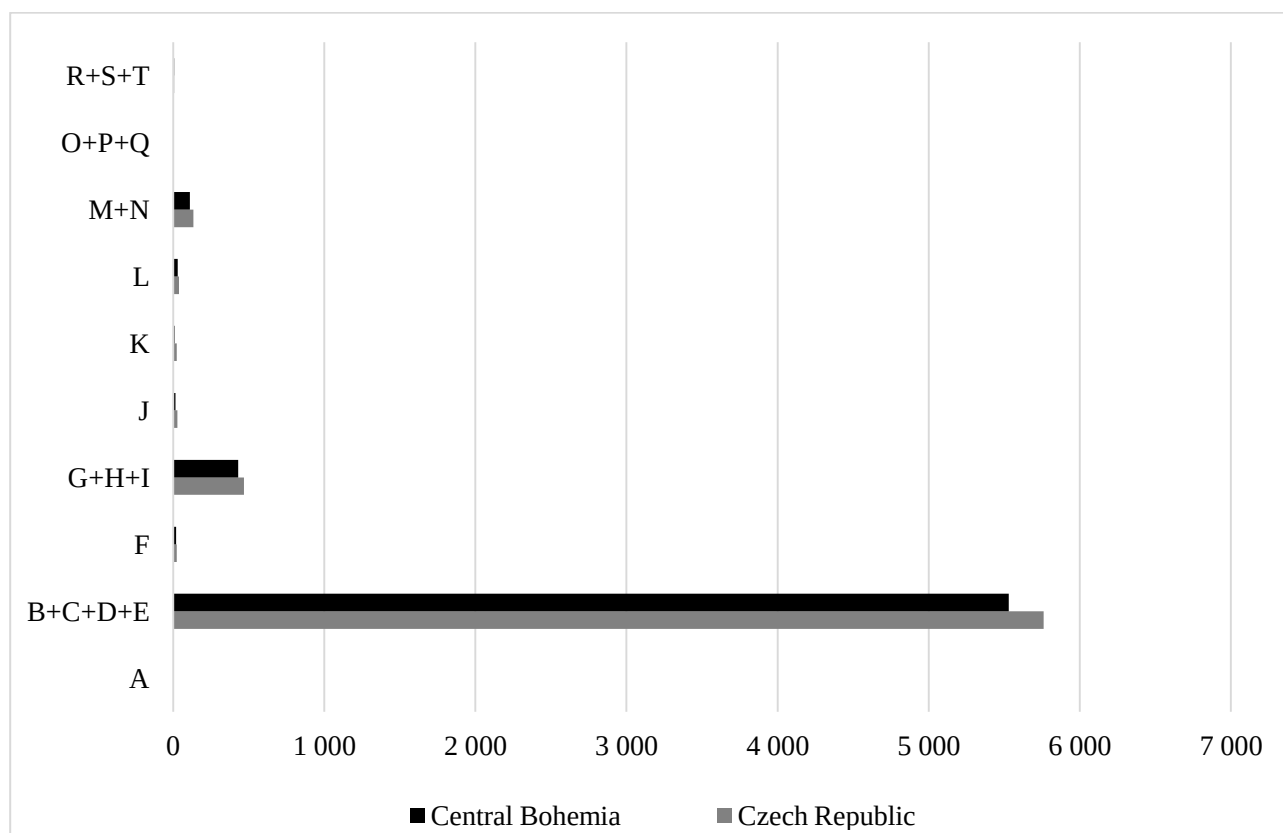


Figure 1 Total change of output, ICT manufacturing, mil. CZK; Source: own calculation

Note: A - Agriculture, forestry and fishing, B - Mining and quarrying, C – Manufacturing, D - Electricity, gas, steam and air conditioning supply, E - Water supply; sewerage, waste management and remediation activities, F – Construction, Services: G - Wholesale and retail trade; repair of motor vehicles and motorcycles, H - Transportation and storage, I - Accommodation and food service activities, J - Information and communication, K - Financial and insurance activities, L - Real estate activities, M - Professional, scientific and technical activities, N - Administrative and support service activities, O - Public administration and defence; compulsory social security, P – Education, Q - Human health and social work activities, R - Arts, entertainment and recreation, S - Other service activities, T - Activities of households as employers and producers for own use.

Table 2 represents increase in gross value added caused by the investment. Results are influenced by the availability of regional producers and their ability to satisfy specific regional demands. The highest total increase of gross value added is recorded in ICT manufacturing related industries (B to E). In total, the increase of gross value added on national level achieved 851 mil. CZK and 704 mil. CZK on regional level.

	Czech Republic	Central Bohemia
A	1	1
B+C+D+E	537	421
F	7	6
G+H+I	209	207
J	14	6
K	13	4
L	18	20
M+N	46	34
O+P+Q	3	2
R+S+T	3	3
Total	851	704

Table 2 The total impact of the investment into ICT manufacturing on gross value added, mil. CZK; Source: own calculation

3.2. ICT services

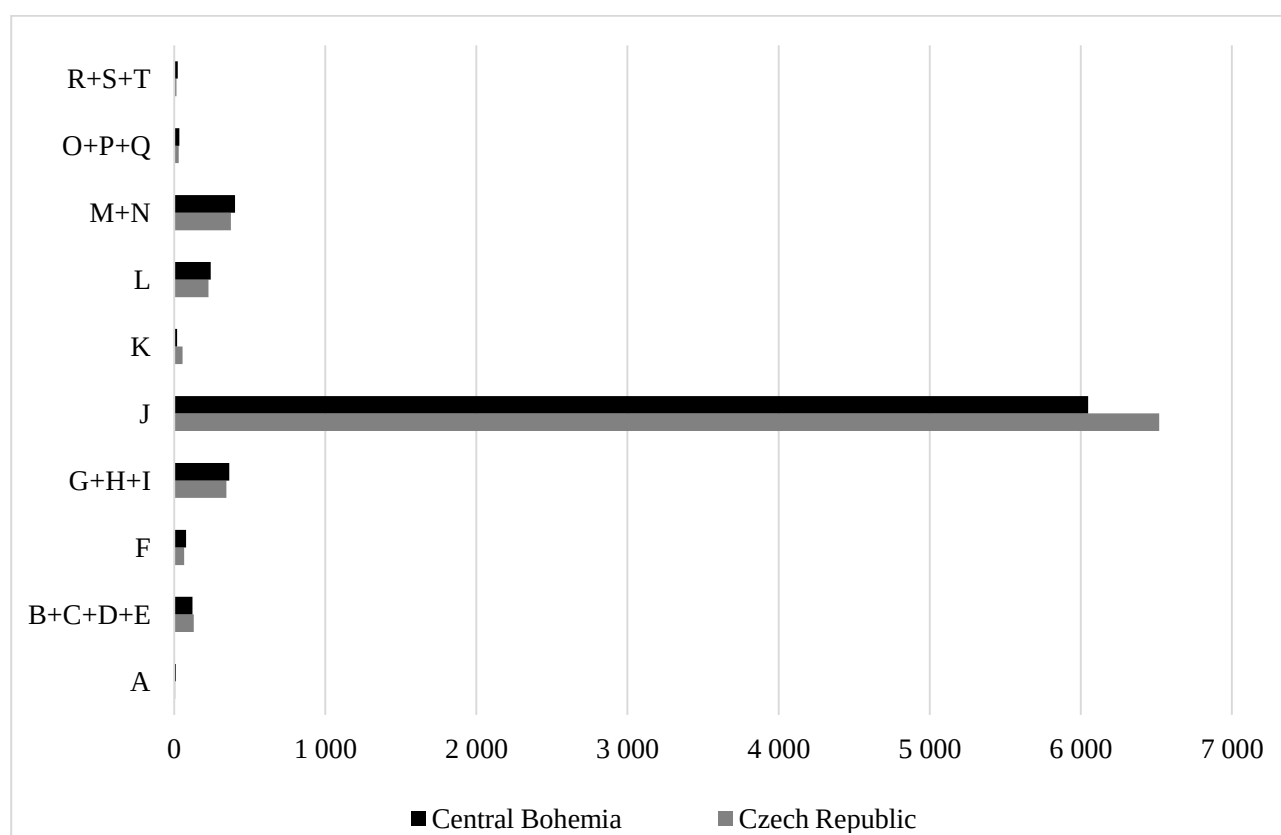


Figure 2 Total change of output, ICT services, mil. CZK; Source: own calculation

Total impact of 5 bn. CZK investment from the resource and users side among ICT services achieved approximately same values as the impact in ICT manufacturing (Table 1). However, the changes of output and gross value added differ. We stated two main products as ICT services products. Thus, the investment of 5 bn. CZK was split in portion of these products on total value of these products on ICT services intermediate consumption. Using this assumption the investment

into product 61 Telecommunications services achieved 2 bn. CZK and the investment 3 bn. CZK to 62 Computer programming, consultancy and related services.

Figure 2 presents the impact of investment to output. The highest impact is recorded within product related to ICT services (J - Information and communication). Moreover, it influences related products such as Professional, scientific and technical activities (M) and Administrative and support service activities (N). The impact is broader than the impact into ICT manufacturing.

The highest increase of gross value added both in national and regional level is achieved within product J (Information and communication). Furthermore, the investment increases gross value added of product G (Wholesale and retail trade; repair of motor vehicles and motorcycles), H (Transportation and storage) and I (Accommodation and food service activities).

	Czech Republic	Central Bohemia
A	2	3
B+C+D+E	35	31
F	23	29
G+H+I	151	174
J	3,455	2,402
K	31	10
L	109	163
M+N	149	147
O+P+Q	21	25
R+S+T	8	12
Total	3,984	2,986

Table 3 The total impact of the investment into ICT services on gross value added, mil. CZK; Source: own calculation

4. Discussion

As Fischer and Vltavská (2011) concluded, it is strongly recommend to distinguish between ICT Manufacturing and ICT Services at the analyses of ICT impact on economy. Results of the input-output analysis fully confirm this recommendation. When we increase the government investment in ICT (through the increase in gross fixed capital formation oriented to ICT products and services), the effect of this investment strongly differs when we invest to ICT Manufacturing or ICT Services. According to above mentioned results, 5 bn. investment in ICT Manufacturing leads to change in gross value added by 851 mil. CZK nationally and 704 mil. CZK regionally, the investment of the same amount in ICT Services affects the gross value added at the national and regional level by 4,084 mil. CZK and 2,996 mil. CZK respectively. The reason of this huge difference consists both in the high share of import on production and in the low share of value added on production within ICT Manufacturing (see Fischer and Vltavská, 2011). Certainly, the impact of ICT investment (regardless to manufacturing or services) expressed as percentage of GDP or employment is much higher to the given region than to the whole economy. This impact will differ between individual regions. For the government investment policy, the RIOTs therefore can serve as a very useful tool. Using them, it is possible to estimate where the ICT investment will be most efficient.

5. Conclusion

Regional input-output tables (RIOTs), recently developed for all the Czech regions, can serve as a very useful data source for an advanced analysis of indirect ICT impact on the regional economy. As an example, the effect of the government investment in ICT on the economy of Central Bohemia region has been estimated. These estimates confirm previous papers which recommend to distinguish between ICT Manufacturing and ICT Services. If we aim to increase gross value added, it is much better to invest in ICT Services than in ICT Manufacturing, when the effect of the investment in services is approximately five times higher at the national level and four times higher at the level of Central Bohemia region.

As challenges for future research we consider analyses of ICT investment impact for other regions of the Czech Republic and therefore more exact quantification of the regional indirect economic impact. Estimates of employment related to RIOTs will be available within several months and the analysis of ICT impact would be extended of the employment indicators and employment effects. Furthermore, wider connection between ICT direct and indirect impacts could be set up adding the input-output analysis. Finally, advanced econometric modelling using RIOTs could be realized for making the recent analyses more accurate.

6. Acknowledgements

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WILL THE POPULATION OF CZECH ICT SPECIALISTS BE ABLE TO KEEP ITS ECONOMIC AND COMPETITIVE POTENTIAL IN 2060 AND LATER?

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Keywords

ICT specialists, population structure, population projection, economic potential, competitiveness

Abstract

The aim of this paper is to estimate the age-and-sex structure of economically active ICT specialists by the highest level of education attained (ISCED 2011) up to the year 2060. Used data come from the final results of the Census 2011, managed by Czech Statistical Office (CZSO). Using the component method and expert scenario of the population projection by CZSO – medium variant we calculate how will look the age-and-sex structure of persons who are relatively young now and who become older one day. Results are not quite positive. The number of these specialists will change, age-and-sex structure will upsize in the top and the average age significantly increases. Will be the distribution of those ICT specialists in 2060 and later sufficient to keep the current level of competitiveness in this sector, economic potential and creation of the innovation? There is an important question, what is better in ICT sector: Young economically active structure full of young (and also ambitious) people or older structure of wise experts and professionals who have decades of experience and practise?

1. Introduction

Czech ICT sector is currently very competitive and performs many innovations in the field of software engineering and information management (Basl, Doucek, 2013). Young and ambitious population structure of ICT specialists working in the Czech Republic allows to implement difficult issues for many private corporations and public institutions and the costs of these implementations are adequate (e.g. in the comparison with more developed Western European countries) (Doucek, Novotný, Voříšek, 2009). Young population structure of these specialists, which is significantly dominated by males than females, (because ICT was always more of a masculine area of interest), gets older one day. Sector annually attracts many applicants for studying and job opportunities in this field (Maryška, Doucek, Novotný, 2012 or Maryška et al., 2012). But there is a certain issue, which is hidden to the public yet. Today's young generation, working in the Czech Republic, will have to work to an older age than previous generations. Retirement age shall be extended and there are speculations that in some sectors could exceed 70 years for male cohort. Many specialists in the field of ICT will probably work in their area of interest until his retirement (Obi, Ishmatova,

Iwasaki, 2013). Although the annual increase in new and young graduates does not weaken (see e.g. Basl, Pour, Šimková, 2008), existing specialists will cause that the population structure of Czech ICT specialists within the next 40–50 years becomes significantly older and highly regressive. Will be then the Czech ICT sector still competitive as today, when practically will work there the same large group of young and beginning specialists and the same large group of wise experts and professionals, who worked in their profession almost 50 years?

The aim of our research is to calculate the estimates of age-and-sex structures of ICT specialists according to highest level of education attained by more sophisticated way, and especially with the impact on the entire population of the Czech Republic. Given that the experts from CZSO construct a fairly accurate population projection in three different scenarios (CZSO, 2013), we calculate on the basis of component method (Keyfitz, 1964, Coale, Kisker, 1986 or Bogue, Anderton, Arriaga, 1993) the estimates of the age-and-sex structures of these economically active persons by highest level of education attained with great precision. The conditions of our calculations are as follows: *(I) selected scenario of the population projection by CZSO is medium variant*. This is because the low and high variant is rather referred to as lower and upper bound. Our calculation *(II) assume the same decline in mortality over time, which is expected by CZSO* (i.e. the increase in life expectancy at birth of males (females) from 74.70 (80.82) years in 2011 to 83.72 (88.61) years in 2060 and linear increase in the total fertility rate from the value of 1.43 in 2011 to 1.56 in 2060. Finally, it is important to note that *(III) our expectations cannot calculate with a dramatic change in the behaviour of immigration and emigration of these specialists*. (The sum of immigrated persons will be the same as the sum of emigrated persons, migration balance will be equal to zero). Census 2011 was processed by the CZSO's methodology and the population projections of the Czech Republic are also calculated by the CZSO's methodology. Our calculations are much more consistent than the estimates, which are corrected each year on the basis of indicators from the other information data sources and mini censuses, because analysed demographical data in this paper contains mostly clear deterministic trend (see e.g. Šimpach, Dotlačilová, 2013b).

2. Materials and Methods

From the results of Census 2011 (CZSO, 2011) we know the total number of persons in the population ($S_{x,t}$) in 5-year age groups ($x-x+h-1$) at time $t = 2011$ by sex (M - male or F - female) and the number of economically active specialists in the field of ICT by highest level of education attained, also in 5-year age groups ($x-x+h-1$) at time $t = 2011$ by sex, where x is completed age and h is the width of age interval 5 years. Because the distribution of these specialists by highest level of education attained is very detailed, we summarize these people into 3 groups only according to ISCED 2011 classification system. Specialists will be divided as people without high school diploma (group ED0-2), as people with high school diploma (group ED3-4) and as people with at least bachelor university degree (group ED5-8). All the numbers of economically active specialists are considered in the age interval from 15–19 to 70+ years. Census 2011 has obviously higher intervals for the total number of persons in the population ($S_{x,t}$), i.e. 70–74, 75–79 ... 100+, but because the number of economically active specialists in the highest age group is relatively small, we consider interval 70+ from the groups of variously educated specialists as comparable with the interval 70–74 from ($S_{x,t}$) group. This measure is commonly used in similar analyses and as previously stated Fiala, Langhamrová (2011) or Šimpach, Pechrová (2013), a significant distortion of the results will not happen. Component method of population projection stands on the assumption that the person at the exact age of x will be next year with a certain probability exactly one year older (Keyfitz, 1964, or Bogue, Anderton, Arriaga, 1993). The exceptional situations are when a person dies, emigrates, or in addition someone else immigrates. Empirical data of age-and-

sex specific numbers of ICT specialists in the Czech Republic according to highest level of education attained shows Figure 1.

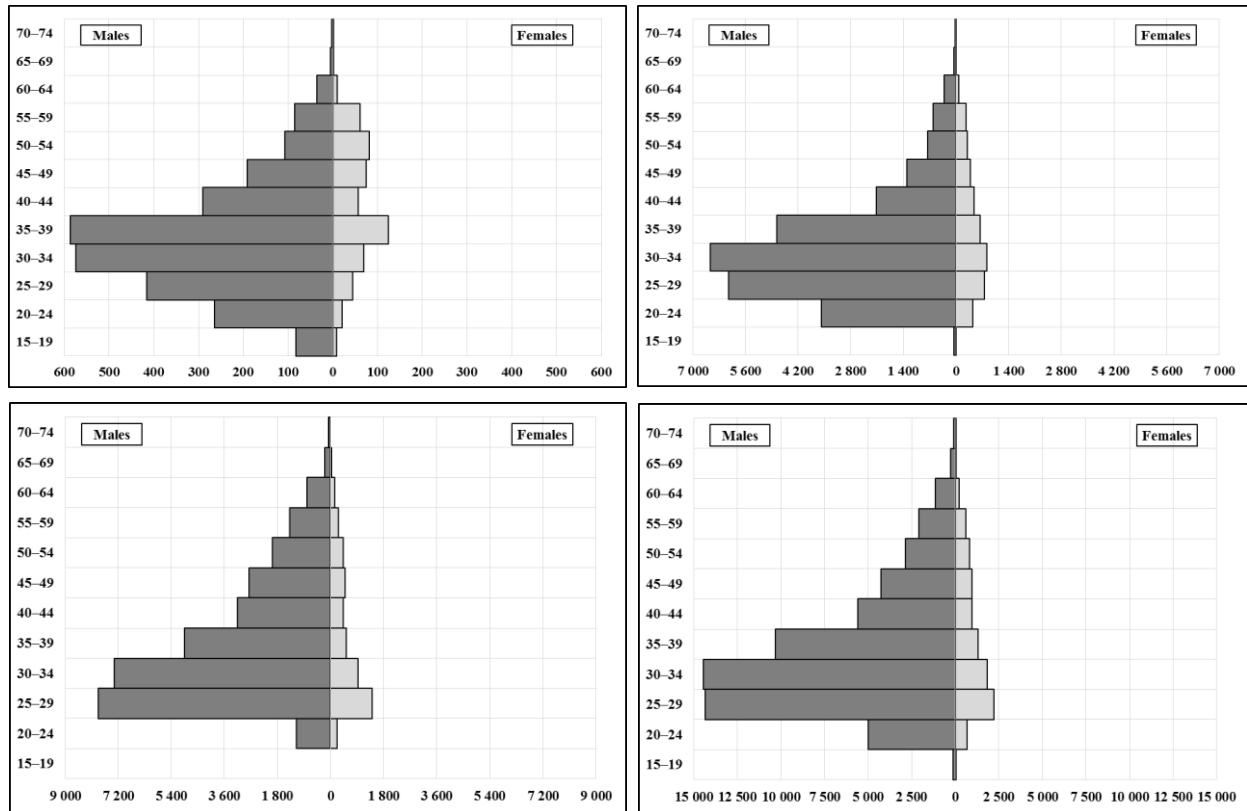


Figure 1: Age-and-sex population structure of ICT specialists educated; at ED0-2 level – top left, at ED3-4 level – top right, and at ED5-8 level – bottom left. Age-and-sex population structure of ICT specialists in total is displayed bottom right. Data source: CZSO (2012), authors' illustration.

Initial assumptions for projection of ICT specialists shows Table 1 for males' and Table 2 for females' cohorts. According to Fiala, Langhamrová (2011) and Šimpach, Pechrová (2013) methodology, in our projection we supposed that each population (and profession as well) has its own saturation point in particular age group which achieves and which also will not exceed in the future. These saturation points, calculated as the proportion of economically active persons (and specialists according to particular level of education attained) to the total population by age group are highlighted in the Table 1 for males and in Table 2 for females. At the same time we are assuming that each specialist works in his / her profession until he / she dies or until he / she reaches the retirement age. (Retirement was generally set at the value of 60 years both for males and for females in the group of people educated at ED0-2 level (without high school diploma), respectively at the value of 64 years both for males and for females in the group of people educated at ED3-4 level (with high school diploma) and ED5-6 level (at least bachelor university degree), the sum of emigration and immigration of specialists in ICT sector is considered equal to zero). Because of this assumption the proportion of economically active male specialists in each cohort after the saturation point will remain at the level of 0.1276% (ED0-2), 1.5634% (ED3-4) and 2.0326% (ED5-8) until he reaches the retirement age and at the level of 0.0287% (ED0-2), 0.2094% (ED3-4) and 0.3932% (ED5-8) until she reaches the retirement age. Lower value of retirement age for ED0-2 persons was set because these persons work from younger age and can therefore enter into retirement earlier.

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Age	S	ED0-2	ED3-4	ED5-8	ED_TOT	ED0-2 (%)	ED3-4 (%)	ED5-8 (%)	ED_TOT (%)
15–19	297 860	82	53	0	135	0,0275	0,0178	0,0000	0,0453
20–24	354 381	264	3 572	1 151	4 993	0,0745	1,0080	0,3248	1,4089
25–29	387 292	416	6 055	7 872	14 361	0,1074	1,5634	2,0326	3,7081
30–34	463 655	574	6 534	7 345	14 467	0,1238	1,4092	1,5842	3,1202
35–39	459 293	586	4 757	4 957	10 310	0,1276	1,0357	1,0793	2,2448
40–44	364 367	290	2 115	3 159	5 575	0,0796	0,5805	0,8670	1,5301
45–49	356 929	191	1 313	2 766	4 274	0,0535	0,3679	0,7749	1,1974
50–54	338 051	107	756	1 973	2 840	0,0317	0,2236	0,5836	0,8401
55–59	369 091	85	600	1 389	2 080	0,0230	0,1626	0,3763	0,5635
60–64	353 635	36	313	802	1 155	0,0102	0,0885	0,2268	0,3266
65–69	250 635	5	48	207	260	0,0020	0,0192	0,0826	0,1037
70–74	163 771	3	19	71	93	0,0018	0,0116	0,0434	0,0568
TOTAL	4 158 960	2 642	26 150	31 705	60 575	0,0635	0,6288	0,7623	1,4565

Table 1: Males' economically active ICT specialists in absolute numbers and proportions in % by particular level of education. Data source: CZSO (2012), authors' calculations and illustration.

Age	S	ED0-2	ED3-4	ED5-8	ED_TOT	ED0-2 (%)	ED3-4 (%)	ED5-8 (%)	ED_TOT (%)
15–19	282 322	8	4	0	12	0,0028	0,0014	0,0000	0,0043
20–24	333 971	21	451	213	686	0,0063	0,1350	0,0638	0,2054
25–29	359 138	45	752	1 412	2 212	0,0125	0,2094	0,3932	0,6159
30–34	435 335	69	813	933	1 821	0,0158	0,1868	0,2143	0,4183
35–39	432 522	124	639	535	1 301	0,0287	0,1477	0,1237	0,3008
40–44	343 645	57	476	438	973	0,0166	0,1385	0,1275	0,2831
45–49	342 704	75	382	489	949	0,0219	0,1115	0,1427	0,2769
50–54	336 610	82	300	420	803	0,0244	0,0891	0,1248	0,2386
55–59	386 841	61	273	257	593	0,0158	0,0706	0,0664	0,1533
60–64	391 152	10	80	129	219	0,0026	0,0205	0,0330	0,0560
65–69	302 702	2	11	26	39	0,0007	0,0036	0,0086	0,0129
70–74	220 356	2	3	0	5	0,0009	0,0014	0,0000	0,0023
TOTAL	4 167 298	556	4 186	4 852	9 615	0,0133	0,1004	0,1164	0,2307

Table 2: Females' economically active ICT specialists in absolute numbers and proportions in % by particular level of education. Data source: CZSO (2012), authors' calculations and illustration.

3. Results and Discussion

We show the current age-and-sex specific population structure of Czech ICT experts by highest level of education connected with the predictions of these structures in 5-year age intervals (actual on 31st December) up to the year 2060 using multi-tree charts. Time evolution is displayed by colour shading when the current values are represented by light shade, the farthest future is represented by the darkest one. It is important to note that our projection does not take into account any scenario that would result in a significant change in the proportion of male's and female's ICT experts in the Czech Republic. In the case that begin a lobby in the future that would persuade the female population to be more focused on studying ICT, our model does not take account of this. As well as we are not able to influence the potential restrictions in the number of students in the field of ICT e.g. by Ministry of education, youth and sports, or a significant increase in the number of students and graduates. Restrictions would have the consequences that the future populations would have far more regressive form than populations presented in Figure 2. On the other hand a significant increase in the number of students and graduates would make more widen the current progressive structure.

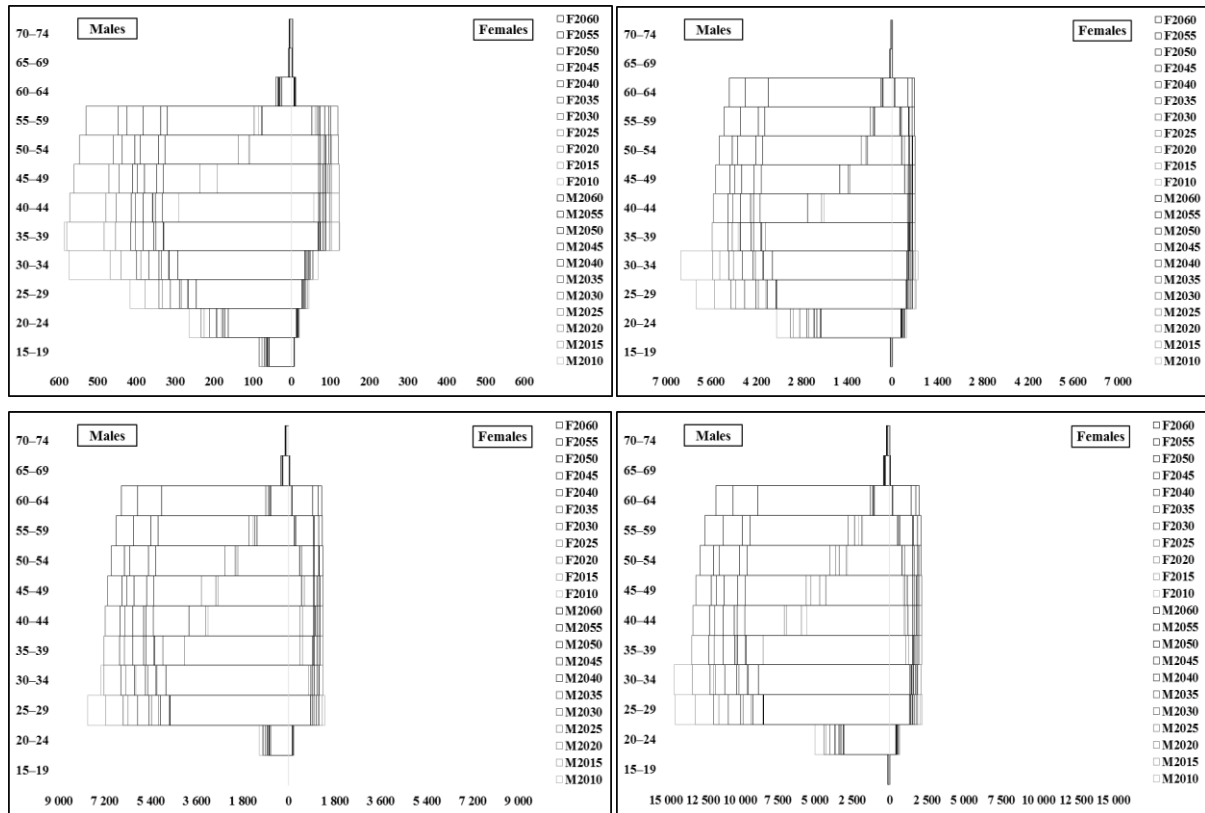


Figure 2: Projection of age-and-sex population structure of ICT specialists educated; at ED0-2 level – top left, at ED3-4 level – top right, and at ED5-8 level – bottom left. Age-and-sex population structure of ICT specialists in total is displayed bottom right. Source: authors' calculations and illustration.

Another information about the expected future population development of Czech ICT specialists by highest level of education attained provide summary graphs with the total number of these specialists (see Figure 3), which show a rising trend until 2050, when (according to our scenario) the ICT sector become saturated. This dramatic situation may not occur if the industry will lose more people than we expect. The probability that ICT specialist completely changes his / her profession is very small (see also e.g. Maryška, Doucek, Novotný, 2012). Interesting conclusions shows also Figure 4, where are calculated the weighted average ages of ICT specialists by sex and highest level of education attained. The relatively high average age of females with ED0-2 education (without high school diploma) is mainly due to the relatively small number of these females in the analysed group (only a few hundred) and older age in general. According to the top-left graph in Figure 1, they are probably the females who worked in this sector even before 1989, where did not need a high school diploma for some reason and currently remain in the sector. The saturation point of the lowest education specialists will probably occur already in 2035 due to early retirement. If we compare specialists aging as a whole – without distinction of education attained, in the case of the male population an average age will grow from 35.87 to 44.58 years and in the case of the female population from the value of 37.84 to 45.01 years. This is a very important increase over time.

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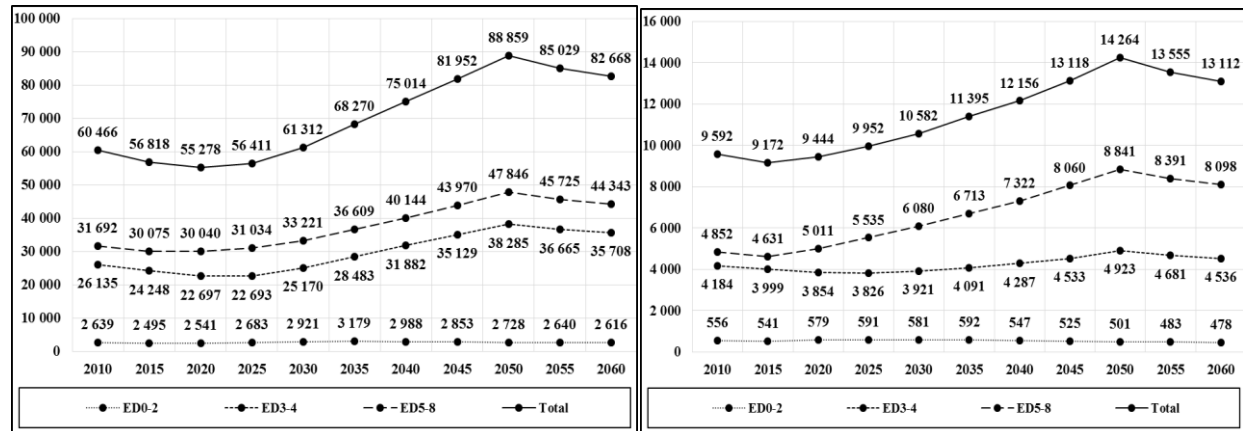


Figure 3: Projection of total numbers of ICT specialists by the highest ISCED 2011 level of education attained.

Source: authors' calculations and illustration.

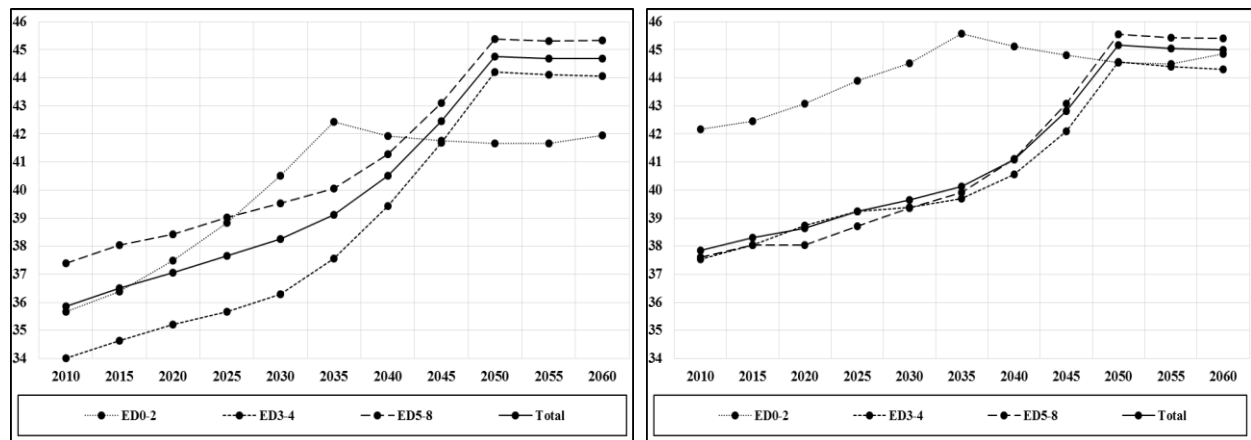


Figure 4: Projection of average ages of ICT specialists by the highest ISCED 2011 level of education attained.

Source: authors' calculations and illustration.

4. Conclusion

Our paper was aimed to show the future form of age-and-sex specific structures of the Czech economically active ICT specialists by their highest level of education attained and to highlight the future higher absolute numbers of these specialists together with a higher average age. Young cohorts that are now very numerous and create the basis of the population pyramids, grow old one day and they will be at the top of the pyramid. Interest in study of ICT does not weaken. ICT is still highly respected and popular sector by the young participants. But if everyone will have to work until an advanced age and probably will not change the field of interest, mentioned population structures of these experts change their character and this issue changes the whole potential of the Czech ICT sector. It is true that the sector will be filled with plenty of wise, experienced and highly skilled senior specialists during the time, but it changes the proportion between young and old as well. While today is one senior specialist the leader of many junior specialists, within the next 50 years could be this proportion very close to 1:1. The question to which we do not know the answer is associated with keeping competitiveness and economic potential of the ICT sector. We are not able to explicitly prepare on the mentioned population change. It is a fact that occurs one day. Who will be in the year 2060 and later the leader in innovation and the main creator of ICT economic

potential? A group of variously educated young junior specialists, or almost as large group of wise and experienced senior specialists? Let us remind in the conclusion that migration between regions or international immigration is an important factor that can affect results of this study (see e.g. paper by Šimpach, Dotlačilová, 2013a). The future challenge for further research could be applications e.g. a modified gravity model or model of human capital and the results would be used for comparison with the study.

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Annex

Age	Males - ED0-2			Males - ED3-4			Males - ED5-8			Males - Total		
	2010	2035	2060	2010	2035	2060	2010	2035	2060	2010	2035	2060
15–19	82	70	62	53	45	40	0	0	0	135	115	102
20–24	264	212	172	3 572	2 863	2 324	1 151	923	749	4 987	3 997	3 245
25–29	416	342	245	6 055	4 976	3 567	7 872	6 469	4 637	14 343	11 786	8 449
30–34	574	335	293	6 534	4 235	3 703	7 345	5 506	4 814	14 453	10 077	8 810
35–39	586	332	329	4 757	4 064	4 037	4 957	5 284	5 248	10 300	9 679	9 614
40–44	290	402	357	2 115	4 924	4 374	3 159	6 402	5 686	5 564	11 728	10 417
45–49	191	445	380	1 313	5 452	4 654	2 766	7 088	6 051	4 270	12 985	11 085
50–54	107	460	404	756	807	4 954	1 973	2 106	6 441	2 836	3 373	11 800
55–59	85	529	338	600	675	4 141	1 389	1 561	5 383	2 074	2 765	9 862
60–64	36	41	25	313	352	3 828	802	903	4 977	1 151	1 296	8 830
65–69	5	6	6	48	58	54	207	249	231	260	313	290
70–74	3	5	5	19	32	34	71	118	126	93	155	166
TOTAL	2 639	3 179	2 616	26 135	28 483	35 708	31 692	36 609	44 343	60 466	68 270	82 668

Table 3: Estimated male' ICT specialists in 2035 and 2060 (in comparison with known year 2010). Values are actual on 31st December of the particular year. Source: CZSO (2012), authors' calculations and illustration.

Age	Females - ED0-2			Females - ED3-4			Females - ED5-8			Females - Total		
	2010	2035	2060	2010	2035	2060	2010	2035	2060	2010	2035	2060
15–19	8	7	6	4	3	3	0	0	0	12	10	9
20–24	21	17	14	451	363	293	213	171	138	685	551	445
25–29	45	38	27	752	634	446	1 412	1 190	838	2 209	1 862	1 310
30–34	69	40	35	813	532	459	933	999	862	1 815	1 572	1 356
35–39	124	70	69	639	508	500	535	953	940	1 298	1 531	1 509
40–44	57	86	75	476	628	546	438	1 180	1 026	971	1 895	1 647
45–49	75	97	81	382	712	591	489	1 336	1 110	946	2 145	1 783
50–54	82	102	88	300	316	644	420	442	1 210	802	859	1 942
55–59	61	120	73	273	295	536	257	278	1 007	591	693	1 616
60–64	10	10	6	80	84	502	129	135	943	219	229	1 451
65–69	2	2	2	11	12	10	26	27	25	39	41	37
70–74	2	3	3	3	4	4	0	0	0	5	7	7
TOTAL	556	592	478	4 184	4 091	4 536	4 852	6 713	8 098	9 592	11 395	13 112

Table 4: Estimated female' ICT specialists in 2035 and 2060 (in comparison with known year 2010). Values are actual on 31st December of the particular year. Source: CZSO (2012), authors' calculations and illustration.

ANALYSIS OF THE USE OF INFORMATION TECHNOLOGIES IN ENTERPRISES

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Keywords

ICT usage, business sectors, survey, Czech Statistical Office, clustering, k-means, elbow method

Abstract

Information and communication Technologies (ICT) in business sector play an irreplaceable role. Nowadays almost all enterprises use computer with internet connection. ICT's help to better communication, sharing of information or more efficient business processes and thus increase competitiveness. New technologies also create new job opportunities. The goal of this study is to find out, if there exist clusters of industries (classified by CZ-NACE) according to the use of ICT's and also to explore, which technologies are used at most in a given cluster. This study is based on the survey "ICT in business sector" performed by the Czech Statistical Office in January 2015, which consists of 98 ICT technologies and 25 sectors. For the creation of clusters k-means method was used. Number of clusters was determined to 5 by an "elbow" method, which compares within cluster sum of squares. The results of the clustering show that there are technologies, which are used in all industries, but there are also technologies, which are used in particular cluster.

1. Introduction

Information and Communication Technologies (ICT) are widely used by organizations to enhance enterprise competitiveness. Evidence in research literature suggests that ICT can contribute significantly to the efficiency, productivity and innovation of a firm. The use of ICT enables the production of goods in a shorter amount of time with the assistance of computerized systems. Studies also show that investments in ICT have a considerable effect on the productivity of the labor force and on economic growth (Oliner and Sichel, 2004). Previous research also finds that, in addition to computer presence, internet use and web presence are also reflected in higher labor productivity (Manochehri, 2012). Ogalo et al. (2011) conducted study focused on adoption of ICT in enterprises. Using Chi-square test they confirmed adoption of ICT and also statistically significant association between ICT adoption level and business performance. This confirms that ICT adoption level is highly associated with business performance and forms an essential ingredient for the success of the organization. Adoption of ICT by enterprises was also studied by Hančlová a kol. (2015). In their study they investigated the factors affecting an adoption of information technology IT in micro, small and medium enterprises SMEs within the transition economies of the Czech–Polish region. The results of the questionnaire survey carried out in 2012 were evaluated by the asymmetric dependence testing and estimation of ordinal regression models.

The analysis results show a different effect of determinants in relation to the size of an economic entity individual SME segments. Because adoption of ICT can be slow, Řeháček (2015a, 2015b) emphasize that implementing new information or communication technology is usually complex process and has to be managed as a project.

There are two main goals of this study: to find out, if there exist clusters of industries within Czech economy (classified by CZ-NACE) according to the use of ICT and to explore, which technologies are used at most in a given cluster.

2. Data description

The data used in this study were obtained from the Czech Statistical Office, which has been doing research focused on usage of information technologies in enterprises for 14 years since 2002 (CZSO, 2015). Frequency of this research is one year and from 2006 is fully comparable with similar researches performed by other countries in the EU. Respondents of the research are individuals and enterprises with 10 and more employees. Total number of respondents for the latest research conducted in January 2015 is 7,644. The enterprises are grouped into its sectors according to CZ-NACE classification. There are following groups of observed measures in the questionnaire:

- corporate computer network and related technologies,
- internet, usage of internet in the relation to the public administration,
- web pages and their usage, ecommerce, e-shopping, electronic invoicing,
- employees using computer and other information and communication technologies,
- integration of business processes,
- electronic sharing of information for managing supplier-buyer relations,
- security of information systems,
- usage of social media.

The results of questionnaires in enterprises are aggregated to corresponding industries. In the rows of the dataset there are different industries of Czech economy according to CZ-NACE (classification of economic activities) and in the columns there are various information and communication technologies. The values in the dataset represent percentage of companies in the given industry, which use given technology.

When lower level of sectoral classification is available in the data, then this industry is used for the analysis, e.g. for industry I (55 - 56) - Accommodation, food and beverage services is available also detailed division into industries I 55 - Accommodation and I 56 - Food and beverage services. When this lower classification is not available, then higher classification of industries is used, e.g. industry K (64 - 66) Banking and Insurance. With regards to this classification 25 industries were used in this study, for each industry 98 variables (technologies) are available.

3. Cluster analysis

Clustering generally is a task of finding natural groups in data. In this study the aim of the usage of clustering is to find which industries within Czech economy are similar in terms of usage of various ICT technologies. Two basic methods for clustering are hierarchical clustering and K-means

clustering. Of course there are some other sophisticated methods, e.g. partitioning around medoids, density based clustering, clustering using random forests or self organizing maps, based on neural networks. In this study K-means method is applied and gives good results.

Algorithm of K-means clustering is as follows (James, 2013):

1. Randomly assign a number, from 1 to k , to each of the observations. These serve as initial cluster assignments for the observations.
2. Iterate until the cluster assignments stop changing:
 - For each of the k clusters, compute the cluster centroid. The k -th cluster centroid is the vector of the p feature means for the observations in the k -th cluster.
 - Assign each observation to the cluster whose centroid is closest (where closest is defined using Euclidean distance).

The goal of this algorithm is to minimize within-cluster sum of squares (1):

$$\sum_{j=1}^k \sum_{i=1}^n \|x_i^j - c_j\|^2, \quad (1)$$

where $\|x_i^j - c_j\|$ means distance between an entity point and the cluster's centroid. Distance between points is calculated using various measures; the most common is Euclidean distance:

$$\text{dist}(x, y) = \sqrt{\sum_{i=1}^n (x_i - y_i)^2} \quad (2)$$

One disadvantage of k-means clustering is the fact that number of clusters has to be chosen before run of an algorithm. In this paper number of clusters was chosen using an “elbow” method. It is based on within-clusters sum of squares, which are computed as distances between data points in a cluster and cluster centroid. The goal is not to maximize homogeneity or minimize heterogeneity, but rather to find k such that there are diminishing returns beyond that point. The value of k is known as an elbow point, because it looks like an elbow. Another possibility how to determine number of clusters is to compare e.g. Silhouette Width index for different number of clusters and to choose number of clusters, where this index is the biggest. In R it is possible to use `clValid` package (Brock et al., 2008).

4. Results of cluster analysis

In the Fig. 1 we can see number of clusters on the X axis and within clusters sum of squares on the Y axis. As mentioned in the previous section, within clusters sum of squares is computed as a squared distance between an entity point and the centroid of the cluster, to which point belongs. Number of clusters was chosen using an “elbow” method to 5. From the Fig. 1 it is evident, that the decrease in the within-cluster sum of squares after adding 6 and more clusters is small.

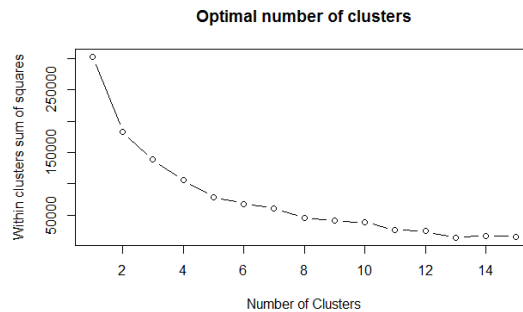


Figure 1: Within clusters sum of squares for different number of clusters

Sectors within Czech economy were divided into 5 clusters according to the usage of ICT. Statistical significance of clustering was assessed using internal measures, which are available in R package *clValid* for validation of clustering (Brock et al., 2008). Among these measures belong the connectivity, Silhouette Width and Dunn Index. E.g. value of Silhouette index equal to 0.27 suggests that clustering solution is good (well-clustered observations have values near 1 and poorly clustered observations have values near 0). In the following Table 1 there are listed particular clusters and its industries:

Production of computers and means of transport
Production of computers, electronic and optical devices
Automotive industry and production of other means of transport
ICT, television and monetary services
Telecommunication activities
Activities in the area of information technologies; Information activities
Publishing activities; motion picture, video and television programme production
Banking and Insurance
Heavy industry and wholesale trade
Wood and paper industry
Chemical, pharmaceutical, rubber and plastic industry; Industry of glass and building material
Manufacture of metals, metallurgical and metalworking products
Manufacture of electrical machinery and apparatus
Manufacture of furniture; Other manufacturing industry; Repair and installation of machines and apparatus
Wholesale trade and retail trade, repair of motor vehicles
Wholesale trade, except of motor vehicles
Manufacture and distribution of energy, gas, water and activities related with waste
Professional, scientific and technical activities
Light industry, food and other activities
Manufacture of food products, beverages and tobacco products
Manufacture of textiles, wearing apparel, leather and related products
Retail trade, except of motor vehicles
Food and beverage service activities
Administrative and support service activities
Construction
Transporting and storage
Real estate activities
Accommodation and travel activities
Accommodation
Travel agency, tour operator, reservation service and related activities

Table 1: Sectors grouped into clusters

Once we have grouped industries into clusters, it is interesting to see, which technologies are used in particular clusters. For this purpose, cluster centroids were calculated. It means that for each cluster average value of usage of given technology was calculated. At first, there are technologies, which are being used in all clusters and industries. Among these technologies belong: computer, high speed internet, communication with public administration – filling, downloading and submission of forms, email, bank and insurance services, web pages, data boxes.

Enterprises in cluster “Production of computers and means of transport” use catalogues and price lists on their web pages, possibility of order or reservation on their web pages, social networks and social media, advertising and web pages in foreign languages the most from all clusters.

Specific technologies for companies in cluster “ICT, television and monetary services” are high usage of local area network (LAN), wireless local area network (WLAN), email and telephone communication at work, remote access to applications, documents or files, receiving of electronic invoices, high share of ICT specialists (81 %) and also big emphasis on security and maintenance of various systems.

Companies of industries in cluster “Heavy industry and wholesale trade” use ICT mainly for receiving electronic invoices, sharing order data and communication with public administration offices, e.g. for the purpose of added value tax. Another big area of usage of ICT in this sector is management of warehouse, production, services, distribution and relationships with customers (use of ERP and CRM systems).

In cluster 4 “Light industry, food and other activities” there are only a few technologies, which are specific for this cluster; enterprises use largely technologies used generally in all clusters. It is interesting, that in this clusters companies have the largest ratio (80 %) according to definition and revision of security policy in last 12 months. Companies use also often ADSL, electronic invoicing or paying value added tax.

Companies of industries in the 5th cluster dealing with accommodation and travel activities have the highest ratio of sharing order data (77 %). They also use email in work often, e-sell, sharing of e-sell data and e-buy. Important are web pages in foreign languages and systems for accounting and management of services.

5. Conclusions

In this study the usage of various information and communication technologies in sectors of Czech economy was analyzed. K-means clustering algorithm was used to divide industries into clusters and using an elbow method the number of clusters was determined to five. The results of the research show that there are technologies, which are used in all sectors and also some technologies specific for a given cluster of sectors. Computer, high speed internet, communication with public administration – filling, downloading, submission of forms, email, bank and insurance services, web pages and data boxes are technologies used in all sectors. This study also found out that there are technologies specific for each cluster.

The focus of this study was similar to study Fischer and Vltavská (2012). The authors analysed the usage of ICT products/services in given industries using national accounts data. They showed how can be this type of data used for the analysis of the share of ICT products on the intermediate consumption and analysis of the share of ICT products of the total output and for the productivity analysis. This study extended their study with identification of frequently used technologies for various CZ-NACE industries.

6. Acknowledgement

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SESSION B: INNOVATION AND STRATEGIC POLICIES

THE ACADEMIC-INDUSTRIAL COLLABORATION AS AN INNOVATION INSTRUMENT

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Keywords

Service economy, ICT sector, innovation, academic-industrial cooperation, Science Park

Abstract

Traditionally, innovations emerge from R&D activities conducted by both academia and industry. However, in service-oriented economy including ICT innovations frequently result from identification of current market needs and fast response to them. We must therefore find appropriate measures fostering service-oriented academic-industrial cooperation combining the dynamism of the service market innovation based on shared values. In this paper, we propose a framework for identification of crucial strategic values, performance indicators, and important innovation factors for particular ICT branches and we will show whether selected cases in our Science Park comply with them.

1. Introduction

Traditionally, innovations emerge from R&D activities conducted by both academia and industry. However, in service-oriented economy, innovations frequently result from identification of current market needs and fast response to them, which is particularly true for the ICT sector (Kozel et al., 2012).

Therefore, as leading academic institutions, our task is to find appropriate strategies, (infra)structures and models fostering service-oriented academic-industrial cooperation (service-oriented AIC) combining the dynamism of the market evolution with the values and long-term goals of traditionally conservative academic institutions.

Thus, successful cooperation models should be based on identification and mutual sharing of values and performance indicators between the academic and industrial actors of the process. Such models can be sustainable in a longer perspective. The values and indicators cover ethics, recognized outputs, funding criteria, and intellectual property management at both academic and industrial partners (Repka et al, 2013).

For this purpose, we propose a framework for identification of crucial strategic values, performance indicators, and important innovation factors for particular ICT branches and we will show some examples on case of a Science Park.

2. Innovation driving forces in ICT service economy

Traditionally, innovations emerge from R&D activities conducted by both academia and industry. However, in service-oriented economy, innovations frequently result from identification of current market needs and fast response to them, which is particularly true for the ICT sector.

Public sector can also be a driving force to introduce innovations, particularly in ICT. Bygstad and Lanestedt (2009) have investigated a large set of public ICT projects in Norway aimed at fostering innovation in this sector. They find that ICT based service innovation is *not* associated with a *tightly run project* (focused on cost, time and quality) or a *professional project manager*. Rather, *successful service innovation* is found in projects with a strong **integration with the service providing organization and the external users** of the services.

It complies with empirically proven conclusions that the service *innovation process* often differs from the *innovation of products*. Namely (Tidd & Hull, 2003) as well as (Djellal & Gallouj, 2001) concluded that:

- Services are usually innovated in networks rather than labs.
- Services are usually developed in *close interaction with the customers* (Abramovici & Bancel-Charensol, 2004).

So, we can draw as conclusion that *integration of users with the service providing organization* is a key driving force which should be examined in a future research. This is in coherence with the ground principle of service provisioning which is *value co-creation* by service provider and consumer.

Bygstad and Lanestedt further suggest that “the vendor is included in the innovation process, and should also be selected on organization development and change management skills, and on longterm partnership – rather than solely price criteria, ... and too harsh practices tend to strangle service innovation.”

Thus, there is an evidence that if the academic partner in an academic-industrial cooperation in ICT service industry plays also a (partial) vendor role, **long-term partnership** together with **organizational development** and **change management** represent important values to contribute rather than just competing by price.

3. Framework for service-oriented academic-industrial cooperation

3.1. Strategy

Therefore, as leading academic institutions, our task is to find appropriate strategies, (infra)structures and models fostering service-oriented academic-industrial cooperation combining the dynamism of the market evolution with the values and long-term goals of traditionally conservative academic institutions. Strategic-level measures are thus crucial for conducting successful AIC.

3.2. Value sharing

Thus, successful cooperation models should be based on identification and mutual sharing of values and performance indicators between the academic and industrial actors of the process. Such models can be sustainable in a longer perspective. The values and indicators cover ethics, recognized outputs, funding criteria, and intellectual property management at both academic and industrial partners. The framework captures the values that are either shared the same, or are in contradiction.

3.3. Strategic driving forces

For incubated businesses, according to Baraldi & Havenvid (2015), the specific strategic drivers of business incubation that were identified in the Karolinska Institute incubator's case were six: *positioning in the value chain, risk taking/time perspective, revenue model, governance/control, internationalization, and cooperation/competition*. The framework concentrates in this dimension on finding the driving forces for both academic and industrial partners.

3.4. Success factors

Mora-Valentin et al (2003) analyzed more than 800 agreements between Spanish firms and research institutions to find the pattern of success. The study identified 10 factors grouped into 5 *contextual* (previous links, reputation, clear definition of objectives, institutional and geographic proximity) and 5 *organizational* (commitment, communication, trust, conflict and dependence). The main conclusions were the following:

- There is a positive link between previous cooperation experience and success of cooperative agreements.
- Firms tend to be generally more satisfied if cooperation objectives are clearly specified.
- Better communication has positive effect on cooperation for both firms and research institutions.
- Commitment has positive influence on cooperation for both firms and research institutions.
- For research organization, trust is related to success.
- Conflict has negative influence on cooperation agreements directly for firms, and indirectly also for research organizations.
- Greater dependence might also have positive impact of cooperation.

3.5. Motivations and benefits

López-Martínez et al. (1994) identify three different categories of motivation for academic-industrial cooperation: structural, institutional and individual: “Structural motivations derive from the economic, political and technological spheres, which have a wide influence over institutional and individual motivation. Institutional stimuli are variables stemming from the particular institutional characteristics of the firm and/or university involved. Finally, individual motivation refers to the personal characteristics of the individual researchers (different cultures, objectives, etc).” Mora-Valentin et al. (2000) have significantly extended the model to describe motivations (educational, political, and epistemological) and benefits (financial, technological, and strategic) for companies, research institutions and also government. We will further even extend this model based on experience from the CERIT Science Park case.

3.6. Framework

We now summarize the framework for identification of crucial strategic values, performance indicators, and important innovation factors for service-oriented ICT businesses. Later, we will show some examples on two cases – CERIT Science Park and Department of Applied Informatics and their collaborating partners. The framework consists of three dimensions representing:

1. **Driving forces:** on one side of this dimension there are *motivations and benefits*, as well as their opposites: *obstacles, controversies*, and other *distractors*. The driving forces can thus be further divided into:
 - a. **Motivating forces** or
 - b. **Discouraging forces**
2. **Values:** on one side, there are *shared* values of the academic-industrial cooperation while on the opposite side there are values being in *contradiction*, i.e. where a *conflict of interest* between the academia and industry appears – reaching the (positive) value on one side means loss on the other. Thus we divide the values according to whether they are shared or conflicting:
 - a. **Shared values** or
 - b. **Conflicting values**
3. **State:** reflects presence or absence of formal structures influencing industrial collaboration such as formal regulations, collaboration agreements, supporting organizational structures. Thus we distinguish:
 - a. **Present structures** or
 - b. **Absent structures**

This proposed structure represents either *coherence* between academic- and their industrial partners in case of *motivating forces, shared values*, and *present structures*. In the opposite case, *tension* in case of predominantly *discouraging forces, conflicting values*, and *absent structures*. When applying the framework, we take our case and identify the factors in the three respective dimensions for both academic partner and their industrial collaborating partners.

4. Framework validation

4.1. Case 1 – CERIT Science Park

Masaryk University established CERIT Science Park as own instrument for fostering long-term cooperation in applied research as well as entrepreneurship mainly in ICT and related fields (Pitner & Ministr, 2014). Science Park is located in a close proximity to the Faculty of Informatics (FI-MU) which was established in 1994 as the very first specialized faculty of its kind in the Czech Republic. Its establishment drew upon decades of experience gained in the area of Mathematical Informatics at the Faculty of Science. Today, with more than 2200 students, the faculty offers a wide range of degree programs at Bachelor, Master, and Doctoral levels. The industrial cooperation is led by the vice-dean for strategy and external relations and has its own administration unit.

We will now validate the above presented framework synthesized mostly based on outcomes from literature and previous research on the case of CERIT Science Park, namely on the cooperation of companies settled in the park with the ICT departments at Masaryk University, i.e. the Faculty of Informatics and Institute of Computer Science, in some cases also other departments where some cooperation occurs (Ministr & Pitner, 2014).

CERIT Science Park currently (Spring 2016) rents office spaces and provides infrastructure and other services to 20 companies. Firstly, we will cluster the companies according to their origin (international, national/local, spin-off or start-up stemming from research), the space allocated by the company in the park (small, medium, large), formal cooperation level within Association of Industrial Partners (AIP) at the Faculty of Informatics (not member, SME Partner, Partner, Strategic Partner), previous cooperation before entering the park (none/sparse, research partner, partner in education), and the ICT branch where the firm is doing its main business (computer security, mainly creative disciplines/content creation/marketing, other).

Firms located in CSP are clustered as follows:

- **Origin:** while 15 firms are local, 5 have foreign roots and/or are active (also) abroad.
- **Space allocated:** majority of companies (13) occupy medium-large space, typically one or two rooms, two are large and the rest (5) small.
- **Formal cooperation** with FI: Two firms are Strategic partners in AIP, 4 belong to the Partners category, 4 companies are SME Partners, and half (10) of the companies are not yet formal partners within the Association of Industrial Partners with Faculty of Informatics. [Not being formal partners does not automatically mean there is no collaboration but there is no long-term formal standardized partnership.]
- **Previous cooperation:** 3 companies are startups originating in research, 3 have already intensively collaborated with the university in R&D and/or educational activities, 2 have tight personal connections to university via students or alumni, one company cooperated mostly for the HR purposes (hiring students), and the rest (11) have only sparse contacts to university.
- **ICT branch:** 6 companies are active in security and critical infrastructure operation, 5 either produce multimedia technology or various content mostly for marketing purposes, 4 mainly develop information systems, two are hardware vendors and the rest has other specializations.

- **Services or products:** Most (up to 15) companies can be designated as service providers while only the resting 5 are rather SW/HW product makers.

Though the distribution is not uniform, we see that the profiles of companies in CSP with some level of simplification can be described as follows:

- Domestic firms: 75 %
- ICT service providers: 75%
- ICT branch: strong in security and critical infrastructures 30 %
- Previous collaboration: 30 %
- Present collaboration in AIP: 50 %

With the profile of companies known, we now apply the framework. Results are shown in Table 1.

Dimension	Positive	Negative
Driving force	Motivating	Discouraging
For researchers	AIC finds some reflection in the individual's (<i>self</i>)evaluation of academicians direct opportunity for <i>conducting contractual research</i>	AIC involves <i>business-related risks</i> (delivery management, quality assurance, contractual risks, NDAs) internal <i>conflicts of interests</i> (research vs. commercial)
For businesses	AIC brings (potentially) free capacity, HR is <i>easier to scale</i> in collaboration with academia <i>fresh influx of new ideas</i> and state-of-the-art knowledge tailored <i>financial instruments</i> for AIC	AIC means to <i>understand</i> the academic values, schedules, and sometimes (<i>in</i>)official rules and responsibilities
Values	Shared	Conflicting
For researchers	<i>be unique</i> <i>be first published</i>	<i>performance indicators</i> mostly publications in academia <i>time schedules</i> mostly free with some fixed points such as submission deadlines for academia <i>open IP position</i> (researchers do not care after publication)
For businesses	<i>be unique</i> on the market <i>be first</i> on the market	<i>performance indicators</i> mostly products/services in industry <i>time schedule</i> mostly fixed and tough for businesses – driven by competition, release plans, customer pressure <i>closed IP positions</i> (businesses prevent publications before commercialization)
State	Present	Absent
For researchers	Process <i>rules and regulations</i> established and verified; <i>Organizational structures</i> present and working, supporting researchers	No <i>direct bound</i> between AIC-related structures and rules vs. <i>other academic structures</i> and rules

For businesses	Some (limited) rules for AIC, eg. <i>IP protection</i> ; Usually <i>weak structures only</i>	Usually <i>no encompassing framework</i> for AIC exists; Usually <i>no strategic level structures</i> (at the board of directors level)

Table 1. Framework for AIC at CERIT Science Park

4.2. Case 2 – Department of Applied Informatics

The second case, the Faculty of Economics (EF-TUO) founded in 1977 is part of the Technical University of Ostrava (est. 1849). Today it has about 5200 students and is the university's biggest faculty. Two hundred and twenty lecturers in addition to numerous external teachers and experts from industry, commercial and public sector provide tuition at the faculty. The industrial cooperation in the area of ICT is concentrated mostly in the Department of Applied Informatics. It has no dedicated administrative support for industrial activities (Ministr & Pitner, 2014).

Department of Applied informatics of Economic faculty of VŠB Technical University of Ostrava proposed framework applies in academic-industrial cooperation project-based „Innovation vouchers” whose characteristics have been described more (Ministr & Pitner, 2015). These projects can, however, also be suitably combined with the "contract research". The result is not only the involvement of teachers and students in solving current problems of the region in the field of information services, but also getting "points" in the scientific activities of the Department. Cooperation requires the consistent implementation of "Success factors" and the principles of motivation.

On the basis of this cooperation we implemented five projects with 3 firms. On projects accounted for 8 students who upon graduation began working in these businesses full time.

Dimension	Positive	Negative
Driving force	Motivating	Discouraging
For researchers	use of <i>innovation vouchers</i> with 3 rd party money direct opportunity for <i>conducting contractual research</i> <i>common projects</i> with industry	<i>Similar as in Case 1</i>
For businesses	use of <i>innovation vouchers</i> with 3 rd party money <i>common projects</i> with academia	<i>Similar as in Case 1</i>
Values	Shared	Conflicting
For researchers	AIC counts towards <i>evaluation of researchers</i>	<i>Similar as in Case 1</i>
For businesses	<i>Similar as in Case 1</i>	<i>Similar as in Case 1</i>
State	Present	Absent
For researchers	Rules and regulations for AIC projects, <i>innovation vouchers</i> ...	No <i>encompassing structures</i> for partnerships
For businesses	<i>Similar as in Case 1</i>	<i>Similar as in Case 1</i>

Table 2. Framework for AIC at Department of Applied Informatics

5. Conclusion

We argued that without a coherent innovation strategies and policies at both organizational and upper levels the full cooperation potential will not be reached. The framework helped us to identify positive and negative factors in three dimensions in both cases.

6. Acknowledgements

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ADAPTING IT/ICT EDUCATION TO CURRENT REQUIREMENTS FROM PRACTICE

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Keywords

Automation study, ICT education, INOHGF, COBRAMAN, requirements for ICT graduates

Abstract

The paper analyses the disproportion between current state of IT/ICT education and companies' expectation on the skills and knowledge of the graduates. Two opinions of conceiving the bachelor's degree study and continuing education in information fields are discussed. Project INOHGF (innovation of courses) and new Master course (within project COBRAMAN) as two attempts to improve teaching methods at Faculty of Mining and Geology are mentioned. Based on the analysis and teaching experience are formulated suggestions for improvement.

1. Development of automation study at the HGF

The automation study at the Faculty of Mining and Geology (HGF) was historically based on the needs of introducing automation and control in the extraction of minerals. At the HGF, therefore, the study course “Automated Control Systems in the Mining Industry” started to be taught in 1962. In the 1990s, the Czech Republic started to reduce mining, which led to the necessity of adjusting the study courses. “System Engineering” and “Information and System Management” courses were gradually designed and accredited, focusing on the application of information technology in the raw material industry. Due to the low level of interest from students, the course dealing with automation in the raw material industry was closed. It is ironic that the low level of interest from students in this field does not correspond with the increase in requests from industry, where companies are increasingly looking for experts in automation (Ministr & Pitner, 2015). This creates a situation where students tend to seek out less technical fields whereas companies experience a distinct lack of technically oriented professionals (Doucek et al, 2015). While the field of automation at the HGF was closed, the steelmaker Mittal Steel in Ostrava will have to employ automation specialists from Ukraine in 2016, because the required positions cannot be filled by experts from the region.

2. Two concepts of two-stage teaching of information science

At universities, there are currently two opinions of conceiving the bachelor's degree study and continuing education in information fields.

The first concept is based on the notion that the bachelor's degree is to provide students with a basic overview of existing technologies, approaches and directions, while the specific tools should be deeply presented only in the subsequent stage. This concept stems from systemic thinking, based on the process from abstract, general and global perspectives to details and specific knowledge.

The second concept is based on the assumption that the bachelor's degree study should lead to a mastery of specific tools and practices, i.e. "the job". Follow-up studies should then deal with more complex and abstract approaches, the integration of knowledge and penetration into deeper knowledge, and should be aimed at more abstract concepts.

Personally, I incline towards the latter group. The first approach has an obvious drawback – if students do not continue in the follow-up study, they actually lack any deeper knowledge and skills, and cannot therefore be very useful in practice.

At the VSB, the opinion of proceeding from the general to the specific led to including the course "System Integration" in the first year of the bachelor's study. For this reason, in 2013, I defined a topic for a bachelor thesis where the researcher had a task to analyse the introduction of the course "System Integration" at Czech universities and selected schools abroad (due to the fact that the researcher spoke German, she analyzed universities in Austria and Germany). The research (Jurečková, 2015) showed that the vast majority of schools in the Czech Republic introduce the course "System Integration" in the second year of follow-up studies as a subject that requires considerable knowledge of IT technologies and teaches students how to integrate these technologies into a single cooperating whole. It is interesting that the system integration usually does exist as a separate subject at foreign universities, but it is part of a series of courses in the following study levels. The results support the latter approach to teaching and, within the innovation of study programs at the HGF, the course "System integration" was shifted to the third year.

3. INOHGF project

In 2012 – 2015, the Faculty of Mining and Geology solved the project "Innovation of Bachelor's and Master's Degree Courses at the Faculty of Mining and Geology, VSB-TUO – INOHGF". The main objective of the project was defined as an "innovation and restructuring of the existing system and the content of bachelor's and following master's degree courses at the Faculty of Mining and Geology, VSB-TUO, in accordance with the requirements of the knowledge economy and labour market needs while respecting demographic trends and priorities of the "Strategic Plan of Activities of the VSB-TUO for 2011-2015".

The outputs of the project are as follows:

- Restructured system of innovated bachelor's and follow-up master's degree courses with an overall lower number of fields of study.
- Creation of new and innovated existing teaching materials.
- Enhanced internationalization of education at the HGF VSB-TUO.
- Strengthening of the cooperation between the HGF VSB-TUO and practice, updating of the system of study fields in relation to practical requirements.
- Better language and professional competencies of academic and other staff of the HGF VSB-TUO.
- Upgraded technical, software and laboratory equipment at the HGF VSB-TUO.

- Processed accreditation materials for restructured fields.

[In Czech: <http://ino.hgf.vsb.cz/cs/vystupy/>]

In further analysis, I will discuss the INOGF project in its part concerning the study areas of automation and informatics. Although the project objectives as defined have been met, I think that the opportunities to improve given by the project were not fully utilized, especially in the area of strengthening cooperation with practice. The project resulted in upgrading study programs – this specifically relates to the newly created bachelor's course “System Engineering in the Industry”, which replaced the existing course “Information and System Management” in 2014. Several new subjects (courses) were created in the curriculum (study plan), and many subjects and study materials were updated. Unfortunately, the project did not include any deeper analysis of requirements for graduates on the part of companies. The new course therefore continues in teaching according to ingrained practices that already do not always comply with the current requirements for education and skills of graduates. The project paid considerable attention to the internationalization of education (especially cooperation with Japanese and Korean universities), which is accessible only to a limited number of students. Notions of local companies regarding the graduates were not addressed.

4. Problems of the current state of informatics courses

At present, it is necessary to adapt the concept of teaching to the development of society. In the age of the Internet and online mobile devices, when previously unavailable information is available immediately, the educational structure “lecture - exercise” ceases to make sense [<http://www.vet.utk.edu/enhancement/pdf/feb11-2.pdf>]. Šedivá (2015) refers to the increasing importance of social media for teaching. Kozel (2012) points out the practical use of Facebook for universities, where the multiplication effects of this social network were activated by cooperation between teachers and students, when solving scientific and innovative projects or in the actual learning process. Students have no reason to attend lectures where the teacher repeats what is downloadable from the Internet; if there is no added value, it is a waste of time for students. Vltavská & Fischer (2014) describe point of view of Czech ICT students about their future jobs and link between their study programme and current job. Maryška (2012) analyses small and medium companies' requirement on ICT professionals' knowledge.

A long-term problem in IT fields is also reflected as a declining interest of students in studying programming, while the industry mostly demands programmers. One of the reasons is the wrong way of teaching programming, which is too focused on mastering techniques and algorithm design. Students often do not understand what the respective procedures are good for, how they could be used in practice. I believe that the programming education should take place using specific tasks and start from visual aspects of the application. The most common programming task is a form for data input or extract (whether on screen or as a report). Therefore, it makes no sense to devote a semester to programming console applications and studying pointer arithmetic if this type of task is almost never met by students in practice.

Another problematic element of the study of IT fields, except non-informatics faculties, is the underestimation of the importance of databases. Relational databases and SQL language are one of the most commonly used technologies. For a number of academics, databases are of a secondary importance, something which does not have sufficient “scientific” potential. This opinion is especially held by people who do not have practical experience. After graduating from university and entering a job, students find with surprise that database applications are the most common types of applications which they encounter, and that data processing is a key activity.

5. Examples from other departments of our university

5.1. European School for Brownfield Redevelopment

As an inspiration for how to create study programs is master course “European School for Brownfield Management” created within the international project COBRAMAN (CENTRAL EUROPE Project 1CE014P4, 2009-2013). The course was accredited in 2014. The study program is a multidisciplinary study that is based on the combination of natural, economic, construction and technical sciences and was created as a result of discussions with managers and investors of the brownfields revitalization or municipalities’ needs (Stalmachová et al, 2011).

5.2. Research in the Department of Economics

Department of Economics at the Institute of Economics and Control Systems is engaged in the research needs of companies in relation to the graduates. As an example is the SGS project "Creation of system for competitive analysis of the industrial companies" the results of which were presented in IDIMT 2015 (Kozel and Chuchrová, 2015). Pawliczek (2015) states situation of strategic planning, innovation activities and consequent economic performance of Czech and Slovak industrial companies based on questionnaire research results. Vilamová (2015) examines the success of metallurgy companies in business markets with regard to the specific features of these markets, the use of specific marketing tools and the new trends in this area. In the field of automation and informatics in Raw Material Industry such a systematic research hasn't been carried out yet.

6. Proposals for changes

Based on practical experience, the experience of teaching, analyses conducted and interviews with representatives of IT companies, I have formulated the following recommendations for changes in teaching informatics and automation at non-informatics faculties:

- Strengthen the teaching of specific skills and the knowledge of techniques and tools in the bachelor's degree program (SQL, programming skills, administration...).
- Better integrate the involvement of companies in the study – the possibility that certain subjects are taught by external specialists – practitioners. It is not realistic for educators at the university to be experts in all possible fields of IT and technology.
- Enable students in the bachelor's degree program to specialize in programming, databases, HW, networks, systems administration – students with good results should be given the possibility to obtain certification in the respective field (including funding of these certifications).
- The possibility of arranging a study plan / curriculum according to the chosen specialization under the leadership of a guarantor (i.e. dynamic inclusion of subjects in the year according to the needs of the curriculum and not rigidly according to the approved accreditation).
- Strengthen the “soft skills” – presentations, teamwork, analytical and communication skills.
- Eliminate the “search” topics of bachelor’s thesis, that lead to superficial compilations of information from the Internet; a thesis should contain concrete solutions to a given problem.

- Link knowledge and understanding of the IT area with the competencies and knowledge of management, economics and production technologies (focused on the processing of raw materials in case of the HGF) – companies prefer specialists who have a wider range of knowledge, who are not “only” programmers.
- Reduce the exercises implemented through assigned semestral works, which is often used especially in the combined form of study; students perceive these semestral works as a formal requirement needed to obtain credit and try to fill the required number of pages; here, there is a space for involving the corporate sphere in the formulation of work themes.

At Institute of Economics and Control Systems we decided to teach programming using the robotic kit Bioloid (from manufacturer Robotis). Robots created from a modular construction kit are great equipment for teaching basic programming structures and how to integrate the hardware and software (Řepka, 2012). Students can see real results of their work - moving robots - which makes teaching attractive for those of them who have not yet met with programming. Bioloid Robots in Education can be successfully used for a clarification of terms of higher mathematics, such as integral or derivative and to show how the explained theory is to apply in practice.

7. Conclusion

Students often ask what tools, programming languages or techniques they should learn to be competitive in the labour market. Discussions with representatives of the corporate sector show that companies especially prefer a desire to learn and work on oneself to the specification of particular technologies. Firms expect active workers who will take the initiative. In this area, I see the largest reserve in the current university education.

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UTILIZATION OF THE DEMO METHODOLOGY FOR SIMULATION OF BUSINESS PROCESSES INNOVATION

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Keywords

Executor, innovation, initiator, requirements, transaction, process model, simulation model

Abstract

The success of the proposed business process innovation is closely connected with the quality of the process model. Expected benefits of this innovation can be subsequently better identified on the basis of dynamic simulation of correctly modelled business processes. The presented approach to the innovation of business processes is based on the creation of a process model by use of the DEMO (Design & Engineering Methodology for Organizations) methodology. Features and benefits of the proposed innovations are verified by simulation of the model in Witness simulation software environment that allows dynamic simulation. The paper describes the basic steps and illustrates the given approach with an example.

1. Introduction

There is still the most serious problem which is connected with human perceiving business processes as some kind of information processes, see (Dietz, 2003; Kozel et al., 2012). An information system is basically a system in the category of rational systems, whereas a business process is a system in the category of social systems (Bazsova, 2015).

Requirement elicitation is usually one of the phases the developers have to undergo. The beginning problem one has to face is how to properly describe the modeling application domain (Hunka & Zacek, 2015). More precisely, which kind of modeling approaches (tools) can be utilized to receive comprehensible and complete requirement analysis. The best way how to capture properly the modeling domain is to start with business process analysis. This approach can be easily understandable both to application domain workers and to software developers too. Proper

identification and description of business processes can be utilized for further modeling of the application domain. The modeling domain is a social system in which human beings in their actor roles form fundamental part. Behavior of human beings is based on entering into and complying with commitments and modeling methodology should enable to model this core feature (Doucek et al, 2014). The DEMO methodology is one of the methodologies that has strong foundation in theory (as opposed best practice methodologies) and is focused on the social aspect of the modeling systems. In addition, the DEMO methodology is versatile enough so it will be used for initial identification of transactions of which business processes are composed and for actor roles identification.

The structure of the paper is as follows. Section 2 briefly describes the DEMO methodology with the respect to the construction and the process models. DEMO analysis of the application is depicted in Section 3. Section 4 deals with simulation. Conclusion and further research are summarized in Section 5.

2. DEMO Methodology

According to the DEMO methodology (Dietz 2006), an organization is composed of people (social individuals) that perform two kinds of acts, *production* acts and *coordination* acts. The result of successfully performing a production act is a *production fact*. An example of a production fact may be that the payment has been paid *and accepted*, or the offered service has been accepted. All realization details are fully abstracted out. Only the acts and facts as such are relevant, not how they are achieved. The result of successfully performing a *communication act* is a *communication fact*. Examples of coordination acts are *requesting* and *promising* a production fact, which essentially constitutes a mutually binding obligation. The subsequent communication acts and facts "*state*" and "*accept*" of the production constitute the fulfilment of that obligation, agreed by both actors. Communication acts and facts together with production act and fact constitute a transaction pattern which is depicted in Fig. 1. The transaction axiom states that any transaction follows a precisely specified pattern; there are certain state transitions and rules that specify allowed and exclude forbidden state transitions (Hunka & Ministr, 2013). The transaction axiom contains two subject roles, the customer (initiator) and the performer (executor), and coordination and production acts that result in coordination and production facts between both subjects. This pattern includes only the so-called "happy path" of the transaction. Each transaction starts with the *request* coordination act made by the initiator. In response to the *request* (represented by the fact *requested*), the executor performs a *promise* coordination act. This coordination act results in the coordination fact *promised*. The *promise* goes on in a *production act*, which results in *production fact*. The production fact brings about the coordination act *state* which results in the coordination fact *stated*. The coordination fact *stated* causes the coordination act *accept* which results in the coordination fact *accepted*. The basic transaction pattern omits cancellation and revoking actions.

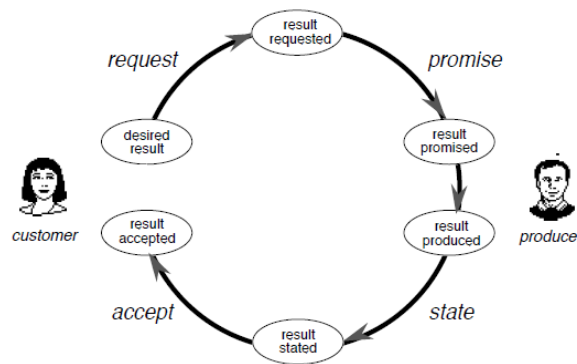


Figure 1: Basic transaction pattern – happy path Source: (Dietz 2006)

The extension of the standard transaction pattern is shown in Fig. 2. The initiator and the executor actor roles are drawn in their partitions (swim lines). The partition of the initiator contains the coordination acts and the decisions are represented by circles (coordination facts) outside the partitions in the diagram. The partition of the executor contains the corresponding coordination acts, the decisions and the production act and production fact. The production act and the production fact are depicted in grey color. The reason for locating the production fact in the executor partition is that the production is usually placed separately from the initiator partition. The coordination facts are situated in the middle of the figure as states in bold format. The complete transaction pattern is extended by four cancellation patterns regarding to the standard transaction pattern. The advantage of this methodology is completely defined state machine inside the transaction pattern. The all essential states are defined in underlying infrastructure.

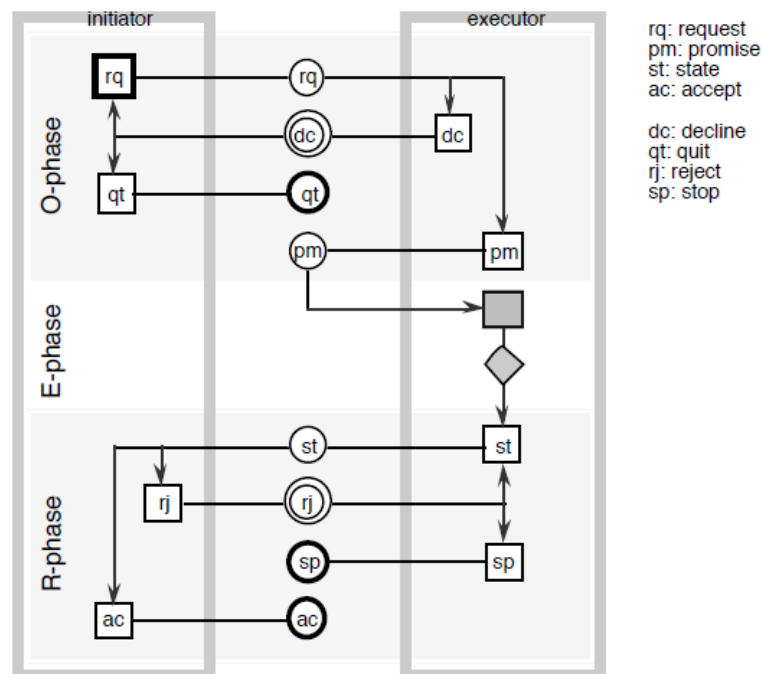


Figure 2: Standard transaction pattern Source: (Dietz, 2006)

A fact is a particular arrangement of one or more objects. A fact is a proposition that can be either false or true, to be validated by empirical observation. A fact may encompass a single object, or may encompass more objects. Depending on the number of objects that are involved in a fact, we

speak of unary, binary, ternary, etc., facts. An example of unary fact is that Vendor is a Person. Another example of binary fact is that a Customer receives a Pizza.

Events are caused by facts in the system that the world is associated with. Events are widely defined as "things that happen in the real world", and that cause some effects. In DEMO there exist only i) (communication facts - one actor communicating with another actor, following the transaction pattern; ii) production facts that describe the production of a specific actor; and iii) facts, that are caused by acts in the real world that may become true or false. Example i): the pizza has been requested by the customer and promised by the pizza baker, a contract has come into existence. Example ii): the production of the pizza baker is a pizza marguerite. Example iii): the exchange rate between the US dollar and the EURO is 1.234. By observation of the world this fact is true or false.

3. DEMO Analysis of the Application

The application covers a business process regarding verification of the copies of the official documents. In case a customer brings both an official document and its copy a public officer has to find out whether the official document is identical to its copy. If so, the public officer confirms the validity of the official document copy and records all these particulars in a special book (register). The applicant of the verification has to pay a fee for this service.

From the assignment, the actor's roles are identified. The external actor roles are the customer who applies for document verification and the payer who pays the administrative payment. The internal actor's roles are the public officer who performs the document verification and records the operation in the registration book and the cashier, who collects the administrative payment. Next, we identify two transaction kinds, the T01 operation recording transaction and the T02 payment transaction. Actually, there are more operations in the summary of this assignment (business process). However, the selected transactions are those operations in which some new service or a new product is created. The T01 transaction result is: operation recording in the registration book was made. This is a new real service that is recorded and it also will be recorded in an information system. The T02 transaction result is: administrative payment was payed.

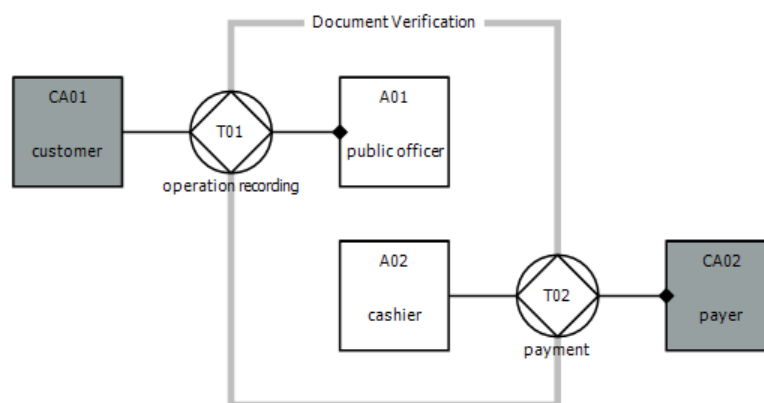


Figure 3: Construction model of Document verification Source: (authors)

The other activities such as kind verification assessment, original-copy comparison, copy authenticity as well as customer signature in the registration book do not create a new service or a new product. The construction model is depicted in Fig. 3.

The construction model depicts boundary of the business process, actor roles and individual transactions. The black dot (point) at the actor role represents that the actor role is an executor of the transaction. The opposite role is an initiator who starts the transaction. Then transaction model which is shown in Fig. 4 presents the inner structure of individual transactions.

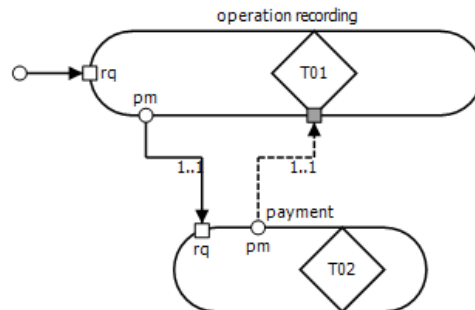


Figure 4: Transaction model Source: (authors)

The customer in the T01 transaction requests verification of some documents. The public officer promises and applies the customer for payment (transaction T02). After the customer has promised to pay the public officer starts with document verification. This description is sufficient because it is obvious that the customer promised to pay.

4. Simulation

Computer simulation represents a robust technique that allows solving many practical problems. Simulation is also an important tool in the design of new, previously non-existent processes, which allows verifying the behavior of proposed processes and thus avoiding errors at the design stage of the process (Ministr, 2013). The entire simulation process is shown in Figure 5.

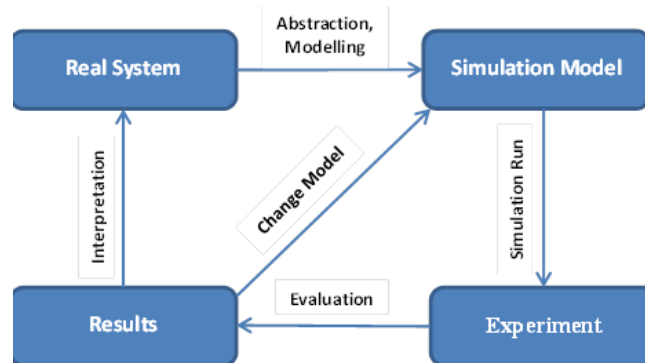


Figure 5: Transaction model Source: (authors)

During the development of a simulation model, it is important to focus on more complicated key administrative and production processes in the organization, i.e. to model the minimum that is necessary to achieve the objective model (Rehacek, 2015) because the creation of a simulation model is quite laborious and expensive thing. At the beginning of simulation model creation the small changes in a simulation model parameters often leads to large addition in its accuracy. As the model becomes more detailed, however, each subsequent change in simulation model parameters leads to a small addition in the model's accuracy. Figure 6 shows a typical relationship between the level of detail of a model and the model's accuracy.

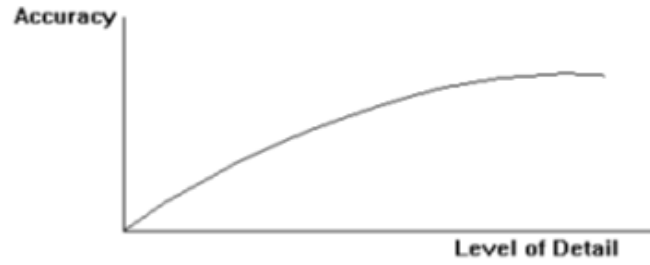


Figure 6: Effect of adding detail to simulation model: (authors)

In addition, the simulation model, which is correctly set up, has a significant impact on the quality of the simulation results, a set of indicators for each component of the simulation model. The indicators used should be derived from the process of simulated targets, which are elaborated on its core activity and resources. The indicators of the simulation model can be grouped into the following categories:

- *Time* that represents the main indicator used in simulation models. Total time (TT) of the process can be expressed as the sum of the processing time (PT) and the waiting time (WT). Very good indicator of simulation the human resources is indicator FTE (Full Time Equivalent) that brings for managers many advantages when they can to compare use of working time particular employees which working in another processes in the same manner (Kolar et al. 2013). FTE represents the available working fund given to type of working role that is subsequently assigned to particular working activities of processes (Tvrdivkova, 2013). Exploitation of working type role (source) can be to determine as:

$$v_i = \sum_{j=1}^n \frac{c_{ij}}{FTE_i} \quad (1)$$

Where is:

i type of human resource

v_i exploitation i-th type of human resource

j number of process activity

n number of process activities

c_{ij} time allocated on j-th process activity executed by i-th of human resource

FTE Full Time Equivalent of i-th type human resource

Using FTE as indicator of process running efficiency allows in Witness easily model and evaluate the using of working time of particular clerks as shows Figure 7.

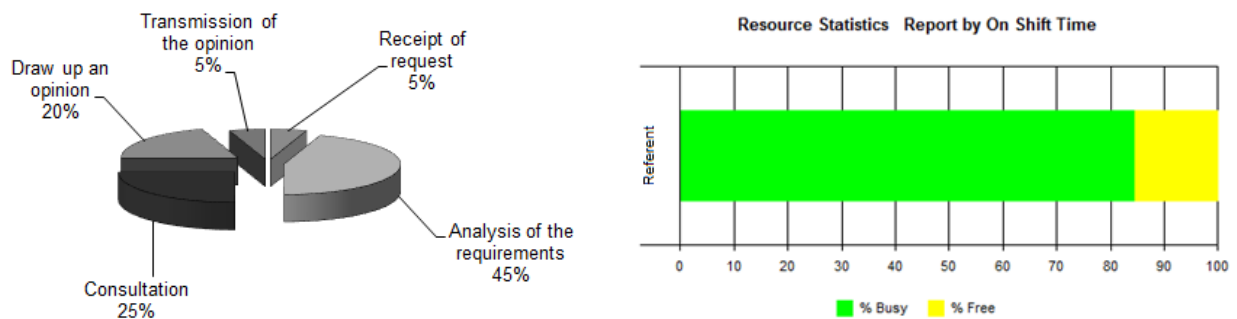


Figure 7: The cases of structure of the clerk working time Source: (authors)

- *Cost of process*, i.e. human resources, materials, key inputs, etc.
- *Production* that expresses number of products, the value of the services provided, etc.

The simulation model therefore assumes the existence of company with advanced process control that has implemented and uses of hard metrics that are based on the measurement of time, cost and production outputs. The Witness simulation development environment provides possibilities for creation and dynamic simulation of innovate changes of processes which have an effect on:

- *Risk reduction* in decision making - accurate prediction which is given by the proposed simulated process;
- *Proposing the optimal solution* among several variations of simulation - enables creation of individual scenarios to be compared and the best option can be graphical presented;
- *Generating an operational asset* - simulations deployed as robust applications become an asset in operational decision making;
- *Supporting of investment decisions* - provides evidence to identify profitable ideas and avoid costly mistakes (Repka et al., 2013).

Simulation models elaborated utilizing the Witness simulation development environment can use the possibility of dynamic simulation, which allows to developers to simultaneously vary the process parameters and monitor the effect of these changes on required level of innovative changes.

5. Conclusion

The companies and organization in the Czech Republic must begin with identification of its key processes and creation of their process maps with the support of verified methodology frameworks (e.g. DEMO). Simulation results of thus formed models provide necessary basis for qualified decision making of a company management. Thus, the processes described, including a set of performance metrics and quality, provide standardized procedures, which then helps to bring the management required level of quality of product and services. In this activity, however, care must be taken in the manner of implementation the innovate changes of process with use the creativity of employees.

By experience of the authors the DEMO utilization in process model development facilitates the transformation process model into the simulation model. The Witness environment allows dynamic simulation of more complicated key processes which require the simulation of impact of the innovative changes.

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BCG ANALYSIS AS AN INNOVATIVE IT APPLICATION IN INDUSTRIAL COMPANIES

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Keywords

Innovation, BCG analysis, BCG matrix, school managers, industrial companies, strategic management, strategic analysis, market analysis, portfolio analysis, business intelligence applications

Abstract

Long-term and strategic cooperation between industry and universities is one of the basic tools for achieving the desired competitiveness of companies. The research team from the Institute of Economics and Control Systems HGF VSB-TUO in cooperation with industrial companies in the region creates an innovative system for processing of strategic analyses of industrial companies, which assists managers in their decision making when solving current needs. One of analyses, which this system includes, is BCG analysis. This is a known method which faces a number of obstacles in practice. The paper shows how the research team proceeded in the integration of BCG into a comprehensive system, and how the negative characteristics of this analysis were removed.

1. Introduction

In strategic management is necessary to evaluate the business environment, i.e. monitor the development in macroeconomic conditions, the behaviour of competing companies and suppliers, but also the needs of our customers and then decide how to manage and make decisions about corporate resources. Market and Business Intelligence Systems (BI) are based on knowledge of the

market, companies, competitors, customers, consumers and all information are being evaluated in context.

1.1. Strategic management and market analyses

Strategic management is a field that is focused on long-term planning and directing the organization. Strategic management in the organization ensures that things do not happen randomly but according to pre-planned, long-term plans. (Zuzák, 2011) Market analyses are an important part of business activities used to determine the focus of the project, the production program and also to identify the necessary technology and other corporate activities. The ability to identify market segments complying with key competencies can be the basis for providing a strong position for competitive advantage. (Johnson, 2008) For strategic market planning are often used modifications of portfolio analyses, specifically BCG analysis. Boston matrix is a tool that can be used to evaluate the company's product portfolio. It also serves as a strategic tool, as it allows the company to realize its market position, identify their strengths and weaknesses, and based on the analysis results, the company is able to build up its strategy or intervene in product offerings. (Tomek, 2009) Practical application is mentioned in the article Analysis of Service Quality Management in the Materials Industry Using the BCG Matrix Method (Ioana, 2009) and in Article BCG matrices in practice in the computer industry (Perkins, 1990).

1.2. Research objectives

In professional literature a large number of analyses has only verbal and very subjective form. For proper management decisions it is necessary to work with obvious and visualized outcomes that are clearly quantifiable. The effort of the research team is to eliminate these shortcomings and to create a software application that will be able to significantly assist industrial companies in strategic decisions. This article deals specifically with the creation of a standardized IT application for BCG matrix. Benefit is mainly in the fact that the user does not need to look for information on how to assemble BCG matrix. The user only needs to start our software, fill defined tables and he will see results and graphs immediately. So the user can immediately see in which situation its products or SBU are located.

2. Theoretical assumptions of investigated issue

2.1. Innovations in strategic management

Due to the rapid improvement of logistics, communications and especially thanks to globalization over the past few decades, the economy based solely on the comparative advantage of a certain sector is losing importance. Innovations are getting faster and more flexible. Innovations are catalyst for growth and represent systematic use of opportunities not only in technology, but in all areas of human activity. The principle of business innovation is a constant search for better ways to satisfy customer needs by increasing the quality of services, products and lowering prices, leading to a better implementation of technological and organizational strategies development. The main driving force for innovation is competition. Innovation management deals with the introduction of something new into operation and running of the organization, enterprise or to the portfolio of its products and services. (Vlček, 2008)

2.2. Cooperation between universities and industrial companies

Mutual cooperation between companies and universities must be based on long term. This is the only way to achieve innovative outcomes of mutual cooperation

A typical example of successful cooperation is existing partnership for several years of research team from the Institute of Economics and Control Systems HGF VSB-TUO with a local consulting company, whose customers are primarily industrial companies. As the author team has in the past repeatedly presented (e.g. Chuchrová 2015 and 2016, Kozel 2015 and 2016) system to support management decision making was made thanks to this cooperation and individual strategic analyses were gradually implemented into this system. Many synergy effects arise from this cooperation. On one side there is a professional potential of team members and on the other side there is a consulting company that has close contact with managers of selected industrial companies.

At the institute of the author team is also another example of the systematic cooperation of industry and academia. In published outcomes of these research teams (see Danel 2012, 2013 and 2015) is discussed issue of financing cooperation, reduce of contract research, innovation transfer for the industry, training of graduates, creation of a database of projects about the revitalization of brownfields or system for quality control in the production of coal and coke. Cooperation between faculties or intercollegiate is also suitable, when the benefits of academic occupation of the research team are shown. Janovská et al (2012) describes an example of such cooperation, where cost savings in the metallurgical companies were achieved thanks to the use of technical analysis methods. As can be seen from the published outputs of another of the experts, who work with our institute, mentioned benefits may help in dealing with academic-industrial cooperation (AIC), see Minister (2014 and 2015).

2.3. Basics of BCG matrix

This method was invented in 1968 by Bruce Doolin Henderson from the American consulting company *Boston Consulting Group* (This is the reason for the name BCG). Its underlying principle is to evaluate individual products, thus products or services of the company in two dimensions, and an assessment of the extent of growth in the market (market growth rate) and an evaluation of the market share (market position). Market share and speed of its growth is changing over time. For this reason, the manufacturer shall manage the life cycle of the product.

2.3.1. Graphical representation of BCG matrix

Expected market growth rate - Answers the question whether market of the product in which the company operates has sufficient momentum – Y - axis.

Relative market share - Its level reflects mainly about the business competitiveness – X - axis.

Total sales volume - Third dimension may be profitability of each product. Importance of the product (total sales volume) is implied by the circumference, which displays the specific product in the BCG matrix.

Using axes BCG matrix is divided into *four quadrants*, each of which represents a piece of the product portfolio. Quadrants of the matrix are called Question marks, Stars, Cash cows and Dogs.

2.3.2. BCG matrix quadrants

Cash cows - Slow-growing market and a high market share. Cash cows are the main financial support of the company and maintain a good market position, they bring high profits, without

requiring larger financial contributions. They allow you to encourage the development of new activities, or cover losses from decay of products or non-profit activities. *Stars* - a rapidly growing market and a high market share. Maintaining these results can be expensive, but the result may be a high profit. Stars need to be converted into cash cows, by investing in advertising or partial innovation.

Question marks - a rapidly growing market and a small share. Regards goods in the process of introducing to the market, these products require significant financial input, but are chances for the future. The market will decide whether to invest in them and turn them into cash cows e.g. by advertising or partial innovations, or withdraw and eliminate them. *Dogs* - Slow-growing market and small market share. This includes products that are promising and ending its commercial career. In the future, it is necessary to suppress the production or withdraw the product from the market.

Individual products gradually change its position in the portfolio. Analyses of current development and the probability of future development of these positions are very good basis for defining the strategic goals and plans for further innovation in business activities. BCG analysis results will help the organization to determine strategic plan for the entire portfolio of products. Products should be balanced in quadrants, so that products in the quadrant of dairy cows should allow funding of other products, but with regard to the life cycle of products is necessary to have in the portfolio of company future potential in the form of stars and question marks.

2.3.3. BCG matrix weaknesses

BCG model assesses usually only two global factors, which do not always mean success factor or the attractiveness of the market. The value - relative share of the market, especially in international markets, may not be a decisive factor in assessing the product's position. The error can also occur if the company assesses the growth rate like - increases / decreases and the market share like - big / small. It is necessary to have a scale and accurately quantify it on both sides. In the model is also not mentioned reaction of competition that plays one of the dominant roles in strategic decision making. The basic idea of BCG matrix is the assumption that the products are profitable, however, analysis ignores this criterion itself. Matrix does not provide information about the costs and profitability. Sometimes the "dog" can be profitable without additional money, therefore, product should be supported and not sold. Another disadvantage is the difficulty to obtain the information necessary to construct the matrix.

The authors of this article are trying to contribute to the improvement of method by linking BCG matrix with an economic portfolio, which takes into account the profitability of individual products.

3. SGS research project

One of the fastest developing areas of information systems are business intelligence applications. There is an increase in the amount of data that companies cannot handle themselves. Another trend is to expand the types of consumers of these systems in top management, middle management and individual employees. Information displaying is constantly evolving. Still, most of the questions on the information are presented in the form of a text format.

3.1. Project assumptions

Market and Business Intelligence systems are typically assembled for regular classic data collected by corporate financial section. But they are not prepared as an evaluation tool for decision support

of strategic marketing analyses. (Návrát, 2008) For this purpose in 2015 there was submitted SGS Project No. SP2015 / 36 Creation of a system for analysing the competition of industrial companies. In this project, the research team from the Institute of Economics and Control Systems dealt with BI and analyses of competition. It has been proven that an appropriate analytical tool for analyses is indispensable for the realization of strategic management for industrial companies.

This stage is followed by another phase in 2016, which is concerned with the competitive position of companies, namely market analyses. SGS Project no. SP2016 / 29 "Creation of a system for market analysis of industrial companies" aims to create an analytical tool, which will include market analysis model to identify the competitive position of industrial companies.

3.2. Project methodology

Theoretical materials of this method were collected and then standardized solution was proposed. This solution should lead managers to compile analysis. The solution is systematic and is part of the future system of strategic analyses, which is gradually updated. Verification of system is carried out on real data of industrial companies in the areas of mining, metallurgy and mechanical engineering. The whole system operates on the basis of available software in all companies, such as MS Excel spreadsheet using the utilities and menus in Visual Basic.

4. BCG analysis as a standardized IT application for industrial companies

In previous published outputs of the author team the creation of a comprehensive decision support system for managers and its application in industrial companies was presented, using mainly the SWOT analysis and Porter's analysis of competitive forces. Currently the attention of the author team is focused on a portfolio BCG matrix. Just as in previous cases, research team wants to create standardized solution for this analysis using software created to remove known weaknesses of BCG matrix. The aim is, that after data entering the market position of the product would be automatically assessed and managers should immediately get a portfolio map, from which should be clearly visible what is happening with their product portfolio.

4.1. Input user interface of the system

Input screens of the entire system are always fully functional and the user can choose which part of the analysis will be addressed. This screen also works as a tutorial example. The system, which is formed at the Institute of Economics and Control Systems will be used for teaching subjects such as strategic management and marketing. The system includes a series of explanatory features, for example when clicking on individual fields (quadrants) a window opens, that describes what these products are and what strategy to use.

4.2. Inserting data into BCG matrix

When user clicks on "Market growth rate" or "Relative market share", the user gets to the main specifications table where it is necessary to fill in all fields. Pink fields are intended for filling and grey fields are locked and user cannot control them. In the first place it is necessary to define the product portfolio (products / services, product groups, the SBU, which user wants to analyse) and then it is necessary to fill in other data relevant for calculation (Fig. 1).

CURRENT PRODUCTION						
s. n.	Products	Profit	Sales of our company	Total sales in the market		Sales of the largest competitor
	Product portfolio BCG		2015	2014	2015	2015
1	Product 1	1 000 000,00 Kč	30 000 000 Kč	205 000 000,00 Kč	226 000 000,00 Kč	24 000 000,00 Kč
2	Product 2	2 000 000,00 Kč	12 000 000 Kč	35 000 000,00 Kč	40 000 000,00 Kč	15 000 000,00 Kč
3	Product 3	4 000 000,00 Kč	42 000 000 Kč	72 000 000,00 Kč	76 000 000,00 Kč	8 400 000,00 Kč
4						

Figure 1 – Input table; Source: own processing, Software SA

In the upper bar can be seen period, in which the variables are measured (year, month). These data are set when entering the system. After entering all relevant information for each area results are automatically generated in the following table (Fig. 2), and after clicking user can find out how the calculation is done.

CURRENT PRODUCTION							
s. n.	Products	Market growth	Share of total sales of the company	Market share	Market share of the largest competitor	Relative market share	Share of specialization on total sales
1	Product 1	10,24%	35,71%	13,27%	10,62%	1,25	36%
2	Product 2	14,29%	14,29%	30,00%	37,50%	0,80	14%
3	Product 3	5,56%	50,00%	55,26%	11,05%	5,00	50%
4							

Figure 2 – Table generating values of axes X, Y, Z; Source: own processing, Software SA

The theory says that the value of the X-axis is a logarithmic scale from 0.1 to 10, when Y-axis crosses the X-axis in the value one. The extreme values of the Y-axis are from 0 to 20%, when growing markets are from 10% growth per year. After initial testing on real data has been found that these values can be met only sometimes. There are various specifics for the various sectors, and different markets, products or businesses cannot be treated equally. Recognising this, the table "Graph axes" was created (see Fig. 3), where the user can choose standard view (according to theory) or own view:

- X-axis - minimum of axis is always 0.1 and the maximum is dependent on the maximum value from the column "relative share" in Fig. 2, therefore, if the largest value from this column is ≤ 10 the maximum of this axis will be 10 with centre in value 1, and if the largest value from column will be > 10 maximum of this axis will be 100 with centre in value 10.
- Y-axis - values are generated from the column "market growth rate." Minimum of axis is calculated as the minimum value of the column "market growth rate," minus 2% and the maximum is the highest value of the column "market growth rate," plus 2%.
- Axes centre - the value in which the x-axis intersects the y-axis, is necessary to be specified in a pink box. The question is: At what value is a market for your company growing?

Chart axis		
Custom view/Standart view	☒	
Axis	X	Y
min	0,1	0%
max	10	20%
center	1	10%
Specify center	x	2%

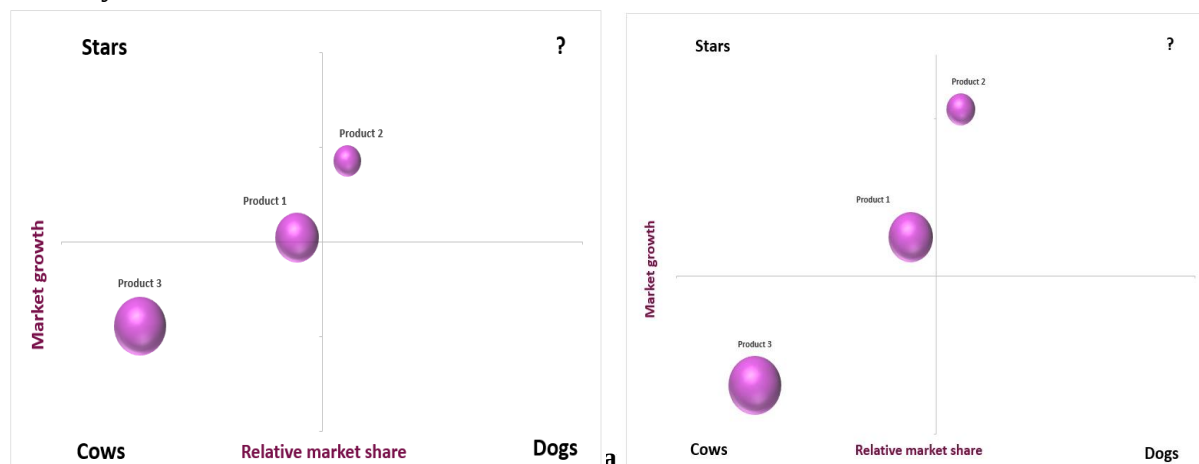
Chart axis		
Custom view/Standart view	☐	
Axis	X	Y
min	0,1	4%
max	10	16%
center	1	2%
Specify center	x	2%

Figure 3 – Matrix axes (standard axes, own axes); Source: own processing, Software SA

4.3. Graphical output of BCG matrix

Button "Change graph axes" displays a graph with respective axes, see Fig. 4. Managers can see how their products or SBU look in textbook example and how they stand according to their own specific situation.

Another innovation of this solution is the implementation of the economic portfolio, which is also part of our software application (but is not the topic of this paper). This innovation responds to the weakness of BCG matrix that does not take into account the factor of profitability of the product / SBU. A product that falls into the category of "dogs" can be very profitable. The user through the button "compare with the economic portfolio" gets to the next graph, which maps the economic profitability of the entered units.



5. Conclusion

BCG matrix as a sub - analysis of the entire system was presented in this article as one of the most popular methods of market analysis, which is often carried out superficially. The main outcome of our present solution is a software application that informs users about the BCG method and its use and has prepared tables - where the user enters the necessary data and our system will immediately generate the results and graphs. It is also supplemented with economic portfolio thanks to the complexity of this system, in order to assess the economic efficiency of analysed products. Thanks to the use of MS Excel spreadsheet and utilities and menu in Visual Basic, this system represents an available solution for all companies that have this common software.

The proposed model will be gradually developed by our research team and will be expanded with additional analyses, and will also be tested in other industrial companies.

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SESSION C: THE MULTIPLE ROLES OF THE PUBLIC IN CRISIS MANAGEMENT

INCLUSION OF MARGINALIZED GROUPS INTO CRISIS MANAGEMENT PROCESSES. MODELS, CASE STUDIES, AND HOLISTIC PERSPECTIVES

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Keywords

Crisis management, public inclusion, democratization, self-efficacy, marginalized groups, case studies, project PROTECT, Helfer Wiens, project EBeCa, MultiRes approach

Abstract

Basing upon the rising number of incidents and increasing impact of natural and man-made disasters and crises in a complex, interlinked, and globalized world (Farazmand, 2001), the necessity of an even more effective emergency management taking advantage of a supportive, compliant, and resilient society becomes evident. Several different models of interaction between professional governmental and non-governmental emergency management organizations and the public can be identified – each with different opportunities and demands regarding resources, information exchange, level of preparedness and support, and last but not least the driver of civil engagement. Most of these different models and modes of interaction and interdependency show a crucial lack of inclusion of some or most societal groups with specific requirements, and thus they are often marginalized in extreme situations. Yet crises and disasters occur all over the world with the highest impact on the most vulnerable in society.

This paper focusses on identifying, categorizing, and attributing specific models and systemic approaches of interactions between the public and professional crisis management and thus highlighting the multiple, crucial roles of the public in crisis management. Specific emphasis will be laid on marginalized groups and their specific communication and information requirements. Socio-demographic specifics like age, gender, education, ethnic origin, language, but also personal history or physical and/or mental disabilities or illnesses can have imminent influence on the level of resilience, self-efficacy, and compliance in crisis situations. While bearing a big potential to address and include thus marginalized groups, not considering these parts of the population bears critical potential for direct and indirect chain effects and loss of lives and economic goods.

In times of growing importance of democratization processes, inclusion and target group specific crisis management in all phases of an incident – from prevention, preparation, response to rehabilitation and reconstruction – good examples to proactively address and inform the marginalized and heterogeneous groups of migrants and refugees, are presented as good practices. Finally, basing on this real world approach and reaching out to filling the still existing gaps towards a broader and even more efficient, flexible and holistic inclusion, the model of an online-offline merging, expanding the MultiRes-approach (Rainer et al., 2015) will be elaborated.

1. Models of interaction with the public in emergency and crisis management

1.1. Approaches of interaction between professional crisis management and the public

Crisis management is often defined as one of the inherent and fundamental tasks of a state or federation, covered by several public bodies (bmi, 2015; Hay, 1999) in cooperation and concertation with non-governmental organizations like ambulance services or volunteer firefighters.

Following this train of thought, Figure 1 shows on the example of Germany, how crisis management is organized on federal and state levels. The layer of a potential inclusion of assisting forces of other states or other administrative authorities are not taken into account in this model but mentioned by bmi (2015) in the narrative part. In this position paper it becomes obvious, that the population is seen as potential casualties to be protected and to be taken care of, not in the first place as partners or relevant, pro-active actors.

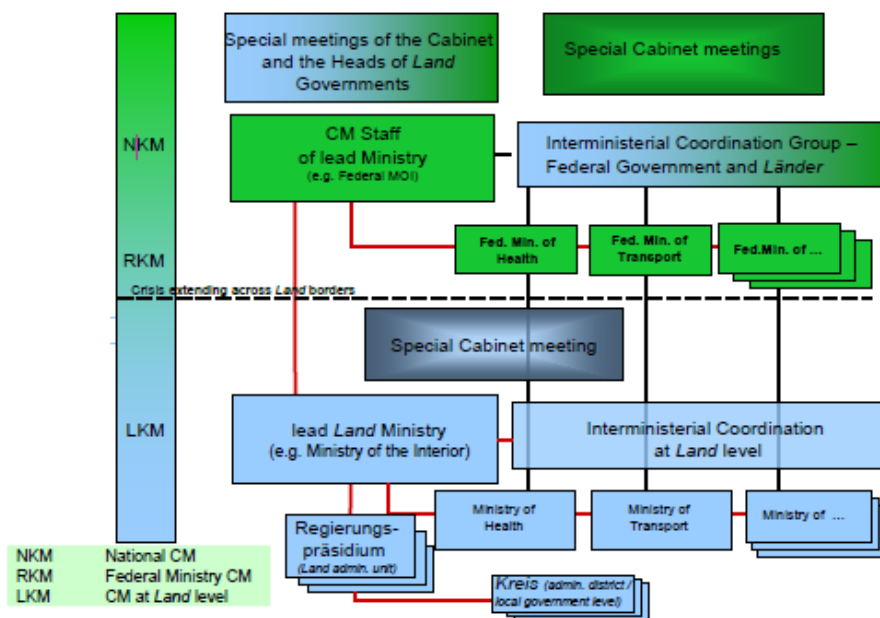


Figure 1 Schematics of the public crisis management organization in Germany (bmi, 2015)

This model is focusing on the official, institutionalized sphere of crisis management. Although civil protection is highly relevant and active in many countries of Europe, as BBK (BBK, 2016) or the Zivilschutzverband Austria (Zivilschutz Österreich, 2016) showcase, the inclusion and also the obligation of the civil society to take part in the prevention and preparedness work of their community as well as in crisis management, is not fully developed.

The European Commission (DG ECHO http://ec.europa.eu/civil-protection_en) also aims at coordinating the official, national stakeholders, and, in addition to the above mentioned, exemplary system, explicitly mentions volunteers and a larger part of the civil society as a target group for actions. However, awareness rising and inclusive democratization is one of the major points regarding the prevention and preparedness dimension of disaster and crisis management, which could and should be focused to a much broader extent and should be actively rolled out, as the further discussion of this paper shows on the small scale example of marginalized groups.

Besides the formal layer of the management of crises and emergencies of different types, extents, levels of complexity and responsibility (Bielza et al., 2008), the civil population plays an important role in tackling severe incidents. In all phases of the disaster management cycle (see e.g. Backfried et al. 2013) a pro-active inclusion of the population and of means of information flow, has massive impact on the effects, efficiency of counter measures, mitigation and recovery of a community hit by a critical event.

Figure 2 shows the traditional model of interacting stakeholder groups in crisis management including the potential data flows via multiple communication channels.

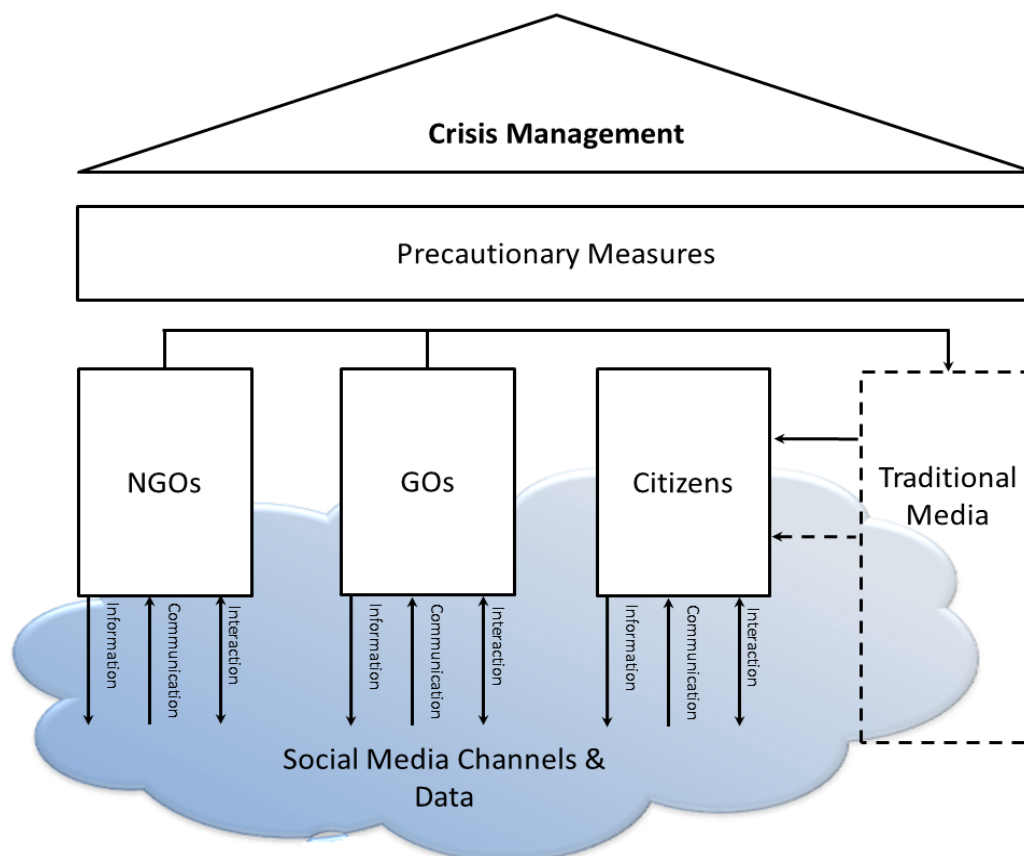


Figure 2 Traditional model for precautionary measures (following SKKM, 2006) enriched by the new social media information layer (Rainer et al. 2013)

The compliance, agency and support delivered from the side of the population are directly linked to the education and level of communication/dissemination of crisis management skills, necessities and knowledge in times between big events but also directly in the event. On the other hand, communication, as shown in Figure 2, as a basic factor for the successful tackling of crisis situations, is one of the crucial and often frail factors of emergency management. In a classical study, Hay (1986) sums up the communication problems potentially occurring on the five different levels of organizational behavior: intra- and inter-organizational, from organizations to the public and vice versa and within the systems of organizations.

In certain societies, these relevant communication channels are vigorously used for training activities on a broad basis. From an early age on, e.g. in Japan, inhabitants are drilled in emergency procedures, a tight network of communication, training, and information channels is permanently active – also due to the geographic position of this country and its exposure to an ongoing series of earthquakes and connected events (Claremont, 2013). Emergency drills are conducted in schools, in workplace environment, in public facilities as an inherent part of everyday life. The borders between the different layers of stakeholders and their tasks shown in Figure 3 are not as rigid in their exclusion of the public as it seems the case in the European approach.



Figure 3 Layered model of stakeholders in emergency and crisis management

Taking into account the evidently weak development of the important role of the citizens and residents in European context as a paradigmatic Austrian study (Kirchner et al., 2011) shows, all means and channels of activating this potential have to be taken advantage of. As Kirchner outlines, the inhabitants of Austria feel well taken care of by public emergency and crisis management and thus see themselves relatively safe. On the other hand, they feel no or very little responsibility for preparation measures or prevention for the case of a major event or a personal emergency.

Thus, resilience and empowerment of the society in the face of a rising number and impact of critical events and an inclusive approach of policy and crisis management organizations but also a pro-active attitude of the population is of raising importance (Graham, 1999). A cooperation of governmental organizations and entities, NGOs, and informed and self-determined citizens as (see Keim et al., 2011; Velez et al., 2012) are more and more necessary to grant an increasingly high quality of a holistic response of complex emergencies. To sum it up, timely, reliable, target group oriented communication and a multi-channel inclusion of all relevant stakeholders is a crucial factor for effective and efficient emergency and crisis management.

1.2. Potential and examples for increased, multi-channel engagement of the public in crises

Socio-demographic specifics like age, gender, education, ethnic origin, language, but also personal history or physical and/or mental disabilities or illnesses can have imminent influence on the level of resilience, self-efficacy, and compliance in crisis situations. As explained above, these factors also influence the level of inclusion into crisis management and preventive measures.

Several platforms and other solutions allowing inclusion of specific population groups in crisis as well as in disaster management already exist. In several countries volunteers are of outstanding importance. Thus, it is helpful to categorize different subgroups of volunteers. According to (Neubauer et al., 2013) one can distinguish between formal and informal volunteer engagement. Formal volunteer engagement is characterized by a strong commitment to a specific crisis or emergency management organization comparable to engagement of employed professionals. The main difference between the two groups is typically the lack of an income in case of the volunteers. This group is not in the focus of this paper. Looking at informal voluntary engagement one can distinguish between pre-registered citizens and pre-organized volunteers. Pre-organized volunteers are typically registered for an organization, they were submitted to a specific training or education, for example a training course and they are organized while performing specific dedicated work in

crisis management. Pre-registered citizens is the part of the population involved in crisis and emergency management with limited or no organizational structure, without specific education or training (not excluding having valuable experience while performing their voluntary work) and finally being only loosely registered to any organization.

Looking at the type of contribution that may be provided by different parts of the population, a distinction between crowd tasking and crowd sourcing has to be made. Crowd sourcing can be defined as assigning tasks to a non-specified, not a priori known group of people, whereas crowd tasking means to assign tasks to a predefined group of volunteers having the required qualification to perform certain tasks (Flachberger et al., 2015). Crowd tasking is an approach applied by the Austrian Red Cross since several years. People willing to assist in emergency and crisis management register on a website, specify their qualification and will be assigned to specific tasks via email and cell phone in case of request. Example given, the members of Team Österreich were and are still deeply involved in the management of the flow of refugees reaching Austria since late August 2015 (Team-Österreich, 2016). The concept of Team Österreich was also adapted in the Czech Republic (Team-Morawa, 2016) as well as Germany (Team-MV, 2016). In order to improve the opportunities of involvement of pre-registered citizens a new approach was developed in the frame of the national research project RE-ACTA (2016) and is further validated within the European project DRIVER (2016). New approaches to improve interaction between professionals and registered citizens are developed, encompassing modules for initial event setup and activation of suitable qualified and available volunteers, iterative task creation and execution processes and finally a module for evaluation of responses (Flachberger et al., 2015).

Several other solutions are available making integration of parts of the population in crisis and emergency management possible. Benevol Jobs (2016) from Switzerland makes self-help of citizens possible in multiple domains, but does not provide the possibility of interaction communication. Multiple systems were realized in the past, including the platform United Nation Volunteers for the recruitment as well as mobilization of citizens during the Libyan crises (UN-Volunteers, 2016) or Crisis Commons (2016). The latter is specifically dedicated to the education of IT skilled volunteers. VolunteerMatch is a platform that was set up in the last stages and the aftermath of the hurricane Katrina in order to improve cooperation between NGOs and volunteers (VolunteerMatch, 2016). A solution from FEMA was provided with a similar goal, i.e. interaction of volunteers with emergency management staff (National Preparedness Community) (America's-PrepareAthon, 2016). The context of All for Good is broader, because it limits attraction of volunteers not to the disaster management domain (AllforGood, 2016). The FEMA Disaster Reporter (FEMA, 2016) shares disaster-related information, allowing volunteers and others to view and contribute information on a publicly accessible map. Another example, PulsePoint (2016) aims to notify pre-registered users in the area of an incident according to their skills. Orion Damage Assessment (Orion, 2016) collects critical decision support information from volunteers so that the emergency management can coordinate and deploy resources to locations in the most need. Finally, Rapid Response Kit (Twilio, 2016) features SMS-powered volunteer sign-up and survivor surveys, flexible push and pull conference calling, and phone tree configuration.

Apart from the platforms discussed above, several Apps were developed to involve volunteers in crisis management such as Volunteer App (2016) from the American Red Cross or Rapid Rescue (2016) from the Singapore Red Cross which is looking for qualified volunteers in the neighborhood in case of an emergency. Some solutions were also developed in Australia such as ReadyQld (2016) dedicated to help preparation of communities for disasters or the Self Recovery App (S.R.App, 2016) designed to prepare to and mitigate the effects of disasters. Emergency Australia (2016) is dedicated to warn the population and to provide incident information for whole Australia.

Some research projects develop also concepts and solutions in this domain. For instance, the EU-FP7 Project iSAR+ (2016) aims at developing a platform that enables volunteers to actively participate in the response effort, through the bi-directional provision, dissemination, sharing and retrieval of essential information by using new mobile and online technologies. The Hands2Help project (Sackmann, 2016) deals with the development of a mobile app for coordination of volunteers during disaster response by alerting the “right” number of “right” volunteers.

1.3. Specific gaps and needs towards fostering inclusive processes in crisis management

Taking into consideration the factors discussed in section 1.1 for successful, efficient, and effective crisis management, it becomes obvious, that certain aspects have to be considered as potentially excluding for specific groups due to e.g. language barriers, limited education, (digital) literacy, and/or access to media sources (Batchelor, 2014), cultural or gender barriers, as well as individual factors. On the other hand, it is this attribution to these factors, which makes groups specifically vulnerable in case of emergencies as they often lack the means to communicate their needs, to have economic or otherwise access to support measures, or to receive understandable, targeted information. Thus, marginalized groups, as defined by O’Keefe (2001), are specifically prone to suffering the highest load of negative effects of emergencies, crises, and disasters (UNDP, 2010).

These elements lead to obviously endangering vulnerable groups like refugees and asylum seekers in the case of emergencies as well as larger scale crises. On the contrary, the potential of beneficial outcomes of crisis situations or personal emergencies among these groups, when information flows, training, and communication flows are initialized and practiced, can be of high impact (see section 2). Taking into consideration the most evident factors that are considered as outstanding regarding social/societal exclusion (Kahn, 2015), and cross-referencing them with the basics most relevant for the target groups of refugees and asylum seekers, the specific needs for a high impact, inclusive approach towards those addressees can be reduced to the areas of apt language, socio-cultural aspects, and a sensible level of complexity as Figure 4 shows:

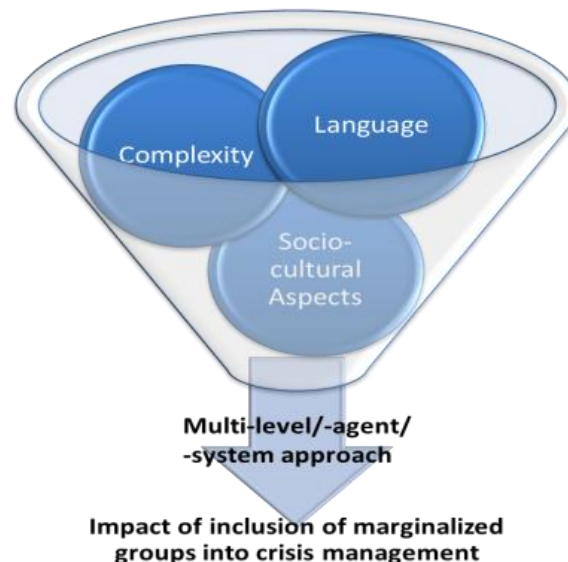


Figure 4 Basic needs and considerations for a high impact, inclusive approach into crisis management

These most integral, basic factors, which have to be taken into account, can lead towards promising projects; however, if the layer of the multi-level, multi-agent, and multi-system approach is not taken into account, inherent limitations will emerge and lower sustainability and scope of the pilots.

2. Case studies of two good practice models in Austria

To illustrate approaches of inclusive forms of crisis and emergency management, preparedness and prevention work, two case studies focusing on specific marginalized groups are presented in the following section. Their objective of disseminating basic crisis management competencies and knowledge about necessary communication/information/infrastructure flows is put into practice in different formats and contexts in Austria. The Red Cross, Vienna branch, and the public civil protection organization “Die Helfer Wiens” have ample experience with transferring those relevant inputs to selected target groups, focusing on specific aspects of the broad spectrum of necessary knowledge and hands on-experience for tackling small, medium, and large emergencies.

2.1. Project PROTECT – a low-threshold success story

The volunteer project PROTECT conducted by the Austrian Red Cross, Vienna branch, is based on an EU-funded transnational project (see PROTECT, 2016 [1] and [2]). Initially it was conducted by nine organizations from the four European countries Austria, Germany, Spain, and the Netherlands from October 2011 to September 2014. The aims of the project were focused on motivating the target group of migrants for volunteering in crisis management and simultaneously making cross-cultural competences an issue in the participating organizations. Besides good practice analyses, special weight was laid on the development of training material and curricula for multipliers. They were intended to pass on their newly gathered knowledge about crisis and emergency management, correct behavior in emergencies, and formal volunteering among the selected target group.

Even two years after the project termination, currently, in 2016, the Austrian approach is still successfully operated. PROTECT has even updated its focus towards the inclusion of the target group refugees/asylum seekers. Thus, special emphasis will be laid on its potential for training and thereby including marginalized groups into an inclusive, successful crisis management.

The main approach of the project PROTECT is to train future trainers of the selected target groups and already active Red Cross volunteers to spread knowledge as “trainers” in these communities. In teams of two to three volunteers the PROTECT-trainers conduct low-threshold, two-hour workshops for the target groups of migrants and refugees/asylum seekers respectively similar communities in their organizations, associations, learning centers, assisted accommodations etc.

The workshops are free of charge and held in German language but if needed, translations in languages like English, Arabic and Farsi etc. can be facilitated by the multilingual trainer teams. The topics that are actively discussed and practiced in the PROTECT-workshops are different cases of emergencies, emergency call, basic first aid, information about key players in crisis management and the various volunteering options in Austria. Low-threshold methods like puzzles, group discussions, use of pictures and interactive first aid practice sequences in combination with a diverse trainer team are the key success factors of the project.

The trainers bring in basic knowledge of volunteering in a formal civil non-for-profit-organization like the Red Cross; on the other hand they have various language competences and knowledge about the specific target groups and their communication needs as they are often members of marginalized group themselves. In the beginning of the project, the time resources and networks of the trainers for getting in touch with and activating potential workshop participants, were overrated. Thus, another success factor of PROTECT turned out to be that workshop coordination and professional volunteer management were facilitated by a dedicated Red Cross project leader. This person is now in charge of networking with the target group organizations, training and supervising the trainers, and taking care of the public relations for promoting the project and its aims.

Until spring 2016, five train-the-trainer preparatory seminars with an output of 65 new PROTECT-trainers were conducted. They held 70 workshops at different organizations, reaching more than 1000 persons of the target groups with very positive feedback. The participants highly appreciate that the trainers of the workshops are volunteers with migrant background themselves and that the workshops are conducted in their own settings and with an easily understandable and figurative vocabulary. This leads to word of mouth-marketing in the different communities and the project management team recently receives lots of proactive requests from the identified target groups.

Factors to optimize the trainings and volunteer management were identified similar to the discussion in section 1.3. Due to the German language level ranging most times between A1-B1, a list with workshop vocabulary will be sent to the contact persons in advance to get familiar with the terminology in advance. Also, specific workshops for female groups are conducted only by female trainers. It has become clear, that the participating women are more eager to talk about personal experiences and more active during workshops led by female trainers who are – in a best case scenario – part of their cultural and lingual background.

Volunteer management will also be optimized in 2016 due to the fact, that from approximately 60 trained trainers only 15-20 are still active: a special focus will be laid on their selection and an advanced training of the trainers. It also has to be communicated clearly and early, that the volunteers should bring enough time resources to conduct at least two workshops per month and that the workshops are – according to the selected target groups – mostly on weekdays during the daytime. This factor makes it difficult for volunteers with a full-time job, to be part of the project.

As the workshops and the possibility to volunteer as a PROTECT trainer have recently become more and more attractive for asylum seekers and people with only basic knowledge of the German language, the current focus of the project lies on translating and adapting the workshop material for these specific target groups.

2.2. Die Helfer Wiens – specific dissemination strategies for specific needs

“Die Helfer Wiens” (<http://www.diehelferwiens.at/>), a regional governmental organization consisting of, and named after their aim, being civil protectors or aiders of Vienna, contribute with an additional good practice model to disseminate knowledge relevant for tackling personal and broader emergency and crisis situations.

Founded in 1964 as “Wiener Zivilschutzverband” by the Municipality of Vienna, this association is mandated by law (WKKG §8, Abs. 2) to spread and communicate basic civil protection knowledge to the citizens and inhabitants of Vienna. Following their strategic mission and seeing prevention as inherently target group oriented issue, in fall 2015, as the migration development became a mass phenomenon, the need for a specifically migrant oriented, basic civil protection seminar, became evident. Thus, the in-house personnel of the civil protectors developed a curriculum for a 3-hour training session that was piloted with two groups of 20 persons each in March 2016. The seminars were funded within the budget of the civil protectors of Vienna and thus a public contribution.

The groups consisted of volunteers recruited in the public shelters and transient homes of refugee seekers (see BM.I, 2016) and were transferred to the location of the seminar in the 7th district of Vienna by representatives of the care taking organizations. They were intrinsically motivated to attending the workshop and thus after the practice oriented lecture pro-actively willing to spread the received information in their houses as informal multiplier agents.

The roughly 40 persons participating in the two pilot seminars were of mixed ethical background and spoke several languages. The status of their asylum applications was not relevant for an attendance at the workshop as the topics were deemed necessary and helpful for every resident of

Vienna, non-distinguishing them by this item. As neither their German nor English proficiency was apt to following the specific area of emergency response, a volunteer interpreter translated the presentation to the Arab language, which was understood by all of the participants. The quality of the translation was identified as a core point for the success of the seminar.

One of the groups was purely male due to the drop out of several female attendants, the second group was gender mixed. Regarding their social background, it was less clear, which groups attended the training; but all of them were sure that the seminar topics were totally new for them and have not been communicated in their countries of origin.

The content of the course was closely oriented on the common seminars conducted regularly and on demand for the citizens of Vienna. Basic information like emergency call, blue light organizations and processes of the rescue chain, small scale firefighting and prevention, but also practical training regarding possible incidents are the core topics that are covered. Knowledge of the interoperable infrastructure of a safe and secure city as Vienna like waste management, energy and water supply added up to these practice oriented seminar parts. An important issue, which was underlined in the course of the workshop, were the different possibilities to support emergency organizations in their duty: either via identifying emergency situations, starting the chain of survival by an emergency call, by safeguarding communication by e.g. obtaining language proficiency or interpreters, or by simply giving access and not interfering with the interventions of first responders.

In an un-structured, open oral feedback round, the impression of the attendees was asked for. It became obvious, that the participants had a very positive attitude towards the content of the workshop but also in regards of the atmosphere and meta-layer of the training. It was reported that the hands on-part and the multitude of show pieces like uniforms, firefighting devices etc. were very useful as no one in the group had ever had a similar seminar experience before and emergency training was a totally new area for them. The request for further seminars was articulated as well as the diploma for the workshop was highly valued and showed the significance of the presented area.

One of the obstacles regarding a broader roll out of the workshops was identified as purely logistic issue: for asylum seekers and refugees, affordability of transportation to reach the venue is a matter. Although the possibility of in house seminars at the shelters was considered, it was deemed to having a higher impact within the premises of the Civil Protectors of Vienna. There, show pieces, material for hands on-training, and workshop facilities were provided and above all, a possibility for the participants to take a time out of their routine at their temporary homes. The integrative aspect of the seminar (see Baldaszi, 2015) was underpinned by the setting in a public building of the City Government which also highlighted the weight and relevance of the seminar and its inputs.

The long term objective of the civil protectors of Vienna is clear: to conduct those services for asylum seekers and migrants free of charge on a high level of quality and to a much larger extent. The inclusive perspective of the training as a part of integration work and the presentation of Vienna as a livable city is as important for the organization as the education of persons to a higher level of self-efficacy and to reduce helplessness in emergency situations. To foster sustainability, further media work and even better interchange with organizations reliable for the basic and intermediary support of refugees, but also the inclusion of feedback and the optimization of the curriculum will be conducted. The civil protectors of Vienna see themselves and their offer as complimentary to first aid courses or other seminars – e.g. represented by PROTECT – and are working for an even closer exchange and collaboration to leverage the inclusion of marginalized groups in emergency management.

3. Holistic Perspectives of fostering inclusion via online-offline merging

Taking up the consequences of the presented models of population inclusion as well as online and offline success stories of approaches to foster inclusive crisis management, potential for a technological support of these systems becomes evident. Currently, the online volunteer-systems as shown in section 1.2, are existing and working without a deeper going institutional link to relevant offline seminars as the case studies of the Civil Protectors of Vienna or the PROTECT-team show.

With their inherent limitations due to either a missing link with marginalized groups, due to restricted access to technology, knowledge or equipment as confining factor or network restrictions in regards of physical/personal outreach, an online-offline combination like the MultiRes-concept (Rainer et al., 2015) opens up. This also becomes evident, as studies confirm that in Austria, and thus potentially in most comparably developed countries in Europe, the effect of depth and integration of the currently used, “traditional” prevention communication is deemed to be insufficient (Kirchner, 2011). Only a small, inherently interested part of the population is reached by brochures, small scale online media representation, or events; most of the content is digested superficially, and the compliance to the integration of preparedness measures, for example, is low.

For the optimization of frictionless, reliable communication/information flows being vital for efficient crisis and emergency management, an disseminating approach target and requirement oriented, online information for specific (e.g. marginalized) groups via real-world (“offline”) multiplier agents like PROTECT trainers, the similar CERT-approach in the United States (Jenkins, 2010), or participants of civil protection seminars, can be identified as one step towards an updated, inclusive emergency handling.

The merging of the practice models outlined in the discussion above, can contribute to a shift of borders, including currently marginalized groups by using efficient and approved systems and agents. By transforming emergency and crisis management skills and knowledge to a personal matter – via including volunteer multiplier agents consisting of community members and opinion leaders – it is an equally inclusive as well as efficient and necessary step to a holistic population outreach for self-efficacy, assistance, and compliance in crisis and emergency management.

4. Summary

The strengths of an online-offline merging of crisis management tools and approaches represented by MultiRes, can support the hitherto successful but limited impact models showcased by the presented examples. The inclusion and sensitive convergence of specific communication and dissemination needs of marginalized population groups lead to valuable and increasing high level impact on harmonization of knowledge and skills on crisis and emergency handling. The inclusion of online material in different languages on different complexity levels, that is oriented on socio-cultural specifics and habits, as well as the empowerment of an open and low-threshold approach via opinion leaders and internal representatives, opens opportunities for a snowball effect.

Compliance with emergency and crisis management measures, knowledge about infrastructure and basics of first aid and the emergency system in a European, complex, urban setting can not only contribute to an enhanced leverage for necessary crisis response by the inhabitants; it is also a milestone for the inclusion of marginalized groups like refugees and asylum seekers in a core area of national stability and civil society cohesion. Disseminating knowledge and skills via a diverse and adaptable spectrum of channels, media, and formats, the target groups become more likely to

being able and willing to contribute sensibly and pro-actively in emergency and crisis situations and thus supporting the multi-pillar model of integrative crisis management and prevention.

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IMMEDIATE HELP FOR REFUGEES IN AUSTRIA – POSSIBILITIES AND LIMITATIONS

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Refugee crisis, immediate help for refugees, voluntary work, public safety and emergency organisations

Abstract

The current refugee situation in Europe is dramatic – more and more people are leaving their homelands hoping for a better life in Europe. Due to the increasing number of refugees, receiving countries are reaching their limits in the immediate help of the same. Studies show that the social engagement of volunteers strongly supports the establishment of a “welcoming culture” for refugees and facilitates social cohesion. Nevertheless cooperation between voluntaries and public safety and emergency organisations is necessary in order to cope with such extreme situations. In 2016, similar to 2015, a high number of refugees is expected in Austria. In order to guarantee adequate immediate help for refugees it is recommended to learn from earlier experiences also in terms of taking up well functioning strategies and preventing past weaknesses. This paper addresses the questions how to learn from such experiences and how these could be used for developing political and strategic recommendations for key players in emergency relief for refugees.

1. Current refugee situation

The United Nations High Commissioner for Refugees (UNHCR) describes the current refugee situation as the largest humanitarian refugee crisis in the post-World War II era (UNHCR 2014). In the first quarter of 2015, 185.000 thousand people applied for asylum in Europe, 9.700 (5%) from them in Austria (Bendel 2015). This number rose to 88.912 until end of December 2015 (BM.I 2015), including 761 cases of “resettlement”, which is based on an agreement between the UNHCR and specific host states that is – besides voluntary return, asylum, and integration – a further possibility for especially vulnerable refugees to receive full protection and the chance of integration (UNHCR 2016). 72.33% of the refugees which were arriving in Austria were male, and 27.67% female. As data on asylum applications of the years 2014 and 2015 of the Austrian Federal Ministry of the Interior (BM.I 2015) show, the number of asylum seekers was particularly high in September, October, and November 2015. In June 2015, asylum applications rose by 334.50% compared to June 2014. Overall, the number of asylum seekers (including cases of resettlement) increased by 212.50% in 2015 compared to 2014 (BM.I 2015).

According to the data of the Austrian Federal Ministry of the Interior (BM.I 2015) most asylum requests were applied by Afghans (25.475), followed by Syrians (24.538) and Iraqis (13.602).

2. Refugee Studies

The current immediate help for refugees brings a high research potential, which can partly build upon existing refugee studies. Applied-oriented refugee studies, which are embedded in globalisation and migration studies, have been established as an independent research area in the past 30 years (Kleist 2015). Turton (2003) states that research in this field should be geared to improving the situation of those directly affected, thus the refugees. Kleist (2015) also points out that refugee studies eventually should address the question how research results could be put in practice and how they could influence refugee policy. Since refugees cannot be considered as a homogeneous group (Binder & Tošić 2003), an impact analysis of aid measures and humanitarian projects is relevant in order to take appropriate political actions. This means that refugee studies need to intensively address the largely under-researched field of refugee care (Karakayali & Kleist 2015) as well as their impacts in order to provide long-term recommendations for political measures.

Besides services of public safety and emergency organisations, processes and performances in the immediate help for refugees depend on voluntary work of the civil society. The European Union Agency for Fundamental Rights (FRA) came to a similar conclusion, pointing out that it is primarily volunteers and non-governmental organisations that are taking care of refugees arriving in the European Union (European Union Agency for Fundamental Rights 2015). This social engagement of volunteers strongly supports the establishment of a “welcoming culture”² for refugees. According to a study by Karakayali and Kleist (2015), voluntary work is not only grounded on the desire to improve the situation of refugees, but also on the intention to actively shape society. Non-profit activities are at the forefront, which support the strengthening of social cohesion. The reasons and motivations for activities in care for refugees, however, are manifold and can also be influenced by the image of refugees presented in media (Karakayali & Kleist 2015).

Already Georg Simmel (1908) stated that care for the poor and weaker parts in society does not only support alleviating the plight, but also contributes to a stabilisation of structures and further facilitates social cohesion. The Council of Europe (2004) considers this social cohesion to be a societal ability that is oriented towards the wellbeing of all members of a society. It does not only foster the establishment of commonly accepted values and a common vision, but also facilitates economic growth as well as technological developments (Woolley 1998). Dobbernack (2014) understands a missing social cohesion as influencing the development of criminality and unsocial behaviour of members of a society, which endangers the social peace. Cohesion through active citizen participation improves social relationships between individuals and consequently also enhances the quality of a society. Social change and new societal challenges such as intense refugee movements need an adaption of the society towards activities and a new understanding of responsibility. However, social peace is not assured by an “active society” only, but also needs political support and legislative changes. Social peace thus needs both: society and active politics. In this context, particularly results of thorough scientific studies can provide a solid basis for political activities in questions of refugee care and integration. While there has been research on the impact of care for refugees on the social peace of a society, these studies have been conducted more than twenty years ago and on different situations than today’s refugee situation in terms of for example numbers of refuge seeking people or their state of origins. In the analysed situations of

² “Welcoming culture” (German: “Willkommenskultur”) has been used as a term explaining positive attitudes of and support by the civil society (as well as of politicians, institutions, etc.) towards refugees, particularly in 2015 when numbers of refugees significantly rose in Germany and Austria.

these studies 72.1% of the refugees were from European countries, particularly from East, East-Central, and South-East Europe (Blade & Oltmer 2005). One of these few studies is that of Brunner, Jost, and Lueger (1994), who conducted a case study on the reception and integration of asylum seekers and transiting refugees in a small Austrian municipality in the federal state Burgenland. The main focus of this study was on the social dynamics of Austrians when it comes to the reception of refugees – a subject that is similarly of high relevance in the current refugee situation. In their paper, Brunner, Jost, and Lueger provided some initial recommendations which particularly aimed at short-termed integration and acceptance by the receiving society. According to their research results, affected municipalities need for example special consulting and supporting services, which can function as preventative measures against difficulties and apprehensions in the population. Brunner, Jost, and Lueger further suggest a structural inclusion and involvement of the population in the reception of refugees in municipalities as well as an encouragement of contact between the receiving society and refugees, which should support the establishment of a mutual commitment and arrangement system. The project being presented will study whether these recommendations for the immediate help for refugees are still relevant in today's situation. Furthermore, the potential role of the countries of origin of the currently arriving refugees will be analysed in the context of integration processes in the receiving countries.

An active inclusion is an essential part of the social capital of a society (Berger-Schmitt 2000). Even if the immediate help for refugees has a positive impact on the structures of an inclusive society and even if it supports the maintenance of the social peace (Kleist 2015), it is necessary to define the possibilities and boundaries of a society: humanitarian aid is not infinite; by contrast, the risk that people reach their personal or structural limits or that they see themselves confronted with other insuperable challenges should not be disregarded.

3. Research Design for evaluating the immediate help for refugees conducted by voluntaries and public safety and emergency organisations in Austria

Considering the current situation in Syria, Afghanistan, and other countries refugees are fleeing from, a significantly high number of refugees – similar or even higher than in 2015 – is expected in Austria in 2016. It is supposed that this situation can only be managed if volunteers and public safety and emergency organisations cooperate in a good and respectful way. In order to ensure such a cooperation in an effective way, it is advisable to learn from earlier experiences, to take up well functioning strategies, and to define weaknesses. In addition, it needs to be considered that humanitarian support from civil society members is not infinite. There are several questions arising from these tensions targeting different entities.

Concerning the Austrian society at large, answers have to be found to questions such as:

- Is the Austrian civil society willing to provide support and immediate help for refugees, to a similar extent as it did in 2015, in 2016 and the following years?
- Do Austrians perceive support on a national and international level as to be sufficient?
- Which role do media and social media play in the participatory behaviour of the Austrian society?
- Which political measures are inevitable in order to strengthen and support the Austrian civil society as well as employees of public safety and emergency organisations in their work in immediate help for refugees?

- What could happen if such a (mental) overload is not taken into account and taken care of? Which impact could that have on the social peace?

With regard to the individual level, the support of volunteers and professional helpers has to be investigated through questions such as:

- When and under which circumstances are individuals from society stretched to their limits related to immediate help for refugees?
- When and under which circumstances are employees of public safety and emergency organisations stretched to their limits?
- How can one counteract personal and structural overextension on a personal, societal, organisational, and/or political level?
- Which kind of aftercare for helping people can be provided in order to process experiences? Who can provide such an aftercare?

In order to answer the above questions and to develop appropriate strategic and political recommendations for action, it is necessary to apply a variety of methods to cover the different target audiences. Yet, only a systemic combination of all of the results will lead to an overall image of the analysed situation. In order to get an understanding of all of the already existing activities in immediate help for refugees in Austria, a synopsis of all initiatives of governmental and non-governmental organisations as well as of private activities is beneficial. Moreover, such a clear outline of existing activities can enable and support an exchange and networking between all participating actors. In order to be able to learn from the experiences from as many employees of public safety and emergency organisations as possible, this know-how should be collected by a nation-wide quantitative questionnaire. Such a comprehensively distributed questionnaire will support the identification of personal, structural, and organisational challenges as well as areas where optimisation is required when it comes to immediate care operations. Furthermore, it will also help to understand opportunities, challenges, and needs for optimisation in public safety and emergency organisations' cooperations with the civil society. The questionnaire will be conducted online, and it will be distributed by public safety and emergency organisations which are directly involved in the project.

In comparison to people working for public safety and emergency organisations such as the Austrian police, Caritas Austria or the Red Cross Austria, who can be reached through the structure of their organisations, getting in touch with those persons who take over care for refugees on a voluntary basis is more difficult. The project described aims at reaching the group of volunteers either via private initiatives or non-governmental organisations they work for, or by directly addressing them at the sites where immediate help for refugees takes place. For this target audience, focus groups and qualitative interviews are considered to be the method of choice, as they allow an in-depth capturing of volunteers' understandings and experiences, their personal and structural limits, and perceived existing and lacking support from the state. Particularly focus groups enable a thorough exchange of experiences, observed strengths, and weaknesses of the cooperation with public safety and emergency organisations or professional aid workers. As only a small group of involved people can be reached by focus groups and qualitative interviews, it is also possible to combine them with an online questionnaire via social media. It can be assumed that many volunteers can be reached via social media platforms such as Facebook and Twitter as they are often used for coordinating activities in immediate help for refugees. In general, social media should not be underestimated: besides coordination activities, they appear to be important tools for

sharing opinions, information, etc. on refugees and also care for refugees. On these platforms, not only proponents of care for refugees intensively exchange their views, but also opponents. In order to comprehensively depict the situation and perceptions of the current refugee situation and in order to not only present the perspective of the active part of the Austrian society, it is further aimed to analyse postings in social media platforms as well as in online media. Such an analysis should help to receive an encompassing overview of moods and opinions on the current refugee situation, and particularly on care for refugees. Adequate ways to carry out such an analysis are web mining and cluster analysis (Munzert et al. 2015).

As already discussed above, a combination of all results of the aforementioned approaches allows to fully describe the public mood on immediate help for refugees in Austria and enables the development of structural recommendations for actions on a political level. These recommendations should particularly aim at optimising the cooperation between the Austrian civil society and public safety and emergency organisations. Such recommendations could affect for example measures in relation to adequate pre- and aftercare of employees of public safety and emergency organisations as well as volunteers which are active in immediate help for refugees.

Studies such as the project at hand are considered as necessary in order to be able to further provide immediate help in similar situations. Moreover, concrete optimising measures are considered as essential, because in case society considers support from both a national and an international political level as insufficient, it can be assumed that societal engagement and the desire to co-create society will be worn out at some point. When this point in time would occur, which circumstances would lead to it, and which role cooperations between volunteers and public safety and emergency organisations play in this context has not been studied so far. This project will address first conceptions of how to study these questions, based on the assumption that (immediate) care for refugees fosters social cohesion. Moreover, it will address how governments could profit from the results of this research.

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RUMORS DURING CRISES - THE DARK BROTHERS OF SOCIAL MEDIA

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Keywords

Crisis Management, crisis indicators, communication, dissemination, posting, blog, news, rumor detection, rumor defense

Abstract

Accurate, valid, and timely information are some of the cornerstones of successful Crisis Management. Social Media are today the primary means for fast-spreading and easy information dissemination due to their availability and ubiquity. Unfortunately not only valid, accurate, and useful information but also unsupported, fictitious, and malicious rumors and hoaxes find their way into Social Media. Crisis Management is especially vulnerable with respect to these undesirable rumors ('bad news are good news'). We need appropriate defense mechanisms.

1. Motivation

Accurate, valid and timely information are some of the cornerstones of successful Crisis Management. This is the case for information collected by various actors (e.g. First Responders, victims, government agencies) and for information disseminated by officials, NGO's and private sources. Social Media are today the primary means for fast-spreading and easy information dissemination due to their prompt availability and ubiquity. Unfortunately not only valid, accurate and useful information but also unsupported, fictitious, and malicious rumors together with hoaxes find their way into Social Media and are widely disseminated, often disassociated from their source. Because many users do not apply the necessary vigilance, critical evaluation, and common sense they often fall victim to such rumors.

Social Media are a new paradigmatic support for communication in crises [Surowiecki-05, Grifantini-09, Miller-10, Hossfeld-12]. [Haddow-08] states: "*the increasing role played by "first informers" (witnesses who now have the ability to transmit information immediately from the event) ... are redefining the roles of government and [traditional] media. ... Government's historical role as gatekeeper is now an anachronism. Traditional media's role as the sole conduit of reliable and officially sanctioned information has been lost*". [Fraustino-12] adds: "*During disasters, the public may use Social Media to organize emergency relief and ongoing assistance efforts from both near and afar*".

The paper is structured as follows: Chapter 2 lists properties of Social Media which contribute to the ubiquity and (largely) usefulness of Social Media and indicates their special usefulness in Crisis

Management. Chapter 3 discusses the various forms of posts (from evidence-based information to fiction-based rumors) while Chapter 4 analyzes their dissemination. Approaches defending and counteracting to rumors are discussed in Chapter 5

2. Social Media and Posts

Social Media provide a discussion platform on the Internet using relatively short, concise, and quickly conceived "blogs" or "posts". They can be quickly read and reacted to. Their effect on Disaster Management is discussed below (identified by "*CM* $\Rightarrow$ *comment* "). They have to be used in connection with other communication channels.

Ease of Access and Use : The ubiquity of access to Social Media, the ease of use, the largely intuitive operation, the low cost, etc. have made mobile phones a commodity. They are also an ideal tool for providing fast, efficient, and almost instant information dissemination for larger communities, but also and at the same time are able to provide feedback from individual persons to central agencies, both by conscious communication or by hidden submission of data, such as geographic localization information.

CM $\Rightarrow$ Affected persons can report back to a local or central agency via 2-way communication channels .

Wide, even global dissemination : Millions of users regularly consult the web, gain information themselves and also act as secondary distributors of posts. The spread of information on a Social Medium is often likened to the epidemiological spread of infections [Jin-13]. However, the message can also reach the 'lone wolves', individuals outside geographically densely populated areas.

CM $\Rightarrow$ This can help in spreading local information and even helpful advice to everybody, but also enables geographic selectivity [Skrbek-10] .

Communication within large groups : Social Media platforms are on the forefront of fast and easy information dissemination to the masses. They provide active communication channels to places in which many people meet (e.g. like sport event) and/or are affected or in danger (emergencies).

CM $\Rightarrow$ This is important for Crisis Management especially when the classical communication means (television, radio) fail to operate.

Top-down, bottom-up and peer-to-peer communication : Social media can conveniently be used to relay information up and down a hierarchy. Equally the communication on a peer-to-peer level is considerably enhanced [Murayama-13]. While top-down communication (for government agencies to the population) can also be handled well by classical means (radio and television), information flow in the other directions (bottom-up, peer-to-peer) has been very difficult.

CM $\Rightarrow$ First responders, decision makers, and the public can gain insight as to how the situation unfolds and can win timely, actionable information due to the networked information supply. Especially bottom-up and peer-to-peer communication is a large improvement for Disaster Management.

Early crisis indicators : Online social networking often has a breaking-news role for an upcoming crises, e.g. such as epidemics. They often create awareness of pending a crisis by publishing widely dispersed singular events possibly indicating a pattern.

CM $\Rightarrow$ These 'early indicator' can provide valuable extra warning time.

Freedom of word : It is very difficult to censor or suppress opinions expressed in individual posts. Censorship usually comes too late: The small time window between blogging and suppression is usually sufficient in order to achieve wide distribution with many copies of the post.

CM ⇒ It is easy to vent opinions differing from the official positions. However, posts of this kind might also be dangerous by possibly leading to panic and other undesirable reactions of the public.

Psychological first aid : Social Media are able to act as a source of psychological first aid during a crisis by supporting community resilience [Neal-12]. If it is possible to contact somebody (even an unknown person) in face of disaster, this can give a certain amount of assurance [Mercer-11, Howell-11].

Crowdsourcing : Crowdsourcing draws on a large but unknown crowd of the online community instead of specialized individuals in order to solve successful tasks such as validation of information, recognition or identification of fuzzy information (e.g. photos), finding hidden contexts or relationships, etc. [Neubauer-13a, Neubauer-13b, Middleton-14].

CM ⇒ Crisis Management can use Crowdsourcing in order to acquire information about isolated or even cut-off areas so as to create real-time situational maps and act accordingly.

Crowdtasking : Crowdtasking is a new approach for management of volunteers. It only addresses a large qualified, preselected, and registered group of individuals using specially designed user interfaces, a structured communication system, and quality assured inputs.

CM ⇒ Only crisis relevant information is generated and non-specific data is excluded. The availability of individual bidirectional communication allows to steer groups of people in order to cause certain behavior (e.g. relocation, movements, specific work, ...) [Neubauer-13a, Neubauer-13b].

3. Types of Posts

We can distinguish between different types of posts, even if the distinction is often fuzzy (fig. 1):

correct news : These posts report and comment on real facts or real events based on real evidence ("evidence based information"). The facts and events are reported correctly to the best of the originator's knowledge.

incorrect news : These posts unintentionally misrepresent the referenced facts and events, by misunderstandings or misjudging the whole situation, but without malicious intent.

rumor : Wikipedia defines: A rumor is "a tall tale of explanations of events circulating from person to person and pertaining to an object, event, or issue in public concern"

A rumor lacks a real factual foundation: it is a fiction, an invention or a hoax, despite some vague connection to reality. It cannot be quickly or ever confirmed. We speak also of "misinformation" or "disinformation". Rumors dwell on their perceived proximity to evidence including much phantasy or even ill intent. Rumors often deflect from serious or immediate problems, they often block adequate information sharing and cause severe problems in many areas. In a crisis situation believing or not may sometimes even make the difference between life and death.

anticipative post : This is an interesting type of post [Poli-14]: Somebody will express a concern or predictions of future events based on a very thin layer of evidence. History has shown that some persons are able to correctly anticipate future events based on evidence which only they are able to

notice. Animals often show this type of anticipative behavior. Formally it classifies as a rumor, but it should be taken seriously.

4. Spreading of posts in Social Networks

Initially some event, evidence, or opinion (real or imagined) induces the so-called Originator to create and disseminate a post (fig. 1). This post is received by a "Prosumer", i.e. a "Producer/Consumer", who consumes and in turn produces blogs. Fig. 1 shows the dissemination process. When the post arrives at a Prosumer it triggers an evaluation/action process consisting of the following sub-processes:

personal relevance check : The first question is: Has the post any relevance for me? Is it of interest or importance to me? If not, it is to be ignored and/or deleted.

validity check : Does the post seem to be truthful, valid? Can/should I believe it? This might require some effort from the Prosumer with respect to (intensive?) checking, considering all the meta-data (originator, time, ...) and contents (referenced facts/events, form of the post, etc.) [Imran-15]. Obviously this includes both guesswork and experience. Finally the decision falls between *believe, distrust, dissent, correct, contradict*.

reaction : The resulting reaction can be

- **ignore/delete** the post (if possible)
- **store/keep** the post without further action
- **re-disseminate** the post with the following basic options:
 - unchanged (1:1),
 - modified, augmented, reduced, changed, added-to
 - corrected, contradicted.

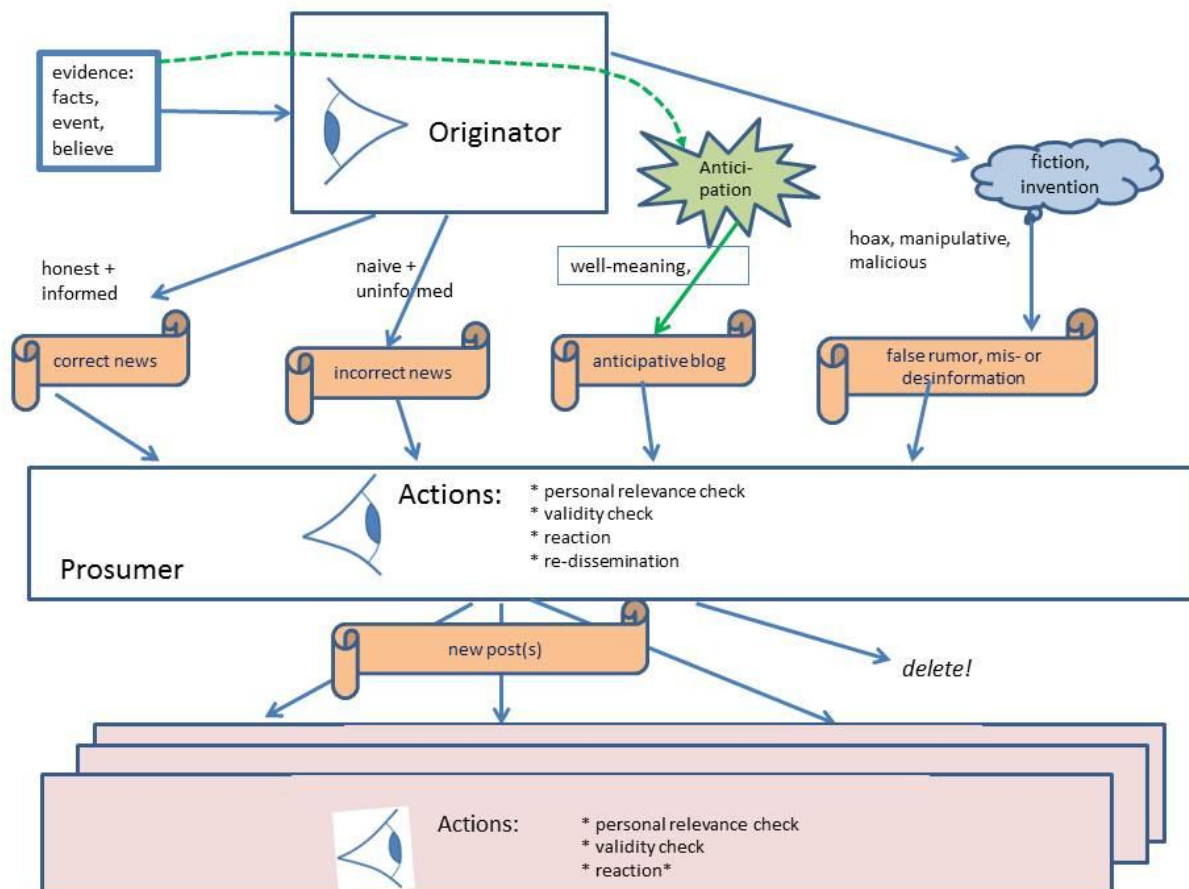


Figure 1: The flow of posts in Social Media

5. Defending against Rumors

The advantages of Social Media have their price: the practically unrestricted and uncontrolled posting in available Social Media networks. They therefore contain an indistinguishable mix of facts, confirmed news, erroneous statements, unfounded rumors, hoaxes, and anticipative posts.

The defense against rumors relies on two tasks:

- Detection of rumors and
- disabling/elimination of rumors.

At present no reasonable strategies for either of these tasks seem to exist. Several reasons account for this:

- No 'entry-control' or true 'personal identity check' for submitting a post. Originators often hide behind a pseudonym.
- No global international law or sanctions against misuse.
- The more malicious a post is, the more will it try to convey trustworthiness.
- In the course of multiple dissemination steps (Fig. 1) news and rumors are distorted and get obscured [Nadamoto-13] ("Chinese telephone").

5.1. Detection of Rumors

Some of the defense mechanisms for detection of rumors are:

Common Sense and Mistrust : Naturally the first defense line against ill-intended rumors is a good portion of common sense and mistrust. Who is the author of the post? To which event/fact is the post related? What does it say? What is the language? Is it credible? etc. Asking above questions enables many rumors to be detected.

Trust building : Trust plays an important role in communications. It is a basis of cooperation between people who have possibly never met before, a situation which is common in Disaster Management [Busa-15]. Does the blog come from a trusted source?

syntactic/semantic analysis It seems that rumors themselves, especially when they have been disseminated several times, acquire certain syntactic or semantic changes which make them different from other post. Typically rumors seem to contain more questions and contain certain skeptical phrases, etc. [Ma-15].

Whitelists, black lists : Based on past experience certain Prosumers can be excluded from the communication or their posts blocked ('blacklisted'). Whitelists assure the acceptance of posts. The problem of fraudulent personalities, however, remains.

Watching corrections/rejections of posts : An interesting approach is to analyze the response/reaction of other posts, especially if they contain correction, contradiction or skepticism. This can be used as an indication of incorrect news or rumors. Some automation is possible by recognizing phrases which express skepticism, opposition etc. [Mendoza-10, Nadamoto-13, Hamidian-15].

Study of the belief-time Statistically posts of questionable validity seem to spread more slowly. This would allow 'anti-rumor-posts' to be started which hopefully at some point in time could dominate the original incorrect rumor [Tripathy-10].

5.2. Invalidating, eliminating Rumors

From the study of literature no realistic solution in academia or industry seems to exist. A few suggestions can be found on how to mark or eliminate rumors and their derivatives. Marking one rumor does not help much due to the multitude of copies having been made and distributed (fig. 1). Some ideas target marking dubious posts, adding a warning (like the spam-warning in e-mail systems [Jin-13], or sending of another post which contradicts the first one.

6. Summary

The use of Social Media has found its fixed place in Crisis Management. Social Media allow the acquisition of accurate, valid and timely information. The drawback is that besides valid and vital important information, Social Media are also swamped with irrelevant, incorrect as far as malicious posts and rumors. Detection is very difficult, elimination practically impossible,

In this paper we have listed the advantages of Social Media in Crisis Management, discussed the various types of posts found in Social Media, including so-called anticipative rumors, drawn a line between valid news and undesired rumors, and shown some defense mechanisms. There is at least hope that rumors can be detected and local defenses built. We hope that this paper may trigger more ideas and approaches to this crucial problem.

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CRITICAL INFRASTRUCTURE PROTECTION: SYSTEMS AND INFORMATION FRAMEWORK OF THE CZECH REPUBLIC

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Critical infrastructure, toxic substance, public administration, systems approach, information and communication systems

Abstract

The issue of protection of critical infrastructure is closely tied to abuse of toxic substances to disrupt or eliminate critical infrastructure elements of a state. The aim of the paper is to present the authors' view on the fundamental connection between the functionality of critical infrastructure, highly toxic substances, and public administration activities in the region of the Czech Republic. Systems approach has been applied to study relevant phenomena and processes holistically in their internal and external relationships, and to discover new and original contributions to the studied field. There is some evidence of the need for a cross-cutting role of ICT in protection of critical infrastructure.

1. Introduction

The security environment is an external environment affecting national security policy. It can be seen as an area or set of conditions within which state interests are both implemented and collide with the interests of other stakeholders in the system of international and national relations.

Processes with a significant impact on the level of national security are enacted in this area. Developments in this environment can be influenced by the reference object (state) only on a limited basis, depending on its potential (Juříček & Rožňák, 2014). The security environment has been characterized by a higher level of unknown processes and fewer possibilities of control. The security environment is therefore largely an environment of uncertainty. Security threats and their sources and bearers have both a state and, increasingly, non-governmental and transnational character – and thus an asymmetric nature (Horák et al, 2015).

Based on an analysis of the security environment of the Czech Republic, it is possible to identify specific threats to its security. Notwithstanding the paper mentions the non-intentional threats, it is mainly focused on deliberate attacks. The Security Strategy of the Czech Republic (2015) includes among the later, inter alia, also *cyber attacks* (CA), and *threats to the operation of critical infrastructure* (TCI); this article primarily deals with this type of threats.

The aim of the article is to present the authors' view on the fundamental connection between the functionality of critical infrastructure, highly toxic substances, and public administration activities. The exploration is based on partial content analysis and synthesis, as well as on induction and deduction applied on earlier findings. As the systems approach has been applied to discover new and original contributions to the studied field – as mentioned by various authors (Exnarová, Dalihod & Mildeová, 2011) – the authors, in the addition to the methods mentioned above, have used the system approach to study relevant phenomena and processes holistically in their internal and external relationships. As Kný stated (2015), the path to optimization of a real security situation leads only through the holistic solution, and the systems approach and systems thinking should not be absent in security objects.

The scope of this research is limited to the region of the Czech Republic; however, the applied systems approach leads us to at least mention the need to respect the international context of security, to draw on international good practices, and to highlight further cascading effects and cross border effects and transfers of toxic materials

Information and knowledge are key phenomena in today's society, rightfully called information/knowledge society. It is therefore clear that the current stage of the security environment development must be closely linked with informatics and set new tasks for its development. Information and communication technology (ICT) capital not only immediately affects economic growth, as demonstrated in (Hančlová et al, 2015), but also represents security threats to the security environment. As demonstrated by Mildeová, Dalihod & Král (2013), holistic systems thinking has been insufficiently applied in informatics. Changes in security conditions, according to Veber and Smutný (2015), should be also reflected in practices currently used by investigators (criminal police) and analysts (forensic laboratory). In this context, it is necessary to see the research presented in this paper.

2. State's critical infrastructure

The state's critical infrastructure (CI) is a key system of elements as defined by the Government Decree no. 432/2010 Coll., and its amendment no. 315/2014 Coll., the disruption or malfunction of which would have a serious impact on national security, securing of the basic living needs of the population or economy of the state. Given the high degree of interconnectedness of each sector, critical infrastructure is at risk comprehensively as a result of natural, technological and asymmetric threats. In other words, the state in case of collapse of critical infrastructure would not be able to fulfill its basic external or internal functions.

According to the EC Directive 114/2008 and the relevant Czech legislation, the functional areas of state activities that require the functionality of critical infrastructure are:

1. Energy
2. Water management
3. Food and Agriculture
4. Health
5. Transport
6. Communication and Information Systems
7. Financial market and currency
8. Emergency services
9. Public administration

Each element of the critical infrastructure can be considered as a system, defined by organizational, technical, and personnel parameters. If a serious harm or even elimination of a critical infrastructure element or system should happen, then the attack must be directed to the sensitive areas of the system, or on the entire system itself. The focus can be thus put on information systems failure, technological equipment failure with fatal consequences (nuclear power station), or even on elimination or incapacitating of relevant personnel (the population). This issue is closely associated with the environment, agriculture and – in terms of our research – the information and knowledge support (Tyrychtr, Vostrovská & Pelikán, 2015).

Thus, as sensitive areas of critical infrastructure, the parts of the system whose elimination would have fatal consequences, can be considered. The question is, how and by which means these sensitive places can be eliminated. As we investigate the relationship of highly toxic substances – critical infrastructure – public administration, therefore it is necessary to start from the relevant system and technological context.

2.1. Highly toxic substances and critical infrastructure

Highly toxic substances can be divided, according to their designation, into combat toxic substances and toxic industrial substances. Both types can cause death, or block an activity of people. They are not primarily intended for inflicting losses on technology, material and equipment.

Combat toxic substances (CTS) are chemical compounds or mixtures which may be used in field conditions. In accordance with Matoušek and Linhart (2005), these are formed by warhead filled with fighting toxic substances and means of transport of this warhead to its target. High toxicity is a fundamental prerequisite that the compound could be warfare agents. Of the many thousands of toxic chemical substances, only a few dozen compounds of combat toxic substances are included in the arsenal.

Toxic effect of *toxic industrial compounds* (TIC) is a result of the interaction of living matter with the substances (for more see Matoušek & Linhart, 2005; Bartlová, 2005; Šenovský et al., 2007). The action of the substance on the organism, and the organism interactions on the fabric are complex processes that depend on many factors. The overall effect of TIC, as well as of CTS, is defined by: 1) the type of TIC, 2) exposure, 3) dose, 4) state of the organism, 5) the effects of other substances in the place of use 6) way of entering into the organism (inhalation, oral, percutaneous).

The given characteristics of warfare agents and toxic industrial toxic substances potentially predispose them to attack critical infrastructure of the state. However, their different properties (physical, chemical, toxicological) limit their effective use for the exclusion of critical infrastructure elements. No matter how possible and effective it might be, it requires sophisticated preparation and a specific way of application (attack). On the other hand, chemical preparation of CTS has been mastered at the technological level, and is well known, although the final product quality may not be high (clean enough); TICs are commercially available and common (Balog, 2007). Thus, just from this context, it is evident that the protection of critical infrastructure of the state against the highly toxic substances is a current issue; the "plan of crisis readiness of the operators of critical infrastructure" should always include an adequate protection option in the event of an attack by highly toxic substances. It is evident that to solve the problem on the whole territory of the state is essentially impossible. In the following chapter, managerial approaches to potential subjects of assault by highly toxic substances are defined.

2.2. Analysis of potential targets in the critical infrastructure suitable for assault

It is evident that any attack on CI would result in significant damage. This damage can be expressed in various ways – for more see (Šauer et al, 1998), or (Pavel, Slavíková & Jílková, 2009).

Critical infrastructure elements, as defined by Government Decree no. 432 / 2010 Coll., as amended by Government Decree no. 315/2014 Coll., may be out of service due to technological accidents, failure of operators, or deliberate destructive actions; in other words, the primary cause of their elimination may be either internal, or external.

If we proceed from the premise that operators of critical infrastructure elements are well selected and professionally prepared, and that they have no motive (political, economic, social, religious, etc.) to attack critical infrastructure, then potential attacks can be expected from the external environment of the state. The threat of attack will increase with fundamental changes in the security environment of the state. Attacks may be by their nature: a) physical (use of explosives, an attack using aircraft or drones, etc. on components or systems of critical infrastructure) b) cyber (attack on control systems and information systems of critical infrastructure elements), c) on public health (extension of highly infectious diseases), d) on nutritional base (epiphytia, zoofytia). In the next part of this paper, an analysis of potential targets for attacks on critical infrastructure in general will be introduced, followed by the selection of targets for attack with the use of highly toxic substances.

Selecting targets of attacks on the critical infrastructure requires: 1) selection of appropriate targets; 2) selection of appropriate implementation to achieve a lethal or non-lethal effect, designated before the attack, 3) evaluation of the attack (its effects). When selecting targets, emphasis will be placed on identifying objects (CI elements), whose loss is unacceptable for the state, or which provide standard benefits (fuel supply, etc.). To identify relevant objects, emphasis needs to be put on those parts of critical infrastructure, which are crucial for the desired effect. Not only the effect of destruction itself, but also psychological, societal, and other non-lethal effects are important in this context (see Table 1). Data in Table 1 are copyright solution to the problem in terms of the comprehensive approach of the Czech Republic to CI protection, based on the Act on Crisis Management no. 240/2000 Coll., as amended.

3. The role of public administration in case of critical infrastructure assault

Public administration generally relates to the notion of governance (Hadrabová, 2008). Public administration requires as its key precondition to maintain an environment in which social goals

can be effectively achieved. This is done by control/management processes implementation. If we are to tackle the emergency or crisis situations, we talk about crisis management of public administration. Crisis management is thus understood as a set of management activities of the competent authorities, aimed at analyzing and assessing security risks, planning, organizing, implementing, and controlling the activities carried out in connection with the emergency or crisis situations. Crisis management has become a standard part of the managerial environment. Usually requires specialists ready to fulfill specific tasks – emergency managers.

Area of CI	Target (local / global)	Suitability for toxic substances attack	Prevailing effects (lethal / non-lethal)	Major sensitive areas
Power industry	local	low	lethal	control centers
Water industry	local / global	low / medium	lethal / non-lethal	contamination of reservoirs, treatment plants, distribution
Agriculture & Food industry	local	low / medium	lethal	contamination of originating products, shopping malls
Health care	local	low	lethal / non-lethal	large health centers
Transport	local	medium	lethal / non-lethal	rail and air control stations, subway, etc.
Communication & information systems	local	medium	lethal	central offices of operators
Financial markets & currency	local	low	lethal	banks, stock exchange institutions, etc.
Emergency services	local	low	lethal	central offices of operators of integrated emergency system
Public administration	local	medium	lethal / non-lethal	central authorities

Table 1: An indicative evaluation of highly toxic chemicals misuse to attack CI (authors)

Crisis management in terms of its functions is indistinguishable from general management. However, the difference can be seen in the content, which is in the case of crisis management fundamentally shaped by a different external and internal environment. The difference can be seen in the areas of objectives, tasks, procedures, powers, and resources to cope with emergencies or crisis situations in particular administrative districts, secured by public administration. Public administration exercised in the case of above mentioned situations by public administration institutions is bound by strict legislative measures (Antušák, 2009).

Public administration includes bodies that are designed to deal with emergency or crisis situations. These authorities (of crisis management) provide analysis and evaluation of possible threats, as well as planning, organizing, implementing, and controlling of the activities undertaken in connection with preparatory measures, resolving crisis situations, or critical infrastructure protection.

The Act on Crisis Management no. 240/2000 Coll., in Part II defines the following bodies of crisis management: Government, Ministries and other central authorities, Czech National Bank, Regional authorities and other authorities with jurisdiction in the region, Municipal authorities with extended powers and Municipal authorities.

It is apparent that the system of public administration in the Czech Republic is ready to cope with this kind of challenges; its abilities have been tested in real crisis situations, and it is able to deal with crisis situations in individual administrative districts. The question remains to what extent, and at what quality it is able to solve the aforementioned problems of the protection of critical infrastructure – it is a certain novelty.

From previously indicated findings related to critical infrastructure protection, with stress on ICT role in this process, and seen from the perspective of public administration, the following conclusions can be derived:

- Pay special attention to connectivity and information retrieval
- Inform superiors, subordinates, neighbors, and the public.

4. Discussion

In Czech companies, *cyber attacks* are often discussed in connection with organizational environment and "Enterprise Architecture" (Helfert, Doucek & Maryška, 2013). In the area of public administration activities, measures against the misuse of data and information – usually seen as setting appropriate technological conditions for information public administration systems – have been defined (Lidinský, 2008). However, the concept of security as understood by the authors of this paper has not been the subject of publishing interest yet.

Unfavorable shift in security due to terrorist attacks, and the crucial role of science in these events forces us to see a lot more risks in comparison to benefits, than just few years ago (Pavlíček et al, 2011). In our above-mentioned research, we identified *cyber attacks* as one specific threat to the security environment of the Czech Republic. We defined *communication and information systems* as one of the functional areas of state activities that require the functionality of critical infrastructure. In Table 1, *communication and information systems* are analyzed as one of the targets of highly toxic chemicals' misuse intended to attack critical infrastructure. Necessity to pay *special attention to connectivity and information retrieval and inform superiors, subordinates, neighbors, and the public* by public administration was emphasized.

When applying the systems approach it is necessary to leave the perspective "one threat, one area, one target, one top", etc. It means to take into account not only incredibly fast development of informatics science in terms of its relationship with the examined area of security as well as with Business Intelligence, Decision Support Systems and Geographic Information Systems (Klimešová & Brožová, 2009). But above all, we must see that informatics works with information and knowledge tools across various areas, affecting all other ones. If, as we have shown in Table 1, attacks on information and communication systems are located only in the central offices of operators, the effect of such an attack – paralysis of information and knowledge support or emergency disposal systems – will impact the entire system of protection. It is likely that the level of advancement of ICT would, in the case of such an attack, contribute to its negative effects (Mildeová & Brixí, 2011), including the effects of synergy (Hajduová et al, 2015). The Table 1 and further comments could thus be the basis for further investigation, a comprehensive approach to protection, and development of scientific hypotheses.

5. Conclusion

The importance of critical infrastructure protection within the scope of public administration results from the turbulent security environment, and conflict transformation into hybrid or asymmetric forms of armed conflicts conduct, for example terrorist attacks. The authors have presented their professional reflection on three issues: highly toxic substances, critical infrastructure, and public administration, and their interrelationships. The authors demonstrate the seriousness and complexity of the issue, not only in the case of highly toxic chemicals' use to attack critical infrastructure elements but also at other levels. Primarily, this article deals with the protection of critical infrastructure against highly toxic substances as a model case. Here the authors justify the need of a systems approach for holistic view of system protection.

The conclusion as to the importance of data, information and knowledge can be clearly specified: Information and communication systems have a key cross-cutting role in the protection of critical infrastructure. As the probability of mediated impact in all other areas of the threats is significant, they must therefore be given special attention. Protection of critical infrastructure is a serious security problem, which requires the taking into account of unpredicted black swan scenarios. To be effective, it is necessary to consider all kinds of potential critical infrastructure attacks, and to look for adequate protective measures. Inspiration to solve problems of critical infrastructure protection in the Czech Republic might be found in the countries in which – under the pressure resulting from direct attacks – this protection has been implemented (Israel), or where these attacks can be expected to be probable (France, Great Britain, Germany, etc.).

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VALIDATION OF THE MANAGEMENT OF PAST CRISIS AND DISASTERS

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Interoperability, inventory, key indicator, requirements, crisis and disaster management, affected infrastructures

Abstract

Interoperability of stakeholders is a predominant requirement of crisis and disaster management. Within the EU-project EPISECC a concept of a common information space is under development in order to facilitate European crisis and disaster management. A pre-requirement to set up such an information space is the in depth analysis of the management of past disasters with focus on interoperability. For this purpose an inventory on the management of selected past disasters was developed. The information for the inventory was achieved by systematic expert interviews using specifically developed online questionnaires. Multiple crisis and disaster managers that are active nationally, internationally or on both levels were interviewed in order to obtain the necessary information. Selected results obtained by this inventory are described in the frame of this paper.

1. Introduction

Adequate information exchange between different actors involved in crisis and disaster management is an imperative requirement necessary for efficient and adequate execution of processes of stakeholders such as first responders in all phases of the crisis management cycle. In the past it turned out that mainly, but not only, cross border information exchange was hampered during the management of past, large scale European disasters. In order to improve the situation a multitude of European projects were launched dealing with approaches dedicated to optimize interoperability. Examples of such European projects are REDIRNET (Redirnet, 2016), SECTOR (Sector, 2016) and SECINCORE (Secincore, 2016), an example of a national project is the Austrian project INKA (Inka, 2016; Lichtenegger, 2015). A pre-requirement of most of these projects is to analyze the strength and weaknesses of process execution that took place in past disasters. In the frame of the project EPISECC (FP7-SECURITY, grant no. 607078) a specific data model was set up in order to develop an inventory on how past disasters were managed. This data model and the inventory were already described in detail in (Neubauer, et al., 2015), this paper included the results of more than 40 interviews performed with European crisis managers by applying the inventory.

2. Methodology

2.1. The data model and the applied tool

EPISECC is aiming at improving the collaboration and the interoperability among first responder organisations, police authorities and other stakeholders in large scale disaster situations. The key element, a concept for a common information space, is developed and validated within the project. Therefore, a pan-European inventory of past critical events/disasters and their consequences focusing on the performance of processes, the data exchange and the organizational boundaries was developed. A detailed description of the following, shortly summarizing chapter can be found in (Neubauer, et al., 2015). The inventory was filled with relevant information in four essential steps: First the data model was developed, which is the starting point for analyzing the management of past critical disasters. It consists of relevant areas of information, such as tools, processes or data (Huebner, et al., 2015). Within these areas, specific fields of information are defined (e.g. process

type, process name in case of the area of information “process”) which include all information provided by stakeholders. In order to ensure that the inventory is filled with useful knowledge, stakeholders such as the Austrian Red Cross or the German Federal Agency for Technical Relief (THW) were incorporated to provide questions on missing and relevant information related to disaster management with focus on interoperability, understood as the ability to exchange information between different systems (Delprato, O'Brien, Nuessler, & Bousema, 2014) and efficiency. Since answers to such generic questions would be mainly descriptive and are not directly suited to be quantified and compared with available information, a step by step process described in (Neubauer, et al., 2015) was developed to convert a generic question into “subquestions” which are answerable using only predefined fields of information. This led to the development of an online questionnaire and to final interviews of crisis managers with focus on, but not limited to the strategic level in order to identify and analyze relevant information on the management of past disasters.

2.2. Data provision - selection of interviewees

At the current stage 49 representatives from organizations involved in crisis and disaster management provided information for the inventory. A majority of 78 % of these organizations declared themselves to be governmental, 14 % were NGOs and the others were distributed over other categories. Many partners of the FP7 project EPISECC were involved in the provision of data for the inventory leading to a good distribution of organizations that were interviewed all over Europe. In total, organizations came from 19 out of 28 member states, in addition organizations from Norway, Iceland and Israel were interviewed. On the other hand, it has to be stated that the distribution over the European countries is far from being equal. For instance, 17 interviews were performed in Austria, 5 in Italy and 5 in Croatia. This distribution has impact on the general representativeness of the inventory data in a pan-European context. Another approach to analyze the type of organizations being interviewed is demonstrating that 33 % of the organisations providing information are acting predominantly in the civil protection / crisis management domain, the second largest category is fire rescue services (19 %). Emergency Medical Services reach 13 %, whereas the category Police obtains 11 %, the remaining 24 % belong to other type of organisations.

The project partners approached more than 100 persons from different European organizations and convinced about 50 % of them to perform interviews. Sending the questionnaire link to stakeholders turned out not to be a successful approach due to the complexity of the questionnaire, it is more promising to perform the interviews face to face or via web meeting. However, several stakeholders added data to their existing electronic questionnaires alone, after having been introduced to the questionnaire during the initial session.

3. Results

The results of the inventory belonging to different main categories, i.e. organisation and disaster can be combined and analysed in a multitude of ways. In the next sections selected results of the analysis are presented. We do not intend to show all possible evaluations arising from the data obtained so far, but to give some selected examples demonstrating the possibilities of the inventory.

3.1. The quality of information exchange

One of the major targets of the inventory was to find an adequate measure in order to quantify the quality of interoperability. An indicator for interoperability was therefore developed (see also Neubauer, et al., 2015). This indicator is described as

$$KI_{Int} = [0,5 \cdot (1 - T_{suc}) + 0,5 \cdot (1 - T_c)] \cdot \left[\frac{D_{Tr-is}}{D_{Tr-id}} \cdot \frac{D_{Us-is}}{D_{Us-id}} \right] \quad (1)$$

where

KI_{Int}	Key Indicator for Interoperability (Value between 0 and 1, 0 = Worst Case, 1 = Best Case) (Moderate Impact of time dimension)
T_{suc}	Normalised Time for setting up an information exchange channel, e.g. a frequency channel for communication (Value 0 ideal case = no time for setting up channel, value 1 worst case = worst case time to set up channel, depending on expectation of stakeholder)
T_c	Normalised Time for exchanging or provision of information (Value 0 ideal case = no time needed for the process of information exchange (ideal, not possible, the shorter, the better), value 1 worst case = worst case time for exchanging information, depending on expectation of stakeholder)
D_{Tr-is}	Data transmitted real status (is); (Value 100 best case = all required data transmitted, value 0 worst case = worst case, no required data transmitted)
D_{Tr-id}	Data transmitted ideal (id); always 100 (100%), all expected data transmitted
D_{Us-is}	Data understood real status (is); (Value 100 best case = all data transmitted understood, value 0 worst case = worst case, no required data understood; understood means understanding the meaning)
D_{Us-id}	Data understood ideal (id); always 100 (100%), all expected data understood

The formula quantifies the process of information exchange and consists of four variables, which measure the efficiency of setting up an information exchange channel, the efficiency of exchanging or provision of information, the amount of data transmitted and finally the amount of data understood. In total 169 information exchange processes were analyzed, whereby values from 0,392 up to 1 (0 is the worst case, 1 the best case) were reached. This indicates that information exchange was limited in the worst 10 cases (see Figure 3-1), but was judged to be at least good in all other cases. In Figure four adequate classes were formed to get a better overview of the distribution of the indicators' values. Obviously there is a high number of good interoperability indicators ($KI_{Int} = 1$). Based on the experience gained while performing interviews it can be stated that this value was often chosen for processes where face-to-face communication was the dominating form of interaction. As long as actors spoke the same language, very often best grading was given for these types of processes. However, in some cases it could have happened that the meaning of the terms of the key indicator were not communicated adequately and/or not correctly understood by interviewees. One has to be cautious when looking at key indicators reaching optimum grading.

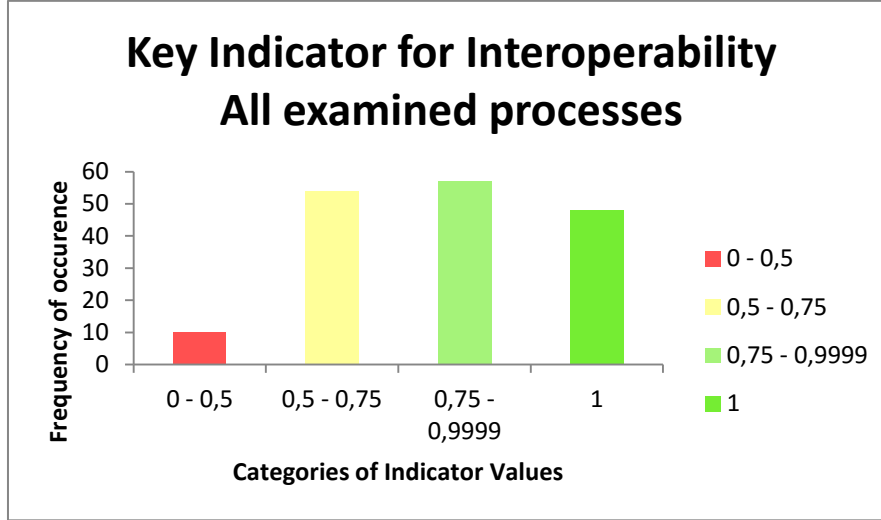


Figure 1: Variability of Interoperability Indicators for all examined sub-processes

The weighting of the above named four factors has not been considered yet. While in (1) the variables D_{Tr-is} and D_{Us-is} influence the interoperability indicator in each case by one third, the variables T_{suc} and T_c influence it just by one sixth due to the addition performed in (1). Another approach to calculate an interoperability indicator would be the following:

$$KI_{Int-2} = [(1 - T_{suc}) \cdot (1 - T_c)] \cdot \left[\frac{D_{Tr-is}}{D_{Tr-id}} \cdot \frac{D_{Us-is}}{D_{Us-id}} \right] \quad (2)$$

where

KI_{Int-2} **Key Indicator for Interoperability-version 2** (Value between 0 and 1, 0 = Worst Case, 1 = Best Case)

(Higher Impact of time dimension)

Here the addition in the first term was replaced by a multiplication, which causes an impact of each factor of one quarter, each. This leads to worse interoperability indicator values compared to formula (1), since $a \cdot b \leq \frac{a+b}{2}$ for $(a, b) \in [0,1]$. The average Interoperability Indicator value decreases from the original version $\overline{KI_{Int}} = 0.79$ to the modified version $\overline{KI_{Int-2}} = 0.74$. For instance, the number of cases below 0.5 increases from 10 to 34.

3.2. Requirements from stakeholders

In order to analyse the narrative description of requirements to improve disaster management and problems faced in disasters, the nine categories shown below were introduced: detection (D), human & physiological aspects (HUP), interoperability (INT), other aspects (O), prediction (Pr), resources (R), training & education (Tr), technical solutions (TS) and standardisation (Sta, including Standard Operating Procedures).

Each requirement given in the input field of the questionnaire was assigned to one of the above given categories. It has to be pointed out that in the majority of cases more than one requirement was provided. In total 79 requirements were collected. Figure gives an overview on the number of requirements sorted according to categories.

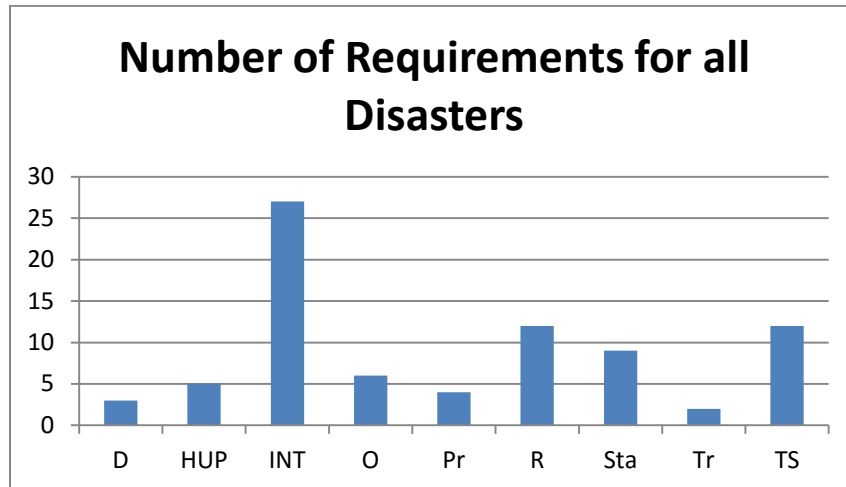


Figure 2: Number of requirements according to categories in all examined disasters

This result can be seen as contradiction to the rather good interoperability indicators shown in Figure 1. Although final conclusions cannot be made at this stage, it has to be taking into account that the interoperability indicator is focusing on very specific sub-processes in crisis management, whereas requirements and problems specified by stakeholders are often related to higher, more generic process levels.

3.3. Affected Infrastructures

The field of information “Affected Infrastructures” appears in the online questionnaire as a multiple choice field (this is independent from the requirements discussed in chapter 3.2). From a total of 45 entries to different disasters, the field “Affected Infrastructures” was selected 37 times. The selectable infrastructures are Transportation, Communication, Energy, Health and Other; in case Other is selected, the type has to be specified in a free text field. The most frequent entries in the free text field were: Water Supply (35%) and Buildings (44%). As one can see in Figure 3, the infrastructure Transportation is the most frequent affected with a probability of being affected of over 90% and Health is the least affected infrastructure having a probability of 35%.

If the disasters are split up in different categories (Complex, Hydrological, Geological, Climatological and Technological), a dominance of Transport as affected infrastructure for all categories can be seen. All infrastructures specified above have been especially heavily affected by Geological disasters. While in general an infrastructure is affected to 58%, for geological disaster this number increases to 96%. In 80% of cases all infrastructure categories were affected. Additionally it must be noted that the distribution of the affected infrastructures for Hydrological disasters is very similar to the distribution of all examined disasters.

3.4. Other results

Since the analysis of the inventory is far from being completed, only a few additional remarkable results are going to be discussed. A possible field of interest is for example “Duration of the response phase”, which is calculated by the difference between the two fields of information

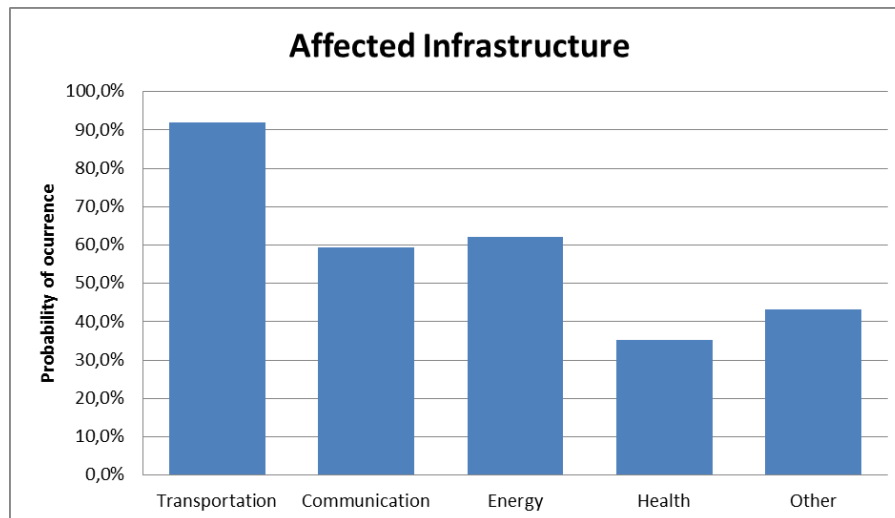


Figure 3: Type of Infrastructures affected in all examined disasters

“Response phase end date” and “Response phase start”. An analysis of all examined disasters shows an average duration of the response phase of 15.7 days, with a minimum of less than one day and a maximum of 82 days. Furthermore it can be said that natural disasters (hydrological, geological, and climatological) require a remarkable longer response phase which averages 20.7 days, than technological and non-specific disasters with an average response phase duration of 2.7 days. It has to be mentioned that not all interviewees provided information on the duration of the respective disasters.

The field “Degree of Interaction” describes the degree of interaction between - in a certain process - associated organizations with possible values between 0 (no interaction) and 10 (very intensive interaction). The collaboration between the organisations was mostly very intensive, in 79% of all cases a degree of interaction value of 8, 9 or 10 was chosen. A correlation between the interoperability indicator and the degree of interaction can be excluded, since the correlation coefficient is -0.03.

An analysis of the communication media used during cooperation with another organisation showed a high usage of the public services GSM (which was chosen in 98% of cases), MAIL (84%) and Public IP (75%), contrary to the dedicated services, where TETRA was the most used service with a usage in 18% of the cases.

4. Discussions and conclusions

The results obtained using the questionnaire developed within EPISECC can be used to draw some preliminary conclusions on the management of past European disasters. For instance, requirements and problems of stakeholders that arose predominantly in the response phase of disasters show that in the majority of examined events, requirements were mainly related to interoperability. This supports the raised claims on improved information exchange both on cross border as well as national level. In addition, the analysis of these requirements provides detailed insight in problems faced while managing different types of disasters such as flooding or forest fires. Concerning the topic of interoperability, a lack of an operational picture was expressed several times in case of hydrological events. In some contrast to all other type of disasters, improvements related to detection are expressed in case of geological events. The results of the inventory demonstrate clearly (details not shown here) the large diversity of tools as well as standards & procedures used

by European crisis managers. This lack of standardization is again in line with the interoperability related constraints described above. The rather high values of the interoperability indicators achieved in more than 160 communication processes do not seem to support this trend. However, one has to take into account that interviewees were free to select very specific communication sub processes that occurred in past disasters that may not show challenges that arose during other information exchange processes taking place during the same disaster. For instance, only very limited insight could be gained on cross border information exchange. In such situations the probability of language, procedural as well as cultural barriers is much higher compared to intra national communication.

In conclusion, the analysis of the 47 interviews provides a fairly good insight into the challenges European crisis management is facing. Although the interviewees represent organisations from 19 out of 28 member states of the European Union the number of interviews is yet not enough to claim EU wide validity for the conclusions drawn so far. The methodology applied to develop the inventory turned out to be a very suitable approach, having the potential to be used on European level in case the inventory would be used by several European countries to document the level of cooperation. Currently, the project team is applying the inventory to analyse the quality of interoperability with specific focus on the refugee and migration crisis currently challenging Europe.

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SESSION D: SOCIAL MEDIA FOR INFORMATION MANAGEMENT

FACEBOOK - PRIVACY SETTINGS AND PERSONAL INFORMATION DISCLOSURE

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Keywords

Social media, information sharing, Facebook, fictional profile, privacy, personal information, social networking sites

Abstract

The paper describes a social media experiment on correlation between Facebook profile privacy settings and willingness to share (disclose) personal information. A fictional Facebook profile was used to send friend requests and the reaction in relation to Facebook privacy settings was observed. For data evaluation Neural Network algorithm and Decision Tree were used. The essence of this work was to analyze 400 users divided into 4 groups (the first group had on Facebook real photo and real name, the second group had real photo but fake name, the third group had fake profile photo, but real name, and the last group had both examined factors false). The results indicate that people, who are willing to share more private information, such as real profile picture, education or phone number, are in fact also more open to new contacts. However, in relation to the profile name those users that have a fake name are more open to accept the friend request. Still, by and large all users are more likely to care about their privacy settings, as they make no or only a few private information visible.

1. Introduction

A social network in the context of new media is an open and highly dynamic infrastructure “that connects computers to each other and to a range of external devices, and thereby enables users to communicate and exchange information” (Gane & Beer, 2008, p. 16). As such these networks represent social structures that are able to integrate ever-more nodes (i.e. users) and thereby expand almost limitless (Castells, 2009, pp. 501–20). Social networks can also be defined as a body of applications that increase and support group interaction and shared spaces for collaboration, social connections, and aggregate information exchanges in a web-based environment. (Kiráľová, & Pavlíček, 2015, Sediva, Mullerova, 2014).

According to official Facebook (2016) statistics 1.490 million users worldwide logged in to Facebook in August 2015. To put this into perspective, the social network Twitter had 316 million and LinkedIn had 96 million active users.

Altogether, the given examples indicate to which extend social networks have become part of people’s live, allowing them to have a variety of narrowly defined relationships with steadily

changing sets of network members (Gane & Beer, 2008, p. 25). In fact, social networks not only integrate people within nations, but also accelerate integration among the nations of the world. Information and communication technologies (ICT) have interconnected the world and increased the productivity and keep driving the economies (Pavlicek, Sigmund, Oskrdal, & Hubacek, 2011). In line with this, social networks are directly linked to and accelerate the process of globalization. Today social network services are available in almost every region of the world. And, as people connect, communication platforms change the way governments, organizations and people behave, giving them opportunities to share and discuss their interests, preferences and opinions in ways that were unimaginable just a decade ago (Luthans & Doh, 2014, pp. 2–3).

Nevertheless, in order to scientifically investigate social networks one should have a certain awareness of the different areas to consider. First of all, social networks are not a mere online phenomenon. The full picture consists of social networks online and offline, including their interactions as well as further influencing factors, such as the issue of privacy or copyright protection (Wellman & Haythornthwaite, 2008, p. 35). Aside from that, it is on the one hand the users themselves that are of interest, but on the other hand also the quality and type of the social relations between them – for example friendship, family ties, co-working or mere information exchange. This also suggests considering how technology makes these social connections possible and thereby shapes social relations (Gane & Beer, 2008, p. 27). Finally, two relevant question related to this are, how do users in turn collectively shape the social network structures, and for what reasons are such online connections made possible?

1.1. Privacy

In his book “Free Culture” Lawrence Lessig (2005) points out how the Internet has changed the people’s privacy (along with copyright issues). While before the Internet the privacy of ones ‘browsing habits’ in – let’s say – a bookstore was largely assured, it is no longer true when one browses online today. Privacy in general was assured due to “an inefficient architecture for gathering data and hence a market constraint (cost) on anyone who wanted to gather data” (Lessig, 2005, p. 278). Simply put, spying used to be quite time and resource consuming. The digital technology, however, has removed the “friction” and obstacles, which the inefficient architecture of real space entails. Therefore, privacy is no longer inherently protected as it used to be. (Lessig, 2005, pp. 277–279)

Companies, such as Facebook, make use of this change in architecture to create new revenue opportunities. Facebook gathers the data provided by its users and sells it to companies interested in targeted product recommendations and advertisement. For example, if a woman changes her relationship status to “engaged”, Facebook will display advertisements for wedding dress shops in her area, provided these shops paid for such advertisement beforehand. Thus, Facebook is able to gather data very cost efficiently and sell it with great margins. As Douglas Rushkoff pointed out at a conference in Berlin 2011, it is normally the customer who is paying for a service. In the context of companies like Facebook, however, it is advertiser who is paying. Thus, people having a Facebook account are not Facebook’s customers, but its product. (Heimbach, Gottschlich, & Hinz, 2015) (Solon, 2011)

In addition, at the latest since Edward Snowden revealed that the U.S. National Security Agency (NSA) uses Facebook and other social media profiles to gather data and create maps of social connections in 2013, it is clear that it is not only the corporations who make use of the change in architecture. Governments and their national intelligence and security services benefit from digitalization of social networks too (MacAskill, Dance, Cage, Chen, & Popovich, 2013). And, what is more, hackers as well are interested in gaining access to private data.

At this point it should be clear, the presumption that behavior, which is private offline, is also private online is thoroughly misplaced. In fact, in order for the Internet to function it must capture, retain and transmit the information users enter into it. Thus, on the Internet information can never be completely protected from being accessed by a third party. On top of that, the domains to which privacy is protected legally are far narrower than many would expect, allowing network site providers like Facebook to conduct very profitable business models. (Walther, 2011, p. 4).

Such violation of privacy has severe impacts. Already Foucault's analysis from 1977 of Bentham's Panopticon, illustrates the effects of total transparency (Lauer, 2012, p. 569). Once the feeling of possibly being under surveillance at any given moment has been created, it does not matter if someone is actually being watched. As Gilles Deleuze (2016) depicted, we are transitioning into "Societies of Control". This kind of society completes itself at the point at which its subjects expose themselves voluntarily due to a self-generated desire. One can observe this self-disclosure especially well on social network sites, where users share their opinions and preferences, friendships and other private information to gain perceived advantages in return (Ziegele & Quiring, 2011a, p. 181). This "hyper-communication" guarantees transparency, leading to a situation in which perceived freedom and control become one, and autonomy is lost.

All in all, it was not meant to neglect the positive aspects and opportunities arising from new media and especially social networking sites. Digitalization and wide spread of ICT benefits economy (Fischer, Novotny, & Doucek, 2015) and creativity (Vondra, 2015). Nevertheless, looking at issues related to privacy opens questions concerning network site users' behavior and awareness, as well as which – if any – steps they actually take to protect their online privacy? (Sigmund, 2014)

1.2. Privacy settings in Facebook

Every social network is dealing with private information that requires a certain level of security. Today's social networks are hiding some personal data from other users by default and at the same time are providing the individuals with possibility to manage their privacy settings and set up the intended audience for every type of content on their page.

Talking specifically about Facebook: all personal information, posts, photos and other personal content was public by default until 2014. It was easy to change the audience for example to "Friends only" or "Only me". For the first-time or careless users though there could be a risk of sharing some content with wider public by accident. Since 2014 the default privacy settings has been changed to "Friends" in order to secure users from sharing the information unintended for general public.

This change by default impacted only new users. For the existing users there was implemented a reminder that pops up when a new post is submitted, asking to choose an audience for that post. This setting can be changed anytime for individual posts and contents.

Additionally there has been implemented a "privacy check-up" to enable users to review their privacy settings and to control the applications in use which gives to user even more control on the shared information and the audience (Magid, 2014).

2. Hypotheses and research question

Based on the theoretical foundations set out above, the following three hypotheses have been proposed:

- H1: “The users with stricter privacy settings will reject the friendship request from stranger with higher probability than the users with more opened profiles.”
- H2: “The users having both fake profile pictures and a fake name will reject the request from stranger more often than those having real names and profile pictures.”
- H3: “Nowadays there are more users in the age of 20 to 30 years with stricter privacy settings than users with more opened profiles.”

3. Methodology

We conducted a social experiment on Facebook because an enormous amount of privacy leaks is actually caused by users themselves, according to (Krombholz, Merkl, & Weippl, 2012) (Wang, Xu, & Grossklags, 2011). So the Facebook users’ reaction to friend request was tested. In general and also in our study, the assigned treatment is the only element in the subjects’ environment the researchers control. All other elements remain unaffected; we for example had no pre-contact information about the requested Facebook profiles. (Greenberg, Shroder, & Onstott, 1999, p. 157) Thus, the basic idea was to create a fictional Facebook profile and establish friendships connections with as many Facebook users as possible, then collect and analyze the data they revealed.

The base for our choice was a study devoted to similar social experiment on Facebook done by T. Greitemeyer and I. Kunz (2013). Their research: Name-Valence and Physical Attractiveness on Facebook: Their Compensatory Effects on Friendship Acceptance - examined whether Facebook users are more likely to accept friendship requests from other Facebook users with positive names and who are physically attractive. According to this study the highest probability to be accepted on Facebook have attractive women with positive (real) names, which was the key element for our essay. Therefore we decided to create a fictional profile of a young and pretty girl with a common Czech name Tereška Dvořáková. We focused on the quality of a profile picture – it was quite important to make Tereška look real and friendly. Consequently, a photo of a blonde smiling girl was elected.

We tried to create quite realistic and complex profile to guarantee a high social attractiveness. We filled in her date of birth as October 21, 1991 (age 24). Furthermore, we filled in realistically the place of birth, residence, employment and the university: Tereška was born in Karviná, lives in Prague, works at Student Agency and studies at University of Economics, Prague. We also set that she studied at High school in Karviná. All of these information we set as public. As for her interests: upon the study of several others similar profiles, we identified following common interests of similar girls: music pages: Majk Spirit, Europa 2, David Guetta and Maroon 5; sports: Hockey; other Facebook pages: Haluze.eu, Vysoká škola ekonomická v Praze, Mango and Zara; languages: English, German, Portugese, Czech and Slovak; motto: “Carpe diem”; introduction: “Mladá holka, co miluje smích”, which means “A young girl who loves to laugh”; favorite films and TV shows: The Hunger Games, How to train young dragon, The Matrix, Frozen, Forrest Gump, New moon, Tangled, Breaking dawn, The Simpsons, Two and a half men, The Bing Bang Theory and Česko Slovensko má talent; books: Harry Potter and the Order of the Phoenix, The Little Prince, Twilight, Fifty Shades Freed, Anne Frank, and The Da Vinci Code: From Dan Brown’s Fiction to Mary Magdalene’s Faith. We set a public cover picture as well as a profile photo. After that, we posted 5 photos of dogs and updated her status. The status was „Konečně zpátky na webu“ which means “Finally back on the web”. We shared a YouTube music video and added photo of her last meal. The description was „S holkama na večeři“ which means „With girls at dinner“. The

created fictional Facebook profile is shown in Figure 1 and accessible at: <https://m.facebook.com/profile.php?id=100010533544140&fref=ts>

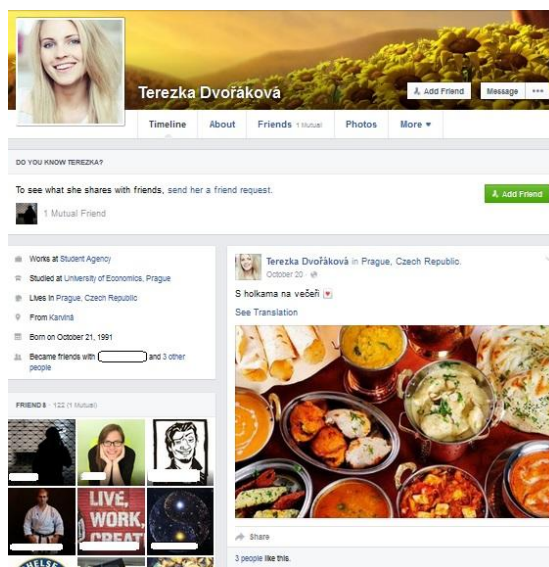


Figure 1: Fictional Facebook profile

3.1. Case design: Multiple-case study

We decided to do our experiment on an unofficial student Facebook group of VŠE. The group has around 12.000 members. We decided to run our experiment on 400 users in total, divided by the criteria real/fake name and real/fake profile photo into 4 groups, each group receiving 100 friend requests.

3.2. Study Limitations

Gender of our fictional profile could influence and support the decision of male Facebook users to accept the friendship request from female in comparison to the request from male user, therefore it could translate into the results of the research.

The correlation between acceptance/rejection of the friendship request and gender of the requestor and requested can be a topic for future separated research with a similar methodology.

Furthermore, the research was targeted at students of University of Economics, other audiences may have slightly different results.

3.3. Data collection

The social experiment on Facebook was actively conducted between October 22nd and October 29th, 2015. As a preliminary step, we asked a few friends to add the fictional Facebook profile Tereza Dvořáková as their friend, in order to make the profile look trustworthy. We then started to send friend requests. An interesting fact is that at the end of the period of sending requests Tereza actually started receiving some friend requests from strangers. We marked every friend request we sent in the table. We were interested whether the respective contacts accepted our friend request or not. We also noted, whether the following information were publicly visible: profile privacy, photos/pictures, friends list, contact information (telephone and e-mail), posts, city, job, relationship status, date of birth and educational background.

3.4. Data analysis

For the purpose of the study, the data collected in the Excel, then the sheet has been imported to MS SQL Server Analysis Services which adds data mining capabilities for SQL Server databases. Based on that input 4 mining models have been created (for hypothesis H1 and H2):

- Two Neural Networks
- Two Decision Trees

These two mining algorithms were identified as the most appropriate to analyze the collected data and validate the hypotheses for the following two reasons: (i) the collected data are discrete; (ii) the algorithms belong to the classification algorithms type, which can predict one or more discrete variables, based on the other attributes in the dataset.

The last hypothesis H3 requested the comparison of two groups of Facebook users with different (stricter and less strict) privacy settings, therefore the Column Chart was chosen to visualize and evaluate the results as the 'Model 3'.

3.5. Validation

For both mining models the input data has been randomly split into Training set (50%) and Testing set (50%). The sets are based on the percentage of data for testing, and the maximum number of cases in the testing dataset that has been collected. The training was used to create the mining model. The testing set was used to check model accuracy.

4. Results

After analysis had been performed as it was described in previous paragraph, the arising results have been captured for each hypothesis.

4.1. Model 1 – H1

H1: "The users with stricter privacy settings will reject the friendship request from stranger with higher probability than the users with more opened profiles."

Following attributes based on the profile settings have been tracked: photos/pictures, friends list, contact details (telephone and e-mail), posts, city, job, relationship status, date of birth and educational background. For each of the categories the value could be "visible" or "not visible" according to the content of the Facebook profile to which the friendship request has been sent.

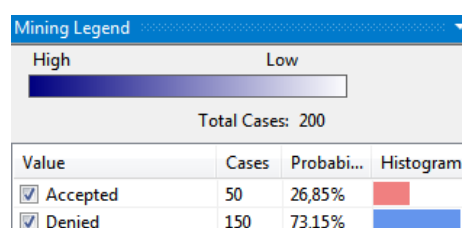
With help of the Neural Network algorithm the correlation between the privacy settings and the non-/acceptance of the friendship request was tested. In the Table 1 below the probability that the Facebook user with certain privacy setting will accept or decline the request is mapped.

Attribute	Value	Favors Accepted (Probability in %)	Favors Denied (Probability in %)
Contact - Telephone And Email	Visible	65.80%	33.50%
Relationship Status	Visible	51.61%	47.70%
Date Of Birth	Visible	51%	48.15%
City	Visible	34.12%	65.18%
City	Not visible	5.23%	94.07%
Posts	Not visible	22.19%	77.11%
Date Of Birth	Not visible	8.49%	90.81%
Friends List	Visible	20.76%	78.54%
Relationship Status	Not visible	11.22%	88.08%
Friends List	Not visible	11.27%	88.03%
Contact - Telephone And Email	Not visible	11.31%	87.99%
Job	Not visible	15.88%	83.42%
Job	Visible	12.25%	87.05%
Educational Background	Visible	15.57%	83.73%
Posts	Visible	12.41%	86.89%
Educational Background	Not visible	14.81%	84.49%
Photos Pictures	Visible	14.67%	84.63%
Photos Pictures	Not visible	13.12%	86.12%

Table 1: The Neural Network, H1

From the table above, it is evident that users with visible contact information, relationship status and date of birth have a slightly higher probability to accept the friendship request from an unknown person. On the other side, the attributes like city, posts, friends list, job, educational background and photos do not play a significant role; independent from whether these information are covered or not, the probability of declining the friendship request is very high in both cases.

A similar situation is shown on the decision tree – according to this model the most valuable factor for Accepting/Denying the request is the visibility of the date of birth. In three-fourths of all cases the request for friendship will be rejected with a probability of 73.15%, if the birth date is covered. The remaining quarter with visible date of birth will accept the request with 26.85% probability – see Figure 2.

**Figure 2: Mining Legend, H1**

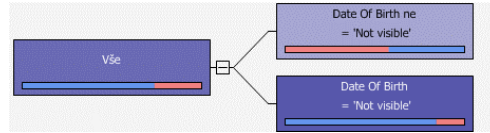


Figure 3: Decision Tree, H1

4.2. Model 2 – H2

H2: “The users having both fake profile pictures and a fake name will reject the request from stranger more often than those having real names and profile pictures.”

During the data collection it was also examined, whether the name and the profile picture of the user in Facebook seems to be real or fake.

Attribute	Value	Favors Accepted (Probability in %)	Favors Denied (Probability in %)
Name	Potentially real	20.79%	78.51%
Name	Fake	61.78%	37.52%
Profile Picture	Fake	27.37%	71.93%
Profile Picture	Potentially real	50.08%	49.22%

Table 2: The Neural Network, H2

The reaction of users falling into one of those categories on the friendship request from unknown person is evident from the table above. It is interesting to note that the users with potentially real name with quite high probability will deny the request and people with a fake name are more open for new friendships (the probability is 61.78%). At the same time, users with a fake profile picture will reject the friendship request with a probability as high as 71.93%. However, a potentially real profile picture does not have much influence on the rejection or the acceptance of the request (the probability is almost 50:50).

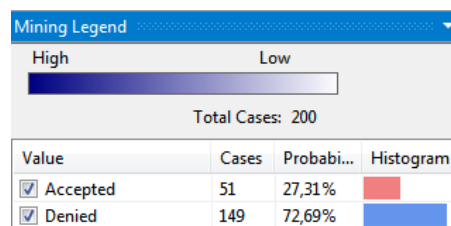


Figure 4: Mining Legend, H2

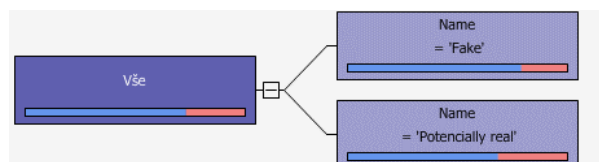


Figure 5: Decision Tree, H2

The decision tree, based on name and profile picture data, defines the name attribute as the most indicative to how a user will react to the incoming friendship request. Again in three-fourths of all cases the request for friendship will be rejected with a probability of 72.69%, in case the name is real. The remaining quarter, which has a fake name, will most likely accept the request.

4.3. Model 3 – H3

H3: “Nowadays there are more users in the age of 20 to 30 years with stricter privacy settings than users with more opened profiles.”

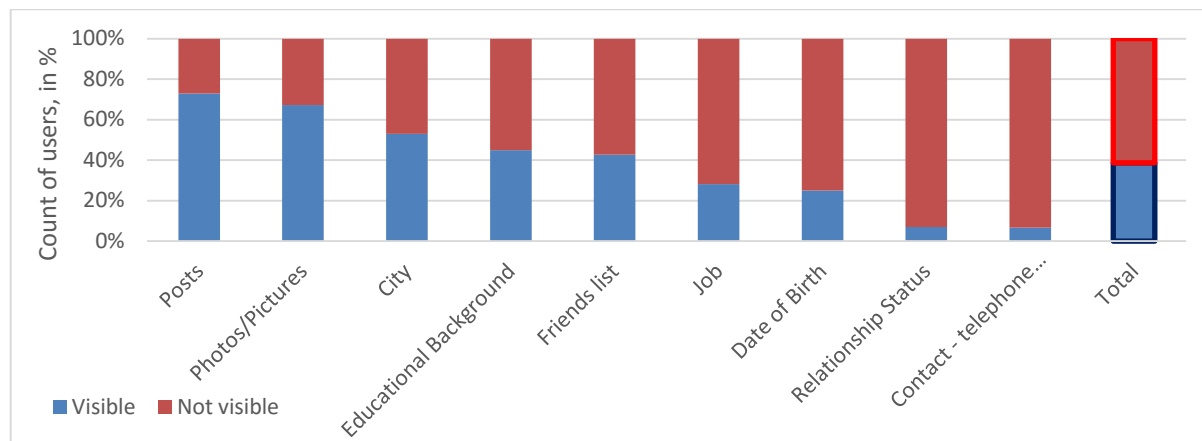


Figure 6: Column Chart - Privacy Settings Usage Comparison

The column chart at Figure 6 displays the number of cases in which the privacy settings are applied for each followed-up attribute of Facebook user profiles relative to the total number of captured profiles. The last column features the total of proofs. It reveals that more than 60% of all profiles use the privacy settings in order to hide some personal user information and limit the access of other users to it.

5. Discussion and conclusions

Considering the first hypothesis H1, the data indicates that the specific privacy settings show a rather mixed picture, to whether a person denies or accepts a friend requests from our profile, an attractive female stranger. There is rather a general trend to deny the request, which neither clearly confirms nor objects our first hypothesis.

Still, it was interesting to see that for the users, who share their contact details (telephone and e-mail address), there was the highest probability (65.80%) to accept our friend requests. So, the result indicates that people, who are willing to even share this private information, are in fact open to new contacts. This actually is reasonable, since it is exactly the information strangers need to get in very direct contact with the respective persons; for example via a phone call.

Continuing with our second hypothesis H2. We here again saw an interestingly mixed picture. People having a real profile picture are likely to accept our friend request, and so are people having a fake name. For the second hypothesis this means it was, if at all, only partially confirmed.

However, there may be interesting interpretations of this result. First of all, it seems people who are creative in creating a fake name, are more communicative and willing to be active on Facebook by accepting new friends in their network. However, the actual explanation may be that these users simply do not risk as much, since they do not disclose their actual name. Furthermore, the profile picture is the sensitive information, which works the other way around. Users, who have a faked profile picture, supposedly do so because they seriously care about their privacy. Thus, here the deny-rate was high for those who had a fake profile picture.

Testing the third and last hypothesis H3 revealed that first of all users in general are more likely to care about their privacy settings. This means they do not make private information visible. So, the hypothesis was confirmed.

Moreover, this in combination with the overall higher probability to deny our requests, reveals that people are still critical and concerned about their privacy on the internet. They may share quite an amount of information with friends, like they would probably also do offline, but they try to protect their privacy to the greater public.

All in all, we were able to test and partially confirm our hypotheses. The results are interesting and suggest alleys for future research. However, there are certain limitations as well, as we will discuss in the following chapter.

6. Limitations and future research

Although the study at hand was able to test the hypotheses, it is also important to consider its main limitation. In fact, it directly suggests avenues for future research.

A first limitation is the scope. Only a very small fraction ($N=400$) of the overall social network phenomenon was investigated. In fact, we solely looked at the members of one particular Facebook group. Thus, direct conclusion can for certain only be drawn for this Facebook group and its members. Still, the paper at hand draws conclusions in a quite generalizing manner. Thus, further studies are required to confirm (or dispute) the conclusions, possibly improving its inductive significance. In fact, there is the possibility of moving from our specific observations to broader generalizations and theories. In this context, we would also like to mention a further outlook for future research: Do people start to pay more attention to their privacy and get more selective with whom they are sharing the private info? To test this we would suggest performing same test in the future.

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A CHANGE IN THE CONCEPTION OF THE FACTORS WHICH FORM CUSTOMER EXPECTATIONS

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Keywords

Customer expectations, word-of-mouth, social networks, influencers, quality loop

Abstract

The formation of customer expectations has traditionally been seen as an interaction of four factors: explicit product promises, implicit product promises, word-of-mouth communication and past experience. This article discusses changes in the structure of the word-of-mouth factor and the approach used to measure its strength resulting from the massive expansion of social networks. It considers in particular the consequences of these changes for theory. The principal changes relate to the influence of different stakeholders within the context of word-of-mouth and a mathematical model is proposed for calculating the size of this factor's influence. The article also considers changes in the quality management process, which is based on knowledge of customers' needs and expectations.

1. Introduction

Customers' expectations and needs play a key role in the planning and improvement of quality. There is a very broad range of support for this aspect of an organisation's management – e.g. methodological, normative and conceptual documents covering various aspects of the quality management process.

Quality can be characterised in simple terms as the “degree to which a set of inherent characteristics of an object fulfils need or expectation” (ISO, 2015). The process of quality management has been modelled in a number of ways (Soltani et al, 2008), one of the most widely applicable of which is the model known as the quality loop.

The quality management process begins with the formation of the needs or expectations of a stakeholder (referred to in general as “requirements”) in relation to a specific object. Most frequently this refers to the requirements of a *customer* in relation to a *product* and the logic of the quality loop is very often explained using this example (Parasuraman, Zeithaml & Berry, 1985). The customer forms a particular idea of what they expect from the product (expected quality).

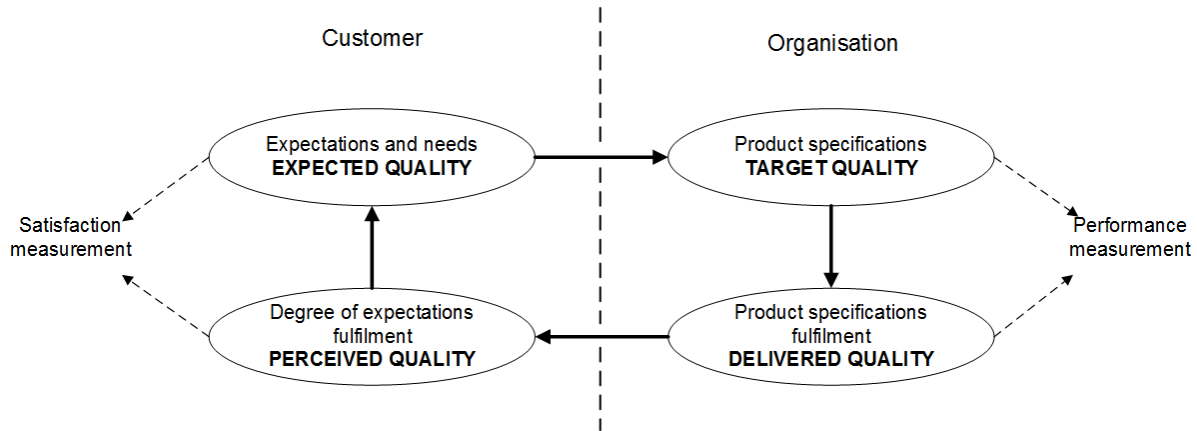


Figure 1: Quality loop; source (CEN, 2001), modified from (Parasuraman, Zeithaml & Berry, 1985)

If an organisation wishes to satisfy a customer's expectations, it needs to identify this idea, understand it and produce a product design which implements the relevant parameters (target quality). It must then supply a product with the planned parameters to the customer (delivered quality). After delivery of the product, the customer tests its characteristics and compares them against their expectations (perceived quality). The result of this comparison should be their satisfaction, i.e. "perception of the degree to which the product has satisfied their expectations" (Sroufe & Curkovic, 2008).

In studies of the quality loop, high attention has been (and still is) given primarily to the area of planning and implementation of the product, evidence of which is the relatively broad body of research (Dahlgard et al, 2013) and also methodological information (Arumugam, Antony & Douglas, 2012) covering these aspects of the process. Knowledge of customers' needs and expectations is often the subject-matter of marketing-oriented studies (Stanko & Bonner, 2013), which give a relatively detailed analysis of the factors that can influence the formation of customers' expectations. One of these factors is shared experience (in contrast to customers' personal experience), whose importance has been seen to increase as social networks expand (Zhang et al, 2012). The development of information technologies and the growing popularity of social media are changing existing social habits (Bicen & Cavus, 2011), and may also be affecting individuals' purchasing habits.

This article examines the changes in the importance of external factors affecting the formation of customer expectations. The article is based on the logical comparison of earlier research and theoretical accounts of the formation of expectations.

2. Customer expectations and the factors that influence them

Customers' expectations of a product determine an organisation's qualitative objectives. The theory of quality management includes a number of systematic procedures for identifying these requirements (Hong et al, 2008), and incorporate them into product specifications, e.g. QFD or APQP (Agouridas et al, 2008). Since quality is characterised as something that has a continuous character – as is emphasised by the word "degree" in the definition of quality – so the fulfilment of expectations is likewise something that can be achieved in varying degrees. A high degree of fulfilment of expectations means the achievement of a high level of quality while, conversely, a low degree means low quality. Perception of product quality is influenced by the degree of fulfilment of multiple expectations that customers bring to the product before using it (Kopalle & Lehmann, 2006). In the 1990s, research concentrated on understanding tolerance of the degree of fulfilment of

expectations. A group of authors also presented interesting findings showing that for important customer expectations (usually those relating to a product's basic functions), the zone of tolerance is significantly narrower than for less important (supplementary) customer expectations.

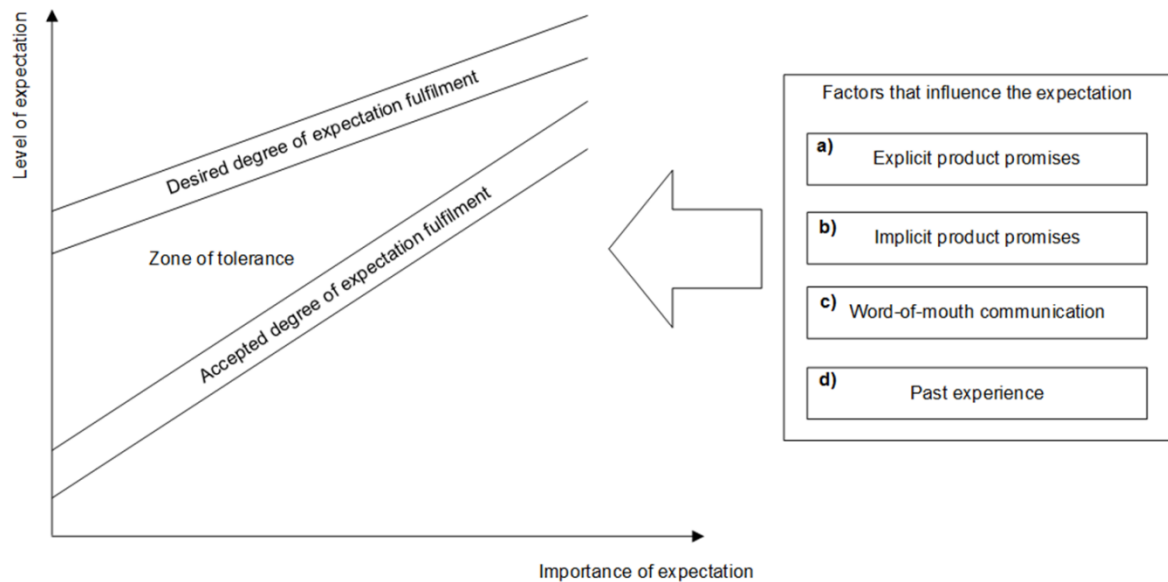


Figure 2: Customers' tolerance zone in relation to fulfilment of expectations (Zeithaml, Berry & Parasuraman, 1993)

Past research has also given significant attention to the factors that influence customers' expectations. Over time, four generic categories of factors have been established, which can be described as follows:

1. Explicit product promises – this is the set of inherent characteristics that the organisation includes in its communication on its products; it may be personalised (if a sales representative described the product to a potential customer) or non-personalised (in advertising and brochures); this is the factor whose strength of influence the organisation is able to control. (Steinhart, 2012)
2. Implicit product promises – the set of assigned characteristics communicated by the organisation; the most frequent of these is the price of the product, which gives a customer a certain sense of its level of quality. (Steinhart, 2012)
3. Word-of-mouth communication – how other stakeholders comment on the product or present their experience of it (e.g. primary influencers: friends, family; secondary influencers: neighbours, colleagues, teachers, independent experts and so on). (Libai et al, 2010)
4. Past experience – the set of customers' personal experiences of a particular product which are an important source of the customer's initial expectations if they consider buying the product again. (Pocheptsova, Labroo & Dhar, 2010)

These factors include the influence of three groups of stakeholders – organisations, influencers and customers. The relative strength of the factors as communicated by these stakeholders can vary from sector to sector. Their importance can also rise and fall under the influence of overall changes in the market. It is this change in response to global development that will be considered in the next section.

3. Change in the importance of external factors in the formation of expectations

This article is concerned with the influence of the word-of-mouth communication factor. The area represents the communication of experience from persons with whom customers come into personal contact, which customers take into consideration to a greater or lesser extent when forming their expectations. The term used for the factor in French, *bouche à oreille* (Téboul, 1998), gives a more precise sense of its meaning – communication from mouth to ear, that is to say direct communication with a relative or a person the customer knows well.

The theoretical framework set out in the following sections relates to purchasing decisions in the need identification phase. It comes after customers have defined their needs (they know what they need) and when they are proceeding to form their expectations (seeking information on suitable products).

3.1. Influence by word-of-mouth before the rise of social media

Before the rise of social media, this factor in the formation of expectations involved mainly personal communication with persons with whom customers already had a close relationship – the most important influencers. Their influence was stronger the more a customer accepted their personality and the more frequently they interacted directly without intermediate media. The number of influencers of this type tended to be relatively stable and low. This is probably the reason why relatively little attention was given to measuring the strength of influence exercised by such influencers. Its strength can, however, be expressed by a simple relationship taking into consideration the size of the group of influencers, the closeness of the relationship with the influencer and the level of interaction as follows:

$$\text{Influence strength} = \sum_{i=1}^n \sum_{j=1}^m (w_i * p_{ij}) \quad (1)$$

where

$$w_i = PK_i * IF_i \quad (2)$$

i ... 1, 2, ..., n type of influencer

j ... 1, 2, ..., m number of influencers

w_i ... influence strength (weighting) of an influencer of type i

PK ... how well the customer knows the person / how closely they are related – value in the range (0,1) where the limit values represent “completely unknown” and “closest person”

IP ... level of interaction – a value in the range (0,1), where the limit values represent “passive, occasional and intermediated communication” and “active, frequent and direct exchange of information”

p_{ij} ... number of influencers of type i – a value in the range (0,1), where a low value indicates a small number of persons (usually in single digits) and a high value indicates a large number of people (in the order of hundreds or thousands)

A small number of types of influencers (n) (siblings, friends, teachers, role models) with a small number of individuals in each type could still have strong influence on a customer's expectations because their relationship with the influenced person was very strong. The influence from this factor therefore depended primarily on a relatively limited number of small groups of influencers with whom the customer had a very close relationship and frequent and direct interaction.

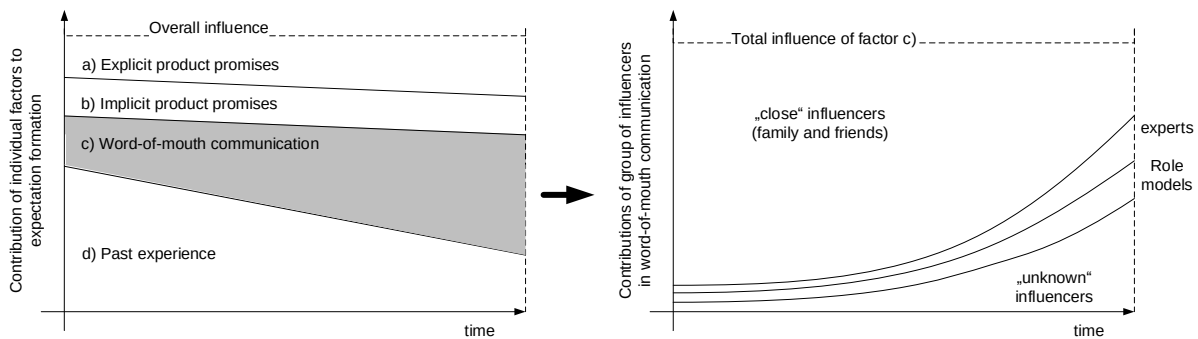


Figure 3: Change in the strength of factors influencing the formation of expectations (left), change in the strength of stakeholders in the context of word-of-mouth influence (right) adjusted from (Zeithaml, Berry & Parasuraman, 1993) and (Libai et al, 2010)

The older models of the formation of expectations should be revised to reflect the changes in the factors affecting customers' expectations. In particular, they must take account of the change in the strength of the different factors and the changes in the internal structure of the word-of-mouth factor. The authors have proposed a model that meets these requirements in Figure 3. The left part of Figure 3 shows the change in the relative influence of the aforementioned four factors that influence customers' expectations. The growth in the strength of explicit product promises is the result of the rapid increase in advertising and the proliferation of its forms at present. The influence of implicit product promises, represented first and foremost by price, is relatively constant, since there has been no major change in access to information on prices. Word-of-mouth communication has a stronger influence, possibly as a result of better access to product information, including user evaluations (various reviews, user rankings and so on). The influence of past experience with a product has become weaker because of the wide diversification of products resulting from the growth in competition and relatively quick access to customer information on product quality (usefulness, functionality and suitability) and information on others' experience of the given product (even before they themselves try the product).

In the right part of the Figure 3, the word-of-mouth factor is broken down according to individual groups of influencers and also shows the changes in their contribution to the factor's overall influence. This part of the illustration is a graphical representation of the situation in which, under the influence of changes in individuals' social habits (use of social networks, or information technology in general), there is a rapid growth in the strength of influencers that the customer does not know well (often people writing anonymously about their experience with a product).

3.2. Causes and effects of the changes in the factor connected with social media

The rise and rapid expansion of social media has significantly improved access to a large amount of information and created new communication channels between social network users. Social media have made it much easier for people to establish relationships, but these relationships tend to be much more superficial (Libai et al, 2010). This means that an individual could have a lot more acquaintances than before the rise of social media but a lot fewer actual friends. The effects of social media on the formation of customer expectations can be characterised as a change in the source of influence. While in the past a customer's expectations were formed by a few individuals who were close to the customer (Libai et al, 2010), nowadays the main source is a very large number of very superficial acquaintances, or possibly even completely anonymous individuals, whose opinions the customer finds on social media or by directly searching on the internet. There has been a change in the relative strength of different groups of influencers. The strongest influence

has shifted to the very large number of influencers with whom the customer has only a very “superficial” relationship.

This may be a consequence of social developments which favour a more superficial form of communication and a gradual reduction in the closeness of influencers. Some of the new media, e.g. web sites which show customers’ ratings of a product, have created a special group of influencers which were relatively inconsequential before the rise of social media, either because they did not exist, or there were few of them or it was very difficult to access them. It may not be clear whether a site’s content is produced by a group of either unknown or anonymous customers sharing their experience on social networks or whether it is the artificial construct of advertising agencies (Steinhart, 2012). In both cases the large size of this group is strengthening its influence on the formation of customers’ expectations. This development suggests that it may be necessary to reconsider the sustainability of the traditional concept of four factors of influence.

It is natural that a change in the social habits of the population (potential customers) may be reflected in a change in the factors that influence the formation of an individual’s expectations. In the case of one of these, word-of-mouth, there is a change in the character of the factor itself. Customers no longer receive direct, trusted information from a person they know well, but public information from a large number of almost unidentifiable influencers (e.g. contributors to social networks). These contributors are a new and important group when it comes to the formation of customer expectations. In terms of formulas (1) and (2), the strength of this influence depends not on closeness but on the large number of influencers. Various contributor profiles provide information on the characteristics of these groups but it is very difficult to establish the reliability of a profile or its contents with any confidence.

Experts tend to have less influence on expectations than on the selection from a previously chosen short-list of products. They use ranking and rating schemes based on various methodologies and they have their activities and trustworthiness validated under various certification schemes.

The influence of social media has grown thanks to their rapid expansion in all sections of the population and the easy availability of all sorts of information. The claim that the strongest influence has shifted from “close” influencers to a group of “anonymous” influencers can be explained by a simple example. The time that customers spend “consuming” information that they need or seek on social media, and subsequently filtering the frequently distorted information, eats into the time that they could spend developing their relationships with closer persons and finding out their actual opinions and attitudes. This change in behaviour has been documented by numerous studies in the social sphere (See-To & Ho, 2014) (Balaji, Khong & Chong, 2016).

4. Discussion and conclusion

This article has presented a hypothesis for which there is much evidence but which requires further research to determine the actual extent in which customers are influenced by contributors on social networks – for example by means of targeted research. Such research would have to consider more than just the formation of expectations. Findings on the formation of customer expectations are reflected in customers’ purchasing decisions but only have a very approximate influence on their satisfaction. According to Figure 1, another important component of satisfaction is the customer’s perception of the product after its use. If customers acquire excessive expectations as a result of an influence campaign using contributions on social media, there is a risk that over the long term this could have a negative effect on customer loyalty, especially if the product fails to fulfil unrealistic expectations fuelled by contributors on social media. For this reason, any survey must study both the formation of customer expectations and the perception of the product, with follow-up

measurement of the degree of satisfaction. Further research could then focus on the change in value management as a result of the influence of information management.

Besides these methodological implications, the treatment of the topic is relevant for other practical and theoretical issues. These relate to a new trend in the evaluation of the quality of products and services. Not so long ago, a major factor in the formation of customers' expectations was the experience of people close to them or the opinion of specific experts who used sophisticated methods and ranking techniques with criteria and weighting. Nowadays, social media are encouraging increased reliance on the opinions of anonymous and unidentifiable users because these are easy to understand, easy to gain access to and above all plentiful. Communication technologies and social networks have changed the perception of customers who are strangers and they are now seen as people whose reviews can have a major impact on decisions (in the present example, the selection of a product) – they are thus a new stakeholder. This article has discussed the effect of social media on the formation of customer expectations. The traditional conception of the factors determining customer expectations needs to accommodate the growing influence of social media by changing its structure. The reduced importance of “close” influencers and the rise of the very numerous group of “remote/anonymous” influencers could call into question the basis for retaining a unified factor for “word of mouth”.

The behaviour of manufacturers and advertising agencies shows that in place of the clear and identifiable group of primary influencers, there is an increase in the strength of secondary influencers in the formation of customer expectations. Investigation of the current relevance of the categorisation of factors affecting the formation of customer expectations is therefore a legitimate scientific question in need of deeper research. It appears that one of the possibilities for a more accurate categorisation of influences in the formation of customer expectations could be a fundamental revision of the “word-of-mouth communication” factor. This would take into account, for example, the appropriateness of factors, their content, the strength of their effect, the forms in which they operate and the efficiency of such operations. Social media provide a broad new space for influencing customers' expectations. Thanks to the accessibility, easy comprehensibility and massive scale that social media bring to the distribution of information on products and services and on the opinions and experience of users, the previously weak influence of secondary influencers has been greatly strengthened. One potential response to the developments in this area could be the creation of a number of independent groups of influencers including acquaintances, non-acquaintances, role models and experts, and even virtual influencers (software robots).

These are just some of the research questions that this issue opens up. There is already much research being conducted on the social, economic, technical and other implications of information technologies and social networks. The modifications of existing approaches to the formation of customers' expectations described in this article, including the quantification of the strength of the word-of-mouth factor, also have implications for quality management, in particular its initial stage, in which customers' actual needs and expectations are identified.

5. References

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DETERMINANTS OF KEY MEASURES OF THE SOCIAL MEDIA

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Abstract

The aim of the paper is to find the determinants of the key measures of the success of the Facebook (FB) page – organic reach of the FB posts and the number of engaged users. Both measures are given to the relation with the number of FB page fans. Two FB pages of a different size are compared (A – large FB page with almost 60 000 fans and B – middle sized with almost 10 000 fans). Two-equation simultaneous model is constructed. Key FB page's success measures are explained by the number of likes, shares and comments. The results show that smaller FB page has higher reach per one post than the larger. However, if there were no "comments" and no "post reach", the number of lifetime engaged users would be higher in case of larger page. Increase of the number of post's "shares" increases the post reach statistically significantly only in case of smaller FB pages. We also found that the fact whether the reach is paid plays an important role in achieving the reach of the posts and engagement of the users.

1. Introduction

Social media became the part of our daily routine (Pavlíček, 2014). For any organizations, social media provide new ways for communication and collaboration with their stakeholders. One of the most used on-line social medium is Facebook (FB). Recent statistics confirms that FB with 936 million daily active users on average for March 2015 (Facebook, 2015) is an important world social network. "The widespread use of Facebook by individuals around the world attests to its potentiality to play important social, educational, and several other communicative and interactive roles" (Aladwani, 2014).

The reason for heavy usage of FB might be its relatively simple concept. Each user creates his or her profile, firms and institutions create the pages. The main platform for discussions is the page's

“wall”, in which the account holder and his or her friends (e.g. people who are the friends of the person) or fans (in case of the firm’s or institution’s page – i.e. people who “liked” the page) can post messages. Each post maybe responded by comments or marked by “like”. The post can have a form of a text, photo, photo album, share other profiles’ posts, videos or events (Forkosh-Baruch and HersHKovitz, 2012). Those activities create engagement of the users on the firm’s or institution’s page. “Social media are becoming an ever more important part of an organization’s media mix,” (Peters et al., 2013). Despite that, according to Bonsón et al. (2015), “there is a very limited empirical research examining the impact of media and content types on stakeholders’ engagement on social media platforms...” Therefore the aim of this paper is to address this issue.

The success of the organization’s presence on FB could be measured by several metrics. The most frequently observed is the number of fans of the FB page (people who “liked” the page). For the complex view, other important metrics should be monitored – organic reach of the posts and the number of engaged users. So-called “organic reach” of the post tells how many people could be reached for free on FB. Out of the people that the FB page is able to reach, a metrics “engaged users” measures the number of the users that took action on the page or with its content (for example click somewhere or wrote a story). The users who are engaged with the FB page are the most valuable audience segment for the company, since they are the ones consuming and sharing the content on the network and help to spread it. The advantage of this metrics is that it is not limited on the FB page’s fans, but comprises all engaged users. A FB page can for example have many fans, but low number of engaged users when it does not produce an interesting content which would the FB users share, like or comment. According to (Forkosh-Baruch and HersHKovitz, 2012) the more the account of the firm is active, the more possible it is to increase users’ engagement.

Similarly, the reach of the posts grow to some extend with the number of fans. However, they are also other determinants of the post reach. For its increasing, Pechrová et al. (2015) recommend to publish short posts and amusing content (such as photos). It is suggested that the metrics “engaged users as a percentage of total (or organic) reach” can serve as an indicator for the activity the FB page’s audience develops over time. Also monitoring the “engaged users as a percentage of fans” over time can indicate whether the FB page is able to attract / generate an active audience. The article examines not only the key metrics “lifetime post organic reach”, “number of lifetime engaged users” and “the number of fans”, but also their determinants – “likes”, “shares” and “comments”. Those variables gathered for a group of similar pages can be included into Data envelopment analysis and the company or institution can derive its efficiency in communication at FB pages and compare itself with other similar subjects (see study of Pechrová and Lohr, 2016).

2. Data and methods

The paper analyses two well-established FB pages with high and middle number of fans in the period from 1 January 2015 to 30 March 2016. The data were provided anonymously and therefore we will mark the large one as “FB page A” and the middle sized as “FB page B”. While the FB page A had almost 60 thousand fans (59 796 at the end of the period), the FB page B had 8825 at the beginning and 9687 at the end of the period. Besides the number of fans, other important measures (“lifetime post organic reach” and “lifetime engaged users”) are observed for both pages. Firstly, those characteristics are described for both pages and compared to each other. Consequently it is tested whether they statistically significantly differ. As based on Shapiro-Wilk normality test (1), none of the variable is normally distributed, a non-parametric Wilcoxon rank-sum test is used ($H_0: \mu_0 = \mu_1$, i. e. arithmetic means of variables are equal) (2).

$$W = \left(\sum_{i=1}^Q u_i x_i \right)^2 / \left(\sum_{i=1}^Q k_i^2 \sum_{i=1}^Q (x_i - \bar{x})^2 \right) \text{ where } k \text{ is given as } k_i = \Phi^{-1} \left(\frac{i - 3/8}{q + 1/4} \right), \quad (1)$$

x are values of empirical distribution of the variable and Q ($q = 1, \dots, Q$) is their quantity. $x_{(i)}$ is i^{th} the smallest number in a sample, $\bar{x}$ is an arithmetic mean of the variable. If p-value is lower than significance level, null hypothesis is denied and the variable does not follow normal distribution.

Having marked the variables for FB page A by X_1 with Q_1 observations and for FB page B X_2 with Q_2 observations and sorting the data of both to non-decreasing sequence, Wilcoxon rank-sum test sums up the ranking for X_1 (marked as T_1) and ranking for X_2 (T_2). Based on those two a statistics U_1 and U_2 are calculated (2). If $W = \min(U_1, U_2) < W_{\alpha}^{[Q_1, Q_2]}$, the null hypothesis is rejected.

$$U_1 = T_1 - \frac{Q_1(Q_1 + 1)}{2} \quad \text{and} \quad U_2 = T_2 - \frac{Q_2(Q_2 + 1)}{2}, \quad (2)$$

Based on the definition of the organic reach and engaged users we suppose that the number of likes, shares and comments could have an impact on both. It is also assumed that organic reach and engaged users metrics influence each other. Therefore, a multi regression model with two equations was constructed. To avoid endogeneity problem (both – organic reach and the number of engaged users are considered to be explained variables) a simultaneous model was utilized.

First, multicollinearity was checked in correlation matrix calculated as (3).

$$\mathbf{X}^T \mathbf{X}, \quad (3)$$

where $\mathbf{X}$ is a matrix of explanatory variables. If the pair correlation coefficient exceeds the value of 0.8, the multicollinearity would have to be removed.

Second, a two-equation model is constructed (4):

$$\begin{aligned} \beta_{11}y_{1t} &= \beta_{12}y_{2t} + x_{0t} + \gamma_{11}x_{1t} + \gamma_{12}x_{2t} + u_{1t} \\ \beta_{22}y_{2t} &= \beta_{21}y_{1t} + x_{0t} + \gamma_{23}x_{3t} + u_{2t} \end{aligned}, \quad (4)$$

where y_{1t} is the number of lifetime post organic reach (index 1 indicates that it is first explained variable and index t marks the time when the post was published) y_{2t} is the number of lifetime engaged users (second explanatory variable in time t), x_0 is the constant. Explanatory variables are the number of likes (x_{1t}), shares (x_{2t}) and comments (x_{3t}). β are the parameters of endogenous variables and γ of exogenous ones. Note that index 1 denotes the first equation and index 2 the second one. The model's parameters were estimated using two stages least squares method (TSLS) which comprises from two steps. First, the empirical values of explained variables are replaced by theoretical ones as follows (5):

$$\hat{\mathbf{Y}}_E = \mathbf{X}(\mathbf{X}^T \mathbf{X})^{-1} \mathbf{X}^T \mathbf{Y}_E, \quad (5)$$

where $\hat{\mathbf{Y}}_E$ is a matrix of theoretical values of endogenous variables in the explanatory position, $\mathbf{Y}_E$ is a matrix of empirical values of endogenous variables in the explanatory position and $\mathbf{X}$ is a matrix of explanatory variables. Second step estimates the parameters (6)

$$\begin{bmatrix} \beta \\ \gamma \end{bmatrix} = \begin{bmatrix} \hat{\mathbf{Y}}_E^T \hat{\mathbf{Y}}_E & \mathbf{Y}_E^T \mathbf{X}_* \\ \mathbf{X}_*^T \mathbf{Y}_E & \mathbf{X}_*^T \mathbf{X}_* \end{bmatrix}^{-1} \begin{bmatrix} \hat{\mathbf{Y}}_E^T \\ \mathbf{X}_*^T \end{bmatrix} \mathbf{y}_e, \quad (6)$$

where $\mathbf{B}$ is a vector of parameters of endogenous variables and $\mathbf{\Gamma}$ is a matrix of parameter of exogenous variables, $\mathbf{X}_*$ is a matrix of explanatory variables included in particular equation, and $\mathbf{y}_e$

is a vector of endogenous variable in the explained position. For each equation, the estimation has to be done separately in order to obtain the matrices of parameters' values (7).

$$\mathbf{B} = \begin{bmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta_{22} \end{bmatrix} \quad \mathbf{\Gamma} = \begin{bmatrix} \gamma_{10} & \gamma_{11} & \gamma_{12} & \gamma_{13} \\ \gamma_{20} & \gamma_{21} & \gamma_{22} & \gamma_{23} \end{bmatrix} \quad (7)$$

After the estimation, economical, statistical and econometrical verification of the model follow. The economical verification assesses the sign and the intensity of the influence of parameters on the explained variable. Statistical verification contains t-test to test the statistical significance of the parameters of the model ($H_0: \gamma = 0$ or $H_0: \beta = 0$), F-test testing the statistical significance of the model as a whole (H_0 : all parameters are jointly equal to 0), and the coefficient of determination (basic R^2 or adjusted R^2) which tells to what extent the model explains the reality.

Econometric verification included the tests of heteroscedasticity (Pesaran-Taylorův test heteroskedasticity) and normality of residuals (Jarque-Bera test). The absence of homoscedasticity affects the parameters – the estimation is unbiased and consistent, but it is not the best. If there is a heteroscedasticity present (i.e. the variance of the residual is not finite and constant) so-called HAC errors (heteroscedasticity and autocorrelation corrected errors) should be used during the model estimation. Normality of the residuals is assumed. However, even if the residuals are not normally distributed, it does not affect the quality of parameters' estimation.

For meaningful comparison of the FB pages, the elasticities of the parameters (e) were calculated on a sample mean. They were derived as a derivation of endogenous variable (y) according to i^{th} exogenous (i.e. the value of a parameter) multiplied by the ratio of average value of exogenous ($\bar{x}_i$) and average value of endogenous variable ($\bar{y}$) – see equation (8).

$$e = \frac{dy}{dx_i} \cdot \frac{\bar{x}_i}{\bar{y}} \quad (8)$$

3. Results and Discussion

FB page A published 421 and FB page B 657 posts during the examined period. While the FB page A had almost 60 thousand fans, the FB page B had 8 825 at the beginning and 9 256 at the end of the period. FB page A published posts during the period with average reach 2 916 (it means that it reached by 1 post 5% of its fans). It engaged over 192 thous. users (455 on average) who gave 17 183 likes (41 on average), made 4 379 shares (10 on average) and 3 272 comments (8 on average) to the posts over the examined period. Contrary to that, FB page B reached twice more users (2 134 688 users in total and 3 249 on average). It accounts for almost 35% of all fans. The page engaged 147 976 users (225 on average) who gave 6636 likes (10 on average), 332 shares and 766 comments. Regarding the type of the posts, over half of larger pages' publications were links.

The average reach of the posts is higher in case of smaller FB page B, but the users' engagement per one post is much higher at larger FB page A. It was further tested whether the variables differs. Firstly, it was found that none of the observed characteristic was normally distributed (the null hypothesis H_0 : range comes from normal distribution was rejected in all cases). The two-sample Wilcoxon rank-sum (Mann-Whitney) test revealed that all variables statistically significantly differ between both pages. Only the lifetime engaged users number might be similar if we consider 0.01 level of significance (99% probability). Descriptive statistics of a sample are displayed in table 1.

Recent researches suggested that FB cuts the reach of a post when the page is larger in terms of the number of fans. According to server Dočekal (2015) the pages with hundreds to thousand fans have reach around 15–20%. Ten thousand fans pages more likely under 10%, and hundred thousand around 5%. Our results seem to confirm those assumptions. However, we must keep in mind that final reach of a post depends on many factors (such as the type of the post, how the fans are active – how they share, like or comment). We examine the determinants closer.

Variable	Total		Per 1 fan*		Average		Min		Max	
	A	B	A	B	A	B	A	B	A	B
Lifetime post organic reach	1 227 495	2 134 688	20.53	230.63	2 916	3 249	0	0	27094	11 441
Lifetime engaged users	191 625	147 976	3.20	15.99	455	225	1	3	20783	2169
Like	17 183	6636	0.29	0.72	41	10	0	0	951	194
Share	4 379	332	0.07	0.04	10	1	0	0	657	11
Comment	3 272	766	0.05	0.08	8	1	0	0	878	24

* FB page A: 59 796, FB page B: 9256

Table 1. Descriptive characteristics of a sample; Source: Own calculations based on data from FB pages

First, a correlation matrix of the values was displayed. In all cases, the correlation coefficients had positive sign implying that increasing of the number of comments likes, shares and engaged users is higher when the reach is higher. Also higher number of likes shares and comments implies higher number of engaged users. There was higher correlation found between both explained variables. However, none of the paired correlation coefficient between explanatory variables exceeded the value of 0.8. There was no multicollinearity found and all variables can be used in a model.

FB page A \ FB page B	y_{1t}	y_{2t}	x_{1t}	x_{2t}	x_{3t}
y_{1t}	1.0000	0.5526***	0.3765***	0.3412***	0.3486***
y_{2t}	0.3883***	1.0000	0.4224***	0.1997***	0.3622***
x_{1t}	0.2571***	0.2489***	1.0000	0.4341***	0.3464***
x_{2t}	0.1854***	0.0661	0.7615***	1.0000	0.3144***
x_{3t}	0.1628***	0.1641***	0.4269***	0.2492***	1.0000

Note: Correlation matrix for FB page A is displayed under and for FB page B above the diagonal; * marks significance level $\alpha = 0.1$, ** $\alpha = 0.05$, *** $\alpha = 0.01$.

Table 2. Correlation matrix; Source: Own calculations based on data from FB pages

Second, wo-equation simultaneous model was constructed. To ensure the calculability of a model, the identification of each equation was done. The general rule is that the number of endogenous variables in particular equation g_* ($g = g_* + g_{**}$) minus 1 has to be smaller than or equal to the number of exogenous variables in other equations k_{**} ($k = k_* + k_{**}$) – in other words $g_* - 1 \leq k_{**}$. In first equation, the post reach is explained by the number of engaged users, likes and shares. Second equation explains the number of engaged users by the post reach (simultaneous relation) and the number of comments.

Based on statistical verification, the models have different quality. In case of FB page A where there was less data available, only constant according to the t-tests is statistically significant on the 90% level of significance in the first equation. In the second equation, only reach of the post has

statistically significant influence on the number of engaged users. Both models as a whole are statistically significant (see results of F-test). The changes in explained variable are explained by the changes in explanatory variables from 14.46% (or only 13.84% when we consider adjusted coefficient of determination) in first equation and from 15.11% (14.70%) in the second equation. Therefore the goodness of fit is not very good. There might be other explanatory variables for post reach and user s' engagement which were not included into the model or more data is needed.

Model for FB page B has higher explanatory power. It explains the post reach from 33.82% (or 33.51%) and number of engaged users from 31.92% (31.71%). Also more coefficients are statistically significant. It is due to the fact that there were more data. There were 657 observations available. F-test revealed that the model as a whole (both equations) was statistically significant.

Econometric verification revealed that the distribution of the residuals was not normal in both equations and for both cases. This does not affect the quality of the estimated parameters. Pesaran-Taylor test for homoskedasticity rejected the null hypothesis (H_0 : the residuals are finite and constant) in all cases (both FB pages and both equations). Hence, there is heteroskedasticity present. Again, the quality of the parameters is not affected, only the standard error is biased. Therefore we used HAC error and re-computed the models again. Results (displayed in table 3) control for heteroscedasticity (the results of original models are not presented).

Facebook page		FB page A		FB page B	
Equations	Coef. [Variable]	Coef. (Std. err.) sign. level	Avg. Elasticity	Coef. (Std. err.) sign. level	Avg. Elasticity
$\beta_{11}y_{1t} = \beta_{12}y_{2t} + x_{0t} + \gamma_{11}x_{1t} + \gamma_{12}x_{2t}$	$\gamma_{10} [x_{0t}]$	1599.75 (896.172)*	---	1887.12 (146.80)***	---
	$\beta_{12} [y_{2t}]$	3.36 (3.28)	0.38%	5.59 (0.79)***	0.37%
	$\gamma_{11} [x_{1t}]$	13.08 (26.19)	0.13%	7.67 (7.16)	0.02%
	$\gamma_{12} [x_{2t}]$	30.86 (40.93)	0.08%	355.04 (73.61)***	0.05%
Statistical verification	R2	0.1446	---	0.3382	---
	adj. R2	0.1384		0.3351	
	F-test	2.09*		52.06***	
$\beta_{22}y_{2t} = \beta_{21}y_{1t} + x_{0t} + \gamma_{23}x_{3t}$	$x_{0t} [\gamma_{20}]$	777.72 (603.48)	---	200.16 (72.19)***	---
	$y_{1t} [\beta_{21}]$	0.42 (0.22)*	0.61%	0.13 (0.02)***	0.66%
	$x_{3t} [\gamma_{23}]$	0.10 (1.96)	0.0004%	8.33 (6.55)	0.02%
Statistical verification	R2	0.1511	---	0.3192	---
	adj. R2	0.1470		0.3171	
	F-test	2.47*		708.38***	

Note: * marks significance level $\alpha = 0.1$, ** $\alpha = 0.05$, *** $\alpha = 0.01$.

Table 3. Results of simultaneous models; Source: Own calculations based on data from FB pages

The coefficients have expected sign in all cases. Constant tells that if there were no likes, no shares and no lifetime engaged users, the lifetime post organic reach would be 1599.75 in case of FB page A and 1887.12 at FB page B. This might be considered as the basement, “the normal”, or “the usual” post reach. They represent approximately half (1.8 and 1.7) of the fans. It was expected that larger page with more fans will have higher reach. However, during the observed period an average reach was higher in case of the FB page B with 6 times less fans (see Table 1). This proves the fact that FB cuts the organic reach of the bigger pages.

Other parameters are interpreted in absolute terms and express the marginal change in explained variable when explanatory variables changes by one. When the number of lifetime engaged users increase by one, the lifetime post organic reach increases by 3.36 in case of FB page A and 5.59 in case of FB page B. Again, larger page has lower post reach when it engages one user more. For meaningful comparison, the elasticity of the parameter should be used. In percentage terms, when the number of lifetime engaged users increase by 1%, the lifetime organic reach of the post increase by 0.38% in case of FB page A and 0.37% in case of FB page B. When the number of likes increases by 1 the lifetime post organic reach increases by 13.08, by 7.67 respectively. In this case the marginal effect of 1 more like is higher when the FB page is larger which is in line with the expectations. Elasticity tells that the one percentage change of number of likes causes 0.13% or 0.02% change in post reach. The likes seem to be more important for larger pages than for smaller as they bring higher reach. However, none coefficient was statistically significant and therefore no universal conclusion can be made.

When the number of shares increases by 1 the lifetime post organic reach increases by 30.86 on FB page A and by 355.04 on FB page B. This could suggest that shares are more important for smaller page. The elasticity tells otherwise. Higher effect is in case of the larger page, but it is not statistically significant. When the number of shares increases by 1% at smaller page, the organic reach statistically significantly increases by 0.05%. The second equation explains the number of engaged users, hence the relation to the post reach is simultaneous. When the number of lifetime post organic reach increases by 1, the number of lifetime engaged users increase by 0.42 on FB page A and by 0.13 on FB page B. It is not a significant change in absolute terms, but in relative, only 1% change in post reach brings high change of engaged users. When there are no comments and no lifetime post organic reach, the number of lifetime engaged users is 777.72 at larger FB page and 200.16 in case of smaller page. When the number of comments increases by 1, the number of lifetime engaged users increase by 0.01 in case of FB page A and 8.33 at FB page B. It is logical as the users who comment or do any other activity on the FB pages are “engaged”. It can be seen that in relative terms the effect from obtaining one comment is higher in case of a smaller FB page. However, the parameter (coefficient) was not statistically significant.

Our results show the importance of the “traffic” on the FB pages. Likes, shares and comments increase the engagement of the users and hence the lifetime organic posts reach. However, the effect is not statistically significant for larger FB page. It might be due to the fact that high percentage of its posts is paid (37.3%). While the total lifetime organic reach over the whole period is 1 227 495, paid is 3.8 times higher (4 672 942). This implies that FB paid reach might diminish the organic reach (and the statistically significant influence of likes, comments and shares – i.e. the activity of the fans). It also seems that small pages profit more from the number of engaged users and number shared posts. The richness of the post is also important. As found out by Sabate et al. (2014) the inclusions of images and videos raises the impact of the post in terms of likes. Especially using images and a proper publication time are significantly influencing the number of comments, whereas the use of links may decrease this metric.

4. Conclusion

The aim was to find and examine the determinants of the key measures of the success of the Facebook (FB) page – lifetime organic reach of posts and the number of engaged users. Both measures are influenced by the number of FB page fans. But the relation between the size of the page and post reach and users engagement is not positive and linear. We compared two FB pages of different sizes from 1 January 2015 to 30 March 2016. FB page A had almost 70 000 fans and B almost 10 000 fans. Two-equation simultaneous model was constructed. Both FB page's success measures are explained by the number of likes, shares and comments respecting the requirements for model's identification. Our analysis showed that smaller FB page has higher reach per one post than the larger and is able to reach 35% of its fans while the larger only 5%. Increase of the number of post's "shares" increases the post reach statistically significantly only in case of smaller FB pages. If there were no "likes", no "shares" and no "engaged users", the post reach would be approximately at the half level of the average organic post reach. If there were no "comments" and no "post reach", the number of engaged users would be higher for larger page. There were statistically significant results obtained mostly in case of smaller page. It might be due to that the large one utilized more paid reach. FB paid reach might diminish the organic reach. The relation of organic and paid reach shall be the subject of future survey as same as the content and types of the posts in order to see whether they influence the reach and users engagement.

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INTERNAL COMMUNICATIONS SUPPORT THROUGH ENTERPRISE SOCIAL NETWORK

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Keywords

ESN, enterprise social networks, employee, communication

Abstract

The paper deals with the benefits of enterprise social networks for the purpose of internal communications and data sharing between employees in the company. In many companies is very poor communication between employees and the other for leadership of the company. Social networks is currently one of the approaches to the solution of enterprise communication. The text first describes the issue of internal communication. Also mentioned is the status and trends in the market of enterprise social network solutions.

1. Introduction

Social networks and media in the enterprise information system used for different objectives and purposes. Their use has been so far focused primarily on the external communication with customers and business partners. Social networks are becoming an important channel of communication with existing and potential customers. They become an integral part of CRM applications. Social CRM is a new approach to the customer so different from traditional forms of CRM, the need in companies to implement entirely new business strategy which must be reflected in business management. (Šedivá, Müllerová, 2014).

The potential use of social media is much greater. Informal communication between participants, availability of connection 24 hours a day, the possibility of sharing data of different formats, lower financial costs for implementation and not least the popularity of this form of communication among users new possibilities of social networks opened up for communication employees within the enterprise.

One of the most important factors of effective operation and management of the company is to promote internal communication between employees of the company. The company addresses this functionality in the information system of the different technologies and software, eg. in-house portal, intranet, groupware, ECM applications or Web 2.0 tools. Managers want to use social networking functionality in companies in secure environment. Enterprise social network (ESN) is used for internal communication within the organization and has access to it only a certain group of people. The goal of internal communication is to make employees better understand what is

happening in the company, where it is going, what role it plays, and so they wanted to contribute to the business goals and improve relations between them. (IIK, 2015)

Personal profiles in ESN can save not only common information about the employee but also information about his competence, projects and work skills. Furthermore, there exist profiles of objects that contain particular client accounts, documents and reports that relate to a given object. Ineffective internal communication may then (Fiedler& Horakova, 2012) related to the following negative consequences, some of them can be essential for the enterprise:

- assigned tasks and organizational goals are not achieved,
- low motivation to achieve the required goals,
- lack of confidence in company management,
- financial losses due to lower work efficiency,
- higher turnover of staff, or even factitious illness.

The above mentioned negatives of internal communications can have a significant impact on the running of the whole enterprise. Can greatly slow down information flow between employees of the enterprise. These negative impacts dysfunctional communication within the company can be dealt with implementation of the new means of communication - Enterprise social network.

2. Can Social Networks Help to Increase Productivity in Enterprise?

ESN provides a unified platform for customers, employees and partners to collaborate on tasks, knowledge sharing and communication. It can also be used as a platform to support customer support through shared knowledge portals and instant communication tools. Users also have the ability to assign tasks and monitor the development of the project, set reminders and notifications, schedule meetings and other events. Of course, users have their profiles and the ability to record the latest updates, status, graphs, links to articles, and more.

According to the research accounts for about one fifth of the average employee seeking information. The introduction of enterprise social networks, this figure drops on average by about 13%. (Chui, 2012). An interesting observation is that more than a third of firms admitted that they had introduced ESN just because it uses competition and did not want to be left behind. (Van Vonno, 2015). Improved results that companies with ESN reach, yet are quite significant.

Due to the ability to create group conversation, the better and faster access to data decreases the necessity of organizing meetings by an average of one quarter, so in total, employees have more time on their work. It was also a significant improvement in the field of employee involvement in projects due to the higher level of knowledge and awareness by up to 147%. Employees are also more loyal due ESN his company on average about one-fifth. Another advantage can also be a great savings for software, hardware, licensing and pricing of storage space for data. Employees can also considerably faster to look up data and files they need. (Margolis, 2016).

According to another survey published by the McKinsey Global Institute, enterprise social networks have also proven to increase productivity and speed innovation and increase profits. Specifically, the time required to introduce innovations shortened on average by almost a third, productivity increased by 15% and profits grow faster on average by a tenth.

Among the most interesting results of the social survey was also SAP in collaboration with econsultancy.com. The Company has calculated that companies in the US market lost an average of 26,000 per year per employee due to communication barriers. (Bughin, 2015)

2.1. Role of Employees in Implementing of ESN

The implementation of ESN is not for companies easy because it is a strategic project. It refers to the large number of employees, and therefore the success of the project is heavily affected by human factor. Traditional way, where companies only provide training of their employees is not often successful. In order to use solutions and enterprise social networks successful, employees need to be active. Therefore are often used different teaching methods, like gamification. (Valdman, 2014)

Complexity of implementation and possible solutions to the problem can vary according to the size of the organization. Typically, you must first familiarize workers with the network, explain the benefits and encourage them to use. In the future, employees need time to get a new communication tool used to it and know its benefits. The length of this period depends on the quality of employees on applications for ergonomics of the application, the number of functions that the organization wants to use, and of course on the skills of the employees.

Easier progress of adoptions by ESN (Mumba, 2016) can support the following terms and conditions:

- *Financial* motivation - financial incentives for executives to understand the importance of changing what savings are expected and what advantages the new system, in which the company invested. This strategy must be fully transparent and clear system of rewards.
- *The transition process* - business managers, line managers and team leaders must implement processes that can be done only with ESN Business Manager.
- *Culture* - corporate culture should be implemented into the implementation plan ESN users to better adapt to the changes.
- *Training* – is very important, but it is often overlooked in an adoption process. Training and demonstrations should take place before, during, and after the introduction of ESN to achieve the best results.
- *Gamification* - a tried and tested form of introducing ESN. Employees can offer rewards or points for using ESN, eg. For sharing, commenting, or “likes” posts. The reward system is suitable for the entire period of use, because then you can follow the initiative of workers and traffic on enterprise social network.

2.2. Selection of the ESN Solution and the Market of ESN

There are many types of Enterprise Social Networks. They aimed at doing the different roles in companies. They can provide different control logic, design and locations - such as communication systems (such as Yammer), a collaborationist separate systems (like Jive), networks that are part of comprehensive software solutions to companies like SAP Chatter or predominantly on knowledge collaboration, such as Sharepoint. (Parkinson, 2015).

Ten core functions and goals of ESN) that are required for the use of social networks in corporate environments are presented in the Table 1.

ESN Function	Goal
Connecting people	Community and social network
Communication	Communication in a community
Sharing and discussion	Cooperation
Knowledge management	Storing and sharing knowledge across the community
Web and content management	Publishing and content management
Coordination with external communities	Connections with customers, suppliers and stakeholders
Tools for the delivery process	Allows the system to be used throughout the process and deliver business value added
Productivity tools	Productivity with this tool must always be higher than without it
Interoperability	The ability to link to it and integrate into other systems
User knowledge	Lack of knowledge of ESN leads for users to tend not to use network

Table 1: Required Functionality of ESN (Parkinson, 2015)

The above mentioned functions required for ESN are also the key issues for the selection of a particular solution social network. When designing a network should consider the following basic questions:

Will be enterprise social network connected to other applications in information system? For efficient work of employees is necessary to collaborate across applications in the information system (e-mail, CRM or other ERP applications). Users can then work directly with other applications in the social network.

Is there user-friendly interface of application? Easy and friendly user interface will accelerate the adoption of new application users.

What level of application security offers the system? Because this is a cross-sectional solutions to many users across the enterprise, it is necessary to ensure security for the various levels of the organizational terms.

How large should be the a user profile? Profile allows the employee to describe their skills and experience, which will allow easier tracing of the employee and to facilitate identification of the right people for new projects.

What options file sharing system offer? The user should be able to upload, share and collaborate on documents of various types (text, image, multimedia, ...). This functionality will be for many companies an important factor in the selection. It is possible to add tags to your files to facilitate their traceability?

To what extent it is possible to customize the product? After the product has been implemented, the company may want to add another extension, or a product more customizable. It can be created custom applications for the platform? What tools? What level of expertise will require the development of applications?

What kinds of mobile features are available? Mobile devices enable collaboration anytime and anywhere, which is necessary especially in the field of interpersonal communication. Is the system

accessible from mobile devices and which mobile platforms are supported? Are some of the functionality of the mobile device somehow limited?

The current market offers enterprise social networks represents a relatively wide range of applications. The current leaders on the world market are IBM Connections, Salesforce Chatter, Yammer and Jive Software. (Figure 1) Market ESN field, however, rather rapidly. The highly anticipated Facebook at Work, whose entry into the market will almost certainly pulls no small number of clients for himself and cause the adoption ESN other companies. It is therefore expected that the market will be entering Facebook heavily affected.

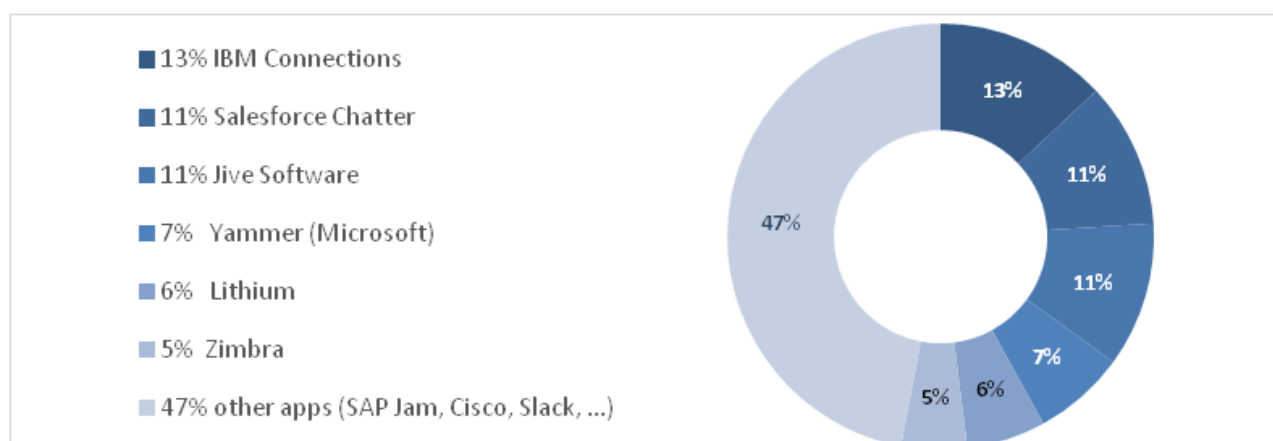


Figure 1: The share of large ESN market leaders in 2015 (Source: (Margolis, 2016))

Microsoft (Yammer), Slack and other influential companies expect to issue a new generation of ESN already in 2016, for which the expected enhanced features such as detailed analysis of the content and information management tools - an effective and interactive social intranet and extranet. New tools likely to increase the level of productivity of workers and companies. Many factors will influence future developments, eg. the level of customization of the new ESN version. (Hawes, 2015)

Despite the great potential of ESN has not happened yet time when the enterprise social networking the main point of conflict communications people, processes and information.

3. Social Networks Usage in Companies in the Czech Republic

Using social networks and other social media in companies in the Czech Republic lags far behind compared to the EU, according to a survey conducted by Eurostat in 2014. (Eurostat, 2016). Data to be valid for January 2015 show that only 20.4% of companies in the Czech Republic use social networks, 9.2% of companies use the sites for sharing multimedia content and only 2% of businesses use the sites for sharing knowledge. These numbers are far below the average in the EU (Figure 2 shows only selected EU countries).

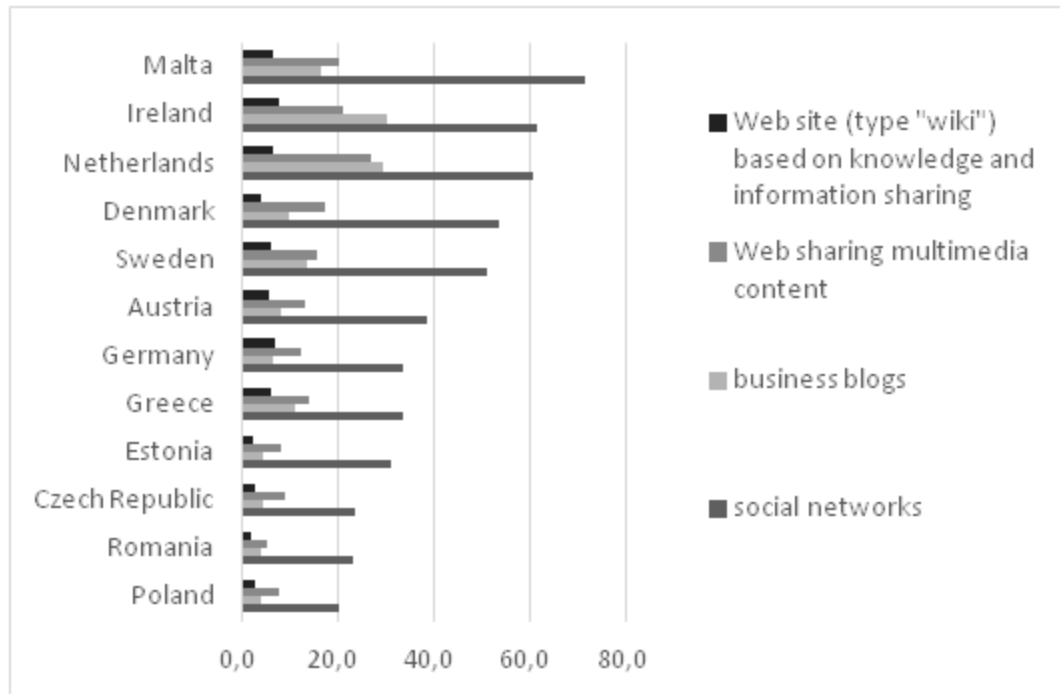


Figure 2: Active social media usage in enterprises in the EU (January 2015)

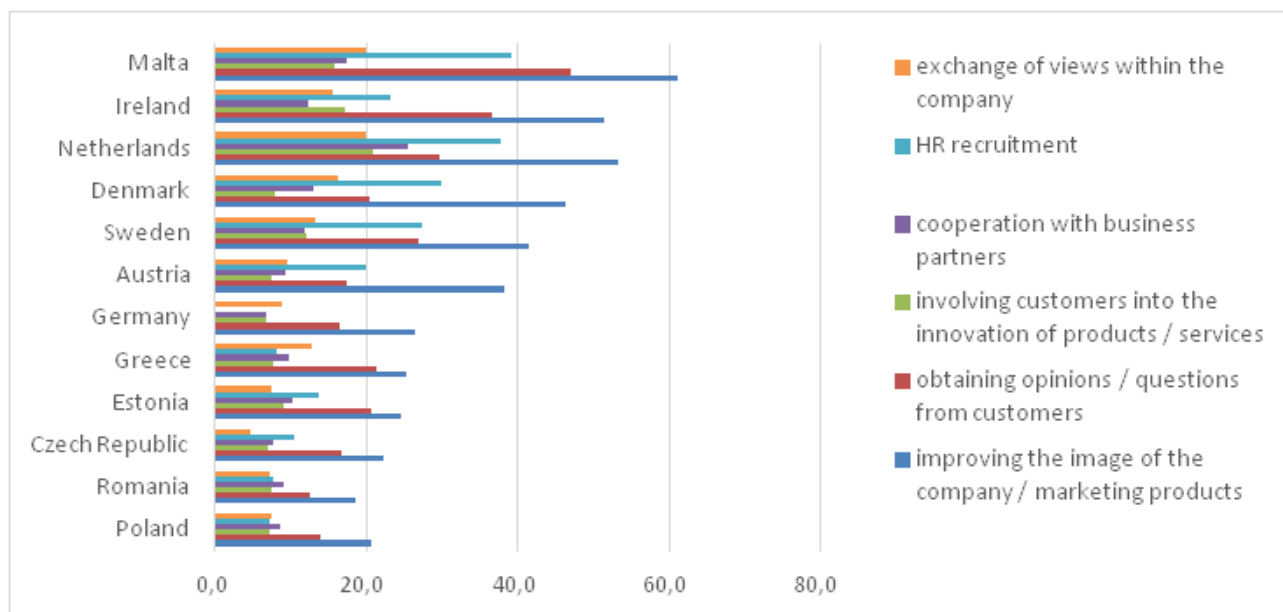


Figure 3: Reasons for using social media in enterprises in EU

Malta, Ireland and the Scandinavian countries are using social networks the most. Social networks there uses 60-75% of enterprises. 39% of EU enterprises use social networks on average.

Figure 3 shows the purpose of the use of social media in enterprises in selected EU countries (CZSO, 2015). Social networks are still used mainly in external communication, especially for marketing and HR management (up more than 60% of enterprises) and for obtaining or monitoring opinions of customers on the network (20%-47%) . The use of social networks for internal communication is not yet solved in companies in a much lesser extent (from 10% to 20%).

4. Conclusion

The most innovative companies use enterprise social network for data management and collaboration for more than 10 years. (Margolis, 2016). McKinsey Global Institute followed 1,500 companies and their use of social technologies between 2006 and 2015. During the observation, it was found that the results of this study are particularly beneficial.

By 2011, however, corporate social network used by more than 40% of companies. Already in 2012, almost half of the surveyed companies communicate and share data across the organization using the ESN. Since then, growth slowed slightly, which between 2012 and 2014 there was an increase of only 10%. By 2017, analysts predict that enterprise social networking will take 70% of companies will market saturation. (Margolis, 2016).

It is widely known that the communication level dialogue allows businesses to more quickly build trust among customers, employees and suppliers than traditional answering queries with a delay such as via email.

The text of this article results in the following conclusions:

- Design of the enterprise social network is no longer seen as a closed network for community employees, but is perceived as a platform for communication between employees, customers and business partners.
- To design and enterprise social network solutions not only applies the rules to design any application information system, but simultaneously solves in close relation with other disciplines such as psychology, consumer behavior, interpersonal communication and company management.
- To be solution of the corporate social network for internal communication effective, it must be very carefully analyzed what goal is a solution to meet ESN. Consideration should be given, for which community people network is designed, for what purpose, what data should be shared, related to the type and size of the company.
- The human factor plays a very important role. Network design, methods of communication and involvement of individual employees is a very sensitive matter. It should be well considered design of the user interface for fast and easy communication.
- Finally, the successful deployment of social networks depend on the involvement and activity of employees, and therefore it is necessary to think well motivated, which will support the activities of the employees. It should also be integrated into the business management.

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SPECIFICS OF USING SOCIAL NETWORKS IN THE MARKETING IN SLOVAKIA

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Keywords

Social network, marketing, B2C, Slovak Social networks, Czech Social networks, business support

Abstract

Social networking phenomenon affected the whole Internet community and constantly gaining new users of all ages and from all areas social, cultural and economic life. The paper focuses on the use of social media in the B2C marketing from production and sale of beer. The introduction and literature section describe the basic approaches to social media in marketing. The third part of this work presents the results of survey focused on if the social networks help as a tool for business support and if yes, how. The paper gets the feedback from customers about the promotion of company on social networks.

1. Introduction

Social networks like Facebook are an interesting area in which the brand can act as an independent individual who gives information also another separate subject. However, this is only one of many options that provide social networks, any social network allows for much more advanced features, such as e.g., the formation of different games, groups and systematic presentation tag, each at least slightly experienced user.

Each company is yet another, and social networks offer a variety of different tools to use. That the company knew at all for it to choose a suitable tool, you need these tools as well as methods for utilizing tell where the art of social networking is dedicated to many authors. They have focused most of its attention on ways of their exploitation, and not on a real impact on which companies are, therefore, this impact can be measured simultaneously and difficult. Social networks have typically chosen at a suitable communications positive influence on society, especially on building relationships with your customers. The question is whether there are effective not only in communications, but also when they are used in the sale itself. Motivation for the emergence of this project is to investigate the effects of social networks, as the sales channel for the company and when it will focus mainly on business on the Internet.

The importance of using social networking as a marketing tool is growing rapidly. The analysis of the interdependencies between customer and consumer network can help to attract corporate customers who have been identified through traditional methods. Today, with advances in information technology, social networks are not limited to physical face to face. Online social

networks have become a new interface for direct oral marketing. While direct, oral marketing has greater impact on the purchase decision of customers, in recent years, with the growth of the Internet and virtual communities, oral communication has been created in online channels.

Specific area is Slovak market because, despite computerization Slovaks very little use of internet sales. Yet that does not cover the growing tourism segment the same amount as in the rest of the European Union. The average result of the sale in the EU is 25,7% and Slovakia has only 19,2 %. (Poštová banka, 2016).

2. Literature review

Social networks are defined as a body of applications that increase and support group interaction and shared spaces for collaboration, social connections, and aggregate information exchanges in a web-based environment (Šedivá, Mullerová, 2014). Social networks and their use are rapidly expanding into different areas, due to their popularity and quick interventions of many target groups of users. Therefore, for example, they are popular among students and their teachers (Pavlíček, 2015, Šedivá, 2015), and of course as a tool of marketing communication (Királ'ová, 2015).

"Marketing on social networks is not a direct way of influencing potential customers, but indirect. It is not an immediate sales but creating awareness among customers, which eventually result in a sale. Therefore probably it is best to define marketing on social networks very similar to defining the general marketing. It is a "way of communicating, creating and providing value to customers." (Scott, 2010.)

Social networking is a social structure made of nodes which are generally individuals or organizations. They are interconnected by means of one or more specific types of communication such as financial transactions, friendship, business, emotions, passions, hobbies and habits. Nowadays huge volume of information on social networks, blogs, sharing sites and sites related to scenic cities and big countries are available. (Zamani, 2016)

In 1960, for first time, social networking was introduced at the University of Illinois of United States. Then in 1997, the first social networking site was launched to URL of Sixdegrees.com. But after the 2002, there was explosion of commerce in social networking websites such as LinkedIn and Orkut, which caused enormous changes in the social networking field. (Chen, 2007)

In the world of e-marketing, new trends are emerging and new models are introduced o business. One of the latest trends is social networks which not only attracted a large number of users and visitors but represented a space for advertising of companies and various corporations. Social networks have connected people to all different types of favorites and one of the growing areas in use of social networks is pages and issues related to manufacturing and service organizations and companies.

„One of the most difficult marketing tasks is the prediction of demand“(Lumsden, 2001). This forecasting method is divided into two main groups: 1. qualitative methods 2. quantitative methods. „Qualitative methods are methods that use mind detailed analysis to assess future values in demand“(Lumsden, 2001). Quantitative methods are based on the analysis of current and past data and sometimes also consider future demand and potential changes.

A specialist in the marketing is still engaged in development of exact tools to measure effectiveness of marketing communication.Measuringthe effectsof using social media in the marketing communicationsofbusinessenterprise research is published by Smutny (Smutnyat al., 2013).

An important element of applications on social networks is the ability to build your own image or brand. Facebook available hundreds of the most popular applications and every day hundreds people- regularly use as a marketing tool is not bad, plus it does not cost anything and it's very easy“. „The best marketing tool on Facebook is three useful ways to get information and ideas on a network where people interested in your products and services are interested in. Itscommunication “between friends,,“between groups „and“ between applications“. (Scott, 2010).

3. Methodology

Purpose and research tasks. The research was focused on the importance of targeting ads by using the Internet in selected specific product sales i.e. beer. The survey focused on respondents living in two regions of Prešov and Košice. Brewery is a local brewery, which has the ambition to save place in studied region and whilst also wants to expand to the whole territory of Slovakia. Beer named Šariš product belongs to the transnational network Topvar.

Current status. In Central Europe as well as in Slovakia, holding their first facebook.com, which is communication channel for many products and is the most popular social network in the world.

The goal was to find out how to use social networks randomly selected group of respondents.

The aim of the research was to find out how to use social networks randomly selected group of respondents, as well as their uses enterprise that we have chosen.

The aim was to: 1. To find out of the business entity as it helps to use social networking as a tool for business support. 2. Get the feedback from customers about the promotion of your company on social networks. 3. Determine whether Internet traffic is younger or older vintage.

Assumptions: A1/ assume that the website associated with the promotion of beer will attend more men than women. A2/ assume that younger respondents increasingly using social networking and Internet sharing than older vintages.

The main method for us became a quantitative method using a questionnaire and obtain information needed to confirm or reject our assumes set. We questionnaire method we chose for its economy, anonymize (increase the honesty and sincerity of answers), financial modesty and easier evaluation.

The total number of questionnaires was 700 pieces, of which we returned for the research period 700 (100%) completed questionnaires.

The questionnaire contained eight questions and closed two demographics. The questions were formulated briefly and simply the respondent easily understands the meaning of the question. The answer questions were specifically designed to respondents could choose one or several options at its discretion. The questions were intended to determine how often they use the Internet and where, what needs to be used, what the social networks most used by respondents on what devices are connected. Other issues we examined which types of sales are the most used social networks and how their users perceive then as they notice ads on the website and what should be their subject. The last question focused on whether it affects education using the Internet.

Research was conducted between 2014 and 2015 the population of the Prešov and Košice regions. Research was created in collaboration with Peter Marhefka and part was used in the final thesis Petra Marhefka.

With processing the data obtained, we used mathematical-statistical methods and we summarize them in outcomes by focusing questions to test hypotheses. The research results are presented using graphs given in absolute numbers and percentages.

4. Results and discussion

The basic question we addressed is the use of the Internet respondents. The questions were focused on finding internet using in different age structures. What kind of place, and what used to work with the Internet. At the same time questions were aimed at how and why they use social networks.

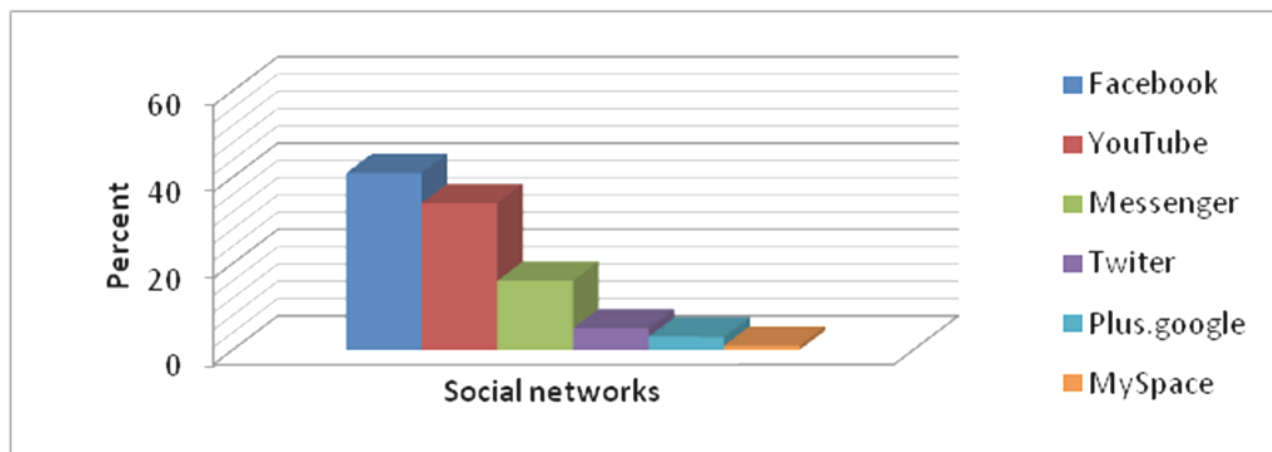
Of fusing it shows that most respondents use the internet every day 480 (69%), second only to the respondents to the number of 150 (21%) who use the Internet several times a week, followed by respondents using the Internet a few times per month in the number of 40 (6%) and as a final group of 30 (4%) which does not use the internet at all.

We also questioned why use the Internet, what is their main concern when working on the Internet

When reviewing meet the needs of most frequent use of the Internet and our findings tell of a total of 700 respondents, which asked respondents could select more than one, with 190 (22%) expressed surf on social networks, 170 (20%) use the Internet for connection to the bank, 160 (19%) using e-mail, 150 (17%) of online shopping, for viewing video clips, pictures, movies, 70 (8%) of respondents to seek employment it uses 60 (7%), the education used 40 (5%) of respondents stated as other work programs by various statistics 20 (2%).

Respondents reported further what social networking sites are most used. On this question, respondents could give more options.

Most respondents said social network Facebook 310 (41%), followed by YouTube with the number of 260 (34%), Messenger uses 120 (16%) of respondents Twitter 40 (5%) of respondents Plus.google 20 (3%), MySpace 10 (1%) of respondents does not use LinkedIn, and none of the respondents. Seegraph no. 1.



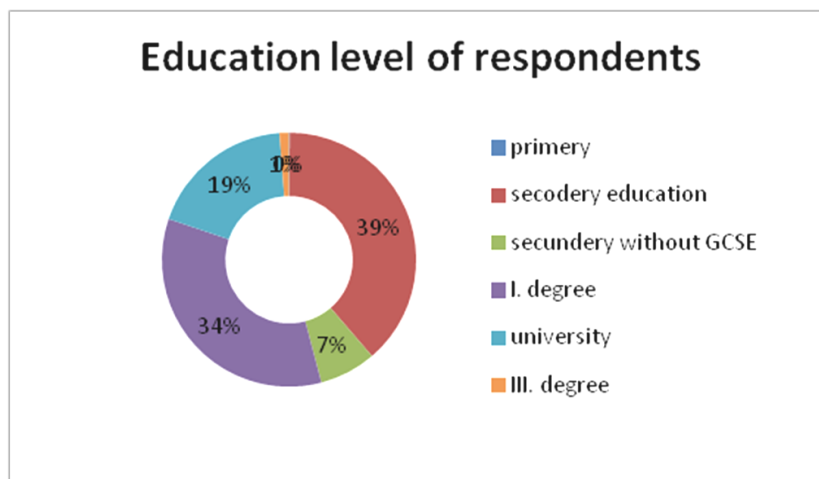
Graph 1

To devise a suitable advertising is necessary to find out what device devices are most often connected to the Internet

Respondents' reactions to advertising web sites Šariš. We were asked our respondents on how they notice these ads. 250 (36%) stated that they have their everything, but tries to ignore, it still is everything 220 (31%), sometimes the perception of 190 (27%) of respondents, ignoring the 40 (6%) of respondents.

Education of our respondents. Respondents were educated to upper secondary education 270 (38,6%), followed by a group of higher education in the first grade of 240 (34,3%), it is a university

education. 130 degrees (18,6%), followed by secondary education without GCSE 50 (7,2%), higher III. degree 9 (1,2%) and basic education was 1 (0,1%) of the respondents. Seegraph no 2.



Graph 2

After seeing the advertising pages of this company could improve information on events, festivals and beer marches as they think most 210 (25%) of respondents, followed by information about competitions, which reported 160 (19%) the respondents, it is the information about discounts the number of 140 (16%), multiple images might appear on a page that holds 120 (14%) of respondents, 60 (7%) of respondents said that they could contain a humorous comment, colorful advertising would be interested in 50 (6%) of respondents and other options did not nobody.

Examining the age is a crucial factor, as we see clearly on who may be targeted advertising via the Internet and how SPOSA can reach respondents. The answers we can see that out of 700 respondents, the largest group consisted of 250 (36%) of respondents aged 18-23 years, followed by a group with the number of 240 (34%) of respondents aged 24-33 years, 140 (20%) were group from 34-44-years age group 45-60- consisted of 50 (7%) and respondents over 60 years of age were 20 (3%) respondents.

Discussion. The aim of our research was to find out how to use social networks we randomly selected group of respondents, as well as their uses enterprise that we have chosen. Based on the processed data collected for our research undertaken using a questionnaire aimed at verifying hypotheses we have checked the following conclusions:

Verification formulated hypotheses, we used data that we have arrived quantitative and qualitative processing of individual respondents' answers.

A1/ which assumption was that the more respondents will be men than women, our assumption was confirmed. Based on the analysis of the results relating to the examining beer ads we can say that of 700 respondents surveyed was 410 (59%) men and 290 (41%) women.

A2/ in which we assumed that respondents aged 24-34 years attending the Internet more frequently than respondents 45 to 60 years. The assumption of this hypothesis is confirmed to us. An analysis of the responses to the last demographic issues, that of the 70 respondents largest group consisted of 250 (36%) of respondents aged 18-23 years, followed a group of 240 (34%) of respondents aged 24-34 years, 140 (20%) constituted a group of 34-44-year age group 45-60- consisted of 50 (7%) and respondents over 60 years of age were 20 (3%) respondents.

The aim of the research was to find out how to use social networks we randomly selected group of respondents, as well as their uses enterprise that we have chosen.

To learn how to help the social network for business, we have teamed up with a company that we chose Pivovar Saris, via email. Our questions about how the business use of social networks and willingly provided information. Using social networks and the Internet in their business is multifaceted. Use the quick contact with each other, contacts with suppliers or customers, and customers. This well-known company uses in a large number of social networks like Facebook, Instagram, YouTube to promote their products thereby enhancing their sales, advertising various events and meetings, of course, cannot do without their quality beer. Finally, a communication on Facebook where people write their opinions and insights.

Our second objective was to determine the feedback from customers about the promotion of your company on social networks. Since in our case the company for beer, our findings have focused on the use of not only the Internet but also to a particular company. The findings, which we observed in 2 assumptions have confirmed to us that in this case social networks use 410 more men (59%) than women 290 (41%).

If we compare the Internet traffic by age so we can see that most Internet visitors is among the younger generation aged 18-23 years with a number of 250 (36%) indicating that interest in this age group is really the greatest. Followed by group number 240 (34%) of respondents aged 24-34 years, 14 (20%) was formed by a group of 34-44-years age group 45-60- consisted of 50 (7%) and respondents over 60 years of age were 20 (3%) respondents.

To achieve the objectives it is essential that the Company maintained activity and communicate via social networks regularly and long term. The key to success is mostly interesting and interactive communication with current and potential customers. The main tool storefront Saris consider a business page on Facebook as well as YouTube, which also still used.

Especially for a product Šariš is created a website www.saris.sk. In a joint website: www.pivovarytopvar.sk where is original interactive web portal called: Social media pub, where the brand has its special folder Šariš- Srdcom východniar. Advertising slogan Šariš- Srdcom východniar is from 12.9.2012. It was open day and started the promotion of this product with this advertising slogan. The first in the internet company started to advertise their presentations shares and later began to use Social media pub as creative access point for presentation and promotion advertising videos.

On Social media pub are offered the additional options for users, not only share and rate videos, but can create a new comment or dubbing for advertising spots. Along the page are posted by the 300 clip about which people can vote. It is an interactive site one offering the latest products and promotion of company and product awards. Very important it is creating a community: Som Východniar and Mapa Východniarov and their updated and posted on the net. At the same time there are only the facts that create a sense of exclusivity.

The company has created its own Facebook page: <https://www.facebook.com/saris.sk/> where share its activities, published a calendar of events, and also promote its videos. Sharing sites is about 35 000 people who LIKE individual videos or posts.

Other social media is YouTube. YouTube is along the (stage in 30.5.2016) suspended 400 videos related to advertising brand Šariš. With the slogan Srdcom Vychodniar are 246 videos. Most watching had a video entitled: Čekovský obchodný zástupca pre Šariš with the 331,069 viewings.

On Instagram #sarissrdcomvychodniar are suspended 4 posts and comment s users Instagram. The largest number of LIKE are 49 positive and 7 negative. Company is using Instagram by examining areas that interest users Instagram and what he likes and what not.

It is therefore necessary to support the older generation in the use of modern "phenomenon" for example, various computer courses. By now the Internet by Slovak Statistical Office uses 48% of older people in the various online shopping where you try to save some money and also "skyping" with your loved ones who support family and social ties.

5. Conclusions

Social networks play an important role in modern marketing product presentation. We see that as well as current trends are particularly unstoppable in a global society and there is no problem in the fact that Slovakia has undergone a transformation after a totalitarian society, which had the effect of Saris with customers. Is it still the consequences of such a law, and generations of people who were in productive age 20 years ago? But this does not, even to this generation of people able to mobilize knocked could it be involved in community life network within the product presentation. Internet and social networks created in each segment of the potential targeting of ads, while the improving the procession product and meet the needs and satisfaction to customers. The community is a natural way of life for any man is creating virtual personal relationships that are irreplaceable, because it changes lives and helps share values to be virtual.

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VALIDATION OF THEORY OF CONSUMPTION VALUES SCALES FOR DEAL SITES

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Keywords

Deal sites, theory of consumption values, qualitative research

Abstract

Deal sites became a widely used artefact. But there is still only a limited number of papers investigating their adoption and use. Most of the research published on the topic is qualitative. It is typical for an early stage of investigation of any new artefact. The Theory of Consumption Values explains purchase behavior. The aim of this paper is to validate scales for the Theory of Consumption Values for deal sites. This should pave a way for quantitative investigation of motives for purchasing using deal sites.

1. Introduction

Deal sites are used by a variety of services and retailers. Probably the most well-known deal site is Groupon. There are several reasons for it. First of all, the company spends a high percentage of the budget on marketing activities. Secondly, it was discussed in mass media because of several reasons. It was the first deal site to go public - in late 2011. Moreover, it was the biggest initial public offering by an Internet firm since 2004 when Google went public. Media coverage in financial media was even higher due to the fact that Groupon did not use standard accounting metric but it tried to present revenue as profit while, actually, the company was in loss. Additional media coverage stems from the fact that the stock price was falling already shortly after it started to be traded - from \$20 it went to almost \$30 but it fell approximately one tenth since then.

The core feature of deal sites is that they offer coupons (discount vouchers). These (deal sites) coupons need to be purchased (old-time paper coupons were typically for free in newspapers or alike). Deal sites coupons usually offer deep discounts (possibly of 50% or more). According to Gros and Grosová (2006), price of goods or services is just one of the selection criteria, though still very important. According to Delina (2014), "transparency is not so clear dogma as it is presented in most of scientific papers or commercial proclamations". In general, traffic at a site does not necessarily turn into sales, as it was illustrated by Tolga Saruc, Dorčák and Pollák (2013). Smutný (2015) investigated importance and the use of online marketplaces (e.g. AppStore,

Groupon) for marketing activities. Šedivá and Müllerová (2014) investigated use of social customer relationship management and they found that its use depends on company size.

Groupon's business model is specific in a sense that these coupons become valid (and money is withdrawn from customer credit cards) only if there is a threshold number of coupons sold for a particular service or goods within a certain amount of time. Customers tend to share the offers they like/purchased/want to become valid on social media in order to attract more customers, so the threshold number of sold coupons is achieved. This specific feature of Groupon generates additional social media buzz compared to deal sites that do not require a threshold number of coupons to be sold in order for a coupon to become valid.

Last but not least reason for deal sites to be discussed in media is the fact that both customers and companies have mixed experience with using deal sites coupons. Edelman, Jaffe and Kominers (2016) analyzed how to make offers profitable for companies selling Groupon coupons and they suggested that it would make sense for a company to allow a customer to buy only one coupon. But Friedman and Resnick (2001) pose that such a restriction is hard to implement because a consumer can set up more than one account and buy more coupons from one company this way.

The Theory of Consumption Values (Sheth, Newman and Gross, 1990) provides a framework to categorize customer's motives for buying:

- functional values - values related to utility,
- social values - values related to being highly valued by others,
- epistemic values - values related to learning,
- hedonic values - values related to pleasure,
- conditional values - functional and/or social values present only in some situation.

The Theory of Consumption Values is not so widely used - there are only 15 entries at the Web of Science Core Collection - 12 journal articles and 3 conference papers - besides the article published by Sheth, Newman and Gross (1991) which was already 370 times cited by Web of Science Core Collection, many times instead of their book (Sheth, Newman and Gross, 1990).

The rest of the paper is organized in the following way: In the next section, there is a description what data were collected and how, and how they were analyzed. In the following section, results of the analysis are presented. The last section offers conclusions.

2. Data and methodology

Data were collected in the spring semester 2014 using an on-line questionnaire. Respondents were 284 university students from Denmark. Most of them were from Aalborg and Aarhus universities in their first to fourth year of study. Of them 131 stated that they used deal sites and 96 of them fully filled the questionnaire, so the effective sample size is 96.

Although some data from the questionnaire were already analyzed and published, the papers focused on awareness versus non-awareness of deal sites (Sudzina, 2015a), use versus non-use of deal sites (Sudzina, 2015b), frequency of use of deal sites (Sudzina, 2016a), and its link to intention to use deal sites (Sudzina, 2016b), not on any of the Theory of Consumption Values factors influencing use of deal sites.

Statements for functional and hedonic motives were adapted from (Venkatesh, Thong and Xu, 2012). Statements for social values were adapted from (Sweeney and Soutar, 2001) and an

additional one from (Yeh and Teng, 2012) who adapted it from (Au, Ngai and Cheng, 2008). Statements for epistemic values were inspired by multiple scales and invented. Statements for conditional values were invented. The order of all these statements was randomized in order to minimize the effect of one answer influencing the following answer. Responds were asked "To what extent do you agree with the following statements?" on a 1-7 Likert scale were 1 meant strongly disagree and 7 meant strongly agree.

Cronbach's alpha was used to evaluate suitability of scales for functional, social, epistemic, hedonic, and conditional values. Correlation matrices are provided in order to check the relationships between items on particular scales. Pearson's product-moment correlation coefficient is used by default. (SPSS software was used for the analysis.) All correlation coefficients in a correlation matrix need to be positive for calculation of Cronbach's alpha. (Since the statements did not use negative formulations, scales did not need to be reversed.) In order to increase Cronbach's alpha, it is possible to exclude a statement or statements with low correlation with the remaining statements. It had to be used for conditional values in the following section.

3. Results

In order to check if the assumption for calculation of Cronbach's alpha is fulfilled, i.e. if all correlations coefficients are positive, correlation matrices in Table 1-5 are provided.

A correlation matrix for functional values is provided in Table 1. Cronbach's Alpha is .786. In (Venkatesh, Thong and Xu, 2012), where this construct comes from, the second item was dropped. But based on the correlations in Table 1, there is no reason to drop the second item for deal sites.

Statement	No.	1	2	3	4
I find deal sites useful in my daily life	1	1			
Using deal sites increases my chances of achieving things that I need	2	.428**	1		
Using deal sites allows me to find deals more efficiently in comparison with other media	3	.455**	.472**	1	
Using deal sites helps me to find deals more quickly in comparison with other media	4	.455**	.510**	.567**	1

Legend: **. Correlation is significant at the 0.01 level (2-tailed).

Table 1: Correlation matrix for functional values

A correlation matrix for social values is provided in Table 2. Cronbach's Alpha is .782. The fifth item coming from (Yeh and Teng, 2012) correlates well with the first four items coming from (Sweeney and Soutar, 2001), so the five items can be used together. In case there is a need to decrease number of statements in a questionnaire, actually, the first (not the fifth) item could be omitted.

Statement	No.	1	2	3	4	5
Using the deal sites helps me to feel accepted by others	1	1				
Using deal sites makes a good impression on other people	2	.274**	1			
Using deal sites gives me social approval	3	.458**	.414**	1		

Using deal sites would improve the way I am perceived	4	.277**	.432**	.488**	1	
Using deal sites enables me to get more recognition from friends and family when I tell them	5	.380**	.504**	.515**	.436**	1

Legend: **. Correlation is significant at the 0.01 level (2-tailed).

Table 2: Correlation matrix for social values

A correlation matrix for epistemic values is provided in Table 3. Cronbach's Alpha is .730. In case there is a need to decrease number of statements in a questionnaire, actually, the first and/or the third item(s) could be omitted.

Statement	No.	1	2	3	4	5
I used deal sites to experiment new ways of doing things	1	1				
I used deal sites to find the new offers	2	.321**	1			
I used deal sites out of curiosity	3	.160	.448**	1		
I used deal sites to learn about new types of products, services	4	.349**	.365**	.314**	1	
I used deal sites to learn about locations of stores/restaurants	5	.270**	.508**	.306**	.467**	1

Legend: **. Correlation is significant at the 0.01 level (2-tailed).

Table 3: Correlation matrix for epistemic values

A correlation matrix for hedonic values is provided in Table 4. Cronbach's Alpha is .827. In (Venkatesh, Thong and Xu, 2012), all three statements formed the construct as well.

Statement	No.	1	2	3
Using deal sites is fun	1	1		
Using deal sites is enjoyable	2	.598**	1	
Using deal sites is entertaining	3	.668**	.573**	1

Legend: **. Correlation is significant at the 0.01 level (2-tailed).

Table 4: Correlation matrix for hedonic values

A correlation matrix for conditional values is provided in Table 5. Cronbach's Alpha is only .544. It is due to the first item that does not correlate with other items. So, it can be suggested to use only the second and the third item, Cronbach's Alpha is .707 then.

Statement	No.	1	2	3
I value the information this service offers with the help with which I get what I need in different seasons (e.g. Christmas)	1	1		
I value the information this service offers with the help with which I get what I need once in a lifetime events (e.g. purchasing a wedding gown)	2	.157	1	
I value the information this service offers with the help with which I get what I need in emergency situations	3	.185	.547**	1

Legend: **. Correlation is significant at the 0.01 level (2-tailed).

Table 5: Correlation matrix for conditional values

To sum up, all scales (a shortened scale for conditional values) have Cronbach's Alpha higher than Nunnally's (1978) threshold of .7.

4. Conclusions

Deal sites require still more investigation. Although majority of customers are aware of deal sites, it is not yet fully understood what motivates and what hinders customer's interest in buying coupons. One of relevant frameworks for such investigation is the Theory of Consumption Values. To the best of the author's knowledge, Theory of Consumption Values constructs for deal sites were not validated in any publication yet; moreover, they were not even proposed.

This paper proposed Theory of Consumption Values statements for such constructs; moreover it provided the validation of these scales. Scales for functional, social, epistemic, and hedonic values were found to be suitable without any changes. The scale of conditional values had to be modified, one item was dropped. It is possible to recommend the scales for future research of deal sites with the Theory of Consumption Values framework.

Future research in this field could additionally consider motives from the Unified Theory of Acceptance and Use of Technology, the Diffusion of Innovation Theory, and the Information Systems Success Model.

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VIDEO BROADCAST FROM ENTERPRISE SOCIAL NETWORK: CASE STUDY

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Keywords

Broadcast, Case study, Cognitive skills, Enterprise social network, Multimedia, Video

Abstract

Social networks are the opportunity for enterprises to interconnect their employees, share information and knowledge, develop company culture and in general support the work efficiency. Social networks as a software platform are able to be connected to various devices supporting both on demand or broadcast streaming to appropriately technologically equipped offices. In the case study presented in this paper, there has been found that linking video stream directly from the social network to the workplace by an on wall screen is not effective in corporate environment. The problem is distraction of employees' attention and decrease of work effectivity. Video stream is useful only in rest areas but not in workplace. Other options of content sharing have been discussed, like podcasts or flyers. The situation with video streaming was discussed and explained by cognitive theory of multimedia learning and its principle of dual coding. Conclusion is that the use of broadcasted media takes its place in company environment but has to be selectively setup in accordance to the places' use. Cognitive load of the content and its media form affects employees' ability to work and perceive the media at once.

1. Introduction

In this paper, there are described corporate social networks in general and the medial forms of their content sharing. Multimedia outputs can be uploaded and shared by all users of the social network in purpose of publishing. The effect of multimedia forms made by streaming is explained by cognitive approach in order to find the causes of observed situation from case study. Main studied feature of the forms is the ability to attract the attention of the recipient in accordance with his work concentration. The aim of this paper is to describe and discuss observed effect of the broadcasted video content directly from the enterprise social network to the specific parts of workplace area.

The case study presented in this paper showed that video content is distracting during work process and that it should be replaced with palatable options. This case study has been done in branch office of one supra-national enterprise. Multimedia blogging platform was implemented with output links connected to an on wall screens. These are present on several parts of the workplace and are used to stream video broadcast. Results and discussion to the case study brings inspiration for implementation of corporate social network improvements to the work ambience.

2. Enterprise social networks

Social networks nowadays, by to the rise of web 2.0, have become one of the strongest media channels for communication. They are used for sharing and publishing information content directly from its users. The purpose of doing this is a one or two way communication motivated by the aim to exhibit or share experience, statements or point out curiosities by a variety of medial forms. Social media have a role of a blogging platform where content is published from time to time or in planned series. It has been used for both personal and work purpose. Research paper from 2014 showed that companies have varying attitude to use of social networks by their employees during work. Some of them prohibit them and some of them allow. If it is possible to use them, it is raising the employees' satisfaction but not the employers' (Pavliček, 2014). Corporate social networks should replace the classic ones and fulfill the employees' need to be in touch which social network service in restricted corporate environments. They can also help with raising the productivity.

Due to the high popularity of social networks, there has appeared congestion of the web by users' content. By this, the need arose for the rise of the effect of recipient's attraction. This led for example on Facebook to implement uploading videos directly to the Facebook page instead to a video server which provided a link to the repository. Facebook videos are played automatically and automatically catch the attention. Videos are the most intensive communication form from the perspective of cognitive process. Videos and photos are the most popular and shared content in the environment of social networks. They have become the usual communication forms of presentation, information or entertainment. Videos and photos allow to tell continuous story or to make continual engagement of social network users (Serapio & Fogg, 2009). Video is the proper tool for marketing communication in general and it is also suitable to do a marketing of internal enterprise information as well. Social networks have found their role aside of personal matters also in enterprise environment for work improvement. This purpose includes support of information and knowledge sharing, socialization of employees, development of corporate culture, cooperation or also a gamification of work process (DiMicco et al, 2008). In wider context, social media have changed attitude to running the companies in way of taking care of its social capital. Enterprise that implements these functions should be labeled Enterprise 2.0 (Makkonen & Virtanen, 2015).

For the explained purposes there are used available social network platforms and also developed new customized applications or program services that provide social media functions. Social media would be connected to other software solutions and run on different types of hardware that should enhance both their impact on users and the value in connection with corporation's information system. Social network should be used on two way communication terminals like computers or cellular phones and also on standalone one way screens or speakers. The content on social network is usually available on demand but should become broadcasted (see example of automatically played Facebook video). At this place there has to be mentioned that on contrary to technological possibilities, there is big risk for companies' work productivity because these applications would become time wasters (Turban et al, 2011).

3. Case study

This paper's findings are based on qualitative research method the case study. In spring 2015, there was established a development team with goal to design, develop, implement and deliver a blogging platform that will support the human capital in branch office of one supra-national company (its name and some details about the project will not be mentioned, because of the non-disclosure agreement). The objective of this project was to deliver platform supporting awareness

of individual team's work outputs and employee's experience. The goals of the sponsor were to support linking of the work teams, to share findings, ideas, know-how and to develop company socialization and culture tool. One of the objectives was also to show multimedia content for these purposes by using the office on wall screens. Greatest challenge of this project was to experimentally merge two services: the blog (social network) and on wall screen broadcast. These services usually work separately. This experiment was meant to bring higher effectivity and participation of employees in work environment and information stream. This led to establish multimedia blog platform with user interface and output handling the video stream. The default situation to start the project was available software solution platform and technological infrastructure including screens located in most of the enterprise office and rest space. The multimedia blog was delivered and provided the functions of internal corporate social network. It is based on publishing articles and photo or video content that would be created by any employee. This blog is connected to the screens for multimedia content broadcast. It has on demand interface accessible online and the broadcast of videos service directed to the on wall screens. Employees could access the platform from any device and upload all types of multimedia content if they ask for rights.

The case study presented in this paper refers about the multimedia blogging platform project and answers the question if the intended stream has brought required effect. Data were collected by observations and interviews of two enterprise interns with employees. The multimedia blog and its video streaming links to the screens were first run in offices, halls, kitchenettes and rest places of the enterprise in one story. There have been nearly 80 employees in touch with the broadcasted videos. On the blog, there were about 10 users with rights to upload and share videos in the beginning. Employees were asked for their feeling about broadcasted material and the impact to their work. This project was completed with **mixed feelings**. The screens located in the work area were in 90% turned off by the employees with explainer, that they distract them from work. In areas that are intended to rest like kitchenette or lunch-room the screens stayed turned on and the employees stayed and watched the content. So the attractive video content has been delivered but the objective remained unaccomplished. By asking for the reason, majority of answers revealed that the problem that made employees turn off the screens was not the content of the videos but the video form. The prototype run of the blog was run twice with the same outputs. The result of the blog implementation was that the video content is really effective in attracting of the attention but it also distracts the employees from work.

Before starting the discussion, there will be explained cognitive process and the principle of cognitive load, which describes the main reasons of the observed effect. Cognitive approach was chosen in accordance to the work of Professor Richard Mayer and his team who studied the principles of multimedia effect on recipient and the factors of attention and split attention and perception overload.

4. Multimedia in social networks

Social media platforms allow publishing content by text, photography, video, animation, sound, graphics and their combinations, like text and emoticons or photography with text comments. These forms affect the way of perception and possibilities of other parallel involvements. By the cognitive approach there should be pointed out pictorial and narrative forms. Pictorial forms depict the world. Narrative forms describe the world by a language. By the psychological research there is proven that the combination of pictorial and narrative forms creates bigger impact on the recipient (Mayer, 2009). It is because of bigger cognitive load that is directed to his cognitive skills that has limited

cognitive capacity. It is driven by synergy effect of the involvement of two cognitive mechanisms including verbal and image processing (see Figure 1).

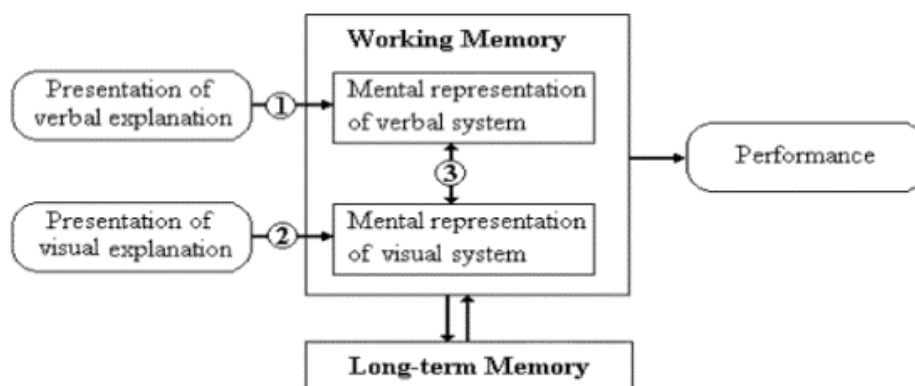


Figure 1: The dual coding (source: Mayer, Sims, 1994)

There is also another difference in amount of cognitive load connected to dynamics of media form. Static media forms like text or combination of text and picture make lesser cognitive load than dynamic media forms like video. Video is made from dynamic multiple pictorial and sound layers which includes image and narrative contents (Mayer & Moreno, 2003). Communication with low cognitive load causes active perception that means that recipient has enough free cognitive capacity to take the delivered content, to think about it and to use his knowledge to enhance its meaning or understanding. Communication with high cognitive load is delivered and perceived with lower ability to critically evaluate or enhance it.

Cognitive load is proportionally connected with the ability to attract the attention. By this explanation, video is a dynamic form of intensive media which produce big cognitive load and has a high potential to attract attention. There is also difference in access to the video. If the video is accessed on demand, it means an intentional act of selection and turn it to play. It attracts the recipient only by the screenshot or the placeholder image. In the case of broadcasts like the TV or stream services the content is put in order and played continually. In the first case when video ends there is new attraction just by selection. In the second case the attention is caught by the newly played video regardless of the content. The attractor is just the medial form. This principle is used in development of huge social networks with intention to keep users for longer viewing and participation sessions. There has been already mentioned Facebook. Similar situation is happening on YouTube where automatically played videos have been established after the end of previous ones in few seconds.

5. Discussion

In accordance to Figure 1 depicting the principle of dual cognitive mechanism and in accordance to the principle of cognitive load, there should be told that during the work in office the cognitive capacity is allocated primarily to the work and the rest should be used for secondary activities. If the secondary activities take too much of the cognitive capacity, they will start to distract the concentration from work and make the employee unable to work.

In this case it is very important if the medial form and content received from enterprise social network is accessible on demand or by broadcast. On demand forms are less invasive and it depends on the finding, selection and intentionally pressing play. Until this moment, the on demand

form does not hold extra cognitive capacity in contrary with the broadcast form that attracts the attention all the time.

The presented case study has proven that distraction from disruptive video broadcast leads to turning off the screens in the office and letting them on in rest areas. The asked question remained unanswered. How to reach the goal of intended blog platform to spread information and keep enough attention of employees to the work? Impacts of the cognitive principles presented for video forms are positive in case of entertainment but should be unwanted in case of work support. High attraction is distracting from other involvements. Several observations made during the case study showed that 7 of 10 employees use the radio to eliminate distractions from work. They played music or spoken word. Broadcasted sound is in case of occupying cognitive capacity less intensive than the video. So people can still hold their attention to the work. Solution for broadcast from corporate social network would be the form of sound podcast instead of video. Podcast is the sequence of sound sequences ordered in one playlist that is standardly delivered as one sound file. As the teams and individuals upload presentation or explainer videos to the enterprise social network, they would also upload sound content same way. This innovation would also reduce the need for technological support on both production and reproduction appliances. Visual representation of the enterprise social network using broadcasted media improved after the findings from case study is presented on Figure 2.

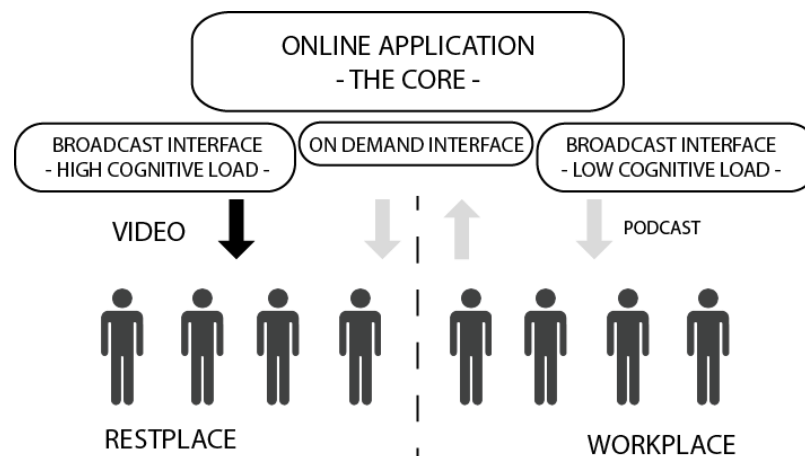


Figure 2: Diagram of enterprise social network with broadcast (source: author)

This solution will be tested in the future but by the explanation of cognitive approach, it is expected to be more effective. Another option besides podcasts that meets the updated requirements are the static visual forms showed on the screens. They were used before the video was implemented but the sponsor found them inadequate.

6. Conclusion

The outcomes of this paper brought findings that broadcasted media forms from enterprise social network have to be designed and streamed in accordance to the broadcast target place in enterprise. Experiment that was done was immature and technologically driven. The use of video has two sides. One is that video is the best form to attract attention but by this it is also the best form to distract from work concentration. The problem of distraction during the work is severe for enterprise productivity. During work, there is limited cognitive capacity to perceive streamed content that differs from the actual work objective.

Conclusion from the discussed case study is to use and combine more kinds of broadcasted medial forms with different cognitive load. If the broadcast is oriented to a workplace, there should be used less distracting medial forms like sound formed into the enterprise radio or to the playlist of podcasts. Videos should be accessible on workplaces but rather than by broadcast it is more suitable to access them on demand by online interface corresponding to the situation when an employee needs information from the video. If the broadcast is oriented to rest places, halls or waiting rooms, it is suitable to use video because of high potential to attract the attention in purpose of internal or external marketing communication, information, education or entertainment. Back to the objective of the enterprise multimedia blogging platform these solutions should be implemented by making the platform more complex and with features of multimedia content management in accordance to the situation and part of workplace. The changes should be without fundamental changes to the information system core, but it will make the need for more technological and content management features. Both video and podcasts need assistance to manage the quality and to control the contents of the broadcast. Future plans of the research are to make new case study with updated blog and to observe the behavior of employees in the company. After taking over the barrier of the blog adoption by its users there will be new possibilities to measure its effectivity of broadcasted company information to work and connected objectives.

7. Acknowledgements

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HOW TO PROMOTE KNOWLEDGE MANAGEMENT SYSTEMS TO ACHIEVE BETTER PERFORMANCE

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Keywords

Social network, knowledge, solution, project, company

Abstract

The article presents the results of the research performed in 2014 at a medium size Czech company. Research is focused on the issues of how companies' management and the rest of employees are trying to solve the problems with the emphasis on re-using of existing solutions and knowledge transferring. The research shows that despite the company's policy to prefer the use of software tools to gather, store and search for already existing knowledge, information and data, some employees would rather contact co-workers. There is a strong negative correlation between position inside the social network of the company, the number of searches for information and the use of the software by these employees. Conducted interviews show that these employees, who prefer human interaction over the knowledge system, often find better solutions than those stored inside the system. The best results are achieved by those who combine knowledge system as the initial source and based on their satisfaction with offered solution they contact the others. On the other hand, the employees who only use the system are often able to find suitable solution, but also not the optimal one.

1. Introduction

Knowledge Management Systems (KMS) enables the effective usage of all information gathered either during processes, communication with customers, suppliers or during a daily work of employees. Necessary data can be retrieved from general company information systems, but for special kind of information (e.g. lessons learned, communication with certain contractor) is much more suitable and effective to use specialized KMS that supports the transfer of both tacit and explicit knowledge across the company.

Employee's knowledge and skills are definitely important components which helps company to become effective and valuable. One of the problems is according to Armistead and Meakins (2007), that employees leaving an organization may be less willing to co-operate in their sharing knowledge and also employees threaten by losing their jobs are not motivated to record their knowledge to be shared with their possible future replacement.

Social Network Analysis (SNA) goal is to reveal, describe and evaluate the relations between individuals, teams, organizations, and resources. We can use the nodes to represent them using various tools (e.g. sociogram, matrix and metric).

Sociogram graphically represents the relations between the nodes and their structure. Edges (mostly in the form of lines or curves) which are connecting nodes (they represent people or other entities inside the relevant network).

If we separate the form and the content of the communication (Nadel, 1957) it is possible to identify and to compare the structure of various social groups, and to create the models of their relations based on mathematical analysis of the networks.

For every node and network a number of parameters can be observed, e.g. closeness centrality, clustering coefficient, degree, durability, eigenvector centrality, intensity, etc. (Scott, 2013).

2. Literature overview

Armistead and Meakins (2007) pointed out that interview or detailed recording of task could be suitable to capturing explicit knowledge. However, critical tacit knowledge, which is more difficult to capture by these means is lost. Ho, Kuo, Lin & Lin (2010) suggested that trust between employees should be promoted to enhance knowledge sharing.

Xing & Helfert (2008) conclude that there is a lack of user input in traditional knowledge management approaches and one of the possible ways how to support knowledge management and collaboration is through social networks.

Study (Carboni & Ehrlich, 2013) shows that individuals close to the core of a team outperformed more peripheral individuals, but only to the extent that teams were high-performing or had been together longer as a team. The research results also coincides with a general discussion on the implications for HR (Human Resources) theory and practices targeted at improving individual performance outcomes.

According to (Licorish & MacDonell, 2013) software development team performance is affected by team structures and by core communicators as well. Core communicators work as gatekeepers of their teams' knowledge, and the performance of these members was correlated with their teams' success. Licorish and MacDonell (2014) later found that core developers' attitudes and knowledge sharing behaviour were linked to their involvement in actual software development and the demands of their wider project teams. The main suggestion of this research is that easy information flow, better communication, question asking and exchange of ideas could probably help the developers to achieve the goals easier.

Yang and Tang (2004) found that group cohesion was positively related to overall performance, also group characteristics, e.g. cohesion and conflict fluctuated in different phases, but in later stages, much less cohesion occurred and the advice network seemed to be very important. This conclusion was based on the empirical evidence collected from 25 teams in a system analysis and design course.

On the other hand, there are newer studies (e.g. Wise, 2014) which confirm that social network topology is a valuable predictor of team performance and prove that, as so many other social network measures, group cohesion and team performance share, an inverse 'U' shaped relationship, not strictly as positive one as previously posited.

Study (Lin & Tan, 2014) showed among other results that the positive relations between the organizational members' interrelationships and their performance, and that individual with higher centrality in the organization work more efficiently. Cross efficiency and network centrality appear to be lowly correlated.

Pavlíček (2014) found that European companies had been aware of New and Social Media (NSM) risks and benefits and had created the rules and guidelines for employees. NSM is increasing communication, information flows, employees' awareness and motivation, and to some extent productivity as well. Oppositely, NSM can bring the possibility of abuse and security risks.

We can conclude that NSM can provide variety of functions e.g. performance improvement tools, communication platform for wide range of users, but social networks can be found almost everywhere where people communicate and interact.

3. Research

In 2010 the company implemented a groupware system (wiki based knowledge management system), an in-house developed work-flow and information management system. Those systems were continuously improved according to company management and employee's needs (e.g. additional ticket system). The wiki based system included monitoring of contributors, visitors and additional statistics. During the summer 2014 the research took place (and some parts of it were updated at the end of 2015) in an insurance company focused on identification of communication flows in the company. The main goal of the research was identification of the weak and strong sides of the current state and what should be changed and how to achieve this new better state of communication within the company. The part of research finding has been published in (Měsíček, Petrus, & Měsíček, 2016). With the consent of company's management and the owners we used the gathered data to analyze how employees acquired relevant information about problems and their solution. The part of this task was to find out how they used information sources and also how they searched for problem solution.

We mainly used inputs from e-mails, companies' internal web portal with boards, instant messaging, and document management system content (information about meeting attendance, etc.) to describe, map and analyze structure of the network and interviews and logs from KMS to identify how the system is being used.

The first phase consisted of description of necessary data and available data mainly based on our information needs. The second phase was focused on gathering, evaluating and processing data from various suitable sources. This phase consisted of exporting data from e-mail system (who is writing to whom), who is posting on the board and who comments, likes or tags the post, who used messenger to communicate with other colleagues. Last part of gathering data consisted of exporting metadata about meetings (who was present). From every data source were removed sources (nodes) not belonging to an employee (e.g. e-mail address sending notifications, e-mails with scans from copy machine, etc.) Verifying that conclusions about presence of a connection between two employees or lack of the connection was performed by randomly choosing 25 employees (including 5 external workers/part time workers with only one identified connection to the rest of the network) and we were asking them about their connections. We found out that just two employees reported

that we were missing an existing connection. Both reported connections were weak; communication was just occasional and not work related. The third phase was primarily about designing and actual collecting of additional information based on difference between the data we had already gained and the data we needed to make conclusions based on a good model of social connections within the company. Last phase was focused on final data processing, gathering additional data/information if necessary and also conclusions.

Additional information was gathered by means of interviews with selected employees (9 interviews) with high importance inside the network or with often searches for solutions and enters of new or changed information into the system. The interviews were also focused on how they gathered information, how they searched for people with required knowledge or experience. To verify changes results 25 most active users and contributors were also asked about their satisfaction change. They agreed that the situation improved and the information is better than before the changes.

According to network metrics the company had 281 employees in the Summer 2014 (both full-time and part-time). They have 4171 connections in total (these numbers are related to undirected graph and all connections are symmetrical, i.e. that communication works both ways, without one-way e-mail addresses used to spread information to all employees). The company does not have marginal rate of independent contractors with just a few links to other employees. However, we kept in mind that every company is a living organism under constant transformation.

We successfully distinguished several groups in the social network, but links between the groups were usually weak. Also, usage data from KMS were exported and connected with each employee.

The figure 1 shows the overall social network of the company. Every point represents an employee, colour of the point represents to which group he or she belongs.

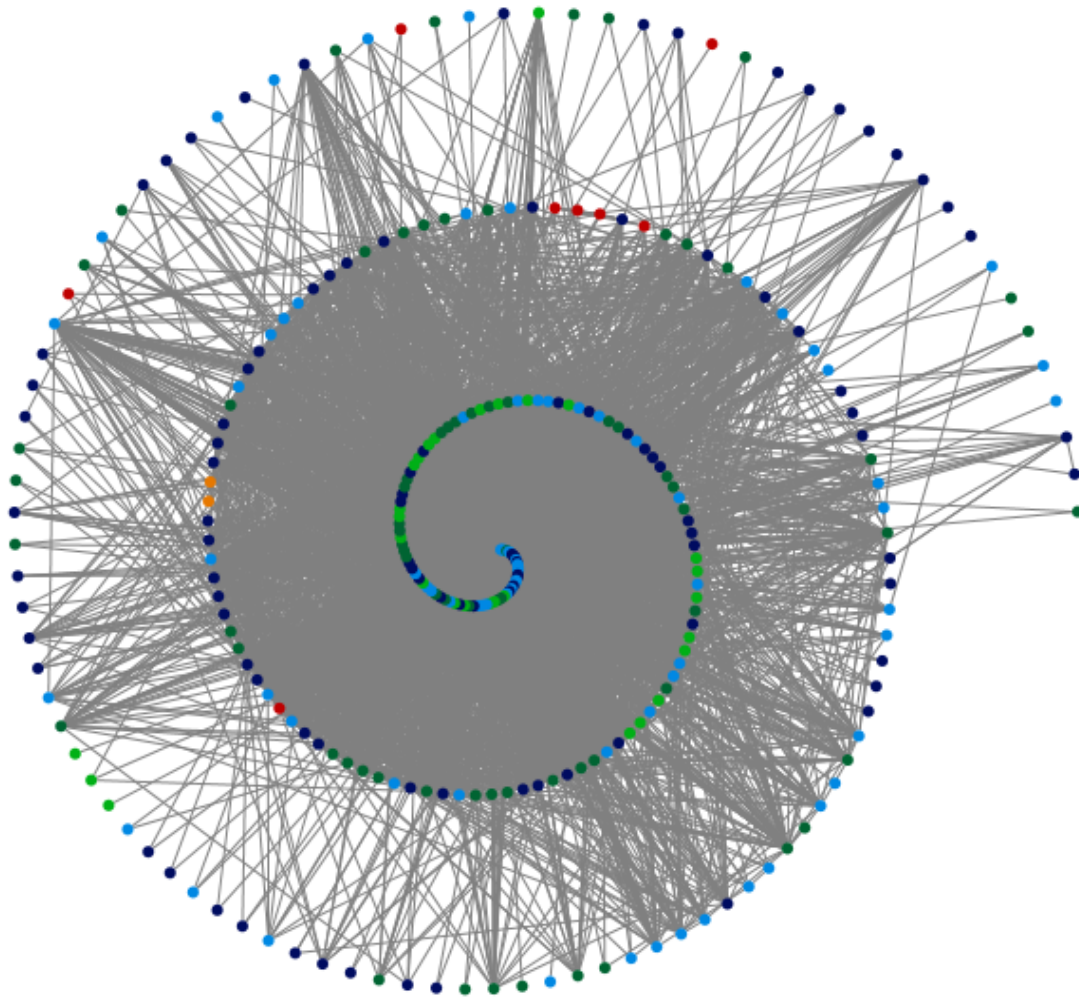
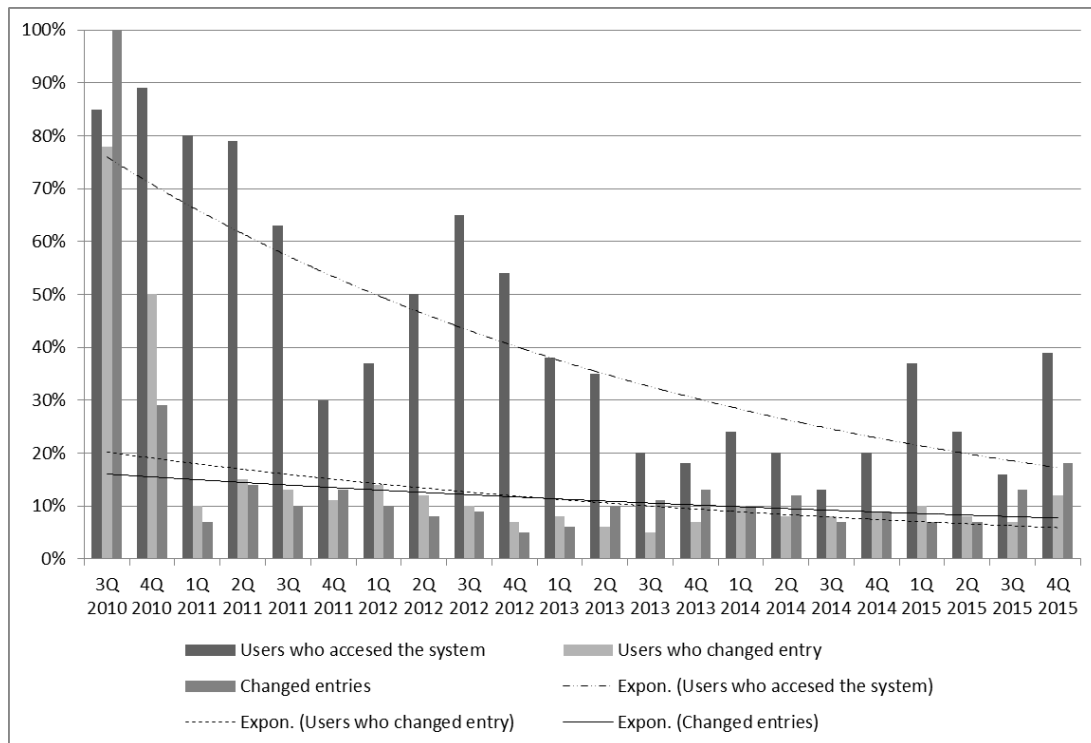


Figure 1: Overall social network of the company

4. Discussion and Results

The graph 1 shows the ratio of employees of the company (those who had access and could benefit from the system) who accessed the system (first column), opened or added new data/information (second column) and percentage of changed entries from all entries (third column). It is obvious that after the first peak there is a continuous decline of traffic (since 2012 when the company went through major structural changes). In third quarter of 2015 just 16% of employees accessed the system. Just 15% of relevant employees contributed four quarters after the system was launched. On the other hand, the contributors ratio had been quite stable in last three years (oscillating between 5 and 10% of relevant employees since 3Q 2012 to 3Q 2015). In January 2014 and January 2015 activities to improve usage of the systems took place (mainly voluntary seminars about how to use the system, edit data and search for required information). It is possible to see that the seminars improved the amount of access to the system, but the number of active contributors has not significantly changed. The total number of changed entries also remained stable. According to Hester (2011) mandatory use of the system could result to resistance of the users and voluntary use is beneficial to the early adopters. The interviews confirmed that active users prefer that use and participation of the system is voluntary.



Graph 1: The ratio of the company's employees who accessed the system, opened or added new data/information and percentage of changed entries of all entries

To identify who uses the systems and how, we used logs of the systems and linked it with social network data and metrics. The previous unsatisfying state of knowledge sharing could have several roots. Main observed reasons could be described as lack of motivation to help others and protection of own knowledge from possible competition and new employees.

The results showed that employees who used the systems were more likely to have below average number of connections within the network and almost everyone had no direct connection with top managers of the company. Just 10 active users (those who created new or modify existing entries) had strong real world connections outside of their department. All other active users kept their strong connections limited to their nearest co-workers. We found that employees with strong position within the network (e.g. high degree, centralities and clustering coefficient) preferred not to use the system or just occasionally. During interviews it was concluded that those employees who had never used the system (4 of them were interviewed) with good network connections were not aware of knowledge of the isolated group inside the knowledge system. After they were introduced to some of the stored data, they started to use the system. Unfortunately, after they started to use the system actively the frequency of use declined and after three months all of them stopped using it completely. After we contacted them three months later, they stated that they preferred to use newly established connection with the content creators to obtain the information directly and also to consult current problems with them. There is a small (around 5 or 7 over time) group of users who are changing most of the entries. Kunstová, (2012) mentioned that "nobody wants to be connected with poor presentation or incorrect information", that's one of the possible reasons why some of them are motivated to keep entries up to date and good structured as well as with accurate content. Licorish and MacDonell (2013) used psycholinguistics and content analysis techniques to study the roles and behaviors of core developers and uncovered that these practitioners worked across multiple roles, and were crucial to their teams' organizational, intra-personal and inter-personal processes. In 4Q of 2015 new motivation system was launched to

improve motivation of selected group of both most active contributors and selected employees with important or key role within the company. Additional kinds of motivation tools should be added in September 2016 (mainly prizes and recognition for authors and editors of e.g. most helping entry). Also, as (Kuo & Young, 2008) suggested, the social and cultural attributes of organizational settings may strengthen people's volitional control in practicing knowledge sharing.

5. Conclusion

After more than 5 years since the knowledge management system was released and despite several attempts to increase the number of active users we found out that the system had to be used also as social connector to help employees to find and contact a right person inside the company. This person knows how to help with the problem not described in the system or described out-of-date. New position was created to help with improving poor level of communication and culture within the company. This employee should help with building trust and better work atmosphere. Additional functionality in the form of ticket system and improved discussion were added to the system. When a user finds the existing information inside the system to be inadequate or needs more details he or she can simply create a ticket and ask the creator of the entry for help. The creator can contact the person and also add more information to the system. Almost 150 tickets were created in three months concerning 79 topics and 380 messages was send between creators and users of the content.

After one month since the release (October 2015) and after the financial motivation system kicked in we found out that the number of changed entries increased almost by 40% to the highest level since 2012 and number of entries/changes is still rising. Also, according to the interviews the creators of the content are much more satisfied because they can see that their work is really helping other employees (mainly at the position with higher fluctuation, e.g. sellers) and user are also satisfied with improved content quality. Financial bonus had been assigned to selected contributors (those who could be efficiently influenced by this kind of tool) to keep them motivated. This solution helped to increase social network density and it also reduced the isolation of teams from the rest of the company by connecting relatively isolated employees to well-connected ones to enable direct knowledge transfer. Origin of all described problems could be found (it is obvious from some interviews) in transformation year 2012 when several employees were laid off and rest of them realised, that this could happen to anybody. However, until recently, the management of the company was unable to acknowledge this.

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MODELLING THE DYNAMICS OF INTERACTIONS

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Keywords

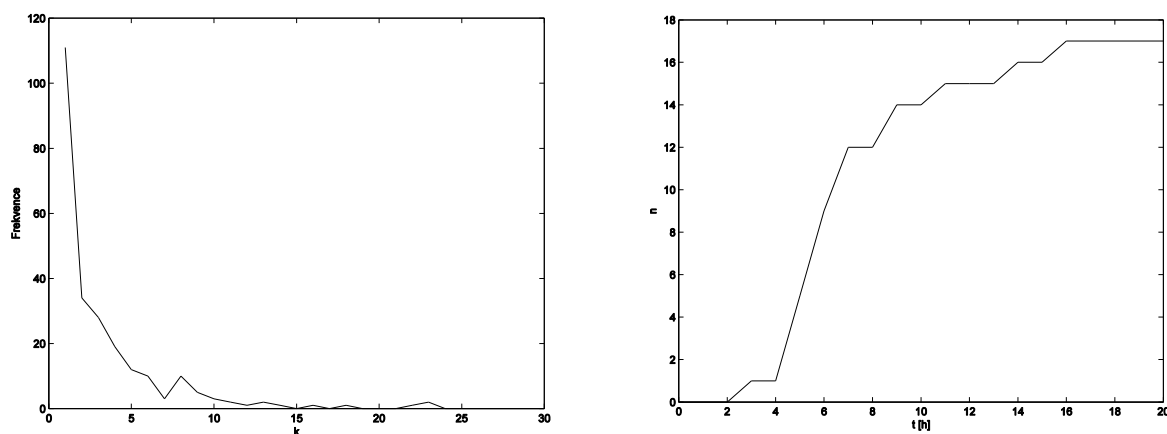
Social networks, discussion dynamics, communication, three parameter model, identification

Abstract

In this paper, a method of modelling the dynamics of electronic discussions is proposed based on the three-parameter model known from the modern control engineering. Knowledge of the model points to possibility of estimating dynamic movements in discussions as well as understanding and designing their maintaining and guidance. Several thousands of real discussions are processed.

1. Introduction

Social networks include all platforms and tools for interactions. It can be communication (Twitter or an electronic discussion list), professional (LinkedIn), or Facebook that is used in a variety of ways (Pavliček, 2013). They are associated with complex systems. In order to investigate properties of such systems, various statistical models are widely used. They ignore individual network nodes and prefer average behavior of large number of nodes that carry out communication. Average characteristics of communication networks are given by Zipf law (Pierce, 1980). The latter determines that frequency of Web sites linked from k other sites (in-links) is proportional to the ratio $1/k^2$ (Mitchell, 2011). In other words, pages linked from a huge amount of the other Web pages, are very rare. A similar type of dependence also appears in the electronic discussion lists. In fact, the latter represent the original social network. Frequency of discussions including k posts is proportional to $1/k$. As shown in the following Figure (left), a corresponding relationship was measured in the dlist



or discussion list Chminf-l for year 2010, like in other years. Interactions including more posts than 25 are rare in this discussion list.

In many cases, the patterns of dynamic behaviour in complex systems are given by the size changes in some populations n , $n > 0$, described by differential equations of type $dn/dt = bn(t)(1-n(t))$. The latter results in known logistic curves. Here, b denotes a size change coefficient (Kahn, 1990). Logistic curves with characteristic shapes of the letter S represent a common pattern appropriate to describe the dynamics of complex systems, regardless of their origin. In some cases, cumulative dynamics of responses in electronic discussions exhibits the shape of the logistic curve too, as shown in the Figure on the previous page (bottom right) for Chminf-l discussion carried out on July 22, 2011.

Advanced control methods use mathematical models which have a potential to study dynamic events related to communication in social networks as well. Primarily, there are three-parameter models (Klán, Gorez, 2011) associated with differential equations $Tdy/dt + y(t) = Ku(t-L)$ and represented by step responses of the form

$$y(t) = K(1 - e^{-(t-L)/T}).$$

An example of such a step response for $K=27$, $T=5$ and $L=1$ is shown in the next page Figure (full line). Variables u, y indicate input and output and non-negative parameters K, T, L gain, time constant and time delay, respectively. Using Laplace transform, this model corresponds to transfer function

$$Ke^{-sL}/(Ts+1).$$

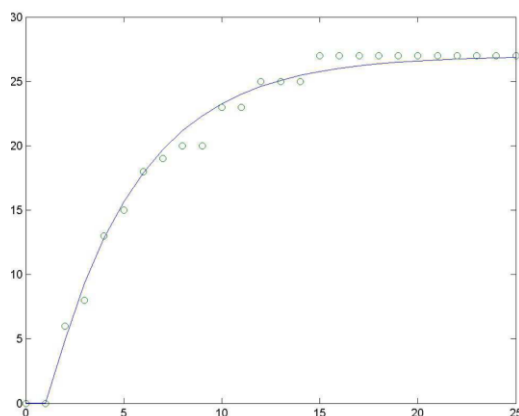
The paper shows that the dynamics of communication networks, under certain conditions, can be identified by the three-parameter models. The latter is yet suitable for purposes of prediction and management of discussions using principles associated with control methods. Since the three-parameter models are widely used in automatic control, various rules have been developed for their use. Here, knowledge of parameters K, L, T is decisive. Just widely known model, the intuitive clarity of its meaning, identification and use can allow to better understand the communication dynamics in social networks, including such elements as posts, likes etc. For example, the use of the specific value of 63% of K at $t=T+L$ is available for estimating sizes of discussions.

The following section explains motivation for use of three-parameter model for discussion dynamics description. Further sections are concerned with identification of three-parameter models from cumulative data of discussions. Moreover, some real examples of identification in electronic discussion group Chminf-l are introduced.

2. Motivation

The author was a participant in one of the discussions on social network, which debated the topic of possible Wikipedia decline despite the noble goal of Wikipedia to assemble all human knowledge. Although a unique system in the history of civilization, the number of active Wikipedia contributors constantly decreases significantly. The principal reason is considered in constraints that community of Wikipedia contributors has created to discourage new contributors. Discussion had a classical format. At the beginning it was an initial post about Wikipedia decline giving the

link (Simonite, 2013) to which the participants debated. After the end of discussion, the author collected the dynamics of discussion, i.e. the cumulative number of posts y to vertical axis versus related times t . It results in the following Figure where the circle indicates the cumulative number of discussion posts at the time (hours). The first post on the subject appeared after about an hour from the initial contribution (time delay). It is followed by the relatively steep growth of posts to gradually slowed after 24 hours to reach the final steady state of 27 posts.



If observing dynamics of this discussion, then one cannot ignore the similarity with the exponential dependence of transient response introduced above. As mentioned, the same transient response with parameters $K=27$ posts/time, $T=5$ hours and $L=1$ hour is inscribed by the full line in this Figure. It well characterizes and describes the dynamics of discussion and associates it with a principal question if is it possible to describe discussions by the related transfer function

$$27e^{-s}/(5s+1)$$

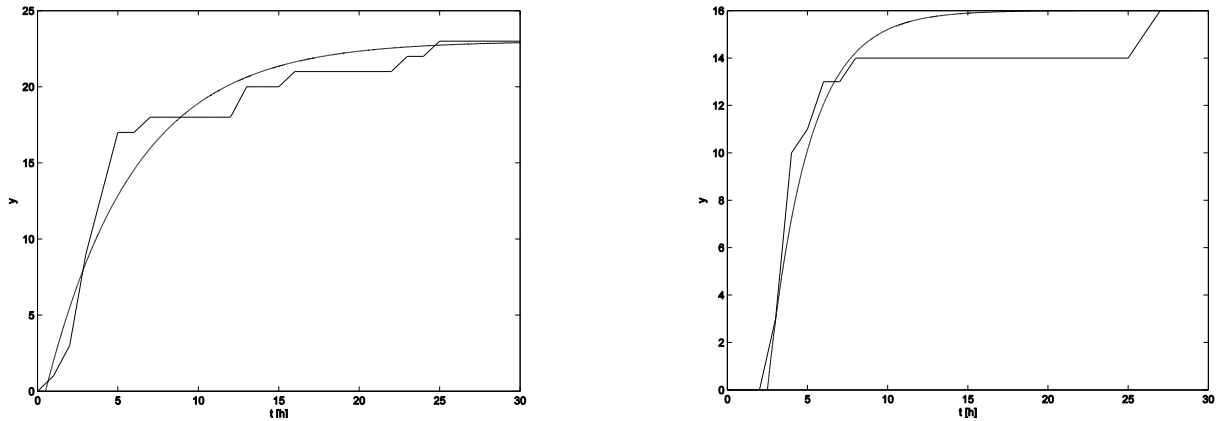
or whether the three-parameter models describe the dynamics of electronic discussions in social networks and the Internet in general?

3. Discussion Dynamics Identification

At the beginning, it is necessary to answer the question whether the dynamics of discussion behaves as a transient response to a step change? Yes, it does. The initial post from which the debate unfolds, appears and lasts. Thus, it fulfils the same ‘shock’ role like unit step expressed by $1/s$ in the Laplace transform. At the time of this step or the initial post, it is possible to set up the start time $t=0$ and (with the zero initial condition) to start measurement of transient response as the cumulative number of the posts.

The dozens of discussions were examined to verify if the discussion dynamics captured in Figure of Wikipedia decline does not represent a random but repeatable shape. For this purpose, the freely accessible archive of electronic discussion list for Chemical informatics Chminf-I (<https://list.indiana.edu>) was chosen. The author is a member of this group since 1995 (Klán, Mindl, Štědrý, Rubešová, 1999). The group has about 1500 participants and well serve as a model paradigm of communication in social networks because indicating the same patterns introduced by the Zipf law.

Discussion subjected as ‘What are faculty instead of using chemistry reference titles?’ from February 2010 represents an example. The initial post (unit step) was sent at 16:35 ($t=0$). The total number of the following posts was 23, which immediately represents gain K associated with unit step. The dynamics of the discussion is captured in the following Figure (left-irregular curve) together with the unit step response of identified three-parameter model by $K=23$ posts/time, $T=5.5$ hours and $L=0.5$ hour.



In order to obtain these parameters, the algorithm of identification described in (Klán, Gorez, 2011) was used. Therefore, discussion is identified by transfer function

$$23e^{-0.5s}/(5.5s+1).$$

Discussions with a larger number of posts (typically >10) indicate common patterns in the aforementioned public archive. It examines discussions in private social networks, too. Data from large amount of discussions confirm the hypothesis that the dynamics of the discussion can be interpreted (with sufficient accuracy) as the dynamics of the three-parameter model. In other words, dynamics of a social network discussion can be sufficiently represented by three parameters, K , L and T .

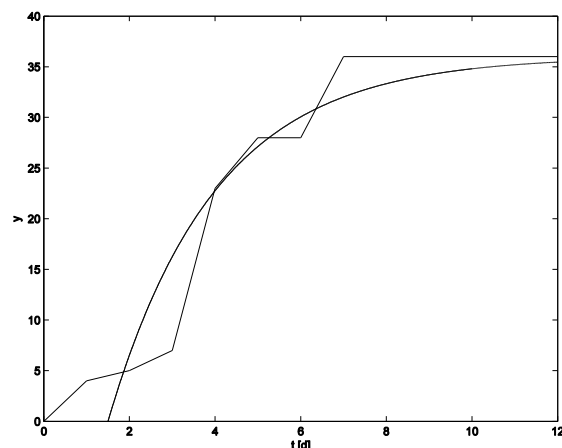
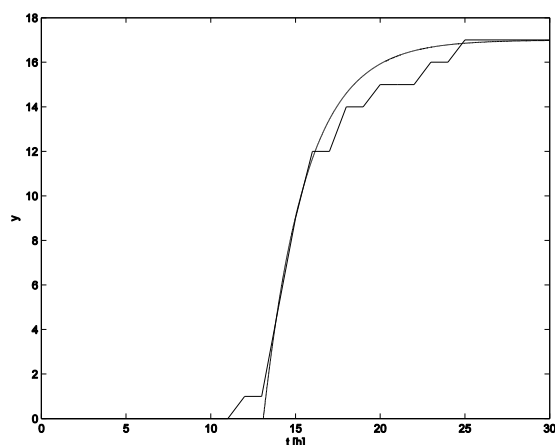
Moreover, it appears that while the parameters of L and T in the dynamics of the discussions are not too much different (typical delay currently was within one hour and the time constant from 1 to 5 hours), the parameter K representing the cumulative number of posts significantly varies. Thus, the situation relates to dynamic systems with a highly variable gain. On the other hand, the above Figure representing the Zipf law suggests that discussions with gain of more than $K=25$ are significantly rare in thousands of the investigated discussions.

4. Examples of Identification

This section shows several examples of identification and illustrates characteristic situations met in the real practice of discussions.

Example 1: Chminf-l 10.3. 2011, beginning: time 15:59, subject: ISTL article ..., basic time unit: hour, Figure: above right. It is a case of the discussion, which had the standard dynamics and that the last two posts were added after many hours. In the case of international discussions due to different time zones (or e.g. working absence), it is a common phenomenon and it currently represents 10% error given by a noise. It is known (Klán, Gorez, 2010) that, for example, good controller tuning has to deal with 20% changes of the controlled parameters.

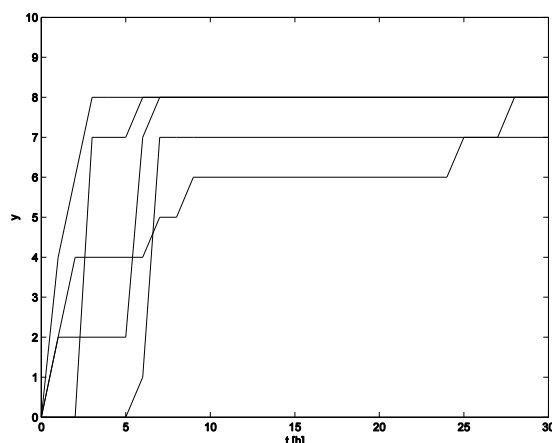
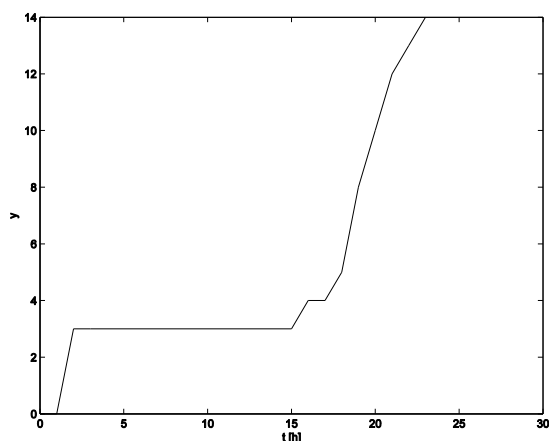
Example 2: Chminf-l 6.1. 2012, beginning: time 1:41, subject: Authors listed in search of ACS Pubs, basic time unit: hour, Figure: the following left.



This example shows the situation with an extremely large time delay, the process by which the first contribution post to the discussion came after about 12 hours. So long delay is examined in discussions rare and when they do, it is usually given by inadequate time posting of the first discussion post.

Example 3: Chminf-l 22.7. 2011, beginning: time 17:23, subject: SciFinder Piracy, basic time unit: day, Figure: above right. It is illustration of discussions with time delays and time constants in days. Furthermore, it captures a somewhat chaotic shape of the discussion dynamics, in which, despite the large variations, it is possible to recognize the exponential character (and finally the logistic curve).

Example 4: Chminf-l 22.6. 2011, beginning: time 18:13, subject: Call for papers from Journal of Chemistry and Chemical Engineering, basic time unit: hour, Figure: the following left. Capturing a break dynamics discussion (e.g. due to the absence in work), which may occur in the discussion, unlike the technological process. It is interesting to see that the dynamics of the discussion is interrupted while the delay continues.



Example 5: Chminf-l 2010, first five discussions including eight posts, Figure: the previous page bottom right. It shows examples of the discussion dynamics with a small number of posts. Such discussions are frequently included in the Chminf-l. In one case, the last post came even after more than 30 hours from the initial post. In the Figure, a step response without time delay is experienced as well as a delayed response with extremely small time constants as well as response with time constant of around 10 hours. All of these responses can be identified by three-parameter model similarly as in previous cases. However, using the predictive power of the model, i.e. prediction of

the characteristic time $L+T$, is difficult. On the other hand, the gain K for newly starting discussions can be estimated by the Zipf law (well introduced eg. in (Pierce, 1980)). Based on the subject of each new discussion, it is possible to predict its order. The latter is associated with number of posts in the discussion.

5. Conclusion

The paper shows an innovative use of three-parameter models in identifying dynamics of social discussions. By this view, the cumulative dynamics of discussions is described as e.g. dynamics of mechanical systems. The paper gives examples of identification of real discussions in the electronic discussion list called Chminf-l.

It is shown that dynamics of discussions is well described by this three parameter model known from the modern control engineering. At the same time, the predictive ability of three-parameter models can be used. In the case of a small number of posts, it is possible to use a combination of the model with the effects of Zipf law. On the other hand, the average communication activity on Facebook includes tens to hundreds of interactions.

In addition to the prediction and estimation of dynamic properties of discussions, the three-parameter model serves in managed discussions when calculating proportional and integral parts. The proportional part can manifest itself by inserting proportionally opposing views or to removing the offending posts, the integral part then historical experience on the subject, experience from previous discussions, etc.

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SESSION E: E-HEALTH: ICT- SUPPORTED HEALTH MANAGEMENT

TRANSPONDING IN EHEALTH – WHEN SENSORS SUPPORT DIAGNOSTICS AND MONITORING

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Keywords

eHealth, sensors, interventions, monitoring

Abstract

Transponding is a new method, developed at Johanniter in Austria to standardize the process of operationalization diagnostic processes and monitoring of health status to new developed sensors. As experience has proven, there is no straight way to measure with new sensors and sensor classes in critical areas like health care. By following transponding as an 8-step standard for changing traditional diagnosis process in behavioral, measureable realizations with the patient in focus, per design, self-efficacy will become a motor for adherence and is a core feature of personalized health care. This paper describes the approach and the legal aspects, which are necessary to be followed to take full advantage of this approach.

1. eHealth, mHealth and wearables

The health sector is claimed to be a growing market and stable in its growth because of demographic change. The WKO (Chamber of economics in Austria) stated this since 2009 (WKO, 2009), and published a study where the second health market (prevention and precaution) is shown as a big motor for growth. For this topic, the growth between 1998 and 2008 for sports devices increased by 3,1% as well as the area of fitness studios (+9,5%). Both are related to the fitness industry and health prevention by sports. The prognosis of the study points towards a growth of 121% between 2005 and 2020. This is paid to developments in medical devices, demographic change and a change of values in society.

When this call for new markets was published, eHealth and mHealth were into place as new terms on the health market to support this growth.

eHealth was defined in 2001 by G. Eysenbach as “an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology.” (Eysenbach, 2001)

In 2016, eHealth is embodied by health insurances e.g. in Austria and is regulated by a health telematik law (BKAÖ, 2012). By this, eHealth has a focus on health related data and electronic

patient records. The exchange of health related data between health care organizations became the primary focus in the reception.

To identify and separate the full picture of an overall eHealth approach from 2001 mHealth was established to bring a second focus to the debate for the development of applications for the smartphone and wearable devices, related to monitoring vital signs and activity. One sub-category are the activity tracker.

mHealth is defined by the WHO in 2011 as “a component of eHealth. To date, no standardized definition of mHealth has been established. For the purposes of the survey, the Global Observatory for eHealth (GOe) defined mHealth or mobile health as medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices. mHealth involves the use and capitalization on a mobile phone’s core utility of voice and short messaging service (SMS) as well as more complex functionalities and applications including general packet radio service (GPRS), third and fourth generation mobile telecommunications (3G and 4G systems), global positioning system (GPS), and Bluetooth technology.” (WHO, 2011)

The developments on mHealth go into various directions. This is from tweeting messages about health status (Chung, Skinner, Hasty, & Perrin, 2016) or activity status up to monitoring of physiologic reactions to drug therapy (Carreiro, Wittbold, Indic, Fang, Zhang, & Boyer, 2016).

Also accuracy of wearables concerning measurements is increasing and allows valid measurements (Alzahrani, et al., 2015). A lot of these wearables are available on the market with different levels of accuracy, reliability and actually different kind of sensors.

The standard seems to be an accelerometer with 3 axes. Other available sensors can measure heart rate by opto-electronic sensors or photoplethysmographic to even measure oxygen saturation. There are devices available as lab-on-a-chip structure for measuring glucose level in the tissue or shirts that measure muscle activity and breathing volume. These sensors provide a lot of information about the person who is wearing the devices. But the question is how this data can be used? The question this article tries to discuss is if it is possible to use these sensors to identify the health status of individuals and monitor certain aspects that are related to health, lifestyle and support in prevention?

2. Sensors as source for health data

A short look in the list of available sensors on the market with a sport, fitness or health relation provides already the insight in an obviously growing market. The major application started in fitness and lifestyle monitoring. A trend for quantified self (Hoy, 2016) with comparison and challenges in social media produced a hype on wearable technology. This made reasonable devices available for a broader market. The general technology is available for years already. In the ambulance service, devices for measuring oxygen saturation in the blood are in place for several years already. But the combination with a social media and a personal dashboard made the large breakthrough possible. Where at the beginning just sports experts were using wearables, the increased demand on the market provided a chance to defund wearables in a more general health usage as well. The higher awareness of a larger group of people made it possible to identify new needs and chances of wearables for health care organizations. In a presentation at the eHealth Forum in 2015, Aumayr presented a general view on the chances of wearables for supporting adherence (Aumayr, 2015). One of the major remarks about the use of sensors was the improvement of self-efficacy.

To use sensors that are worn by the patient and produce data that is directly related to the behavior and visible at an instant to the data subject, self-efficacy is just one issue. Also competitiveness with others (Millington, 2015) and social desirable behavior and aspects of cognitive dissonance (Festinger, 1962) will come in place to increase the impact of a health related intervention.

3. Transponding data

Even with a lot of different sensor data, this data has to be interpreted and transformed from data to information. When the aim is to see results of training, a heart rate monitoring and a scale could be sufficient to get relevant sensor data and provide decent information. Also for measuring blood sugar before taking in the right dose of insulin, a simple presentation of single data is sufficient. When measuring blood pressure, a sample of values gives a decent overview of the situation. These are isolated parameters that are checked. But when thinking about health care and prevention, long term monitoring and analyzing life style and changes is an aim. By this more complex syndromes have to be analyzed for their measurements. Also certain benchmarks are simply not available for therapy control.

3.1. Example diabetes medication

Monitoring blood sugar levels was interesting for ad hoc interpretation. A long term value in comparison was HbA1c value, a value that is showing an interpretation of the average sugar level across 90 days. But what happens in between was not visible to the patient. Since 2015 a device is now available that can measure the sugar level of the tissue, which is related to the blood sugar with a slight time difference. This allows seeing the impact of lifestyle directly and improves adherence. Similar effects of self-monitoring could be shown in a study about adherence and associated factors in 2004 (Vincze G, 2004). This example shows that already simple applications of sensors can increase effectiveness of therapy by providing information and proof self-efficacy of patients.

3.2. General approach of transponding

How can this experience be generalized? This example about diabetes started with a direct transponding from one measure to another with the benefit of making measurements more comfortable for the subject and provided a better overview of the situation overall and in detail.

In general, this approach can be formalized also for a lot other topics. It starts with the description of a disease by its symptoms and how they are measured today. The identification of the symptoms lead to the diagnosis, which is a Yes/No algorithm. When it is decided that a certain disease is identified, a standardized therapy starts and is individualized by time. By this, therapy control has to be undergone. For most of the therapies available, there are blood screenings or check-ups on a certain interval of several months. Success is given, when the markers for symptoms are tending towards the advised norms. This could be formalized as a decrease of intensity of symptoms. The intensity of symptoms is the key for monitoring and base for the operationalization of diseases and symptoms because the change is the necessary value for a new way of thinking about health therapy. By following the approach of Salutogenesis (Antonovsky, 1997), this method of transponding should allow to identify, how people can become healthier and act against symptoms in a way that is directly adjusted to their needs. By this, transponding is defined as the operationalization of symptoms according to available sensors. It allows identifying sensors for certain diseases to increase the chance of monitoring and presenting data for the patient to take control of his or her disease and increase disease management. It brings the impact of behavior and

lifestyle on health before the eyes of the patient and shows effects of behavior to health near to instantly.

3.3. 8 steps of transponding

Transponding includes 8 formalized steps and provides a standardized way to identify sensors for diseases and a guideline for development and developing roadmaps for sensor development.

The first step is the identification of disease related symptoms in general literature.

This is very generic and determines the general disease topic.

The second step is the mapping of ICD 10 (or later versions) symptoms related for diagnostics.

This is the precision and general inclusion. Also, this allows a better control of the related studies and identifying the right measures.

The third step is the operationalization of the symptoms as they are defined by medical standards. After this third step, the focus of operationalization has to be adjusted to associated behavior of the symptoms.

This allows a clear impression on what is measured at the moment and how diagnosis and monitoring is approached now. The focus on the behavioral aspects in the second sub step is already an abstraction for the development or search for sensors.

The fourth step is the matching of symptoms to the sensor types that are probably needed to match the needs of measurements.

The sensor types are aligned with the Council directive 93/42/EEC on Medical Devices (MDD) and provides following classes:

- Non-invasive devices
- Invasive devices
- Active Devices
- Special Rules

With a set of rules (Wellkang Tech Consulting, 2016), the exact class of a device can be defined.

The fifth step is the matching of the sensor types to available sensors.

To identify what kind of sensors are available, a first rough classification for sensors can be given for the health area:

- Vital sign and body marker tracking
- Activity tracking
- Environmental sensors
- Questionnaires and tests

These sensors have to be first identified on this general level and then on detailed level with the exact device.

The sixth step is the definition of expected behavior changes according to the therapeutically interventions and the needed algorithms for this.

Defining the interventions, and how behavior shall be changed by it, is of absolute importance to every design for studies but also a legal requirement since 2016. Full protocols of data procession and pre-defined usage of data has to be made clear to the data subject. But also for the definition of expectations, this step is of importance. Behavior change is measureable and with a standardized operationalization also interpretable. Especially for randomized controlled trials, this provides a clear setting and supports the intervention impact assessment.

The seventh step is the identification of gaps and limitations at sensor level according to accuracy and availability of sensors.

Expectations of measurements have already been mentioned. It is also necessary to be aware of limitations and potentials of sensors in several ways. Beside the technical limitations, the increased variance in measurement during long term monitoring has to be taken into account. Just when the at least a statistical relevant data set is available, this design based flaw is eradicated. Another limitation that has to be taken care of within a risk assessment would be data protection of the collected data and the transfer protocols between devices. This has become a legal obligation since May, 2016 according to the EU General data protection regulation in Art 35(1) (EU, 2016).

The eighth step is to finally adjust the operationalization by using the associated and correlated behavioral markers to monitor the impact of an intervention. For development of new sensors, in this final step of transponding, the operationalization for new measurements can be decided and formalized on the roadmap for development.

Following this eight steps of transponding, it should be easier to identify possibilities to measure in a medical environment with new sensors the impact of interventions for supporting adherence and to increase self-efficacy by design. New sensor technology is sometime not as accurate as needed to be for a direct clinical application. But for long term monitoring and therapy control it is supportive and improves awareness of the patient for his or her health status. Already the transparency of personal health related data by the patient is changing the role of the patient as an object of therapy to the subject of therapy with a better chance of understanding what this could mean to the individual.

4. Legal aspects to be considered

When transponding sensor data to provide measurements to identify health risks, they are considered as health data. This data is personal data. Under the regulations of the EU, data protection law is applicable and has to be respected.

4.1. Data Protection Regulation

Since 26th May 2016 the General Data Protection Regulation of the European Union (EU, 2016) is in place and provides a legal base for data protection of personal data. Health related data is defined as personal data. In Article 9(1) health data is classified as special category of personal data and by this a processing of this data is – in general - prohibited.

Only if certain requirements are fulfilled it is allowed to process the data. It is possible to process health data if the data subject is giving explicit consent to the processing. This means, the data subject is informed about the way the data is processed. And the processing of special categories of personal data is allowed just for the limited to the specified processions that are stated prior in the consent (Art.9(1)b).

It is necessary for research to provide now a large informed consent document that is exactly defining the processes of data usage and the scope the data is used for. This concerns not only research projects but also commercial products. This comes into place when data is analyzed and morphed from raw data or raw values to dashboards and when showing developments. This could be already understood as processing of data.

Transparency is now a right for the data subject and has to be provided by the controller or processor. This increases the need of a good documentation of development and processes of routines. Also the exchange of data is under very tight restrictions.

The health sector and the collection of data are now regulated. It is more complex but on the other hand it provides a chance for better structures in the overall design. This can be shown already in the Regulation under Article 20(1) where the right to data portability is stated. This makes interoperability by design mandatory.

For economic developments this brings a new chance for using interfaces. HL7 as an older standard is already well established and used in several electronic health records of insurance companies or governmental health organizations.

Also a right to rectification (Art.16) and to erasure (Art.17) is now stated clearly.

For services that are based on long term monitoring, it can be troublesome if the right for rectification and erasure is put to use. The algorithms would deliver different results if certain data is deleted and directly affect the quality of outcomes. This can be having negative effects on the data evaluation and therapy quality.

As Big DATA is a topic that is steering hopes in science and development, it has to be mentioned that with Article 5 of this Regulation it will be hard to have a Big DATA approach. In Art 5(1)c data minimization is stated as one of the principles related to processing personal data. Personal data shall be “adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed” (EU, 2016).

4.2. Medical Devices

Following the definition given by legislation what health related data is, it applies for medical devices as well. There are several classifications (I, IIa, IIb, III) to identify the medical devices and the needed certifications (EEC, 1993). The certification is a clear process to allow product development by secured standards. Most of the certification needs are documentation requirements. They are defined in Annex IV to VI and IX in the Council directive 93/42/EEC on Medical Devices (MDD) (EEC, 1993).

Often it is discussed if an app is a medical product or if a health tracker or activity tracker is a medical product. The answer is not always clear as it is depending on the intended use of the device. From the perspective intention, most of the developments in eHealth are medical devices. Also software can be a medical device.

But according to the new Regulation on General Data Protection, the documentation that is needed for a CE certification is almost available by following the legal requirements.

5. Discussion

Transponding is a chance to follow a standardized way for analyse impact of therapies in a cheaper, behavioral oriented way. Also it is a chance for developing supporting mechanisms in therapy

control and for increases adherence. There are also legal regulations at hand, which are supporting developments by providing a framework and security network for developers and users as well.

This concept of transponding is tested in the H2020 project My-AHA (My-AHA, 2016) by Johanniter to balance developments from technology, desk research by university partners and the feedback from secondary end users in the field of frailty prevention.

Special issues have been already identified in the area of social frailty and loneliness.

Also in other projects, this approach is supporting the decision on sensors and interventions and will be used further on.

According to changing legal situations and the sometimes rapid developments on the market, a standardized approach like transponding is providing a chance to get an overview fast, to stick to the targets of the study without getting carried away and helps to keep documentation for the end user in trials.

How strong the relation between the measured impacts to the traditional monitoring systems for therapy control are, is not known until now. But in general, this will be dependent to the design and the accuracy of sensors. The available but limited experience with this new approach points in a promising direction.

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ICT SUPPORT OF THE QUALITY MANAGEMENT IN HOSPITALS

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ICT, health care, quality management, patient satisfaction

Abstract

The Faculty of Health Studies at the University of Pardubice has historically been cooperating with hospitals of acute care in the Pardubice region in the field of quality of care (since 2015 under the Hospital of Pardubice region). One of the long-term themes in the field is setting a system of quality care assessment – patient satisfaction evaluation. The whole concept includes a questionnaire design, data collection criteria, data analysis and interpretation including data validation by control data collection and questionnaire evaluation in order to achieve increased reliability. The created system is based on ICT covering tasks connected with an on-line patient admission, data processing, all the way to shared benchmarking of single hospitals.

1. Introduction

Modern health care uses a whole series of advanced technologies. Nowadays, particularly IT forms an information spine of a successful medical care. Information and communication technologies belong among standard means assisting in life-saving actions, primarily thanks to their versatile utilisation, continuous access to important information and improving efficiency of single medical and administrative processes. Health monitoring and IS/ICT facilities surveyed by European Union show that there is a certain potential for improvement in the Czech Republic. In order to obtain

findings of eHealth implementation and IS/ICT application in medical facilities, comparative research of Joint Research Centre (JRC) and European Commission (Sabes-Figuera, 2013) was used. Czech hospitals are 100% equipped with computers, High Speed LAN, and they preserve information about their patients in the electronic form (Potančok et al., 2015). However, in the Czech hospitals there are certain barriers to successful ICT development predominantly related to financial and human resources (Antlová, 2013). In certain areas there are still missing systems both on organisational and national scale, sharing medical prescriptions, electronic data exchange in central databases, to name a few. National registers have been in the long term running under the Institute of Health Information and Statistics of the Czech Republic (further on “NHIS”), established in 1960. The Institute is an organisational component of the state; its founder is Ministry of Health. NHIS is defined in Act no. 372/2011Sb, On Health Services and Conditions of their Provision (Act on Health Services) Section 70, Paragraph 1 (the Act has been valid since April 2012). The Institute cooperates with associations of hospitals, associations of physicians, professional medical societies, health insurance companies and other organisations, particularly when precise specification of the NHIS contents and utilisation of the collected data are concerned. On the international level of health statistics the Institute cooperates particularly with WHO, OECD, the UN, EUROSTAT and other organisations. The Institute is the official presenter of NHIS data for the Czech Republic (UZIS, 2016).

However, the Health Sector also engages changes in the relationship to patients as recipients of care and clients. A patient has been undergoing gradual transformation from a passive role into an active role in the past two decades. This process affects the end quality of care through diagnostic, therapeutic, and nursing processes. These processes are provided by gradual electronization of the medical data (Karpetski, 2010). Thus the technologies enter the medical facilities within the framework of comfort assurance during hospitalisation (Wi-Fi access points). Online access of patients becomes a standard in the frame of marketing services, providing entertainment and communication access, but also offering space for evaluation of the quality of care provided to patients. We can observe a wide range of patient's activities available to the patients via Internet, particularly their access to mass media (Aumayr, 2015). On the other hand, there is a need for preventive control of information feed available to both health care professionals and patients to avoid their potential information overload. There is a certain risk of information overload present in hospitals (Nešpor, 2011) concerning especially health personnel, nevertheless, this overload can also affect patients (Bawden, Robinson, 2008) and influence their mental condition (Kappos, 2007). In their work, Zeldes and Baum (2011) describe effects of information overload which may even result in an utter loss of interest in new information. The issue of quality management in modern health facilities is becoming a theme of scientific research. It is happening due to the fact that quality management forms a part of coordinated processes of health care and its aim is to minimize risks of adverse events and to determine good practice. Quality of care, especially the care provided by doctors and also non-medical personnel is a topical subject. According to Donabedian, quality health care can be defined as care granting maximal benefit to patient's health and a situation when expected benefit exceeds costs of all treatment procedures (Bártlová et al., 2008). As stated by Škrála and Škrlová (2003), quality in modern healthcare represents satisfaction of certain requests decided on by a client. In order to maintain quality assurance in healthcare facilities satisfaction needs to be monitored, assessed, and increased.

Quality assessment and safety in healthcare in the Czech Republic is legislatively enshrined by the Ministry of Health of the Czech Republic (MZČR) in Act no. 372/2011Sb, On Health Services and Conditions of their Provision (Act on Health Services). Within this act the provider is obliged to assure quality and safety of healthcare according to article 47 paragraph 3 letter b) by means of introducing internal system of quality assessment and assessment of healthcare safety (Act

no. 372/2011 Sb. MZČR, 2011). Regulation no. 102/2012 on quality assessment and safety of residential treatment and healthcare and Bulletin MZČR no. 16/2015 among others determine the standard: patient satisfaction monitoring (Regulation no. 102/2012 MZČR, 2012, Bulletin no. 16/2015 MZČR, 2015). The conditions for patient satisfaction monitoring are determined only in general terms. One of the standards determined by the Joint Accreditation Board is monitoring patient satisfaction (Joint Accreditation Board, 2013). For instance benchmarking belongs among concrete instruments for quality comparison in particular institutions. Comparison is subject to using identical indicators of measurement, identical questionnaire, respectively, and the same methodology. The instruments must fulfil elementary criteria of indicators according to Gladkij (2003): sufficient validity, practicality, sensitivity, and specificity.

2. Creation of a system for patient satisfaction evaluation

The goal of the project was to set methodology for patient satisfaction monitoring in a way which can be feasible in acute care hospitals in both inpatient and outpatient groups of patients and expectant mothers. The selected methodology must provide wide feedback for improvement of care for benchmarking of single hospitals. Considering the fact that all involved hospitals currently belong to one organisation and all hospitals are currently accredited by the Joint Accreditation Board, it was necessary to create a consistent tool for data collection.

The main empiric research framework, which aimed at finding a suitable methodology for assessment of patient satisfaction as follows: to create questionnaire design, to create methodology of data collection in two surveys per year (spring, autumn – control survey), data processing, data analysis, data interpretation relied on the IT/IS facilities of the hospitals and the university. The hospitals were allocated certain capacity on the university server and LimeSurvey system was made available for data collection. Questionnaire validation and data validation were run by the students of the control survey directly in hospitals via tablets connected on-line. Control survey was run to prove validity and reliability of the questionnaire for patients. Data were evaluated using statistics in every single hospital and they were further analysed in comparison of single hospitals using contingency tables.

Since 2012 a questionnaire containing 23 questions has been used. Each respondent could express their comments in writing at the end of the questionnaire. The questionnaire focused on three main parts: personnel approach, quality of care and satisfaction with treatment, and hotel service in hospitals. The answers of the respondents were obtained within the nominal scale, in both positive and negative bands. The target group composed of hospitalized patients at wards, outpatients, and expectant mothers in five hospitals of acute care in the Pardubice region. The questionnaires were filled in order of the groups of discharged patients or at the moment of the visit to the out-patient department. The questionnaire was distributed in printed form and it was available directly at the hospital departments. There were also questions which were irrelevant for care satisfaction assessment. Example of such question: ‘Has the personnel verified your name when administering drugs or before performing medical interventions?’ this question does not directly relate to patient satisfaction. On the contrary, it rather checks observance of rules and this is to be checked by other tools, e.g. audits. After three years of using the original unified questionnaire created by the hospitals, there was run a new analysis of the questionnaire and its results were obtained in 2015. The questionnaire was no longer in compliance with the elementary criteria: practicality (too lengthy), sensitivity (it did not reflect changes in time, the results did not differ in time periods), and specificity of the measured field (many questions were aimed at the observance of quality standards and not at the assessment of the patient care satisfaction). The

assessment did not bring any new knowledge, it ceased to be the engine of improvements and its evaluation was relatively demanding. Based on the results of the foreign questionnaire review and expert interviews with quality managers and with assistant managers of nursing care, a new, simpler and patient friendly questionnaire suitable for more practical data processing was prepared.

In 2015 the new questionnaire was for the first time introduced and assessed. It consists of 7 closed questions and an extra space for more comments. The questionnaire comprises questions related to elementary areas of satisfaction: treatment, information clarity, hotel services: food, cleanliness, room/department equipment. In conclusion the patients provide overall assessment and hospital references. The patients answer on a scale from 1=excellent to 4=unsatisfactory, 1-2 belong to the positive band and 3-4 belong to the negative band. Introducing the numerical scale of assessment provides more space for evaluation and data interpretation becomes more transparent, especially in case of benchmarking. In the final part of the questionnaire the patient can express their comments and provide justification of their negative assessment. Hospitals placed the assessment questionnaires on their websites and the questionnaire is still accessible there, printed questionnaires are filled in by the patients in each field (hospitalization, out-patient departments, and expectant mothers) all the year round according to present methodology. A selective survey was undergone in a sample of patients in September 2015. The selective survey was administered on 2,777 patients in total (497 participated in control survey). The patient file obtained from all 5 hospitals in 2015 constituted of 1,055,926 patients. The questionnaire underwent validation through control survey performed on-line in hospitals by students and also it was evaluated in order to confirm reliability and user comfort (comprehensibility, ability to measure relevance of the question, satisfactory answer scale, relevancy of assessment) in the same file.

3. Selected results

In the following tables there are stated examples of assessment, which were obtained by single hospitals and by the management of the joint organisation. To maintain anonymity, the hospitals were labelled A, B, C, D, E. Table 1 illustrates evaluation of an improper question in comparison with hospitals from the year 2013. This question was omitted after the questionnaire adaptation in 2015. Table 2 illustrates an example of assessment of outpatient satisfaction from the year 2014, with answers to the question: *How did you perceive the waiting room environment?*

In order to confirm validity and reliability of the data collection methodology, a control survey and evaluation survey were performed in 2015. An example of comparison between a sample survey and control survey in a particular question is illustrated in Table 3. The control survey seems to be slightly more positive, the patients tend to be more critical during anonymous surveys. There were no significant differences observed between the two surveys in their positive bands. The control survey exhibits slightly more positive results.

Has the personnel verified your name before administering drugs or performing an operation?						
Answer	Hospital A	Hospital B	Hospital C	Hospital D	Hospital E	Total
Yes	514	367	223	377	201	1682
	89 %	87 %	89 %	82 %	82 %	
Nearly every time	57	36	25	60	41	216
	10%	8 %	10 %	13 %	17 %	

Hardly ever	0	14	2	14	3	33
	0%	3 %	1 %	3 %	1 %	
Never	4	7	1	6	2	20
	1 %	2 %	0 %	1 %	1 %	
Total	575	424	251	457	247	1954

Table 1: Contingency table with answers to the question on name verification 2013

Waiting environment room	Hospital A	Hospital B	Hospital C	Hospital D	Hospital E	Total
Pleasant and clean	672	187	41	273	37	1210
	94,12 %	95,41 %	67,21 %	90,70 %	94,87 %	
Dirty and uncomfortable	2	0	5	3	0	10
	0,28 %	0,00 %	8,20 %	1,00 %	0,00 %	
Inadequate facilities	30	6	11	17	2	66
	4,20 %	3,06 %	18,03 %	5,65 %	5,12 %	
Without answer	10	3	4	8	0	25
	1,40 %	1,53 %	6,56 %	2,66 %	0,00 %	
Total	714	196	61	301	39	1311

Table 2: Contingency table: Patient satisfaction with the environment of the out-patient department in each hospital in 2014.

The Table 4 demonstrates evaluation survey containing results with answers to the question of comprehensibility of the questionnaire query. The patients were asked about the survey query intelligibility, relevancy, if they are able to answer the questions, whether the leading answers are sufficient, and if the respondents would suggest any further questions. All questions in all assessed categories were evaluated predominantly in the positive band (yes, rather yes). In the group of other suggested questions there appeared a frequent suggestion for query about assessment of approach of doctors and nurses. This question was included the questionnaire for the year 2016.

How were you satisfied with treatment in our hospital?	Regular survey	Control survey	Total
1	1403	140	1543
	83,86%	81,87%	
2	228	29	257
	13,63%	16,96%	
3	23	1	24
	1,37%	0,58%	
4	19	1	20
	1,14%	0,58%	
Total	1673	171	1844

Table 3: An example of comparison between regular and control survey of assessment of satisfaction in hospitalized patients in 2015

Do you find the following question comprehensible? : Overall, how would you rate your hospital?		
Answer	Number	Percentage
Yes	135	79%
Rather yes	14	8%
Rather not	19	11%
Not	3	2%
Total	171	100%

Table 4: Frequencies of selected questions of the questionnaire assessment in 2015

4. Discussion

An assessment of patient satisfaction is not a simple task. It was already mentioned by Struk (2004) where the authors allege that „*the care for an individual conflicts with the individual himself. For a layman it becomes increasingly difficult to be well versed in health care. The question is how the patient feels, how we perceive his or her needs and whether the patient satisfaction is considered to be a key outcome of the patient care*”. Von Eiff (2015) states that hospitalized patients should assess what they are able to assess. This ability is very individual; nevertheless, one can operate with a presumption of so called minimum of patient comfort assessment formed primarily by the environment, social climate of a workplace influenced by behaviour and practice of the personnel. The above mentioned author also highlights differences in subjective assessment affected by current health state of the patient (Von Eiff, 2015). There is a range of commercial hospital appraisal surveys which use the above mentioned method of benchmarking, e.g. services of the Health Care Institute – HCI. The HCI questionnaire consists of 30 questions and its administration and data collection are provided by the hospitals. Completed questionnaires can be submitted through any hospital ward, whereas reliability and validity of the results are not examined. Based on the survey results, assessed hospitals are ranked into a list. The data processing and results are provided to the hospitals in return for payment. There is another commercial assessment project called Assessment in the eyes of patients, in the course of which the inpatients assess 50 indicators of quality in total. These indicators make eight dimensions of inpatient care. Results of this survey can enable a hospital to obtain a certificate, *satisfied patient*’ based on the result analysis (HCI, 2013).

With regard to the fact that former assessment is provided in return for payment, the hospital management strive for finding their own solutions to monitoring patient satisfaction. Above discussed tools for monitoring assessment of patient satisfaction commercially seem to be unsuitable for many hospitals. The main reason is its financial aspect but also impossibility of benchmarking caused by inconsistency in tools used by hospitals.

The questionnaire currently in use by the Nemocnice Pardubického kraje joint-stock company is more convenient for both the patients and the hospitals. Even though it is less detailed in structure and it does not cover all situations in which a patient can assess his or her satisfaction or discontent with the health care, after its validation and evaluation, the questionnaire proves to be a suitable tool for elementary monitoring of health care satisfaction of patients. The questionnaire is a suitable tool for communication between a hospital and a patient. This tool is in the context of assessment of patient care satisfaction appropriately complemented with other tools, such as the complaints book and status of a hospital ombudsman. Observance of standards of health care

quality is continuously checked by means of internal and external audits, which reveal potential for improvement. All hospitals are currently accredited by SAK (Joint Accreditation Board, 2013) with a certificate.

The evaluation of assessment of satisfaction strengthens an active role of a patient which is further amplified by comfort of assessment based on IS/IT facilities of a hospital and university. At the same time the whole data collection methodology, its processing and assessment are thanks to technologies designed conveniently also for the management. The entire system works efficiently to avoid information overload in individual participants as highlighted by Cejpek (2005).

5. Conclusion

The Nemocnice Pardubického kraje, joint-stock company is a firm that was founded on 31st December, 2014 integrating five acute care hospitals in the Pardubice region. Currently the hospitals use a unified tool and methodology for assessment of patient satisfaction with hospital care. This tool is based on efficient utilisation of ICT. Thanks to this fact, each hospital in the joint-stock company Nemocnice Pardubického kraje can use benchmarking in order to increase quality of care. They obtain valuable feedback on provided care in single hospitals in the company from their patients and thus they fulfil the standard of quality assessment of patient satisfaction. They also have an opportunity to mutually enrich each other with experience in functional and proven approach with the aim to spread a good name of both single hospitals and the whole company by their care and services.

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EVIDENCE-BASED PRACTICE AS A PART OF KNOWLEDGE MANAGEMENT IN NURSING

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Knowledge management, evidence-based practice, health care, nursing

Abstract

The aim of this paper is to show the use of evidence-based practice (EBP) as a part of knowledge management in health care, with a focus on Czech nursing. The conditions of the knowledge management functioning in health care are generally described in the opening chapter of the text. Furthermore, the paper deals with the explanation of the concept of EBP and refers to some problems of EBP implementation in Czech nursing practice. The final part of the text focuses on the theoretical preparation of students of the medical universities to manage this problem in the clinical practice, including a summary of the results of research on the extent of teaching EBP at Czech universities providing education in nursing.

1. Introduction

Currently, the organizations with the best employees win in the competitive struggle rather than the organizations with the largest financial capital. The knowledge of these employees is crucial. People and their knowledge are very important for organizations in health care, which are characterized as knowledge-intensive. They are the most valuable assets, whose effective use helps to achieve the objectives of the organization and have an impact on its success or failure.

Medical institutions are operating in an environment that is characterized not only by their high demand for knowledge of the staff, but also well-informed consumers. Health care organizations are required to provide high quality services to the public. They must therefore employ and coordinate the specialized knowledge and skills of their employees in order to be able to provide quality health care for patients.

In connection with the application of expert knowledge in health care, we can talk about evidence-based practice (EBP), about the new phenomenon that has recently become an object of interest to the medical practice. EBP allows keeping up with the rapid development of medicine and the increase in new knowledge. EBP enables nursing staff to be more independent and responsible.

2. Knowledge management in health care

Knowledge management is important for all organizations regardless of their activities and the main mission. It is commonly associated with commercial or production companies (Bureš, 2007). In the health sector it is not yet optimally used, although it is crucial for providing of quality health care.

In particular, the specialized knowledge and skills of health professionals are crucial for providing quality health care. The nature of the health organizations requires well-managing the knowledge, since they can be a source of competitive advantage. Understanding the knowledge processes in an organization and how they are used every day, are the critical factor of success (Ferreira, 2010). Health care environment is changing rapidly, and if medical facilities want to survive and succeed in a competitive fight, they must keep up with the development of science and technology and must be willing to learn and innovate.

In the health service, as well as in other areas of the national economy, it is also possible to meet up with two types of knowledge: explicit and tacit. In fact, explicit knowledge is information (Mládková, 2005). Explicit knowledge helps paramedics in the decision-making process. They can be formalized, easily transmitted and retained, for example by means of internal regulations, methodological guidelines, electronic databases etc. It is important not only to retain an explicit knowledge, but also spread it in organizations. Today, especially the internet and the intranet help to spread the explicit knowledge (Sandars, 2006). Explicit knowledge is easily available, and every paramedic has the opportunity to acquaint with it.

Tacit knowledge is the internal knowledge hidden in the heads of health care workers, which can be partly made available for other colleagues. The disadvantage of this type of knowledge is that their holder is an individual who may not always be willing to share their knowledge (Mládková, 2004). There may be a high-quality, knowledge holders, such as an educated nurse, and it is necessary to count with the risk that one day they leave the institution (in the worst case, they can go to a competitive organization). Tacit knowledge is transferred in passing experience to new employees, in the medical facilities usually in the form of coaching and mentoring during the adaptation process.

It is not possible to clearly say which type of the knowledge is better, both of them are irreplaceable. The challenge of knowledge management is to use the explicit and tacit knowledge effectively in decision-making process. According to Beverley (2009) is the knowledge management more associated with the tacit knowledge, i.e. those that have individual employees hidden in their heads.

The effective use of knowledge management in health care leads to improved care for patients, their higher safety, satisfaction, higher motivation of the personnel, it helps to stabilize the staff and reduce its fluctuation, enable professional growth, leads to more opportunities for education, research, innovation, better communication, and improved information systems (Mládková, 2004; Beverley, 2009). Knowledge management is therefore helpful to the whole organization, to its staff and patients. To realize knowledge management is, however, necessary to create suitable conditions consisting in a convenient organizational culture that enables knowledge sharing, mutual support and cooperation, management support, quality human resources management, and information systems (Sandars, 2006).

Nowadays the application of the knowledge management is seemed to be necessary in the health care organizations, because it can respond to the ever-growing competition and helps the medical

facilities to face problems of the increasing demands for the quality health care and the requirements to minimize costs.

3. Evidence-based practice (EBP)

Evidence-based practice (EBP) is an important part of the knowledge management in health care. EBP can also be understood as an extension of knowledge management (Beverley 2009, according to Beverley, 2006). The introduction of evidence-based practice is a response to efforts to manage knowledge in health care. The point is, in particular, the creation, preservation and distribution of explicit knowledge (evidence) and to provide the knowledge for decision making in health practice (Sandars, 2006). The following text is focused on the issue of EBP in Czech nursing.

Rycroft-Malone (2008) defines EBP as a systematic approach using the best available evidence from research, patient preferences and clinical experience in the context of the decision-making process. EBP is an active process, which is based on a search of problems and different weaknesses. Some routine procedures can be discovered within EBP, which currently do not work, lack the sense and do not lead to the improvement of nursing care (Plevová, 2007).

EBP starts the patient's problem formulation and ask the clinically significant questions. It continues with searching for available resources for finding the best evidence and considering the expertise of the nurses and the interests of the patient (McFadden et al., 2007). This phase is time-consuming. It requires searching in databases and in the specialized literature. It may mean a problem for many nurses due to their workload. The problem, especially for Czech nurses, may also be a language or financial barriers. Most professional databases are not available in Czech language and access to them is charged. In addition, the work with the patient remains still a priority in nursing. Nurses prefer to spend their time in the practice and care for patients than to look for the best evidence in a computer.

The whole process of EBP is completed by the application of research results into practice and evaluation of the effectiveness of nursing care provided. This last step is crucial for the assessment of whether the intervention was the best and if it has improved the situation of the patient (McFadden et al., 2007).

Except the lack of time there may be other barriers such as negative attitudes of nurses, lack of motivation and skills. The obstacle in the implementation of EBP into practice is also the overall conservative approach to this issue and reluctance to change current practices. Quite often it is also low knowledge of EBP or the wrong understanding. The problem may also be inappropriate organizational culture or the lack of support from the management of medical facilities and from other colleagues (Harding, 2014). Despite the understanding of the importance of EBP in nursing practice, it is not yet the common part of Czech nursing care.

Ideal conditions and background for the implementation and use of EBP in practice are not created. Nurses, for example do not have access to a sufficient quantity of computers or do not have access to professional databases, in which they could search. Some nurses may also have a problem with searching in databases because they do not know basic work with them. However, this problem is solvable. The question is better preparation of students at universities (see more details in the following chapter). It is necessary to realize that the knowledge of information technology is becoming an integral part of nursing.

The university hospitals have probably the best conditions for using EBP in practice. The Czech university hospitals are in-patient medical facilities and educational institutions at the same time. Specialized workplaces of university hospitals serve as training base for the medical and

pharmaceutical faculties. University hospitals have access to professional databases or may use electronic sources of these faculties. Most of Czech university hospitals use the database Medline and Medscape, which contain articles intended for paramedics.

In the future, it will be necessary to work on removing above mentioned barriers, change the attitude of the management and nurses to EBP because they still resist. Investment in EBP is definitely worthwhile and will return in the form of better health care, in the overall improvement of conditions for patients and in their higher satisfaction.

The development of EBP is so far supported mainly by academics (not only by experts from the field of nursing, but also by doctors, informatics or by employees of libraries). It is necessary to change the way of thinking in the implementation of EBP and it is important to start from the students.

3.1. EBP as a part of the study at Czech medical universities

At present, it is necessary that students of the medical universities have at least basic knowledge of EBP. Part of the nursing studies consists usually of the courses acquainting future nurses with the principles of the scientific work and research, focusing on research, with which they may meet in practice and teaching them research methods and techniques. Students should be able to evaluate used nursing procedures critically and be able to search for ways to improve it, they should know how to realize a research and interpret the results correctly.

13 universities offering study of general nursing exist in the Czech Republic. A list of them is given in the table 1. All 13 institutions offer the bachelor study programs (full-time or combined form), 7 of them master study program (full-time or combined form) and 4 universities offer doctoral studies (also full-time or combined form).

The aim of this paper was to find out whether or not and to what extent is EBP taught at these universities. The method of secondary research was used for this purpose. Data were extracted from the available data sources within this method – from the study information systems (for example STAG and SIS) and from publicly available syllabi of courses on the university websites. The research was conducted in March 2016.

It was found that courses engaged in research in nursing are a part of the courses for general nurses at all 13 universities. Nurses are informed about basic terms from the field of scientific research, data processing and basic methods applied in statistical investigations during their studies.

Evidence-based practice, as an individual course, is taught at 5 institutions out of the total 13. These are University of J. E. Purkyně in Ústí nad Labem, Palacký University in Olomouc, Ostrava University, University of Pardubice and the Southern Bohemia University in České Budějovice. This course (mostly optional or selective) is even part of the bachelor study program at some of these universities (University of J. E. Purkyně in Ústí nad Labem, Palacký University in Olomouc, Ostrava University, and University of South Bohemia in České Budějovice), see the table 2.

EBP is taught as a part of other compulsory courses at 12 universities (including the above mentioned), these usually are focused on a research in nursing and in most cases are taught already at bachelor degree programs, more details again in the table 2 (question marks in the table indicate that this figure could not be determined). Issues of EBP has not been mentioned clearly as a part of the content of the relevant courses at 5 universities, but has been mentioned in their objectives or among acquired skills or student's qualification, e. g. as the ability to "be able to apply research results in the clinical practice" or skill "to use the principles of EBP". These courses are marked in italics in the table 2.

According to the information from the study information systems, bachelor students will acquire the basic knowledge of EBP, they learn critical thinking and search problems, they learn to work with the available electronic databases, Czech and foreign, they learn to search and evaluate evidence found and propose the application of the best evidence in nursing practice.

Teaching EBP, of course, is not possible without adequate human resources and technical equipment. Staffing of the lessons is not easy. It is necessary to get experts and mentors who know EBP and establish cooperation with the employees of the libraries. It is also desirable to teach EBP in computer classrooms, to make students familiar with the work with professional scientific databases and libraries (e.g. ProQuest, Medline), which should have been accessed free. Technical support should include high-quality equipment of computer classrooms (the latest software, the number of computers should meet the demand of students etc., Jarošová, 2014). We should realize that the use of information systems and computer technology is today an integral part of providing safe and quality health care to patients. The nurses as knowledge workers must be able to work with such tools in order to provide the high-quality care.

In the future we need to consider whether or not to give the problems of EBP more space and extend study plans of bachelor degrees on the new courses dealing directly with this issue (at least as an optional subject). Bachelor students are expected to be able to find, evaluate and use evidence found in practice.

Evidently, to ensure high-quality teaching of EBP is not easy. EBP is, however, a chance for the students to acquire critical thinking skills and learn how to develop independent decision-making based on evidence. Skills acquired during their study will help nurses to apply research results into practice more easily. It allows them to manage the large amounts of new knowledge, technologies, literature, and will lead to better health care. The study of the prescribed textbooks is not enough for good nursing practice (Jarošová, 2014).

	UNIVERSITY	FACULTY	STUDY PROGRAM		
1.	College of Polytechnics Jihlava	Not divided into faculties	B (f, c)		
2.	Charles University in Prague	First Faculty of Medicine	B (f, c)	M (c)	
		Second Faculty of Medicine	B (c)		
		Third Faculty of Medicine	B (f, c)		
		Faculty of Medicine in Hradec Králové	B (f, c)		
3.	Jan Evangelista Purkyně University in Ústí nad Labem	Faculty of Health Studies	B (f, c)		
4.	Masaryk University Brno	Faculty of Medicine	B (f, c)	M (f, c)	
5.	Medical University College, Prague	Not divided into faculties	B (f, c)		
6.	Palacký University Olomouc	Faculty of Health Sciences	B (f, c)	M (f, c)	D (f, c)
7.	Silesian University in Opava	Faculty of Public Policies	B (f, c)		
8.	Technical University of Liberec	Institute of Health Studies	B (f, c)		
9.	Tomas Bata University in Zlín	Faculty of Humanities	B (f, c)		

10.	University of Ostrava	Faculty of Medicine	B (f, c)	M (f, c)	D (f, c)
11.	University of Pardubice	Faculty of Health Studies	B (f, c)	M (f, c)	D (f, c)
12.	University of South Bohemia in České Budějovice	Faculty of Health and Social Sciences	B (f, c)	M (f, c)	D (f, c)
13.	University of West Bohemia, Plzeň	Faculty of Health Care Studies	B (f, c)	M (f, c)	

Table 1: List of the Czech universities offering Nursing study program in academic year 2015/2016

Legend: B = bachelor study program, M = master study program, D = doctoral study program, f = full-time form of study, c = combined form of study.

UNIVERSITY	FACULTY	STUDY PRO-GRAM		YEAR	COURSE	
Charles University in Prague	Second Faculty of Medicine	B	C	1	<i>Research in Nursing</i>	comp.
	Faculty of Medicine in Hradec Kr.	B	F, C	1	<i>Introduction to Research Methodology in Nursing</i>	comp.
Jan Evangelista Purkyně University in Ústí nad Labem	Faculty of Health Studies	B	F, C	?	Evidence-based Practice	selective
Masaryk University Brno	Faculty of Medicine	B	F, C	2, 1	<i>Healthcare Informatics</i>	comp.
		M	F, C	1	Nursing Research	comp.
Medical University College, Prague	Not divided into faculties	B	F, C	?	Theory in Nursing	comp.
Palacký University Olomouc	Faculty of Health Sciences	B	F, C	1	EBP in Nursing	comp. optional
		B	F, C	2	<i>Research in Nursing</i>	comp.
		M	F, C	2	Nursing Science	comp.
		D	F, C	1	Evidence Based Practice	comp.
Silesian University in Opava	Faculty of Public Policies	B	F, C	2	Nursing Research 1, 2	comp.
Technical University of Liberec	Institute of Health Studies	B	F, C	2	Research in Nursing 2	comp.
Tomas Bata University in Zlín	Faculty of Humanities	B	F, C	2	<i>Nursing Research Methodology</i>	comp.
University of Ostrava	Faculty of Medicine	B	F, C	2	Research in Nursing	comp.
		B	F, C	2	Evidence-based Nursing	selective
		M	F, C	1	Evidence-based Practice	comp. optional
		D	F, C	?	Evidence Based Practice in Nursing	comp.

UNIVERSITY	FACULTY	STUDY PRO-GRAM		YEAR	COURSE	
University of Pardubice	Faculty of Health Studies	M	F	1	Research in Nursing	comp.
		D	F, C	2	Working with Scientific Material (EBN)	comp. optional
University of South Bohemia in České Budějovice	Faculty of Health and Social Sciences	B	F, C	2	<i>Nursing Research 1, 2</i>	comp.
		B	F, C	3	Evidence-based Practice 1	optional
		M	F, C	1	Methodology of Research in Nursing	comp.
		M	F, C	1	Evidence-based Practice 2	optional
		D	F, C	2	Work with Scientific Staff for Clinical Practice	comp. optional
University of West Bohemia, Plzeň	Faculty of Health Care Studies	B	F, C	2	Research in Nursing and Midwifery 1	comp.
		B	F, C	3	Research in Nursing and Midwifery 2	comp.

Table 2: List of courses with EBP education sorted by universities and their faculties (state in March 2016)

Legend: B = bachelor study program, M = master study program, D = doctoral study program, f = full-time form of study, c = combined form of study, comp. = compulsory, EBN = evidenced-based nursing.

4. Conclusion

The aim of this paper was to inform about the conditions of functioning knowledge management in health care, explain the concept of evidence-based practice (EBP) as a part of the knowledge management, describe the use of EBP in Czech nursing practice and provide an overview of the teaching of this issue at Czech universities.

In medical institutions, knowledge is a strategic resource, because unique knowledge cannot be easily copied and they can mean a big competitive advantage for the organization or they can contribute to increase performance. Knowledge management is a tool of controlling knowledge. The effective use of knowledge management in health care organizations leads to better health care for patients, to their higher safety and satisfaction, it motivates staff, contributes to its stabilization, improves communication etc.

In the context of knowledge management, we talk about evidence-based practice (EBP). EBP is the process, in which research results, preferences of patients and nurses experience are taken into account in nurse's decision making. Nurses must learn to use EBP during their university studies. We provide education in nursing at 13 Czech universities. EBP is taught separately or as a part of other courses. Most Czech universities integrate EBP issues in other courses, usually focused on research in nursing. To be able to use EBP in practice assumes that students have the basic computer skills, they are knowledgeable of the English language and research methods and statistics. In the future, it will be necessary to consider whether to implement EBP as an individual course as a part of the bachelor study programs at all universities.

Despite the growing importance of EBP, the knowledge of nurses of this issue in the Czech health organizations is relatively small. Many barriers prevent the implementation of EBP in practice. The

most important are the lack of time and workloads of nurses, language barrier or lack of management support. Active work with the patient is still preferred. Members of the management must create such as an environment in the organization, which will make enable critical thinking and allow the implementation of research results in practice. EBP increases the professionalism of the nursing staff, security and quality of health care provided.

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SESSION F: OPEN INNOVATION AND NEW E-BUSINESS MODELS

ROLE OF ICT IN BUSINESS MODEL INNOVATION IN SMEs – CASE OF SLOVENIA

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Abstract

In digital era, business model innovation (BMI) is becoming one of key activities of every enterprise in order to survive and thrive. The aim of this paper is to investigate the role of ICT in BMI practices in SMEs, which are key drivers of European Economy. We conducted case studies in 4 SMEs from different industries in Slovenia. The results have shown very limited usage of ICT for BMI, except in SME from ICT industry. In addition, observations have confirmed that there is little or no awareness in SMEs on how to systematically approach BMI.

1. Introduction

Rapid, continuous technological development and innovations has led us to the era of digital economy. In digital economy, business is done more and more in a digital way. Digital business does not refer only to digitalization of business documents and information but far ahead. Digital business is defined as “the creation of new business designs by blurring the digital and physical worlds” (Raskino & Waller, 2015). New business designs call for new kinds of products and services, business models, and industry models, as well as new ways of creating value for customers (Raskino & Waller, 2015).

In digital era, business model innovation (BMI) is becoming one of key activities every enterprise must continuously undertake in order to survive and thrive (Hanelt, Hildebrandt, & Polier, 2015). Numerous evidences of successful stories (e.g. IBM, Apple, etc ...) as well as failures (e.g. Kodak,

Nokia - cell phones, etc ...) emphasize the importance of “reassessing and redesigning the way firms create, deliver and capture value or in short; the importance of business model innovation” (Florén & Agostini, 2015). Enterprises must continuously evaluate, adjust and develop their BMs to remain competitive over time and sustain future growth in the future (Amit & Zott, 2012; Teece, 2010; Zott & Amit, 2009).

While the term “business models” have gained increased attention at the end of 1990s (Morris, Schindehutte, Richardson, & Allen, 2006) and amount of literature on BM has increased, sound theoretical foundation is still missing, which applies also for the concept of BMI (Carayannis, Sindakis, & Walter, 2014).

The importance of BMI is rather clear, however many enterprises still struggle with it (Florén & Agostini, 2015) and managers are actively seeking guidance on how to innovate their BMs (Casadesus-Masanell & Ricart, 2010; Florén & Agostini, 2015). Giesen, Berman, Bell, & Blitz (2007) found out that many business leaders have a difficult time to even define BMI.

This is aligned with findings in recent report of European Commission on “The Need for Innovations in Business Model – Final Policy Brief” (Barjak, Niedermann, & Perrett, 2014). Barjak et al. (2014) found out that many European enterprises, still lack awareness and knowledge about approaches and proper tools on how to systematically design, re-think and innovate their BMs

Situation is even more alarming among SMEs (Envision, 2015) which represent 99,8 % of all enterprises and are key drivers for economic growth, innovation, employment and social integration in the European Union (European Commission, 2014). Recent OECD report (OECD, 2015) demonstrates that SMEs show low-uptake rates and are lagging behind in ICT adoption and are less likely to innovate their BM. According to recent European Commission report “The Need for Innovations in Business Models – Final Policy Brief” (Barjak et al., 2014) across all countries and industries, approximately one out of 20 SMEs was classified as a business model innovator. The share decreased from 6.3% in 2008 to 5.5% in 2010. The report also emphasizes that BMI is a complex phenomenon and there is a need to continue research on BMI to gain better understanding of BMI drivers, factors and practices. In addition it is recommended to put special attention on education and training, information and advices for SMEs with an overall goal to raise the awareness about importance of BMI (Barjak et al., 2014).

The aim of this paper is to investigate different BMI practices in SMEs. In particular we are interested in gaining deeper understandings about the role of ICT in BMI practices. For that purpose we have conducted case studies in 4 different SMEs in Slovenia. We have applied a framework from Hanelt et al. (2015) for analyzing the role of ICT in BMI practices.

The paper is organized as follows. Introduction is followed by literature review on BM, BMI and role of ICT in BMI. In next chapter we present the methodology, which is followed by case analysis and findings. We end the paper with conclusions.

2. Literature review

2.1. Business models

There are several definitions of BMs. Osterwalder & Pigneur (2010, p 14) define BM as follows: “a business model describes the rational of how an organization creates, delivers and captures value”. In broader sense, not just single enterprise but also network of enterprises has to be considered in BM creation and definition (Pucihar, Lenart, Borštnar, Kljajić, & Marolt, 2015). Bouwman, Vos, & Haaker (2008) introduced a broad definition of business models. They define business model as:

“... a blueprint for a service or product to be delivered, the service or product definition and the intended value for a target group of consumers, the sources of revenue, and an enterprise architecture for service or product delivery, including processes, resources (capabilities and assets) required and the financial arrangements between the involved business actors, including a description of their roles and the division of costs and revenues” (Bouwman et al., 2008).

2.2. Business model innovation

There are many different definitions of BMI available from prior research. For example for developing of a framework for analyzing BMI Florén & Agostini (2015) have identified BMI as “a process of refining existing BM, which often results in lower cost of increased value to customers” (Teece, 2010). In our research we adapted the following BMI definition (Pucihar, Kljajić Borštnar, Heikkilä, Bouwman, & De Reuver, 2015): “BMI is defined as changes in business logic, that are new to the focal firm, yet not necessarily new to the world, and have to result in observable changes in the practices of a BM”.

Many researchers have offered various models to categorize different types of BMI (Giesen et al., 2007; Lindgardt, Reeves, Stalk, & Deimler, 2009) and frameworks for analyzing BMI (Harry Bouwman, Macinnes, & Reuver, 2010; Bucherer, Eisert, & Gassmann, 2012; Florén & Agostini, 2015; Mahadevan, 2004). These frameworks mainly focus to the following aspects of BMI: the foremost reason for enterprise to engage BMI (Bucherer et al., 2012; Carayannis et al., 2014; Mahadevan, 2004), core BM elements that can be changed (Florén & Agostini, 2015; Mahadevan, 2004) and types of BMI (Bucherer et al., 2012; Florén & Agostini, 2015).

Main stimulating factors for enterprises to innovate their BM are often related to the need for cost reduction and flexibility (Pohle & Chapman, 2006). Other reasons behind BMI are for example technology development, competition, legislation etc. Several authors distinguish between internal and external origin of BMI (Bucherer et al., 2012; Sorescu, Frambach, Singh, Rangaswamy, & Bridges, 2011) and internal and external opportunities and threats (Bucherer et al., 2012; Carayannis et al., 2014). These drivers influence the change of core BMI elements, which are defined in BM ontologies (Harry Bouwman et al., 2010; Johnson, M.W.; Christensen, C.M.; Kagermann, 2008; Skarzynski & Gibson, 2008). The level of changes of core BMI elements leads to different types of BMI. Some authors distinguish between disruptive and incremental BMI (Comes & Berniker, 2008; Markides, 2006), while others argue that BMI covers changes from incremental adjustments (which are more prevalent) to more radical changes and differ more stages from two above mentioned extremes (Bucherer et al., 2012; Demil & Lecocq, 2010; Florén & Agostini, 2015; Schaltegger, Lüdeke-Freund, & Hansen, 2012).

3. Methodology

3.1. Case study protocol

For the purpose of this study we have adopted multi-case study research method (Yin, 2009). The case study research consists of design, data collection and analysis phases defined in Case Study protocol (CSP) in Envision project (Pucihar, Kljajić Borštnar, et al., 2015). It is expected that at least 40 cases and in addition 20 longitudinal cases will be done in different European countries. In this paper we present results from first 4 cases done in Slovenia.

Types of selected and presented SMEs correspond to the overall structure of European SMEs: 2 SMEs qualify as a family business, 1 as a female and micro and 1 as a “regular” SME.

Data collection methods were defined by CSP (Pucihar, Kljajić Borštnar, et al., 2015) and consisted of two steps: preliminary investigation of available resources (business reports, web sites, media coverage) and semi-structured interview. During interviews, different business model templates were used to encourage discussion. The interviews were recorded and transcribed. Transcriptions and all gathered information prior and during interview were used for preparation of case study report. Additional insights were gathered also through additional short meetings, phone calls or through e-mail. Case study reports were sent to participating enterprises for approval.

3.2. Framework for analyses

Several BMI frameworks were established to enable more systematic approach towards BMI (Bucherer et al., 2012; Florén & Agostini, 2015). For our research we adopted a framework for defining the role of IS in BMI proposed by (Hanelt et al., 2015). The framework considers the role of IS as “an integrated and cooperating set of people, processes, SW, and information technologies to support individual, organizational, or societal goals” (Watson, Boudreau, & Chen, 2010). Hanelt et al. (2015) suggest three roles of IS in BMI, with subcategories:

- IS as a BMI enabler with two roles:
 - New digital business model. This role presumes that IS innovations are incorporated in new business models and represent their core element. The result is new business model, comprising all elements.
 - Digital business model enrichment. This role presumes that existing business models are extended by IS innovations. Digital components are added and address only certain business model components.
- IS as a capability in the BMI process with two roles:
 - Digital support capability. This role presumes that IS act as a means to enhance BMI processes. It mainly targets specific business model components. It is estimated that underlying BMI is already essentially planned.
 - Digital design capability. IS helping to develop BMIs. In this context, IS are not considered only as an executor or support, but enable exploring and design of new business models.
- IS as a frame of reference for BMIs with two roles:
 - Digital platform. Existing, available IS that can be incorporated additionally in the BMI. Specific business model components are affected.
 - Digital eco-system. Existing, available IS provide the background for BMIs and thus determine the design of business models. All business model components are affected for being compatible with digital ecosystems.

In this paper we focus and limit our research to the ICT as an integral part of IS and its role in BMI.

4. Case Analysis and Findings

The four analysed SMEs represent different sectors of the Slovenian economy. All four cases are mature enterprises. Our analysis was focused on drivers behind the business model innovation, changes made in business model innovation and the level of business model innovation. In this paper we focus on the role of ICT in BMI. First, we present an overall description of each

enterprise, following with analysis according to the adopted framework. We conclude with the aggregated findings.

4.1. Introduction of SMEs

Company A

Company A is a family business that was founded in 1993. At first the company was focused in building log cabins, garages, pergolas and making wooden panelling, floor, slats, etc. In 2003 the legal status of the business was changed from sole proprietorship to limited company. Later on, in 2006, the company shifted their activities to the production of wood biomass. While the production of wood biomass in Slovenia is divers and fragmented at the same time, enterprises strive to connect with other wood biomass providers (which are at the same time their competitors) in order to offer high quality wood biomass. With this approach company A also tends to increase the organization of already well developed market for wood fuels in Slovenia. In recent years, after the younger generation took over the business, they acknowledge 300-400 % growth. The number of employees is increasing. Currently, they have ten employees; nevertheless the company barely manage to provide products and services to their customers in time. They do not have website and are not very active on social media sites.

Company B

Company B is a female business that was founded in 2004. It provides a variety of handmade high quality leather shoes, hand bags and accessories with hand painted details. At first the owner had legal status of a self-employed person in a culture, than the legal status was changed into sole proprietorship. Main driver for a change was the need for a help in daily business activities. The main obstacle is that the owner is a driven artist and not a driven businessman. The owner wanted to focus on design of new products rather than selling her products in the store. Additionally, the owner needed help with paperwork. In 2015, the owner had to change legal status of the company to be allowed to employ a personal assistant. Legal change of the company brought additional legal challenges, resulted in higher taxes, more administration and bureaucracy. Company B is also present on the web, because the owner sees the potential in expanding the business to foreign markets. Besides the website, the company has also an online shop and is active on several social media sites.

Company C

The company C was founded in beginning of 1990's as internet service provider and has transformed over the years into high tech IT service and solutions provider in the field of High Performance Computing (HPC). Today it offers services of supercomputer infrastructure to their clients and provides them system administration, optimization and parallelization of code, cloud computing services, web and mobile application development services and project management SaaS services. Today the Company C employs more than 20 highly skilled experts, which are able to provide end to end solutions for their customers' demands. In recent years during economic downturn they faced dropping sales like many other SMEs, which resulted in increased efforts to develop and offer new services to the market. They are constantly introducing emerging technologies to the market, which helped them to increase revenues even during the economic crisis. In recent years they have become an important partner in EU projects (VII frameworks and Horizon), especially in High Performance Computing domain. EU funding represents an important source of income, investment in development of new services and accessing new markets.

Company D

Company D is a family business established in 1992 based on their tradition and inherited chocolate recipes from their ancestor. Shortly after Slovenia in 1991 adopted new legislation, which permitted to establish new companies, the family searched for a place in local region, where they could continue their family tradition of producing and selling chocolate confectionaries products. When they renewed family tradition of producing and selling confectionaries product they had two key attributes for successful start of the company: excellent tasted high quality products based on inherited chocolate recipes and very attractive location nearby highly visited touristic attraction - castle which provided access to market. Even today this is a corner stone of their strategy for successfully producing and selling of their confectionaries products on a market. Having high quality products which offer customers unique taste and highly frequent store location where a lot of tourists and local people are passing by are foundations of their long term success. Today Company D produces more than 150 different kinds of confectionary products. They also offer customized products for individual/custom orders. The Company D has grown throughout the years and has now six chocolate boutiques across Slovenia, as well as a number of established confectionaries local brands. All together they have 20-22 employees, depends on a season; 6 of them being full time employees, other are mostly students. They also have an online shop.

4.2. Analysis

4.2.1. ICT as a BMI enabler

Company A does not give considerable emphasis on ICT and is strictly focused on wood biomass technologies. They are considering the improvement of their online image through web site and social media. In this company ICT does not support new digital BM, neither does currently support digital business model enrichment.

Company B gives more emphasis on ICT, because the owner sees the ICT as an enabler to reach more people and to sell products online. Company B has store located in Bled, one of the Slovenian most popular touristic destinations. During the summer months there are many tourists in Bled and selling blooms, while in the winter it can happen that she does not sell anything in a whole week. Therefore the owner decided to launch online store and promote products through web site and social media. In this company ICT supports digital business model enrichment.

Company C services heavily depend on innovative ICT usage which enables BMI. Company C is building digital platform by deployment of cutting edge ICT and develop their customer focused services on top of ICT. The company has also a website and a webstore where they offer and try to sale services to new business customers. The online sales are rather limited, but they are aware that online presence is of huge importance, especially in their field of work, to reach new potential-targeted customers. This also requires changes in BM. Innovative ICT is driving BMI at company C and supports new digital business models as well as digital business model enrichment.

Company D is in traditional specialized food (chocolate confectionaries products) producing and selling business. They use ICT to extend their current capabilities. For example they have recently setup a webstore for their products to enable worldwide 24/7 sales of their products. In this case ICT serves as additional channel to their customers and as such also enables innovation in BM, which was not possible before.

Although companies C and D webstores enable selling of products and services through ICT based channels to new customers and their both webstores are running for more than 1 year, the bottom line impact of this ICT based channels are rather limited. Both companies C and D perceived this

business model enrichment more like strategic capability to improve relationship with their targeted markets.

4.2.2. ICT as a capability in the BMI process

Company C heavily uses ICT to deliver value to their customers which are accessing high performance computing services exclusively through ICT channel. ICT plays core role in developing capabilities for Company C. They are also very advanced in using of their own developed tools for project management and Company C Wiki Universe to support ongoing BMI internally.

Contrary, we have not identified single case use at Company A, B and D for using any ICT as capability for driving of BMI process.

4.2.3. ICT as a frame of reference for BMIs

Company A and B still relies more on traditional business operations compared to the employing digital platforms or joining digital eco-system. Company C uses ICT as frame of reference for BMI since their digital platform (High Performance Computing Cluster) depends on ICT. The hardest part for them is not managing ICT, but designing and selling business services on top of ICT. They have a challenge to integrate their ICT services offering with other components of their digital ecosystem which is formed with network of industry & research partners.

Company D uses ICT only to extend their current capabilities and only some of their current business component are affected as for example logistics and selling process.

Table 1 summarises the results of analysis of 4 different SMEs based on Hanelt et al. (2015) framework.

Role of ICT	Subcategories	Company A	Company B	Company C	Company D
ICT as a BMI enabler	New digital business model	None	None	Infrastructure as a service	None
	Digital Business model enrichment	Website, Social media	Website, Webstore, Social media	Website, Webstore, Social media	Website, Webstore
ICT as a capability in the BMI process	Digital support capability	None	None	Project management tool, Company Wiki Universe	None
	Digital design capability	None	None	None	None
ICT as a frame of reference for BMI	Digital platform	None	None	High performance computing service provider	None
	Digital eco-system	None	None	Industry & Research partner network	None

Table 1: Multiple case analysis of ICT roles in Business Model Innovation

5. Discussion and Conclusion

In this study we have investigated 4 well established SMEs from different industries in Slovenia. Our interest was in gaining deeper understandings of the role of ICT in BMI practices in SMEs. For the case analysis we have applied a framework from Hanelt et al. (2015).

The results of our investigation have shown that there are significant differences in the role of ICT in all categories of BMI in the enterprises from different industries. In our case Company C, coming from IT industry, heavily bases their business operations, business products and services, channels, revenue streams; basically all core BM elements on ICT. In their case ICT also plays a significant role in BMI as: a BMI enabler, both for new digital BMs (infrastructure as a service) and enrichment of digital BMs (website, webstore, social media), a capability in the BMI process for digital support (project management tool, company Wiki Universe) and a frame of reference for BMI for digital platform (High performance computing service provider) and digital eco-system (Industry & Research partner network).

Enterprises from other industries (Company A - wood biomass, Company B - handmade high quality leather shoes, hand bags and accessories and Company D – confectionaries) significantly lay behind. All other 3 enterprises use ICT only as a BMI enabler for digital BM enrichment category. Company A website is currently under development. They are aware of importance of web presence; however as a small enterprise they strive to react on demands from dynamic fast growing market. They are present on social media, but not really heavily engaged in strategic means. The interesting fact is that Company A had 300-400% growth in recent years despite only very basic use of ICT for the means of business operations. This is a result of growing industry, which they are a part of. However, in nowadays dynamic business environment “no BM lasts forever ... enterprises have to think hard about how to sustain and innovate their BM” (Chesbrough, 2007, p. 15). As a part of larger (international) network of bio-mass suppliers they are aware that they will have to implement ICT in the near future and also rethink BM. Company B uses website, webstore and social media as additional channels to reach new customers, beside the physical store that is located in heavily touristic place. However, the main season is summer, when there are many tourists. In other seasons, there are almost no visitors. Company D uses website and webstore for selling their products abroad. They are aware of importance of web presence and perceive a webstore as an additional sales channel, however not the main one. Their physical stores are located in touristic places around Slovenia, however arrangements with local tourist service providers to make stop by with the tourists at their stores is of crucial importance for sustainability of their business model.

SMEs have implemented widely adopted and available ICTs - website, webstore and 3 of them are also present on social media. These ICTs play role of digital BM enrichment and SMEs are using them to reach more customers and increase sales. Less or rather none attention is focused on ICT usage for other categories of BMI. Overall observation is that there was no systematic use of ICT for BMI, except in some cases in Company C, which is based in IT industry. None of the companies are aware of systematic approaches, methodologies and tools available for BM design and BMI.

Our findings have confirmed that BMI is a complex phenomenon (Barjak et al., 2014) and that there is little or no awareness in SMEs on how to systematically approach BMI. Our observations are aligned with arguments from Giesen et al. (2007) who found out that many business leaders have a difficult time to define BMI and with Florén & Agostini (2015), who claim that many enterprises still struggle with BMI approaches.

To overcome these gaps, better understandings of BMI drivers, factors and practices is needed. Special attention will need to be put on education and training, and providing of information and advices for SMEs, what has also been reported in European Commission report “The Need for Innovations in Business Models – Final Policy Brief” (Barjak et al., 2014). In addition, there is a need for proper ICT tools for all stages of business modeling – from BM design, to evaluation, to redesign and innovation of BMs (Envision, 2015). Special focus should be put on SMEs, which represent 9,8 % of all enterprises and are key drivers for economic growth, innovation, employment and social integration in the European Union (European Commission, 2014).

Last but not least, there are several limitations of our study. The main limitation is small number of currently investigated cases, all based in Slovenia. As this study is a part of European project number of cases from different European countries will increase in following years (Envision, 2015). Further limitation is that four presented cases were SMEs from different industries. Based on research results, suggesting that ICT based enterprises have applied more ICT in various categories of BMI, more cases with deeper analysis within various different industries (industry focused) should be analyzed and compared. For the evaluation of ICT role in BMI we have applied a framework from Hanelt et al. (2015). Our study was limited to investigation of only ICT (as a part of IS role) in BMI. For evaluation of proposed framework, not just ICT but all components of information systems, which is defined as “an integrated and cooperating set of people, processes, SW, and information technologies to support individual, organizational, or societal goals” (Watson et al., 2010) and their roles in BMI practices in SMEs should be evaluated.

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NEW TRENDS IN E-BUSINESS MODELS

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Agile strategies, agile commerce, business models start – up, crowdfunding, e-business model, open business models, sharing economy.

Abstract

Aim of this article is to explore new opportunities and problems of new trends in today's e-business models. Through the confrontation of the literature and two case studies of successful internet companies in Czech Republic we find some trends of successful key factors and also some new problems connecting with these new approaches, especially with the most popular mode - sharing economy. In our two case studies analysis we used Osterwald and Maurya business models point of view and their start-up management approach. We apply the business canvas in two internet companies and proved his using for the new start up internet companies.

1. Introduction

Today the traditional companies do not longer solve the question whether the internet will change their businesses. They knew that if they want to be competitive the discussion whether e-business belongs to business is out of date. But still, it's a long way from strategic intent to execution. Especially today the e-business must be flexible and agile. In recent years we can see big increase of entrepreneurship's opportunities in electronic commerce. According the European Committee the e-commerce is the biggest driving of business. European e-commerce turnover grew by 14.3% to reach € 423.8bn in 2014. Whereas e-commerce is still booming within Europe, the overall economy is only just getting back on its feet. This is evidenced by the fact the European GDP only increased by 1.6% to € 17.3trn. Within the EU28 this growth rate was even a little lower, at 1.4% (<https://www.ecommerce-europe.eu>).

This article brings some information about new trends in different types of e-business models and their strategies. One of them is based on collaborative consumption (called P2P – peer to peer). This model does not require any capital investment to acquire assets. Instead, it relies on a community to supply them, typically in exchange for a revenue share of the transaction. This principle is used for renting of all possible commodities: from apartments and houses over cars and bikes to tools, cameras, books and toys. Anyone who has something what can to offer to others on the Internet can earn on it. This model is transforming also the new start-ups activities. We can see some examples in Czech Republic as <https://emuj.cz/> (based on electric cars), freecoin.cz, finx.cz (lending money) or [Airbnb.cz](https://airbnb.cz/) (arranging accommodation). Our research idea is to find some convenient management approach and to answer the questions: how to define the proper business model and how to help to establish new startups activities, why some companies are successful and

some of them failed in their businesses. We also investigated some opportunities and threats of these new business models.

2. Literature review

Next literature review (table number 1) brings some different views and key findings from case studies on business models. We can see some development and trends but the basic idea (to be competitive through the good service and to fulfil the customer order) is common for all of them.

Author	Methodology	Key findings
Weiblen, T. (2014)	Conceptual and illustrative cases	- Research on open business models splits into two streams. - A proposed harmonized definition and conceptualization synthesizes existing work. - The relationship of the construct to open innovation and business models is clarified.
Frankenberger, K.; Weiblen, T.; Csik, M.; Gassmann, O. (2013)	Case Studies (14 cases)	- A structured process with frequent iterations between four phases underlies business model innovations in established firms. - Managerial challenges differ per phase. - Current research falls short in providing insights and methods to overcome many of the identified challenges.
Frankenberger, K.; Weiblen, T.; Gassmann (2014)	Case Studies (8 cases)	- Five antecedents of opening up the business model in established identified - Different antecedents are more likely to produce certain types of open business models.
Frankenberger, K.; Weiblen, T.; Gassmann, O. (2013)	Case Studies (3 cases)	- The setup of partner networks determines the performance of open business models. - Customer centricity plays a moderating role in determining characteristics of the partner network. - Three ideal network configurations are identified and explained theoretically.
Weiblen, T.; Giessmann, A.; Bonakdar, A.; Eisert, U. (2012)	Research (1 case)	- An e-marketplace to sell partner-provided offerings must handle different similar open business models in parallel. - A taxonomy-based framework based on the parameters of openness and product/service standardization helps managers detail an implementation-level business model.

Table 1: Different approaches in literature

As it can be seen above from table 1, the key finding of successful factors is openness of e-business models. The term Open Business Model is specified by Professor Henry Chesbrough in relation to innovation processes of companies (Chesbrough, H. W., 2007). His definition is: “Open Business Model is using external sources for innovation or external vehicles for commercialization of non-core innovations.”

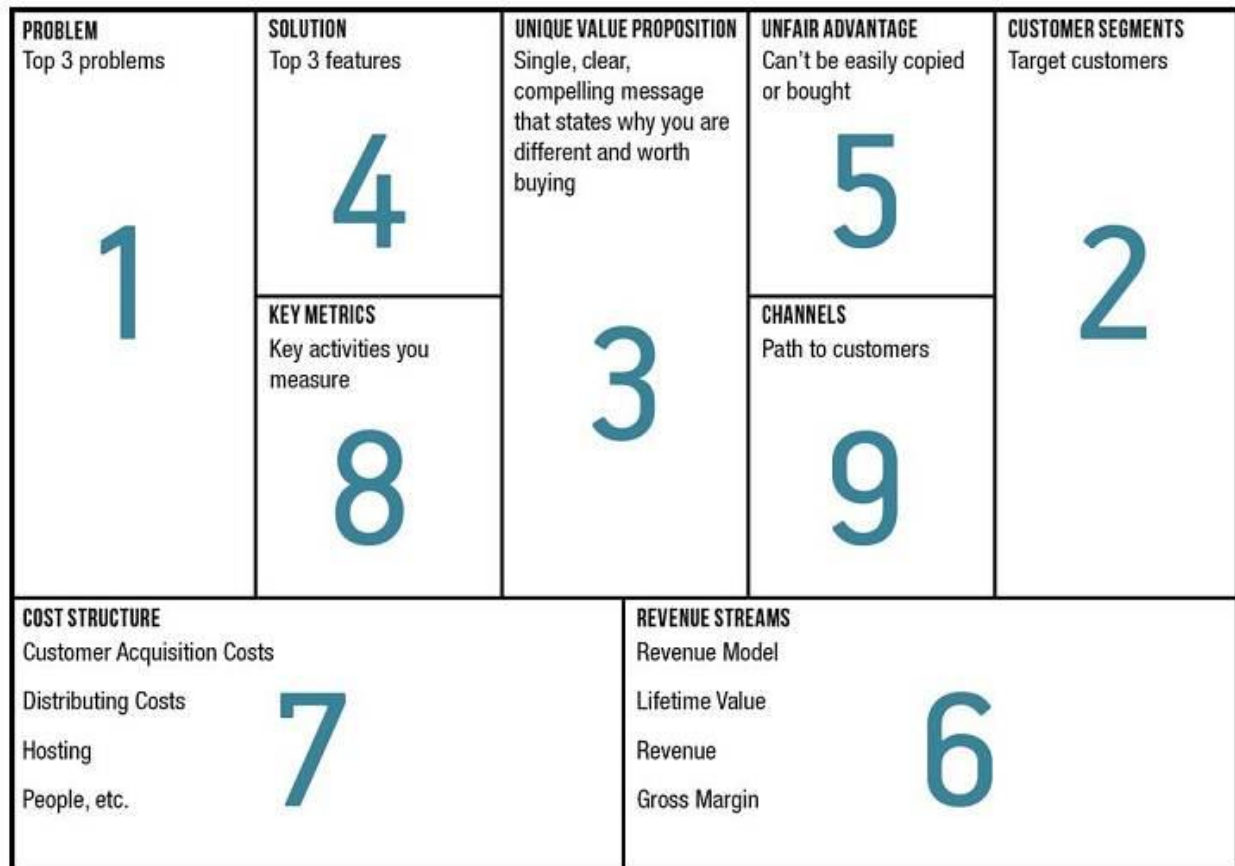
3. Methodology

We can see from literature review in part 2, all researchers use case study methodology. Case study methodology has some several advantages. Basically, a case study enables to study very deeply a particular situation and it has very close contact with practice. We searched two companies and we look on them thorough Osterwalder Business Model (Osterwalder, 2010) and Maurya model. A business model is a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams (Osterwalder, Pigneur and Tucci, 2005). This model is created from successful companies.

Osterwalder Business model definition is based on building blocks consisting of:

- **Description of Product Value propositions:** gives an overall view of a company's bundle of products and services.
- **Customer interface and Customer segments:** describes the segments of customers a company wants to offer value to.
- **Channels:** describes the various means of the company to get in touch with its customers. Customer relationships Explains the kind of link a company establishes between itself and its different customer segments.
- **Infrastructure management:**
 - • Key resources: describes the assets required to offer and deliver the previous elements.
 - • Key activities: are performing a number of activities arranged in a specific way.
 - Key partnerships: portrays the network of cooperative agreements with other companies necessary to efficiently offer and commercialize value.
- **Financial aspects (Revenue streams):** describes the way a company makes money through a variety of revenue flows.
- **Cost structure:** sums up the monetary consequences of the means employed in the business model.

This Osterwalder business model is based on the most common patterns, based on concepts from leading business thinkers. Next approach from Ash Maurya is based on lean management and is called lean business canvas (figure num. 1). This model differs from Osterwalder in next boxes:



Lean Canvas is adapted from The Business Model Canvas (<http://www.businessmodelgeneration.com>) and is licensed under the Creative Commons Attribution-Share Alike 3.0 Un-ported License.

Figure 1: Lean Canvas (<http://www.buissnessmodelgeneration.com>)

- **Problem:** a problem box was included because several businesses do fail applying a lot of effort, financial resources and time to build the wrong product. It is therefore vital to understand the problem first.
- **Solution:** once a problem has been recognized the next thing is to find an amicable solution to it. As such, a solution box with the Minimum Viable Product “MVP” concept was included.
- **Key Metrics:** a startup business can better focus on one metric and build on it. The metrics include the range of products or services you want to provide. It is therefore crucial that the right metric is identified because the wrong one could be catastrophic to the startup.
- **Unfair Advantage:** this is basically the competitive advantage. A startup should recognize whether or not it has an unfair advantage over others.

There are a few other things that Ash Maurya omitted from the original Lean Canvas in an attempt to improve it. These include:

- **Key Activities and Key Resources-** Ash found out that they were more outside-focused when gauged with the entrepreneur’s needs. They had also been covered in the Solution box.
- **Customer Relationships-** a deeply focused startup business should establish customer relationships from the beginning. As such, these were covered in the Channels box.

- **Key Partners-** Ash removed this category regarding the fact that most startups don't require specific key partners when putting up because they deal in unknown and untested products. As such, it would be a waste of time trying to build such relationships.

In next two case studies we discuss (according mentioned business canvas) especially problem solution (strategy) – part 1 from fig 1, revenue (6), customers (2), product value (3) and communication customer's channels (9). In the second case study we describe the situation where start-up was developed as "unfair advantage" model (see figure 1 part 5). This brings some legislative problems which are totally new and therefore we want to mention them.

4. Case studies

These principles of open business models were applied e.g. in the firm Miton. The firm was founded as a start-up by students during their university studies. The second case study is based on the new trend of e-business as a shared economy.

4.1. Case study: Miton, Czech internet company

This paragraph brings some experience from the long cooperation of university and internet company Miton. This company was established in 2000 during long term supervised placement (more in Antlová, K. a Skrbek, J. 2015) by four friends. Their first biggest success was project Stahuj.cz. This project was established on the same idea as foreign download server (Download.com from CNET Networks, Inc). Later this company increases her activities towards web hosting services and also developer their own Content management system Dalen CMS. After that their first biggest business partner was T-Mobile. The first acquisition is portal Turistik.cz in the year 2005. In this year Miton was on the first place in the competition: Deloitte Technology Fast 50 Rising Stars as the most increasing technological company. Together twenty companies were established during their history and thirteen of them were successfully sold. All their new projects are organized as Start-ups. If we look on very successful new project called **Dame Jidlo** (the strategy was: "to compete the pizza delivery and list of pizzas on the fridges") from lean canvas point of view we can see that the first step - problem solving is to connect the restaurants and people who do not cook or do not eat alone in restaurants. The solution (step num. 4 from lean canvas) is portal with connecting these customers, restaurants and delivery. The logistic system had been solved by creation the group of curriers (number 3 from canvas), who use small ecological gas cars. Today the company has 200 thousand of orders per months. Since the December 2015 the logistic part of Dame Jidlo is becoming independent company and is called Delivery Hero and will also deliver for others e-shops. Their competitive advantage is in using of software searching GPS on-line currier position and when the operator accept the order the system will find the most convenient position of the currier.

In the same month (December 2015) another quite new project was started. It is called **Biano**. The strategy of this project is to compete the Ikea and their artificial pictures in catalogs; Beano's catalog is full of real realizations by home architects. Here the problem solving of this project is to connect customs with designers and some interesting or unique producers of furniture.

Older project – very well-known and popular shopping guide **Heureka** was established in 2009 and the strategy was: to combine multiple services into a single unit and to compare the prices so the customers did not need to search individual shops (step number 1). Now is Heureka.cz part of an investment group Rockaway - James Havrlant and this was one of the largest transactions in the

retail sector in recent years. In this company and also in all successful internet companies we can see that it is necessary to be innovative, find some unique idea and to realize it very quickly.

4.2. Case study: Uber and Taxi at the Czech Republic

Next paragraph brings some examples of a collaborative consumption. Such short-term “car sharing” has become quite popular and Avis has acquired Zipcar recently. The practice has also caught the attention of automobile manufacturers who are offering their own car sharing programs, including Daimler Benz's (Mercedes') Car2Go, BMW's DriveNow, Volkswagon's Quicar, and Peugeot's Mu (Firnborn and Müller, 2012). The details of this types of processes are handled by smartphone. Why would auto companies facilitate practices that seem to encourage short-term rental rather than ownership of their cars? One reason is that young people are apparently losing their interest in car ownership as being important to their self-definition. They find cars purchase, maintenance, and parking expensive and increasingly hassle force and they would rather not have the ones. Car-sharing schemes divide into peer-to-peer car-rental services in which you pay to borrow someone else's car (Buzzcar, Getaround, RelayRides, Tamyca, Wheelz, WhipCar) and taxi-like services (Lyft, SideCar, Uber, Weeels) in which people use their cars to ferry paying passengers. Some peer-rental schemes focus on particular types of customer, such as students, or particular types of vehicle, such as high-performance cars. Peer-to-peer taxi services use location-aware smartphone apps, coupled with a central dispatcher, to bring drivers and passengers together. Another example is the process of raising money to fund what is typically a project or business venture through many donors (crowdfunding). This type of models (based on unfair advantage – part 5 from the canvas) has also some problems as are responsibility, missing protection of consumers, legislative problems and some risk consequents.

Open environment of the Internet economy brings not only employment growth, facilitation of payments, time saving, and space for innovation, but also new risks. Obviously, the sharing economy can take many forms. The premise is that sharing information on assets, goods, and services increases their value to the business, individuals, communities and society in general. The Czech Republic is at the beginning of sharing economy development. The collaborative consumption is based on lease, exchange or sharing of assets, goods and services without intermediaries, and on the principle of intermediation costs savings through use of the latest information technology. Providing certain services in the context of business activities in the Czech Republic is regulated and the operator has to demonstrate eligibility for their implementation. An example is the transport of people and their luggage by passenger cars (up to 9 persons), i.e. taxi service. In the Czech Republic it is a trade license granting licensing certification based on a proficiency test at the transportation office in the field of topography, control taximeter etc. Taxi service competitor based on the principles of shared economy is Uber service. At the start of UberPop in Prague there were minimum requirements for their implementation. It was enough to have a valid driver's license, clean criminal record and no traffic offenses. The age of the car to operate a service had to be less than 10 years old. The Municipality of Prague applies the same rules for this service as for as taxis.

It is necessary to provide legal backing for the "employee share", protection consumer of shared economy, rules regarding tax and health insurance. Concerning UberPop service, is this within Czech Republic "carpooling", or violation of the Road Traffic Act? Should “open shared economy” be given clear rules? These questions are arising with the connection of this new business model.

5. Conclusion

As discussed above we can highlight new trends and key factors in business models. These are valid for open business models same as for the e-business model based not on the openness. These trends can be divided to two perspectives. One of these perspectives is **managerial aspect** according the lean business canvas. New e-business model has to be **flexible and agile** because the model has to solve some of the next problems. Model can be easily implemented, to be able to monitor and respond business requests to an individual Web visitor's and to explain their behavior. The new e-business model has to use all possible channels (web, mobile, call center, social networks, stores or face to face). E-business model has to be **holistic** and able to start quickly as small and simple project as start-ups. Therefore it is very convenient to use the startup management. This management helps to drive a project and to turn to grow a business with maximum acceleration. In all businesses the customers have to be able to can find easy what they want. E-business model has to understand how the site capture and store both historic and behavioral data and use them for the strategies. Also e-business model has to easy integrate with other business opportunities and their systems.

When we look on e-business model from the second perspective - technological aspect, the new e-business model has to fulfil next requirements: interoperability, it means that the application functions within a service-oriented architecture. Next factor is synergy, it means that the application supports some other business models and also necessary is scalability. The site performs efficiently through traffic peaks and valleys. The application has also directly empowers the merchandisers, marketing managers, and other business owners. The other information technology trends as big data, open innovation, artificial intelligence, mobile technology, cloud computing are self-evident.

In future research development the authors would like to orient towards the start-up management in new e-business companies and their problems for instance differences in approaches caused the family ownerships.

6. Acknowledgements

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UTILIZATION RATE OF OPEN INNOVATION IN CORRELATION OF THE SME LIFE CYCLE

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Keywords

Open innovation phenomenon, small and medium size entrepreneur SME, the SME life cycle, high-tech industries

Abstract

The open innovation phenomenon has developed from a small club of innovation practitioners, mostly active in high-tech industries, to a widely discussed and implemented innovation practice. And also nowadays has become used also in the small and medium sized enterprises SME. The paper is focused on monitoring the main needs of open innovation according the life cycle stage of SME. The implications and trends that underpin open innovation are actively discussed in terms of strategic, organizational, behavioral, knowledge, legal and business perspectives. Aim of the paper is introduce research and measure the results of open innovation in correlation of the SME life cycle.

1. Introduction

Opening up the innovation process requires a set of instruments. Those tools, for example, enable customers to create or configure their own product with tools kits or enable companies to integrate external problem solvers or idea creators and also must be complementary in life cycle of particular company. Also national and regional government are focusing on support of open innovation in SME with specific tools respecting stage of life cycle of companies. Aim of the paper is introduce research and measure the results of open innovation in correlation of the SME life cycle.

2. Methods

Study of life cycle model of companies help to focused regional innovation strategy more effectively. And we can predict developments of open innovation depending on the stage of the company. Also for development of community of experts is useful to know the correlation of life cycle model an open innovation implementation. It is very important to focused regional policy on innovation in wider connotation and support open innovation concept according life cycle model of company. This statement is result of large survey among the companies.

The scientific method is based on the assumption that the criterion of the truth of a scientific hypothesis consent predictions with the results of research for monitoring were used the tool: The Business-Innovation-Roadmap Tool by smE-MPOWER (is made available under a Creative Commons Attribution-ShareAlike 3.0 Unported License.) This analysis went through around ninety companies. The proposed methodological approach entails the following analytical steps: context analysis and target setting, business innovation analysis, Roadmap definition and initiation of strategic project setup.

3. Results

3.1. SME life cycle and innovation

Innovation is a concept primarily discussed at the interface between science and the economy. And mostly the idea of innovation is connected with technology innovation. This approach to innovation creates the misimpression data relatively linear mechanism exists transforming results of academic achievements into entrepreneurial activity and innovation and research and development are necessary preconditions for innovation. But many medium sized enterprises cannot identify with this concept. Their innovation process is different: it is driven by the market and a multitude of interdependencies with internal and external partners.

The concept of business innovation was introduced by Joseph Schumpeter. Viewing innovation as the centre of economic development he distinguishes invention from innovation. Invention means a novel idea including its development and prototyping or, respectively, concrete conceptualisation within the pre-marketing phase. To qualify as innovation, an invention must be successfully applied and established within the marketplace.

Innovation ideas do not need to be world novelties. One common example of innovation without invention is the process of diffusion and adoption of existing knowledge. The European Community Surveys (CIS) draw attention to the importance of this diffusion process: using existing knowledge in new ways, rather than creating new knowledge (Fig. 1).

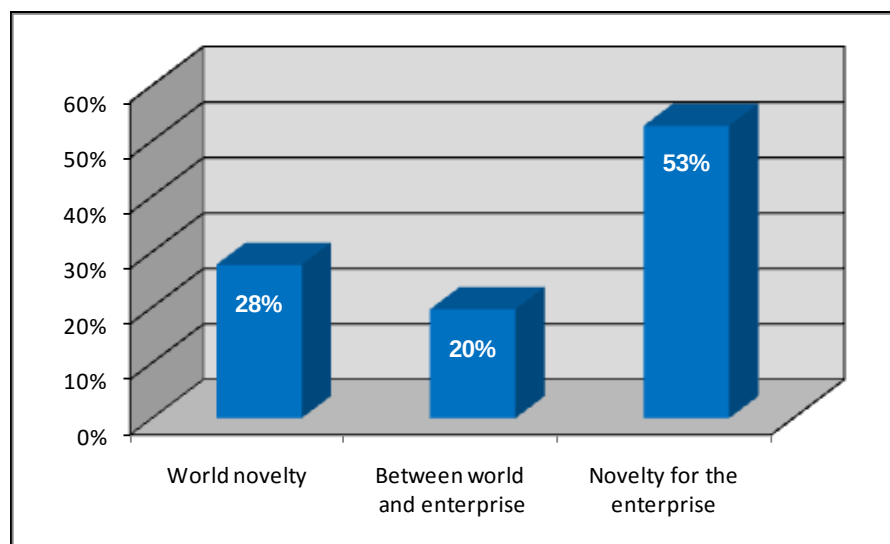


Figure 1: Innovation ideas according its innovation stage.

It is very important to focused regional policy on innovation in wider connotation and support open innovation concept according life cycle model of company.

Open innovation has been supported by region government in South Moravian region in Czech Republic and was implemented in innovation strategy of this region. Working together innovation strategy has managed to create hundreds of skilled jobs in dozens of new high - tech companies. One of the target is to reach successful developing companies in region. One of the very important tool, which was implemented is model of open innovation session with utilization of the need analysis and cooperation with skilled mentors. Thanks to implementation mentors program it is possible measure the main innovation needs and focused open innovation according the SME life cycle. Research was made with one hundred companies in South Moravian region. And here is the schema (Fig. 2) with results showing the stage of development accordingly with needs connecting with open innovation session.

Just three percent of SME in seed stage of SME life cycle need to apply open innovation session, the most exposed group of company is in upscaling stage and expansion stage. Interesting phenomenon, which were observed are the group of companies in consolidation stage. For explaining this interesting phenomenon, we can describe the profile of these companies: these subjects were settled after velvet revolution in the nineties and mostly in the top management there are owners who learnt how to lead and control the company by themselves and now it is coming time to transformation to the professional management board.

Open innovation respecting life cycle model, where are the groups of companies divided into two main group: pre-industrialized companies (start-ups, post-start-ups, handicraft companies) and industrialized companies which operate at relatively high volume levels of production and mass-customization.

And according the scheme of regional innovation strategy the program of open innovation included work with experts and coaches. Coaches will help the beneficiaries to progress over the life cycle of their innovation, from idea to proof of concept, to first pilot application and finally upscaling and expansion. They will empower the SME to cope with challenges such as developing their strategy and organisation, identifying their market and improving ability to attract finance.

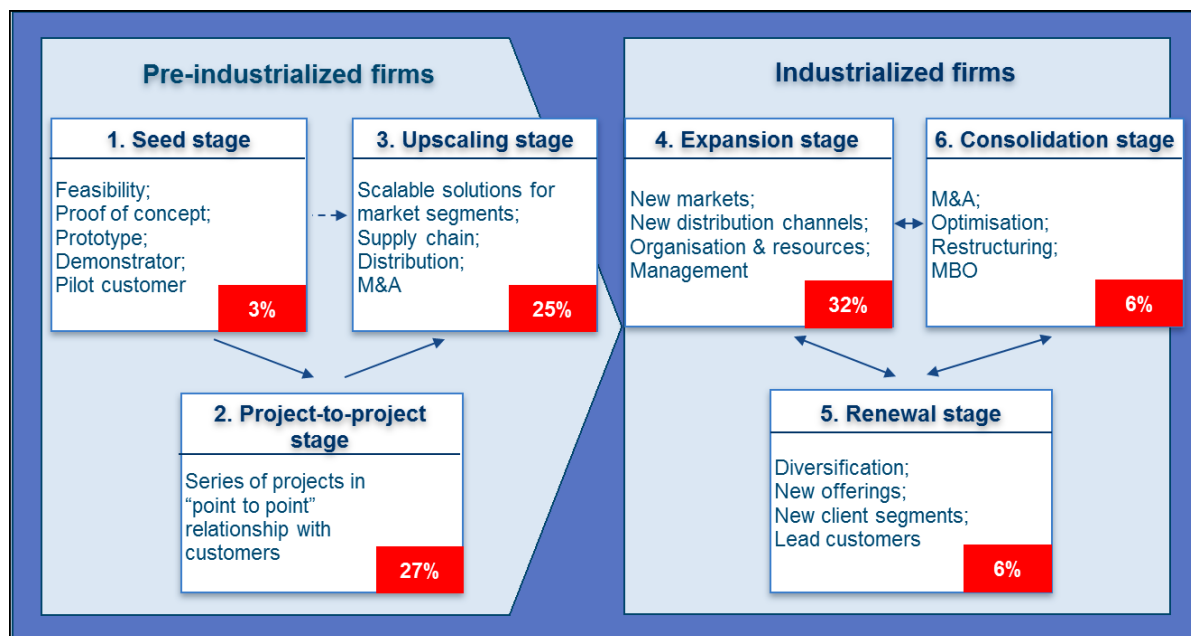


Figure 2: Life cycle stage of the SMEs involved into program

3.2. Critical vectors related to the current life-cycle stage

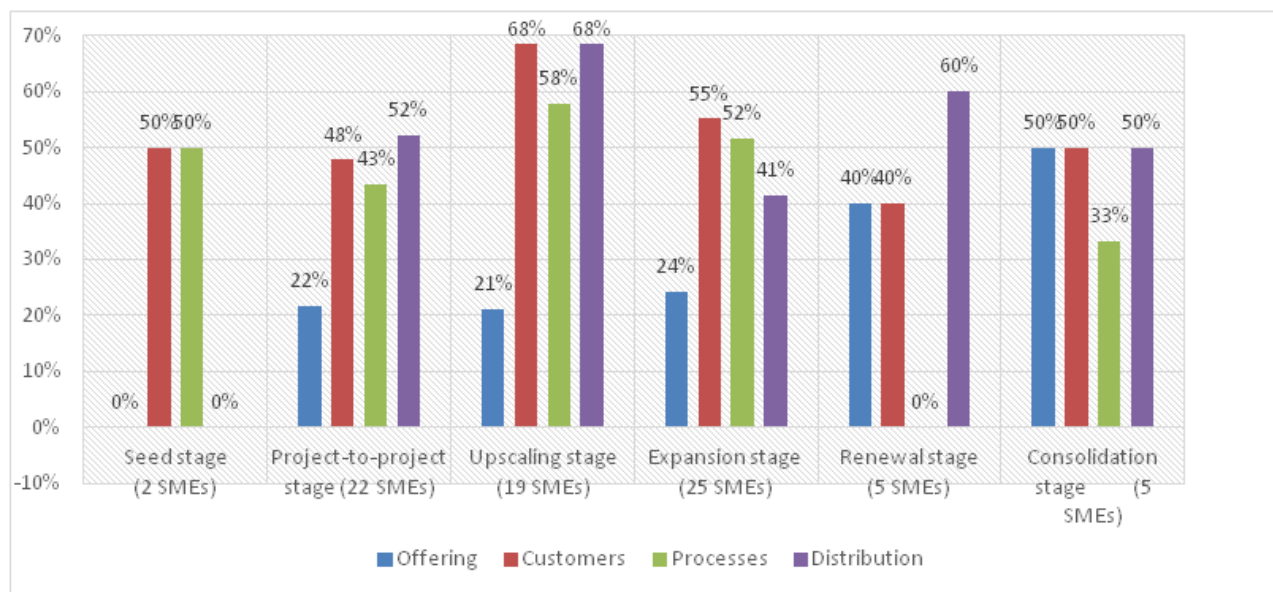


Figure 3: Critical vectors related to the current life-cycle stage

Seed stage company were focused in open innovation mostly on new strategy with customers communication and internal processes. In the group of project to project stage (each project is unique and according to specific customer requirements) is the main topic distribution and new approach to distribution in general point of view (Fig. 3). Critical vectors related to the upscaling life-cycle stage are innovation concerning customers and distribution. Interesting phenomenon, which were observed are the group of companies in consolidation stage. And its critical vectors are evenly distributed.

3.3. Open innovation supported by coaching program targeted to the current life-cycle stage

The mission of the programme of open innovation supported by coaching program targeted to the current life-cycle stage is to initiate the creation of new relationships between companies and researchers from the South Moravian Region, while it is expected that some of them will gradually develop into long-term collaboration. To help company with business development: focused on the identification, analysis and evaluation of potential business opportunities, the definition of business segments and the development of an effective marketing mix and organisation: aimed at mobilizing the resources of the SME to ensure the efficiency and performance of the company's organisation; and cooperation: to support SMEs in planning and implementing innovation partnerships and project consortia.

Open innovation was focused on following topics and the table shows the result the main benefits.

We have improved the technical level (character) of our product/s or process/es.	20%
We have got the access to the know-how valuable for the company technical competency development.	14%
We have found a new market for our current product/s and/or service/s.	9%
We have found a market gap, we would like to fill and develop a new product/service for it.	9%
We have improved work with our customers (better knowledge of our customer needs is showing us new opportunities).	41%
We became better in getting Czech customers (the sales in CZ are increasing).	25%

We became better in getting foreign customers (the sales from abroad are increasing).	18%
We have found a new way of selling.	16%
Our employee motivation / work attitude has improved.	34%
We have clarified what is our target for next 5 (eventually for 10) years and what has to be done to get there.	52%
We have improved our processes.	74%
We have established new partnerships.	19%

Table 1: Result the main benefits of open innovation according targeted to the current life-cycle stage

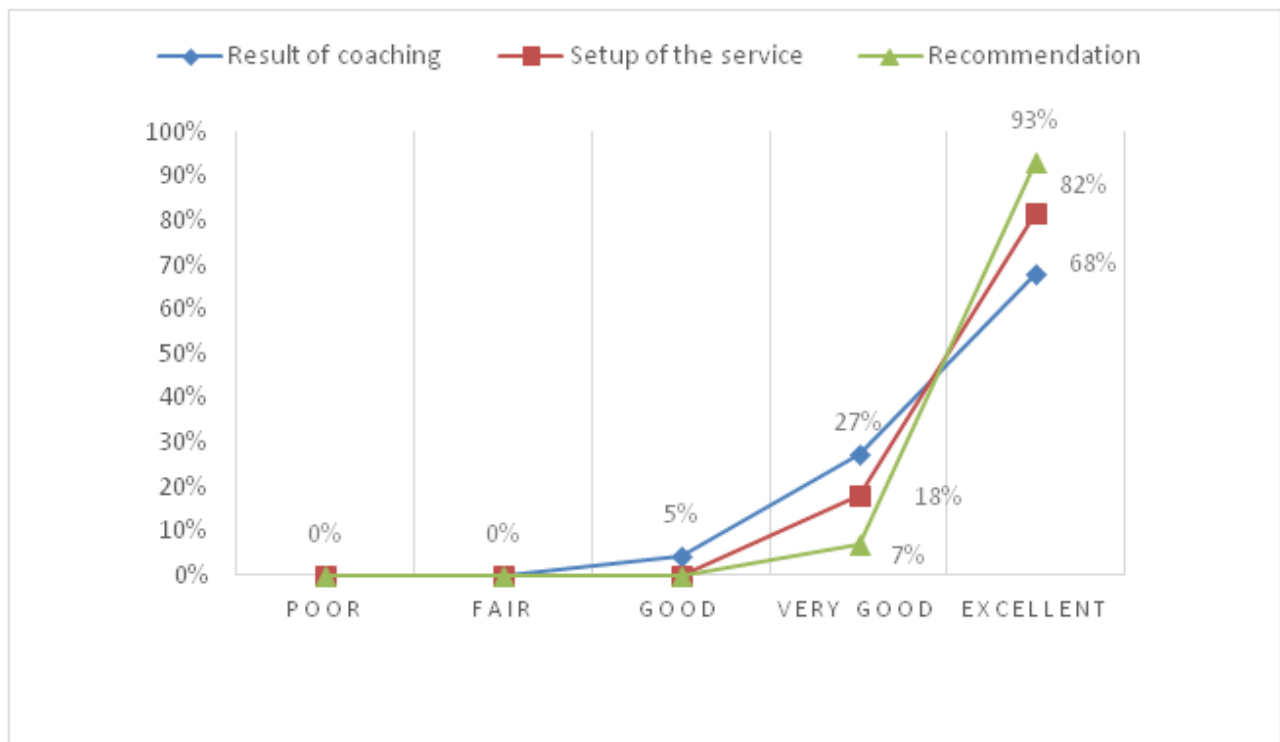


Figure 4: Satisfaction with open innovation according targeted to the current life-cycle stage

Tasks	Description
Overall objective of the voucher system	Support:
	Link between the SMEs and the Universities
	Competitiveness of the SMEs
	More effective setting of the internal mechanisms of the commercialization of the University research
	Stronger position of the Offices of Technology Transfer at the Universities
Supportable activities in the voucher system	Knowledge transfer projects such as:
	Product, process or service development
	Testing and measurements
	Feasibility study

Access to research facilities
Prototyping
Product design
Innovative product business plan development
Economic impact assessment
Market analysis or marketing strategy
Business plan for an innovative product
Innovation/technology audit

Table 2: Description of the open innovation system in South Moravia, Czech Republic (Brno)

Tool use:

The Business-Innovation-Roadmap Tool by smE-MPOWER is made available under a Creative Commons Attribution-ShareAlike 3.0 Unported License. It is free of costs. The user is allowed to modify, commercially use, and pass on the tool as long as "smE-MPOWER (www.sme.mpower.eu)" is kept quoted as source. The tool must be kept free in any derivative version. The Business-Innovation- Roadmap Tool can be downloaded from this address:

<http://www.platinn.ch/eng/Reference-documents/Business-Innovation/>

4. Conclusion

Identify new collaboration opportunities; knowledge of regional, as well as Czech national ecosystem will allow companies to tap into the pool of expertise and talent of start-ups, SMEs, as well as academic institutions in South Moravia, or across the Czech Republic. Regional strategy is partnership of South Moravian companies, local scientists, public authorities and other parties connected to development in the region. Working together innovation strategy has managed to create hundreds of skilled jobs in dozens of new high - tech companies. One of the target is to reach successful cooperation between industry and universities. To help company with business development: focused on the identification, analysis and evaluation of potential business opportunities, the definition of business segments and the development of an effective marketing mix and organisation: aimed at mobilizing the resources of the SME to ensure the efficiency and performance of the company's organisation; and cooperation: to support SMEs in planning and implementing innovation partnerships and project consortia.

One of the very important tool, which was implemented is model of the programme of open innovation supported by coaching program targeted to the current life-cycle stage. The main benefits of open innovation session model are: Simplify work and save time for the company only explain its challenge once, and facilitators take over the tedious job of pre-selection and routine communication with potential partners and multiply offer to the relevant partners across the region/country. Interactive format may generate more ideas - the design of the Open innovation session model allows several participants to interact during the session which increases the chances of coming up with unexpected solutions to the identified challenges.

The tool perspective: Opening up the innovation process requires a set of instruments. Those tools, for example, enable customers to create or configure their own product with tools kits or enable

companies to integrate external problem solvers or idea creators. Especially the low degree of interconnection of the corporate and academic sectors, which prevents the full use of the knowledge base of the region to create the foundations of the long-term prosperity of the local economy.

Reinforce the perception of City Brno and the south Moravian region as leader in the knowledge economy promotion in Europe. Bring value to foreign investors. Demonstrate the interest of the local government to create conditions for the development of knowledge-intensive operations of transnational corporations. Besides the “technical” objectives of the model, it is also necessary to emphasize its marketing objectives, though some of them came into existence only during the programme.

The research has shown importance of need analysis according current life-cycle stage of company.

Company were divided into the groups of companies divided into two main group: pre-industrialized companies (start-ups, post-start-ups, handicraft companies) and industrialized companies which operate at relatively high volume levels of production and mass-customization.

The data show that participation in the programme led to a shift in the perception of the objectives, needs and conditions of the business world. Participants in the programme are now more able clarified what is their target for next 5 (eventually for 10) years and what has to be done to get there. The model can be applied towards improving the very low trust in public administration and build the trust help business innovation opportunities analysis, which is made by innovation centre and on this analysis following open innovation.

Participants in the programme are now more aware of the potential hidden in collaboration. After the end of the coaching project, companies continuing in collaboration with new partners from the local commercial or research sector. Open innovation is an effective way of transfer technology and impact can be increased by proper focusing at SME life cycle to achieve a satisfactory result.

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REALITY MINING: A NEW SUBFIELD OF DATA MINING

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Keywords

Data mining, ubiquitous knowledge discovery, reality mining

Abstract

Reality mining is defined as “collection and analysis of machine-sensed environmental data pertaining to human social behavior, with the goal of identifying predictable patterns of behavior”. As such it can be understood as a particular application area of data mining. Or is there more behind this new notion? And will reality mining become a new subfield of data mining in a same way as text mining or web mining? The paper looks at similarities and differences between reality mining and “classical” data mining and reviews some applications presented by their authors as reality mining.

1. Introduction

Knowledge discovery in databases (KDD) or data mining (DM) is aimed at acquiring implicit knowledge from data and using it to build classification, prediction, description, etc. models for decision support. As more data is gathered, with the amount of data doubling every three years, data mining becomes an increasingly important tool to transform this data into knowledge. In 1990th, data mining was used to analyze tabular data, where each row corresponds to a single object (market basket, patient, bank client, etc.) and each column corresponds to an attribute (categorical or numerical) describing a property of the objects. Such data can be found in many application areas: banking and finance, medicine, manufacturing, sociology, etc. Nevertheless, this type of data is not the only one to be analyzed. Nowadays we can see data mining applied to time series, graphs, data streams, texts, images. And data mining on particular data types became its own name. So text mining became the name for data mining on unstructured textual documents and web mining became the name for data mining on data gathered from web. These subfields of data mining are already well established and accepted both by the data mining/scientific community and users of data mining results. A decade ago, a new term "reality mining" occurs in the data mining community. How is this new term related to "classical" data mining? And what are characteristic features of reality mining applications and projects? The paper looks at similarities and differences

between reality mining and “classical” data mining and reviews some applications presented by their authors as reality mining.

2. Reality Mining vs. Data Mining

The term "reality mining" was coined by Nathan Eagle and Alex Pentland from Media Laboratory, Massachusetts Institute of Technology (MIT) about 10 years ago. According to them, reality mining is the collection and analysis of machine-sensed environmental data pertaining to human social behavior, with the goal of identifying predictable patterns of behavior.

Reality mining studies human interactions based on the usage of wireless devices such as mobile phones and GPS systems providing a more accurate picture of what people do, where they go, and with whom they communicate with rather than from more subjective sources such as a person's own account. As such it can be understood as a particular application area of data mining, where the analyzed data are (usually) collected from wireless devices (like mobile phones or GPS receivers). From the data mining point-of-view, reality mining deals with the most challenging data mining problems as defined in (Yang and Wu, 2006). In particular, it tackles the issues of “scaling up for high dimensional data/high speed streams”, “mining sequence data and time series data”, and “data mining in a network setting”.

The concept of reality mining is also closely related to the concept of ubiquitous knowledge discovery. Ubiquitous Knowledge Discovery can be defined as "Knowledge discovery process in mobile, distributed, dynamic environments, in presence of massive amounts of data". Knowledge discovery in ubiquitous environments is an emerging area of research at the intersection of the two major challenges of highly distributed and mobile systems and advanced knowledge discovery systems. Research areas as defined in the EU funded project KDUBiq (2005-2008 FP6 FET IST) are (Gama and May, 2011):

- data mining in mobile systems, wireless communication networks, calm technologies,
- distributed architectures: distributed data mining, grid, P2P, autonomic computing, agents,
- learning components: statistical learning (incl. online learning), evolutionary computing,
- anytime algorithms data types: spatio-temporal, stream, multimedia,
- security and privacy: privacy preserving data mining, intrusion detection,
- HCI and cognitive modelling: user interfaces of ubiquitous discovery systems.

3. Example Reality Mining Projects

3.1. Complex social systems

A pioneering project in the area of reality mining was realized by Eagle and Pentland (2004). They collected data from 100 mobile phones of students and researchers at MIT over the course of 9 months. This makes about 45 000 hours of communication logs, location and proximity data. Seventy-five users were either students or faculty in the MIT Media Laboratory, while the remaining twenty-five were incoming students at the MIT Sloan business school adjacent to the Laboratory. Of the 75 users at the Lab, 20 were incoming master's students and 5 were incoming MIT freshman. The collected information includes call logs, Bluetooth devices in proximity, cell tower IDs, application usage, and phone status (such as charging and idle). Capturing mobile phone

usage patterns of 100 people for an extended period of time can provide insight into both the users and the ease of use of the device itself. By continually logging and time-stamping information about a user's activity, location, and proximity to other users, the large-scale dynamics of collective human behavior can be analyzed. If deployed within a group of people working closely together, correlations between the phone log and proximity log could also be used to provide insight behind the factors driving mobile phone use. The initial study presented a simple model of behavior in three states: home, work, and elsewhere, the ultimate goal was to create a predictive classifier that can perceive aspects of a user's life more accurately than a human observer (including the actual user). So one central intent of this research was to verify the accuracy of automatically collected data from mobile phones for quantifying social networks. The labels for the classifier came from a survey taken by all the experimental subjects at the end of two months of data collection. The survey asked who they spent time with, both in the workplace and out of the workplace, and who they would consider to be within their circle of friends. These labels were compared with estimated location (using cell tower distribution and static Bluetooth device distribution), proximity (measured from Bluetooth logs), and time of day. Workplace colleagues, outside friends, and people within a user's circle of friends were identified with over 90% accuracy (Eagle and Pentland, 2004).

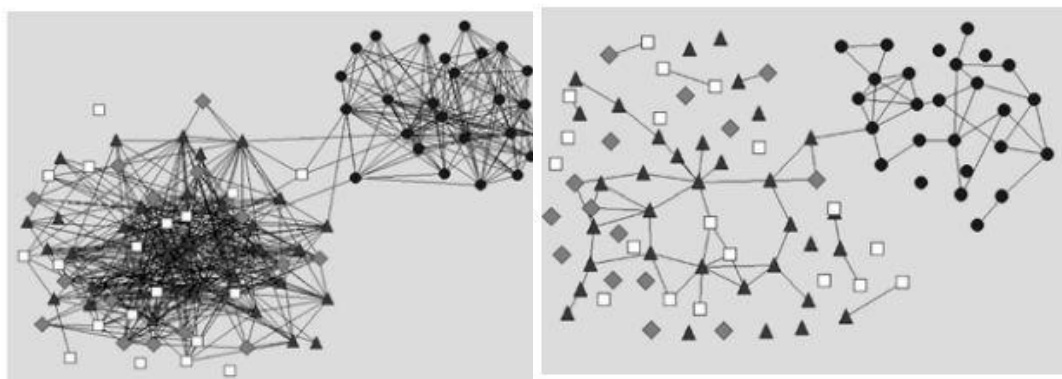


Figure 1, 2: Proximity pattern (left) and inferred friendship network (right). Source: (Eagle and Pentland, 2004)

Weselowski et al. (2013) analyzed the daily travel patterns of 14 816 521 individuals across Kenya (approx. 38% of the Kenyan population) from June 2008 to June 2009 using nearly 12 billion calls and text messages to estimate daily locations for each one. They used a common measure of individual mobility, the radius of gyration, to examine how mobility patterns varied across the country on the district and population levels. This measure reflects both the frequency of travel and distance. For each person, they calculated a radius of gyration value over the year and then aggregated these population values to the district level. They couple this analysis with the results from a survey of socioeconomic status, mobile phone ownership and usage patterns across the country, providing regional estimates of population distributions of income, reported airtime expenditure and actual airtime expenditure across the country. For each district, they used the CDR (call data records) data to calculate the average mobility of individuals within discretized ranges of actual airtime expenditures. In the majority of districts individual mobility and airtime expenditure were positively correlated in the CDR data, also the monthly income and expenditure on airtime reported in survey were positively correlated.

Miklas et al. (2007) examined how mobile systems could exploit people's social relations, in particular interactions between friends, that is people who meet more regularly and for longer periods of time, and interactions between strangers, that is people who meet sporadically, by passing each other by. The authors performed a social-based analysis of a trace of Bluetooth

activity to annotate it with the required information. By studying the frequency of encounters, they could annotate this trace with social information by classifying pairs of people who encounter frequently as “friends”, whereas pairs of people encountering sporadically are classified as “strangers”. They used a 101-day trace of encounters between people equipped with Bluetooth-enabled mobile phones collected by the “Reality Mining” project at the MIT Media Lab ((Eagle and Pentland, 2004) with the goal to characterize the key temporal and social parameters of people’s encounters from this trace.

3.2. Public health and medicine

Mobile phones can be particularly useful in gathering health-related information. Data on a sample population over a given period (a week or a month) can be used, and then assuming some of people are sick, a model to predict how an illness spreads can be created. A well known example of this kind is the work by Buckee et al. (2011); a study of the role of human mobility in the dissemination of malaria parasites in Kenya. Local and regional movements between areas with different malaria risks have several consequences for the transmission and epidemiology of the disease: individuals from low malaria risk regions traveling to high risk regions are particularly susceptible to disease because they lack well-developed immune responses, individuals from high risk regions traveling to low risk regions may carry parasites with them, the movement of people between different endemic regions can bring together populations of parasites that would otherwise remain genetically distinct. Traditional approaches to measuring human movements on these regional scales rely on survey data from national censuses or other household surveys. Mobile phones offer individual-level information on a scale previously impossible, providing a “big data” approach to understanding human mobility. When compared the data from CDR (for 34861 phone users) with travel data collected as part of a malariometric survey (for 2650 persons), the authors found out, that mobile phones allow to collect more accurate data in significantly larger scale and thus allow to create better models.

3.3. Traffic monitoring and control

After the September 11 attacks, U.S. officials scrambled to secure other national landmarks that might become future targets. One of them was the California's Golden Gate Bridge. Might terrorists try to destroy the passageway between San Francisco and Marin County, and if so, how widespread would the fallout be? To answer those questions, the Homeland Security Dept. turned to a small company called Inrix that uses GPS-enabled mobile phones and tracking devices installed on commercial vehicles to monitor traffic conditions. Inrix used its models to predict that the loss of the 1.7-mile bridge would result in immediate transport chaos. But Inrix found that within four days the situation tends to stabilize because people know what is happening and adjust their plans (Hesseldahl, 2008).

The Mobile Century experiment, carried out at the University of Berkeley on February 8, 2008 was intended as a proof-of-concept of traffic monitoring system based on vehicles equipped with GPS-enabled mobile phones. The goal of this controlled field experiment was to test traffic data collection from GPS-equipped mobile phones driving on a stretch of a highway located in the San Francisco Bay Area. One hundred vehicles carrying the GPS-enabled Nokia N95 drove along a 10-mile stretch of I-880 from 9:30am to 6:30pm. The experiment proved that data from GPS-enabled mobile phones alone were sufficient to infer traffic features, i.e., to construct an accurate velocity map over time and space (Herrera et al., 2010). The Mobile Millennium project grew from Mobile Century with a strategic objective to demonstrate the potential of GPS in mobile phones to alter the way traffic data is collected, by leveraging the existing mobile phone infrastructure to collect data

and transmit it directly back to drivers. The public-private research partnership — UC Berkeley, Nokia Research Center, and NAVTEQ, with sponsorship from the California Department of Transportation — launched the pilot program from the Berkeley campus on November 10, 2008. It ran for exactly 12 months. During that time, more than 5,000 users downloaded the Mobile Millennium traffic software onto their phones (<http://traffic.berkeley.edu>).



Figure 3: Snapshot of Mobile Millennium Traffic in San Francisco and the Bay Area. Source: (Herrera et al., 2010)

Santani et al. (2008) presented an empirical analysis of the GPS-enabled taxi dispatch system in Singapore. The data set records the movement of 6,230 GPS-enabled taxicabs over a 24-hour period, as well as the time and location of 38,048 booking requests. The main goals of the analysis were (a) to characterize the efficiency of the taxi system, and (b) to explore the sources of inefficiency. The two types of analyzed data (taxi locations, booking requests) were firstly used to comparing the density of taxis with the frequency of bookings in each of four geographic zones. The results of this first step are then used to identify times and locations in which the demand for taxis exceeded the supply or vice versa. They then analyzed the efficiency of the taxi system by defining driver satisfaction (as ratio of time the taxi was occupied and time the taxi was free or occupied) and passenger satisfaction (as median waiting time in given zone and given hour).

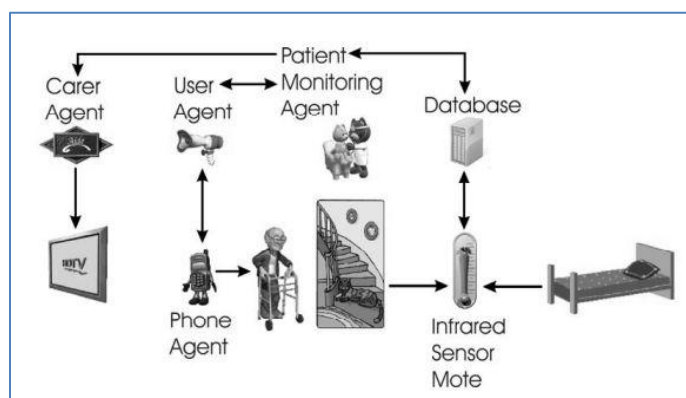


Figure 4: A generic scheme of Ambient Assistive Living Systems. Source: (O'Grady, 2010)

3.4. Smart homes and ambient assisted living

Smart Home and Ambient Assisted Living systems utilize advanced and ubiquitous technologies including sensors and other devices that are integrated in the residential infrastructure or wearable, to capture data describing activities of daily living and health related events (for a generic structure of such a system see Fig. 4). The used technologies can allow for the detection of emergencies and provide the means to increase social interaction and minimize isolation for residents. Smart Home

and Ambient Assisted Living systems are composed of different components one of them being a reality mining component. To illustrate, consider two examples of how reality mining can be used within ambient assisted living system. Clinical pilot data demonstrate that it may be possible to diagnose depression from the way a person talks--a depressed person tends to speak more slowly, a change that speech analysis software on a phone might recognize more readily than friends or family do. Similarly, monitoring a phone's motion sensors can also reveal small changes in gait, which could be an early indicator of ailments such as Parkinson's disease (Pentland et al, 2010).

3.5. Environmental monitoring

Noise pollution is a major problem in big cities around the world. It affects human behavior, well-being, productivity and long-term health. Recognizing noise pollution as an important issue, the European Commission adopted the European Noise Directive, which requires major cities to establish a noise management policy. The first step in the establishment of such a policy is to assess the current situation by gathering real-world data and building strategic noise maps. A standard way how to get data is using sensor networks. However, this approach has several limitations: sparsity of network, fixed location of sensors and high cost. An alternative is thus to use mobile phones to collect the data about noise pollution.



Figure 5: Collective noise map for part of Paris, France. Source: (Maisonneuve et al, 2010)

Maisonneuve et al. propose a low-cost approach involving the general public to monitor noise pollution using their mobile phones as noise sensors (Maisonneuve et al, 2010). The NoiseTube is a research project started in 2008 at the Sony Computer Science Laboratory in Paris in collaboration with Vrije Universiteit Brussel. The NoiseTube platform consists of two components, the mobile application and the Web-based community memory. The mobile application can be downloaded for free (e.g. from <http://play.google.com> for Android based phones) to turn mobile phones into mobile noise sensors. It collects information from different sensors (microphone, GPS receiver, user input) which is logged locally and/or sent to NoiseTube community memory server in real-time. The collected data are thus composed not only of the sound level recorded by the phone's microphone, but also of geographical coordinates, and annotations added by the users. The community memory operates on a central Web-server and collects and post-processes all gathered noise pollution measurements and runs a website which lets users explore, visualize, analyze and search through the data. The main post-processing performed on the server is aggregating info obtained from different users, automatic contextual tagging and GPS correction. NoiseTube thus goes beyond traditional noise maps due to the new nature of the collected data – real, local and personal exposure measurements with additional semantic information.

4. Privacy and ethical issues

Privacy and ethical issues are of high concern even in classic data mining. Collecting sensitive personal data about patients in hospitals, clients in banks or customers in e-shops rise questions about their possible misuse. But at least, people are aware of the data collection process, or must even agree. In reality mining applications the data collection process runs differently, when using mobile phones or surveillance cameras as the source of data, the people usually need not to know that data are collected to analyse their behaviour. So in reality mining these issues are even more important.

The privacy issues regarding data collection and data analysis can be handled on two levels: legal and technical. On the legal level, law and regulations can be adopted to ensure that organizations collect personal data only with the individual's consent, that organizations use personal data only for given purposes the individual's agree with, and that organizations do not distribute personal data to third party. Obviously, when reality mining will be used in real-world applications these restrictions cannot be always met as non-participants in a reality mining project or non-users of a reality mining application will be affected as well (Madan et al, 2009). On the technical level, the basic idea is to deal with sensitive personal data in such a way, than an individual cannot be identified during the data analysis. The easiest way how to approach this idea is by data anonymization; personal info is removed from the data. But anonymization itself need not to be sufficient. Another possibility is data perturbation; here noise is added to the original data in such a way, that individual records are disturbed while keeping the aggregated values from the original data. Distributed computation can also help to solve this problem; each party will store and analyze only part of the originally collected data. If e.g. the original data are stored in a data matrix, where rows are individuals and columns are attributes, then it is possible to partition this matrix horizontally and analyze subsets of individuals separately, or vertically and analyze subsets of attributes separately (Vaida, Clifton, 2004).

5. Conclusions

The main source of data for reality mining applications are mobile phones equipped with GPS receivers. Researchers say they can get a more accurate picture of what people do, where they go, and with whom they communicate from a device they carry than from more subjective sources, including what people say about themselves. In short, people lie - mobile phones don't. Reality mining applications thus have to deal with the most challenging problems of knowledge discovery in databases and data mining: continuous data streams and huge data. Although the example applications of reality mining discussed in section 3 do not use sophisticated machine learning algorithms, they still can be considered as data mining tasks aiming (at least) at data description, summarization and vizualization.

The concept of reality mining is closely related to ubiquitous knowledge discovery (and one of the first papers on reality mining was published in ubiquitous computing journal). The main distinction is, that reality mining is focused on modelling behaviour of people (based on data collected from wearable devices like mobile phones) while ubiquitous knowledge discovery has a broader scope covering also e.g. distributed and autonomous systems that are not necessary related to direct human activities (e.g. sensor networks, power grids or applications in process industry).

Reality mining seems to be a perspective field in which some applications (health status monitoring, environmental monitoring or traffic monitoring) can directly influence our daily life.

But whether reality mining belongs to 10 most important technologies, as published in MIT Technology Review (Greene, 2008) remains an open question.

6. Acknowledgments

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SESSION G: E-SOURCING AND E-PROCUREMENT

DIGITAL SINGLE MARKET CONCEPTUAL MODEL FOR INTELLIGENT SUPPLY CHAINS

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Keywords

Digital single market, data economy, networks, standards, smart supply chains

Abstract

The digital single market strategy of European Commission is focused on utilizing all critical digital benefits to achieve fair and competitive internal European market. The paper is focused on conceptual model development for smart supply chains applying critical pillars of digital single market concept, esp. standardization, interoperability, trust, platforms and data economy in digital space. The bottom-up approach for e-standardisation in smart supply chains is presented based on semantic technologies according and conceptual model for data economy management is provided. The application of this model can stimulate using the synergies from innovative technology approaches adoption for achieving fair, competitive and transparent European market.

1. General

The globalisation of our economy poses a number of challenges to the smaller firms. Cross-border cooperation faces serious problems and obstacles because of not standardized business processes in Europe. Inconsistent development of electronic business environment supporting exploitation of new and more efficient eServices is still one of the biggest barriers to seamless communication, collaboration and generally networking of SME. Current e-environment is characterized by different business standards for electronic document exchange, which is pushed and adopted mainly by bigger players within their respective supply chain. E-Market calls for SMEs friendly business standards for international electronic cooperation to support accelerating their growth.

Nowadays, the common practice of the SMEs is to manage their business documents and processes in the heterogeneous ERP systems installed on the local intranets. In order to exchange documents with the business partners, SMEs in many European countries are often using paper-based communication or emails with the unstructured attachments (in PDF format, spreadsheets, etc.) exported from the ERP software. Received documents are usually printed and manually entered into the recipient's ERP system. Majority of the ERP systems for SMEs are not implementing any e-business standard for electronic exchange of documents or organisation of business information leading to very heterogeneous and ineffective SMEs environment (Maryska et al, 2015, Szabo, 2013). Together, smart negotiation e-services (Klezl, 2014) and security in using digital application are still undervalued (Veber et al, 2016).

2. Digital Single Market

2.1. Background

The Europe 2020 Strategy is a plan with which the EU wants to face the major challenges of the society. The EU has identified five key areas in which it wants to meet its targets by the end of this decade. These are the areas of employment, education, research and innovation, social inclusion, poverty reduction and climate / energy. Creation of the digital single market in EU was set as the first pillar of the EU strategy, which factors of development are intertwined with a number of flagship initiatives (Digital Agenda, Innovation Union, Integrated Industrial Policy and the Agenda for new skills).

Specifics of the digital market should, according to the EC, contribute to the development of innovation, economic and inclusive growth and the general growth of trust in the economic environment and its bodies.

Based on the Digital single market (DSM) strategy and the European Parliament and the Council directive (EU) No. 910 / 2014 from July 23rd 2014 on electronic identification and trusted services for electronic transactions in the internal market, European Commission stresses the needs of achievement and development of the following areas:

- Trust - Building trust is according to the EC a key to economic and social development and aims to strengthen the trust by achieving greater transparency in the online environment but also acknowledges the need of understanding the role of trust in e-environment and its impact on the economic environment and market stability.
- Development of digital services and the digital economy with long-term growth potential - ensured by the development of interoperability and standards for e-business and business systems.
- Developing and understanding of online platforms - creating new forms of market and bringing new multidisciplinary problems and challenges for economic and technical sciences.
- The development of "data economy" that is based on the development of data infrastructure of digital data (open data, big data, etc.) with an estimate of their share in 2020 to be up to 40% of all data. Their use could bring huge billion savings as well as it is estimated that relevant data analysis could strengthen the GDP growth of EU countries by up to 1.9%!
- Development of new skills in the context of the development of innovative environment of the digital market, linked with the growth of data and new knowledge generated in the "data economy" environment.

For the recommendations of the European Commission to be applicable in an effective and sustainable manner it is necessary to understand the practical difficulties and opportunities for developing DSM and the impact of these priorities on transparency, changes in market structures, attitudes and perceptions of DSM elements by market participants, changes in inter-organizational activities, trust and market stability, the asymmetry of information, prices and benefits. All these changes are caused but also due to changes in the behavior of participants on the DSM, and without understanding these changes it is not possible to properly set the practical implementation of the DSM from the legislative, economic and technological point of view and to understand how this model is beneficial, identify constraints and opportunities to control its evolution to obtain the maximum socio-economic benefits (Delina et al, 2014).

Network activities on the electronic market relate to interoperability, standardization and transparency. To understand the importance of these critical factors, several studies have examined the network effects and diffusion theory of innovation and impact on the group of market participants and their innovation absorption capacity.

Weitzel (Weitzel et al, 2003) emphasizes that understanding the networking environment is highly important because without proper understanding of what happens, promoting networking can sometimes be dangerous. Modelling of network effects on products was already dealt by Schoder 1995, stressing that it is the diffuse (network) phenomenon that is critical for understanding the operation of socio-economic environment (Schoder 1995). The scientific literature in the field of network effects is based on neoclassical assumptions, where agents operating in an environment know the entire realistic model and the characteristics of other agents as well as their utility functions, which may lead to a unique and Pareto optimal Equilibrium, but only if the absence of network externalities and unsolvability. Market transparency also plays an important role in this model (Weitzel et al, 2003). Weitzel therefore proposed an interdisciplinary network theory also acceptable by economists and social scientists with acceptance of bounded rationality, incomplete information and social cohesion.

Some specifics in this area are now starting to appear in world studies. E.g. Turnes, P. B. and Ernst, R. (2014) claim in their article that in the near future there will be a huge increase in standardized business processes that will be determined by the need for an enormous increase of interoperability between systems and reviewing of impact on the environment. Delina et al (2014) indicated the need to review the impact of these specifics on actual deployment, acceptance and changing of environmental parameters such as stability, transparency and monopolization.

Regarding the impact of transparency, Henze, Schuett and Sluijs (2015) argue based on experimental research that transparency is an effective tool for the growth of well-being and consumer surplus. Under imperfect information producers keep prices above their marginal costs, and this allows them to "get rich" at the expense of buyers. Thanks to transparency the competition between retailers is better because they see the price and quality of competing products. Veldkamp (2006) argues that transparency is one of the most important factors for maintaining market stability. Reducing information asymmetries allows companies to reallocate resources more effectively in the case of an internal or external shock. Willmott (2003) considers transparency an important factor in building confidence. In digital space, the transparency is achieved through standardization and interoperability development in data economy.

Better standards in B2B and B2C communication in Europe and better information on content access rating and classification schema across borders was already recognized within several standardization initiatives, e.g. CEN, the European Committee for Standardization. Nowadays, SME business environment still suffers from inefficient electronic networks and global supply chains which are still the main advantage for large companies and big industrial consortia. All standardization and business platform development projects were till now focused mainly on top-down approach which was not effective for SME business market and their internal legacy systems.

Current business document standards still cover mainly the core structure of the documents leaving many parts of the documents unstructured. Together, different sectors are dealing with different standardization problems, some of them are characterized by low number but strong product classification standards (PCS), other are using number of different local standards and some sectors are too heterogeneous without any standardization features in PCS. On the other hand, PCSs don't include some other important business information such as contractual conditions, etc. That's why the standardization and interoperability of PCS and business processes as well as related data economy concept development is the challenge and national initiatives should take this into the

account. It will support the development of smart supply chains as the part of smart industry concepts (or Industry 4.0) fulfilling objectives from innovation strategies adopted through European countries.

In this field several EU directives already exist, e.g. directive 2014/55/EU (the Directive) on electronic invoicing emphasizing semantic data models which is now under preparation in the CEN PC 434 and will be approved and published by the early part of 2017, Directive 2014/24/EU on public procurement innovations and other related initiatives.

3. Digital single market conceptual model for smart supply chains

In the paper we would like to present conceptual approach to B2B and B2C PCS standardization, interoperability, data model and related digital single infrastructure or platform which fulfill all identified requirements and is based on bottom-up approach to build environment for intelligent supply chains. For establishment of electronic business network for European market and achievement of critical mass of end users (esp. SME companies) following tasks will be realized:

- to ensure interoperability between selected ERP and legacy systems (in first round crucial providers from different countries with highest number of potential companies=their clients)
- to offer easy integration for other stakeholders (legacy systems providers or individual companies)
- to utilize business information (sensitive vs nonsensitive) from SME legacy systems to build basic information base of our network (formalize skills, offers, needs of companies...)
- to integrate our network directly into their legacy systems with no constraints for free or very small cost
- to offer simple value added services easily understandable for SME users
- to offer complex and sophisticated solutions for more eSkilled SME users to build motivation factors for low eSkilled SMEs
- to provide possibility to not sharing of their perceived sensitive information although linked with non-accessibility to market data and to build self-motivational system to share more data for exchange of high value market data
- to integrate the ecosystem to “world” known business networks (auction providers – NAR, Well management, vertical and horizontal marketplaces as Alibaba or other).

Focus of framework actions

- To create network interoperable infrastructure for enterprise networking. This infrastructure will network SMEs by bottom-up approach through networking of their internal information systems (legacy systems). It will bring new opportunities, extension and value for SMEs basic information systems, e.g. accounting systems and small ERP. It should be based on innovative and smart standardization approaches dealing also with standardization diversity and adaptability. Each ecosystem or infrastructure should be seamlessly interoperable, adaptable and with easy integration into global electronic marketplace to achieve higher critical mass of potential business partners and market opportunities. It will be based on interoperability and e-networking between ERP and legacy systems providers from European regions.

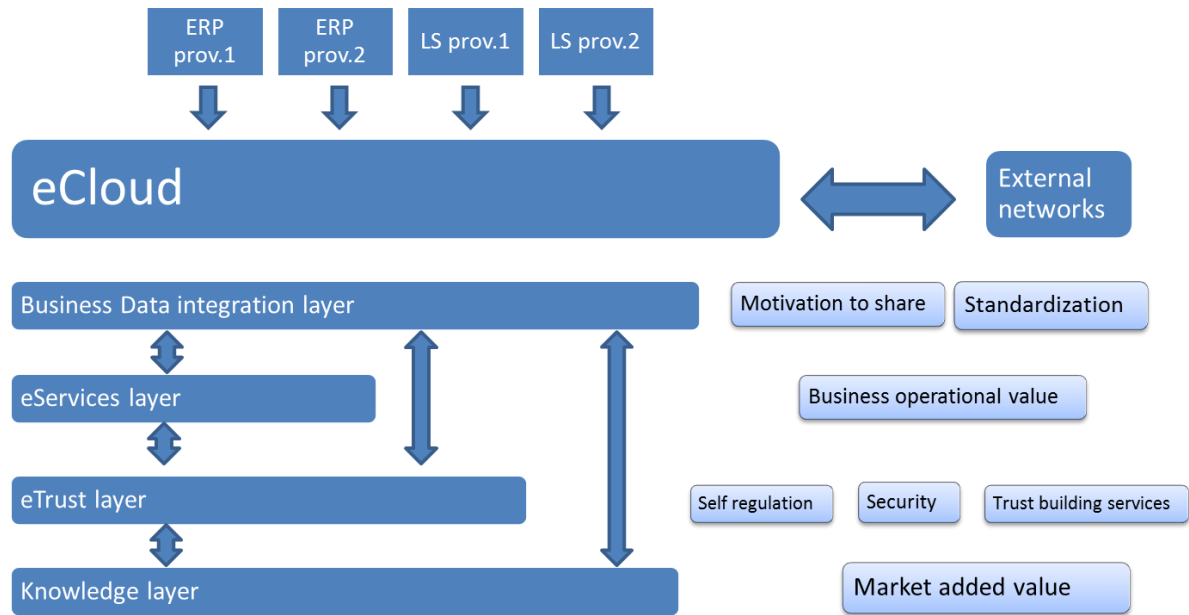


Figure 1: Concept for digital single market infrastructure for smart supply chains

- To create e-service layer for cooperation and business contractual life cycle. New smart eServices for whole business lifecycle, e.g. eSourcing, eProcurement, eNegotiation, eContract management, eCollaboration, collaborative e-procurement, creation ad hoc and longterm cooperative clusters, eSelling and push practices, reducing business spam, more targeted business, risk, financial and funding management, etc.
- To create self-regulation and trust building e-nvironment. To develop new kind of trust building electronic services from quality information, reputation building, online dispute resolution, contract execution support to escrow services. Network infrastructure with data analytical layer will ensure more efficient integration of third trusted parties services for mediations, arbitrages and escrow with more quality data support for objective decision making and higher transparency in opportunistic behaviors.
- To create data integration and analytical layer with knowledge creation e-services for better decision support and market formation. To move from business intelligence to market intelligence. Whole infrastructure with all layers will generate big and exhaustive data with enormous new knowledge identification and creation challenges. New market knowledge will provide information like consumer, company or its employees' behavior, market niches and dynamics, asymmetry, prediction of demand or other important statistics and causal relations for businesses, public bodies, policy makers or consumers.
- To create educational layers through dual/triple education systems based on living lab concepts (dual education system with self-education features through smart data analytical layer and co-learning and knowledge co-sharing between practice and academia). Cointegration of knowledge and service creation in academia and practice business e-environment

The real networking solution between millions of European SME companies will increase market transparency within global supply chains, increase and utilize new market opportunities and competitiveness. Integration of their local or international ecosystems into global marketplaces will increase their market opportunities and understand market and product innovation trends. Through trusted market environment the cost for reduction risk will be reduced and business lifecycle will

accelerate. Through knowledge layer, the business decision making will be more efficient and bankruptcy and opportunistic behavior deforming market will be reduced. It will lead to more stable and healthy market in relevant Danube region.

To be able to fulfill this framework vision, the eCloud data and e-service infrastructure encouraging emerging of new smart e-services for business and consumers is necessary to develop. New “bottom up” approach, sharing knowledge together with wider and suitable standardization of business information will be the first big step as described in next section.

3.1. Adaptive Product Classification Standards development

Nowadays, the common practice of the SMEs is to manage their business documents and processes in the heterogeneous ERP systems installed on the local intranets. In order to exchange documents with the business partners, SMEs are using different form of communication (paper based, emails, different local standards or standards within one specific supply chain) with the unstructured attachments exported from the ERP software. Majority of the ERP systems for SMEs are not implementing any e-business standard for electronic exchange of documents or organisation of business information leading to very heterogeneous and ineffective SMEs environment. It involves problems with internationally interoperable business documents standards or heterogeneity in product classification schemes which is the barrier for higher uptake of eCooperation services and utilizing benefits from Digital Business Ecosystems features.

To support achievement in this area, the main objective of the project is to provide cloud-based platform for standardization and electronic exchange of SMEs business documents and content and organization of business information. On the one hand, Cloud platform will provide common technical infrastructure for providers of the ERP systems, supporting them in adoption of e-business standards. On the other hand the platform will provide standardized and unified access to the SMEs business processes, which is a prerequisite for the new innovative services such as electronic discovery of new business partners, electronic procurement and business analytics on various levels (company, sector, cross-sector/national or European). Note that the platform integrates and leverages existing ERP software, which is already installed and commonly used by the SMEs. In this way, Cloud platform is aimed to break any technological or organizational barriers in the adoption of the standards on the SMEs side, directly providing useful service for efficient, secure and reliable electronic exchange of documents between collaborating partners integrated with the already known user interface of the ERP software.

From the technical point of view, the main components of the platform will overcome the main standardization problems, i.e. data and semantic/terminological heterogeneity of business information exchanged by the SMEs. The platform provides the following components:

Common technical infrastructure for electronic exchange of business documents. This infrastructure will provide common web service interface for integration of ERP systems specifying technical details such as data communication protocol, authentication of partners, data encryption, policy for message acknowledgement etc.

Service for business documents mediation. In the case that some standards for business documents are already adopted on the sector or national level, this component will mediate business documents from local standard to the unified format adopted for the eCloud platform overcoming any data heterogeneity problems.

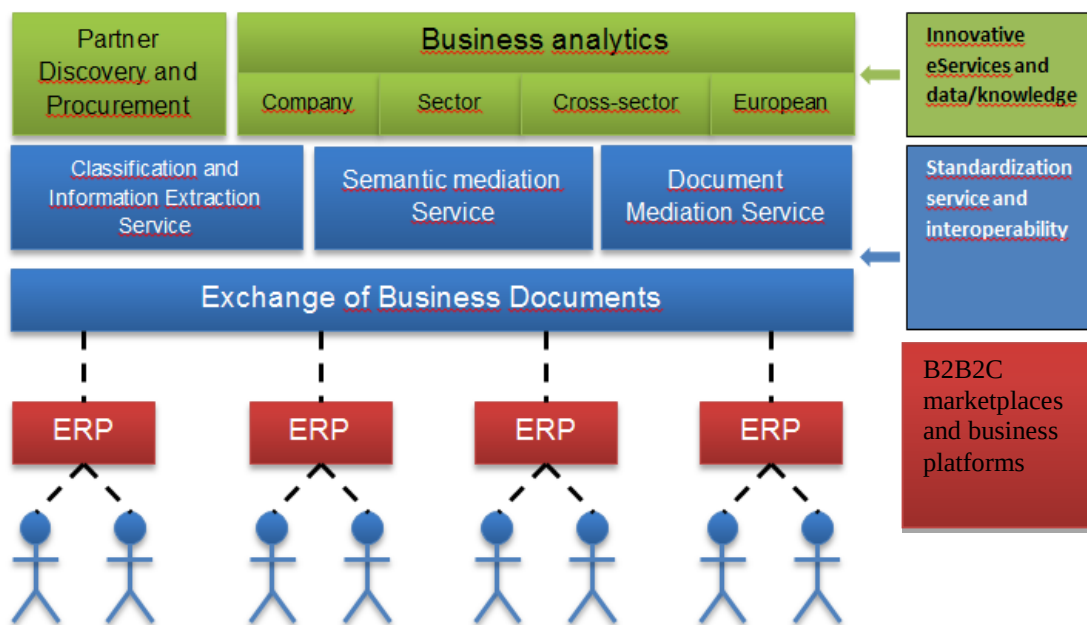


Figure 2: The concept for PCSs and related services development

Note: red and blue is the part of project activities, green is post-project activity of open community of ERP providers by integration of project results

Service for semantic mediation. This component will automatically map various controlled vocabularies, thesauri and ontologies used for product classification and normative specification of other information included in the business documents, such as delivery conditions etc. The clients of the platform (i.e. ERP systems or business analytics services) can specify any supported classification schema and natural language and service will automatically translate and localize the requested information into the specified standard.

Service for classification and information extraction. In the (most common) case that company is not using any standardized controlled vocabulary to organize business information such as catalogue of products, etc. this service will use methods of natural language processing and text mining to automatically extract information and classify plain text description into the normative controlled vocabulary managed by the Service for semantic mediation, i.e. the plain text description can be semantically "lifted" by this service to some controlled vocabulary and then mapped to the standard requested by the client through the Service for semantic mediation.

Infrastructure developed within the project will be open for pilot application utilizing this standardization solution considered by partners.

The standardization is perhaps the most import aspect in the implementation of the infrastructure that enables the global use of electronic business information and implementation of electronic business processes. Standardization efforts can be divided into the following layers:

- Collaboration protocol and messaging, to establish technical environment where all trading partners can exchange the business information in an interoperable, secure, and consistent manner.
- Core data components of business documents specifying library of standardized business documents covering business phases such as ordering, delivery and invoicing/payment.

- Product and service classification standards provide normative list of trading items, their attributes and attribute values. Standards are provided in the form of the controlled vocabularies or taxonomies encoded in XML or other formats including the plain text or spreadsheets with vocabulary terms localized in different languages. Some standards should be recommended for global use and translated to many natural languages. Others are provided for national use, limited to one sector, or specific for two cross-sector industries.

3.2. Data economy conceptual model

To understand the complexity, obstacles, benefits, open issues and potential of data value and the data management system in the digital single market space, it is good to understand all related layers or aspects of data economy management.

For that purpose, basic conceptual model of the management was developed and presented in Fig. 3. The model presents different critical layers which have to be managed and taken into the account. The main concept is based on that aspect, that each layer is separate domain with its own value, assets and management problems.

- The basis for all data environment is the cloud infrastructure for data storage. The cloud infrastructure should be interoperable and should provide all technical aspects related to robust, reliable and secure environment.
- The second layer „Data“ is data warehouse space, where real data are gathered, pre-processed and stored. Data should be characterized in complex manner according to different aspect/parameters:
 - Data types (financial, sociodemographic, behavioral, senzoric, SDI/Geo...).
 - The means of gathering (flight, satellite, IoT, terrestrial, empirical, experimental, modelled, simulated, existed (non)standardized databases as statistical...).
 - The means of preprocessing (statistics, visualization, modelling, simulations, VR or image processing, structured vs unstructured, big vs local data, data vs information vs knowledge...).
 - The possibilities of sharing and aggregation management (additional value from aggregation, sharing, standardization mapping, motivational sentiments for sharing semi sensitive data, ...).
 - The possibilities of practical usage (domain specific, multisectoral, API support...).
 - The possibilities for analysis, evaluations and reporting.
 - The possibilities/necessities, system and frequencies of data actualization/updates.
 - The pricing and business models development (the ways how to identify value, contractual and business conditions...).
 - Usage limitations and problems (legislations, IPR, personal and sensitive data, security models, anonymity-to-openness against backvalue ...).
- API layer to be able to ensure interoperability with external electronic services and application and be supportive to freelancers and software developers to integrate their application into standardized and value oriented environment.
- Application layer which will offer data value for specific e-services or applications based on data usage from data layer and easy access to them through API.

- Global analysis layer is focused on aggregated data analysis in the global system, gaps and needs identifications, shifts and trends esp. for higher layers. It is mainly oriented on specific analysis like policy modeling and market intelligence purposes.
- System management layer should provide management support for global data system, take measures to solve problems, requests and sustainability.
- Framework or policy layer is highest level focused on policy and legislation issues, regulatory vs non-regulatory environment decisions, strategic shifts and visionary management.

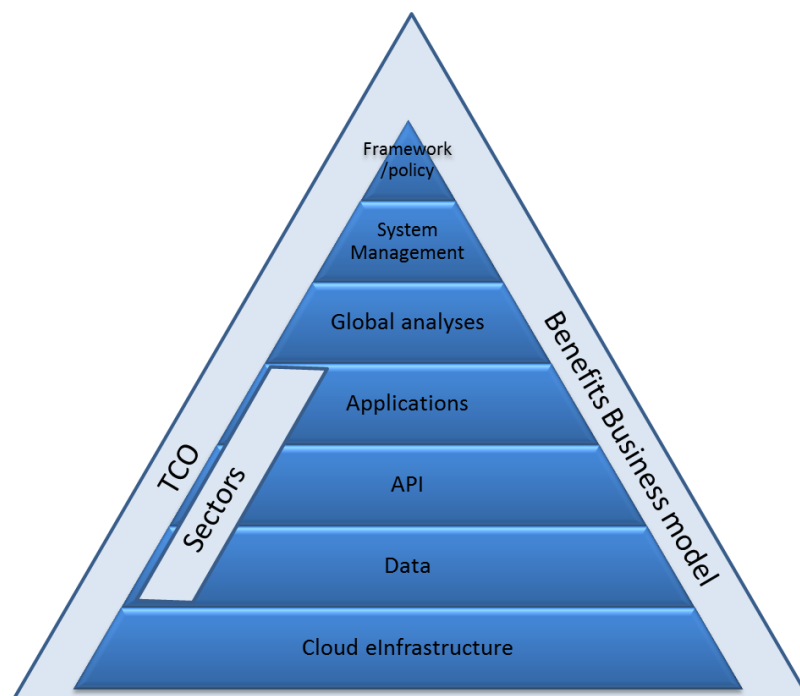


Figure 3: Data economy conceptual model

Together, each layer is affected by sustainability problem, it means for each level the cost together with social or business benefits assessment and identification should be considered.

It means, if data are considered as value within value chain, it is necessary to manage it complex through all mentioned aspects to achieve synergy and optimal way of data usage and to obtain from global and complex single data environment highest social and business value, sustainability and usability. This conceptual model should be applied on digital single marketplace as presented in Fig. 1.

4. Conclusion

To establish open cloud based business information standardization platform will help SMEs to deal with business documents and information through whole life cycle of business process more efficiently. It will bring higher precision of sourcing, e-contract execution, general decision making or new forms of dynamic e-catalogues development inside the local, inter-organizational but also international business processes. Together, interoperable and widely recognized standardization business information service will support self-evolution process where the environment will encourage rising numbers of new e-services. On the other hand, higher formalization and

standardization of business documents and information will offer better interoperability of Danube market with global supply chains and e-markets or world's marketplaces. Very perspective will be new form of market intelligence services (new market knowledge base) providing better transparency in market trends, market niches, gaps and other market indicators with strong support for business and policy makers. Trusted eServices environment will allow emerging of new smart e-services, higher stability and healthy and competitive market with higher resistance against crises or economy cycles for whole Danube regional market.

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THE ROLE OF PUBLIC PROCUREMENT IN PROCUREMENT OF INNOVATION

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Keywords

Procurement of innovation, public procurement, OECD STI Scoreboard 2015, PCP

Abstract

The paper analyses role of public procurement in support of procurement of innovation. Based on analyses of 6 indicators from OECD Science, Technology and Industry Scoreboard 2015 that covers statistics from 19 OECD and non-OECD countries, we use Pearson's correlation coefficient and other non-parametric coefficients to determine which factors influence the percentage of innovative companies with public procurement contracts. The investigated factors are: size of the companies, percentage of firms with public procurement contracts, percentage of firms which receive public funding for innovation and percentage of innovative company. The significant relationship between factors and the percentage of innovative companies with public procurement contract was confirmed only for the first and second factor.

1. Introduction

Public procurement of innovation is not a new concept. The main driver for its development and transformation during the time was a need to create proper innovation policy. The use of procurement in support of innovation change within the last 50 years. Firstly, the public procurement was used by army to procure defense contracts (Edler and Uyarra, 2013). According to Gerosky (1990) defense related use of public procurement have significant impact effects on creation of several high technology sectors such as IT, civilian aircraft and semiconductor industries. During the 80s and 90s of the last century, public procurement become use as appropriate tool to ensure support innovation, competitive advantage and technological readiness in firms. For example Gerosky (1990) and Rothwell and Zegveld (1982) find out that public

procurement is more effective tool in creation and accommodation of innovation than R&D subsidies (Uyarra et. al, 2014). According to Edler and Uyarra (2013) use of procurement methods for acquiring innovation declined during the 90s, only to gain more popularity after year 2000. The procurement was primary used to ensure “strategic use of technology” and also for procurement of innovation. (Edler and Uyarra, 2013). During this period it was called „Public technology procurement” (Edquist and Zabala-Iturriagagoitia, 2015). The public technology procurement (PTP) “occurs when a public agency places an order for a product or system which does not exist at the time, but which could (probably) be developed within a reasonable period.”(Edquist and Hommen, 2000). Because it does not exist at the time, the unique or further technological approaches are needed to achieve requirements of customer. PTP in contrast to traditional public procurement usually require some level of R&D. (Edquist and Hommen, 2000). As Edler and Uyarra (2013) claim this phase was also a phase large, national, infrastructure projects, which were focus on public sector. Next period bring also a change of language and word “technology” was change to word “innovation” in order to signalize broader definition of notion. (Edquist and Zabala-Iturriagagoitia, 2015). In the presence, the procurement of innovation is vastly used together with PCP known as pre-commercial procurement. It is very specific scheme developed by European Union to procure R&D services. It was built upon practices from USA more concretely on Small Business Innovation Research (SBIR) program, but it was redeveloped in order to fit to European legislative (Edquist and Zabala-Iturriagagoitia, 2015).

The aforementioned papers are only a few of several studies, which deal with benefits and barriers of public procurement to foster the innovation. The research presented in this paper analyses public procurement from different point of view. It focus on analysis of factors which influence country percentage of innovative firms with public procurement contract. In order to determine the role of public procurement in procurement of innovation from countries point of view, we decided to investigate these research questions:

RQ1: Does the percentage of firms with public procurement contracts within the country influence the percentage of innovative firms with public procurement contracts within the same country?

RQ2: Does the percentage of innovative firms within the country influence percentage of innovative firms with public procurement contracts within the same country?

RQ3: Does the percentage of firm receiving public support for innovation within the country influence percentage of innovative firms within the same country?

RQ4: How does the distribution of countries’ percentage of innovative firms with public procurement contracts change, when the size of the companies is considered?

2. Methodology

The sample used in this research is based on OECD Science, Technology and Industry Scoreboard 2015 dataset. The reason why, this kind of dataset was chosen is because, “the OECD has played a key role in the development of international guidelines for surveys of business innovation (Oslo Manual) and the design of indicators constructed with data from such surveys. Over 200 indicators in the OECD Science, Technology and Industry (STI) Scoreboard show how OECD and major non-OECD economies are starting to move beyond the crisis, increasingly investing in the future.” This dataset provides information regarding the innovation from 34 OECD countries and a number of non-OECD ones. Although the information provided here covers periods from 2009-2013, this dataset is still, to our knowledge, the latest survey covering area of innovation procurement in e.g. EU countries. To test relationships presented in the research questions, we selected several

indicators, which are presented in the Table 1. Based on the survey methodology some indicators can be break down according to size of the company (total, SMEs, large) or according to sector in which company operates (manufacturing, service).

Questions	Results of Shapiro–Wilk test of normality	Normal distribution	
	Types of innovation	Test statistics	Verdict ($\alpha=5\%$)
1	Innovative firms, as a percentage of total firms	0,96774	Not rejected
	Public financial support for innovation activities		
18	Firms receiving public support for innovation, as a percentage of product and/or process innovative firms	0,90174	Rejected
	Innovation and participation in public and international markets		
32	Firms with public procurement contracts, as a percentage of total firms	0,96181	Not rejected
33	Innovative firms with public procurement contracts, as a percentage of total innovative firms	0,95636	Not rejected
34	Innovative firms with public procurement contracts, as a percentage of total firms	0,98586	Not rejected

Table 1: Results of normality test for OECD INNOVATION INDICATORS (Source: OECD, 2015)

Most of the data provided in the study are in the form of percentages (ratios). To test relationships between these variables we decided to use Pearson's correlation coefficient that in order to be precise require normal distribution of variables. The results of the Shapiro–Wilk normality tests are presented in table 1. Because the null hypothesis of normal distribution of the sample was not rejected at $\alpha=5\%$ for all questions except question number 18, we use Pearson's correlation coefficient to test the relations determined in the RQ1 and RQ2. For RQ3 we decided to apply non-parametric statistics such as Kendall's tau-c and Spearman rank correlation. Also here, all the tests were done at $\alpha=5\%$ significance level. To describe differences between distributions presented in RQ4 we conduct box-plot analysis. Moreover to graphically present examined relationships presented in RQ1, RQ2 and RQ3 we used scatter plot diagram. In order to provide answers to research questions, the dataset includes only countries, which provide values for some of the indicators presented in Table 1. The final dataset covers 20 countries. The description of the countries in the sample is provided in Figure 1.

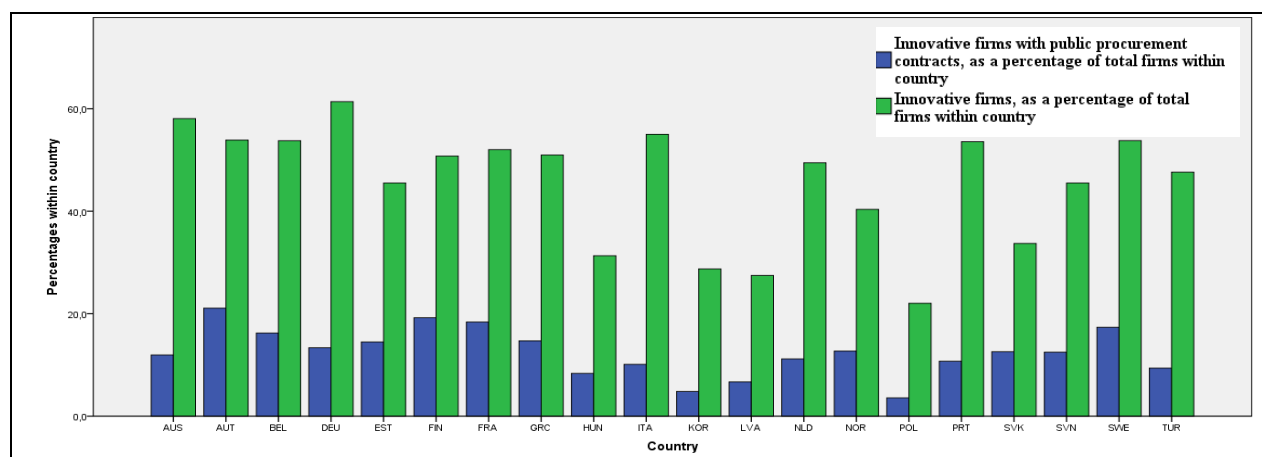


Figure 1 Description of the sample (Source: Author)

3. Research

3.1. Research Question 1

The RQ1 test relation between percentage of firms with public procurement contract and percentage of innovative firms with public procurement contract. The motivation for such study is find out whether the countries which have most of firms contracted through public procurement also have most of innovative firms with public procure contracts. We are trying to find out whether examined countries do not use the public procurement contract mainly to fund non-innovative companies.

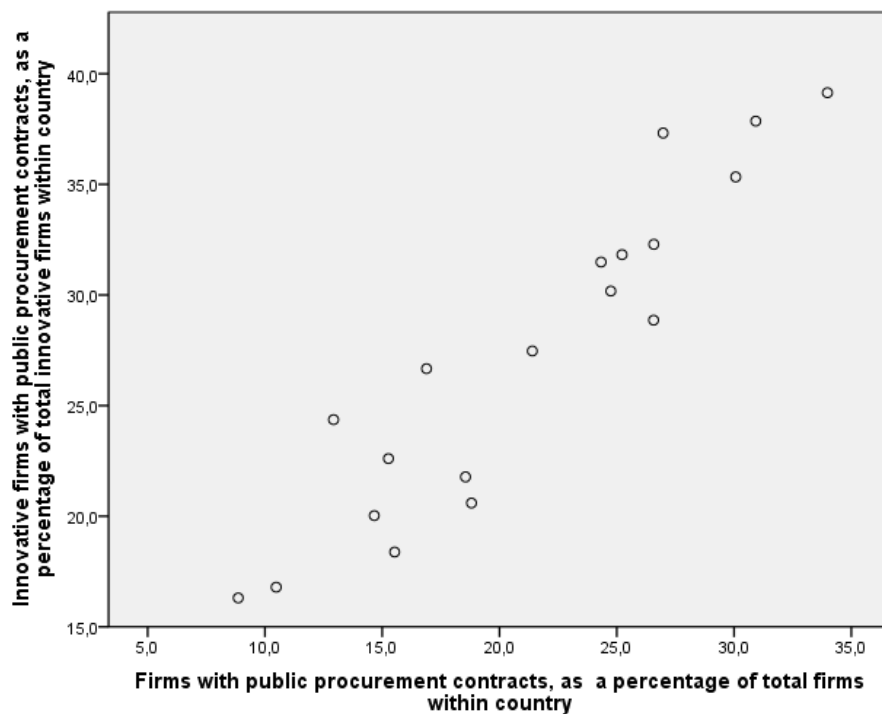


Figure 2 Scatter plot describing relationship between percentage of firms with public procurement contracts and percentage of innovative firms with public procurement contracts (Source: Author)

As can be seen that from Figure 2 and verified by Pearson's correlation coefficient presented in Table 2, there is a statistically significant and strong relationship between percentage of firms with public procurement contracts within the country and number of innovative firms with public procurement contracts represented as percentage of all innovative firms within countries.

	Value	Asymptotic Standardized Error ^a	Approximate T ^b	Approximate Significance
Pearson's R	,937	,025	11,055	,000c
N of Valid Cases	19- (Turkey was excluded because of missing data)			

a. Not assuming the null hypothesis. b. Using the asymptotic standard error assuming the null hypothesis. c. Based on normal approximation.

Table 2: Review of results of correlation analysis for RQ1 (Source: Author)

3.2. Research Question 2

The RQ2 tries to determine relationship between percentage of innovative companies within country and the percentage of innovative companies with public procurement contracts within the same country. This relation should examine whether countries with high percentage of innovation firms, also have high percentage of innovation firm with public procurement contract. In other words this research question tries to find out whether there is a relationship between number of innovation organizations within a country and number of innovation companies with public procurement contracts. It is based on assumption that supporting creation of innovative companies can lead to fostering public procurement of innovation.

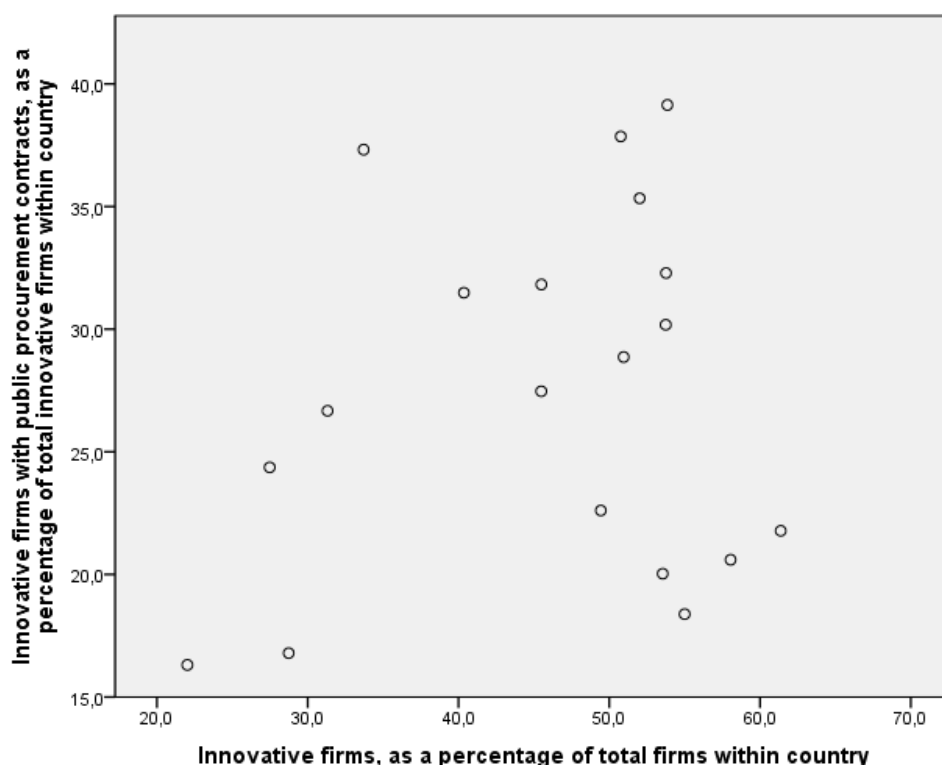


Figure 3 Scatter plot describing relation between percentage of innovative firms and percentage of innovative firms with public procurement contracts (Source: Author)

As can be seen on Figure 3 and verified by Pearson's correlation coefficient in Table 3, very weak and statistically insignificant relation (at $\alpha = 5\%$) was found between these variables. Based on these results, it can be assume that volume of innovative firms doesn't influence the volume of innovative firm with public procurement contract.

	Value	Asymptotic Standardized Error ^a	Approximate T ^b	Approximate Significance
Pearson's R	,199	,239	,838	,413c
N of Valid Cases	19- (Turkey was excluded because of missing data)			

a. Not assuming the null hypothesis. b. Using the asymptotic standard error assuming the null hypothesis. c. Based on normal approximation.

Table 3: Review of results of correlation analysis for RQ2 (Source: Author)

3.3. Research Question 3

The RQ 3 tests whether there is a relationship between number of firms receiving public support for innovation and number of innovative firms. The purpose of this question is to determine whether countries with high percentage of firms receiving public support for innovation, also have higher percentage of innovation firms.

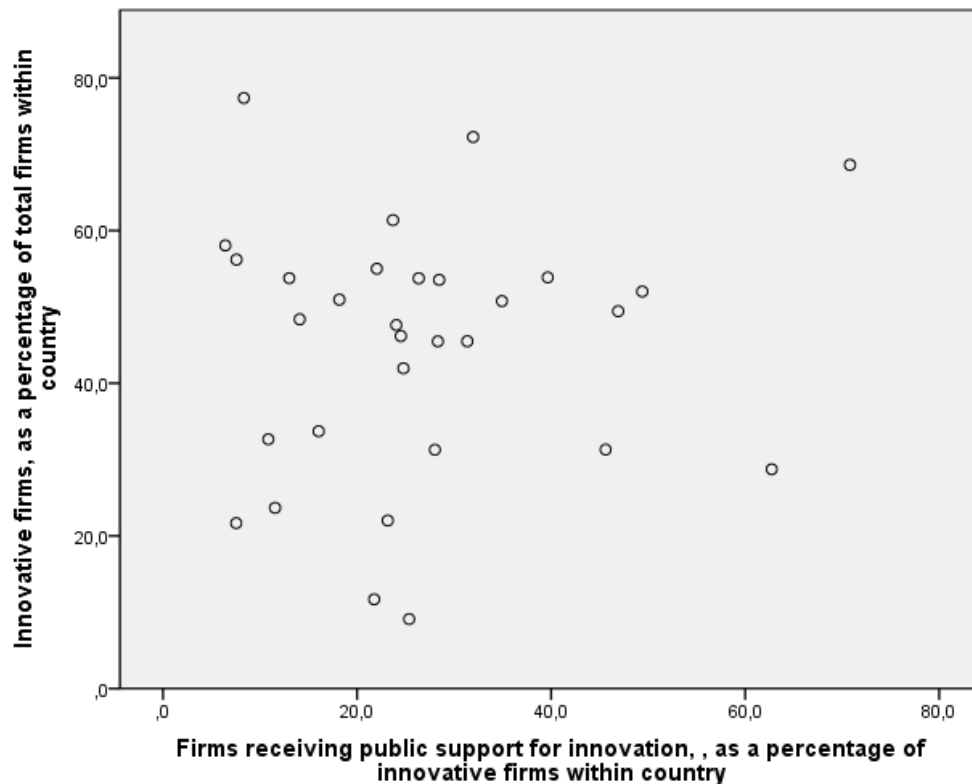


Figure 4 Scatter plot describing relation between percentage of innovative firms and percentage of innovative firms receiving public support for innovation (Source: Author)

Based on Figure 4 and non-parametric coefficients presented in Table 4, we can assume, that there is a very weak and statistically insignificant relation (at $\alpha=5\%$) between number of firms with public support of innovation and number or innovative firms. Such result lead to assumption that increased number firm receiving public support for innovation does not have influence on number innovation firms in the country.

	Value	Asymptotic Standardized Error ^a	Approximate T ^b	Approximate Significance
Kendall's tau-c	,019	,144	,135	,893
Spearman Correlation	,032	,202	,172	,865 ^c
N of Valid Cases	19- (Turkey was excluded because of missing data)			

a. Not assuming the null hypothesis. b. Using the asymptotic standard error assuming the null hypothesis. c. Based on normal approximation.

Table 4: Review of results of non-parametric tests for RQ3 (Source: Author)

3.4. Research Question 4

The motivation behind RQ 4 is to determine the differences between distributions of countries' percentage of innovative companies with public procurement contract based on size of these companies. As left part of Figure 5 suggests, the percentage of innovative SMEs with public procurement contract is lower than percentage of large organization with the same type of procurement contract. According to box plot analysis in 50% of all tested countries the percentage of innovative SMEs with public procurement contract varies from 21% to 32% of all innovative companies in country. On the other hand the same percentage for large firms in 50% of all countries varies from 28% to 38%. The bigger difference is recognized, when we compare mentioned variable as a percentage of the total firms. As right part of Figure 5 illustrates, there is a big difference between countries' percentage of large innovative companies with public procurement contracts and countries' percentage of SMEs. According to these finding it can be assumed that procurement of innovation conducted through the public procurement is in majority of examined countries mostly executed by large innovative firms rather than by innovative SMEs.

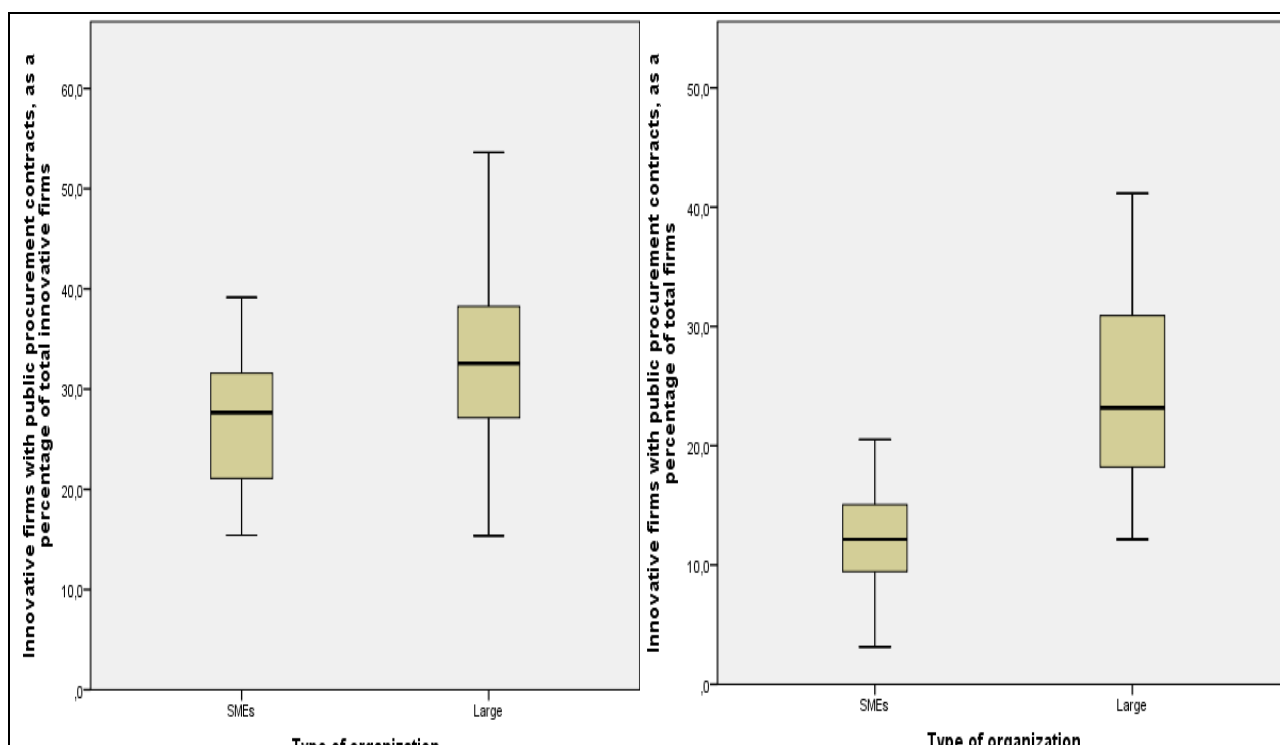


Figure 5 Box plots describing distribution of countries' percentage of innovative firms with public procurement contracts according to size (Source: Author)

4. Conclusion

Presented paper is focused on role of public procurement in procurement of innovation. It tries to determine what influence the volume (percentage) of innovative firms with public procurement contract. It is based on assumption that reason why innovative firms acquire public procurement contract is that the innovation is part of subject of procurement. The study investigates few research questions. The aim of the first research question is to determine relationship between public procurement and previously mentioned variable. According to Pearson's correlation coefficients strong and statistically significant relationship was confirmed between these variables. This lead to

assumption that improvement of procurement environment in the country in order to increase number of firms with public procurement contracts, can lead to increase of innovative firms, which provide their innovation through the public procurement contract. Totally different story provides analysis of second research question. The same coefficient show indifference (very weak and statistically insignificant relationship) between percentage of innovative firms and percentage of innovative firms with public procurement contract (as a percentage of all innovative firms). This suggests that with increase number of innovative firms (as a percentage of all firms), the proportion of innovative firms with and without public procurement contract does not seems to be affected. Similar results, by use of non-parametric statistics were discovered, in order to provide answer to research question 3. Even in this case coefficients determine very weak and statistically insignificant relationship between number of firms that receive public support for innovation and number of innovative firms. This means that if country raise number of firms which receive public support for innovation, it does not mean that in the same country the number of innovative firms will be higher. The Last RQ4 tried to uncover, what impact have size of the company on percentage of innovative firms with public procurement contract. Boxplot analysis showed that in majority of the countries large innovative companies have by far higher probability to acquire public procurement contract than the SMEs.

5. Acknowledgment

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EXAMINING ELECTRICITY E-AUCTIONS BY ASSOCIATED HOUSEHOLDS

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Keywords

Reverse electronic auctions, associated e-auctions, households electricity purchasing.

Abstract

E-auctions held by associated households seem to be a new trend for purchasing commodity in Czech Republic. Households can achieve significant financial savings on commodities such as electricity and natural gas. In this paper, we set a goal to define and ground the associated e-auctions in existing e-auctions literature, to explore their results and to analyze factors influencing their results. Using correlation analysis, we found that while the Average price per MWh after the e-auction is influenced by forward price of Electricity.

1. Introduction

Implementation of e-sourcing tools such as reverse electronic auctions in purchasing process enable organizations the potential of financial savings and other benefits. Reverse e-auctions are mostly used by private organizations and, to a lesser extent, by public institutions. Recent trend of so called joint e-auctions held by associated households enables them to reach savings mainly on commodities such as electricity or natural gas. Through the mechanism of association, independent households or small companies can aggregate their demand for these basic commodities and increase the attractiveness of the lot for distributors. That way, they can reach the savings otherwise unavailable for individual customers.

While reverse e-auctions held by companies and institutions are relatively well-researched, the same certainly cannot be said about the associated e-auctions, mainly due to the newness of this concept. Undoubtedly, many of the current approaches and findings can be taken from standard reverse e-auction field, but the specifics of associated e-auctions might lead to some misconceptions when applied directly.

The paper is organized as follows: first, brief summary of current research on reverse e-auctions is established as well as an attempt to define associated e-auctions. Then, electricity market for households in Czech Republic is explained. Then, we provide empirical research with real e-auction data from eCENTRE e-auction system and analyze the factors influencing the results.

2. Theoretical background

In this section of the paper, we provide basic definitions and insight on reverse electronic auctions. We also define associated e-auctions, their benefits and requisites, and try to find common ground between standard reverse and associated e-auctions. We also briefly describe electricity market in Czech Republic.

2.1. Reverse electronic auctions

The main principle behind reverse e-auctions is the competitive bidding of pre-selected potential suppliers in a specialized online tool for the right to supply goods or services on pre-negotiated specifications (Beall et al, 2003, Bulow & Klemperer, 1996). Generally, it can be seen as one of the e-procurement tools alongside electronic requests for quotations or supplier databases (Karjalainen & Salmi, 2013). As such, e-auctions are more suitable for transactional purchasing categories and contexts (Emiliani & Stec, 2001). It is convincingly shown that under the right conditions, e-auctions can generate more than 5 % savings (Wagner & Schwab, 2004). Other benefits include, but are not limited to increased market efficiency, improved procurement process efficiency, access to a larger supplier base and lowering the risk of unfair behavior amongst the contracting sides (Mabert & Skeels, 2002, Beall et al, 2003, Delina, 2014).

2.2. Associated e-auctions

Associated e-auctions are similar to regular reverse e-auctions held by companies or institutions, with main difference being multiple contracting authorities on the buying side (hence the name 'associated' e-auctions).

The main mechanism is the aggregation of demand so that the lot is more relevant for potential suppliers. The purchasing power (and demand) of a single individual household is not enough for the supplier to prepare better than tariff price and conditions. Joskow & Tirole (2004) state that average electricity bill of a household is around 100 times lower than average electricity bill of an industrial company, while the prices per MWh are almost 2 times higher for the household. However, when thousands of those individual households are aggregated into one lot, standard e-auction mechanism of competitive bidding is activated and individual households can potentially get closer the prices per MWh usually paid by companies. Associated e-auctions are usually held by specialized companies.

Those companies manage the contracts with households, communicate with both contracting sides and operate the e-auction software (either licensed third party software or developed in-house). So far, associated e-auctions held by households are limited to purchase of commodities such as electricity or natural gas.

2.3. Electricity market in Czech Republic

Originally, the electricity market was highly monopolized, vertically integrated system with government-granted monopolies managing the production, distribution and billing of electrical power. Since 1980s, there has been a strong liberalization movement in this sector starting in UK and USA (Joskow, 2008).

Electricity market liberalization in Czech Republic was driven by European Union Electricity Market Directives, focusing on unbundling the industry and opening the national market (Jamassb & Pollitt, 2005). Under the EU directives, all members were obliged to liberalize the market from July

2007. The market in Czech Republic was liberalized even earlier, from January 2006. Since then, it can be described as privatized, competitive environment where the customers (households and organizations) have free choice of suppliers (Chemišinec, 2010).

Households draw the electricity for their consumption based on a contract with chosen retailer. The price consists of (a) regulated price set by Energy Regulatory Office, which is seen as a payment for the usage of the power grid, and (b) price of the electric power itself. (b) can be further divided on constant monthly fee and payment for distributed MWh, either in single or two (high and low) **tariffs** (ČEZ, 2016). Generally, one tariff is more common for flats and two tariffs for houses using electrical energy for heating or water heating. Furthermore, each household has assigned one of nine **distribution rates** (two one tariff and seven two tariff) based on the consumption and appliances (ČEZ, 2016). Furthermore, each retailer can brand its offering into **products**, differing in name and prices. Products with time-bound clauses have usually lower prices per MWh (ČEZ, 2016).

The licensed electricity retailers usually purchase the power from spot or forward market, or may use e-auction process himself. The degree of freedom usually depends on the market regulator (Pérez-Arriaga et al, 2010). There is also ongoing debate about the effectiveness of the retail competition for small consumers, some authors (e. g. Joskow & Tirole, 2004) even suggesting that distribution utilities should be required to sell electricity for averaged spot market price and differentiate based on value-added service such as additional information on the energy consumption etc (Joskow, 2008).

3. Research methodology

Due to the newness of the associated e-auction phenomena, we conducted an exploratory research, covering two main parts: (a) descriptive statistics, covering the number of households involved, total amount of MWh per auction, price per MWh and most importantly, savings. Then, we consider the variables of average price per MWh and average savings and examine potential factors that could influence those variables (b).

We examined the factors of spot and forward prices of electricity, and exchange rates of Czech crowns, Euros and US Dollars.

3.1. Used data

The data used for this research come from real associated e-auctions conducted by Czech company eCENTRE in 34 consecutive months from March 2013 to December 2015. The auction is held on monthly basis, with varying number of households involved. Generally, there are two ways of incorporating a household into an associated auction: the household is either contacted by eCENTRE sales team, or applies directly through a form on its website. The household can be flat or house, with varying number of people, energy consumption (we know the amount of MWh in both low and high tariff for each household associated in an auction) and previously used supplier and tariff. However, those data are highly sensitive.

Possible limitation of our research is the lack of any information about the competing suppliers in the dataset – the company rated those data as highly sensitive. We were however ensured the portfolio of the suppliers is very stable. Some households who were associated in the first e-auctions were also already part of the associated e-auction for the second time, as their contracts from the first e-auction already expired. Those households should reach lower savings (according to

existing e-auction literature, e. g. Beall et al, 2003), but there's no way to test that assumption, due to the anonymization of the households.

To test the factors potentially influencing the savings, we acquired data from public sources on spot and forward electricity prices on the Power Exchange Central Europe page. Exchange rates were downloaded from Czech National Bank website and the prices of diesel from page Penize.cz.

3.2. Research methods

First, we analysed the inductive statistics of mean and standard deviation for the variables of Number of households, Total MWh, Average tariff price per MWh, Average final price per MWh, Average savings and Monthly fee.

The average tariff price per MWh is computed as weighted average of prices in both tariffs paid by the households before the e-auction. Average final price is then the weighted average price per MWh after the e-auction. Average savings are the difference between those two:

$$S_A = ATP - AFP \quad (1)$$

, where S_A are the average savings, ATP is the Average tariff price and AFP average final price. The Average savings are therefore computed in Kč/MWh and not in percentages, as is perhaps more usual in e-auction research. This perhaps simplified approach was possible due to the unified measures of each e-auction.

In the second part of the research, we analysed the factors influencing the average prices, savings and fees using Spearman's correlation coefficient, as the variables are not of normal distribution. The coefficient can be computed as

$$r_s = 1 - \frac{6 \sum_{i=1}^n (i_x - i_y)^2}{n * (n^2 - 1)}, \quad (2)$$

, where i_x and i_y are the ranks of each observation and n is the number of observations.

4. Analysis of associated e-auctions

In this section of the paper, we first examine descriptive statistics for each of the concerned variables. Then, we test the correlation for each of the variables possibly influencing the associated e-auction result.

4.1. Descriptive statistics

First, we examine the descriptive statistics for number of households and total amount of MWh.

	Median	Std. Deviation	Minimum	Maximum	Percentiles		
					25	50	75
Number of households	686,50	1199,66	136	4904	248,50	686,50	1696,50
Total amount of MWh	3409,91	6261,66	715,67	24857,22	1183,61	3409,91	8356,38

Table 1: Number of households and Total amount of MWh: Descriptive statistics

As those variables are not of normal distribution (tested by Kolmogorov-Smirnoff test), we chose median and quartiles as the statistics.

We can see that while median number of households is 686.5 units and total MWh amount 3 409.91 MWh, the standard deviation for both variables is quite high (higher than the median). This is due to high fluctuation of both variables: minimal number of households was 136, while maximal was 4904. Lower numbers (and amounts) were generally observed in the year 2014.

Total amount of MWh was also fluctuating, more or less in alignment with the curve of Number of households (Spearman's coefficient for these two variables is 0.996). You can see total amount of MWh on the main y axis and number of households in the auction on the secondary y axis.

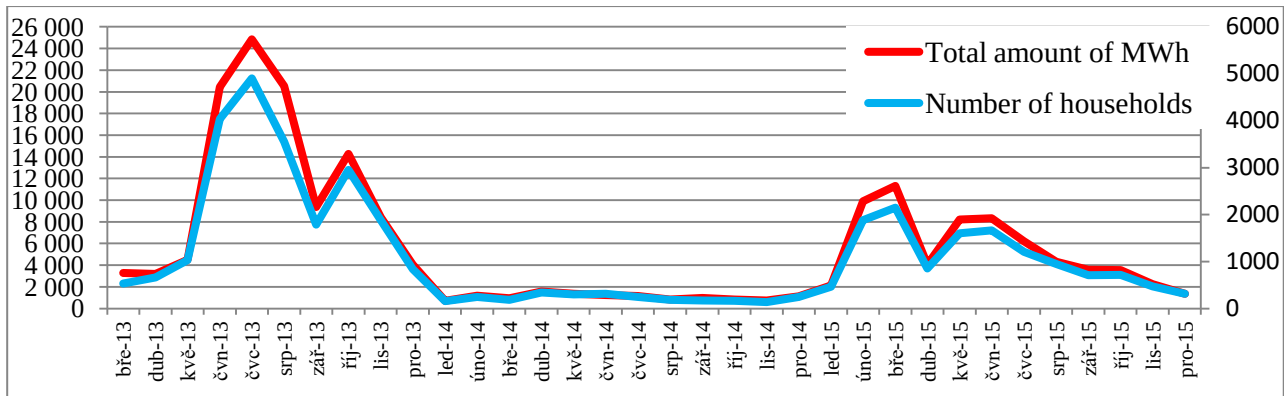


Figure 1: Number of households and Total amount of MWh in associated e-auctions

	Tariff		Final	
	Median	Std. Dev.	Median	Std. Dev.
Monthly fee	53,536	5,24	9,999	14,6
Average price	902,664	87,24	756,627	65,9
Savings			157,968	70,43

Table 2: Monthly fees, Average price and Savings: Descriptive statistics

Table 2 highlights the mean prices and savings before (Tariff) and after (Final) the e-auction. We can convincingly say that the prices for both Monthly fee and Average price are lower after the e-auction, thus generating savings.

Monthly fee again shows greater volatility after the e-auction, possibly as the effect of varying prices of input commodity (raw power). We'll examine this phenomenon in the next chapter. In some months, the final monthly fee after the e-auction was 0, as the suppliers competed not only for the price of tariffs, but outbid each other also for the monthly fee.

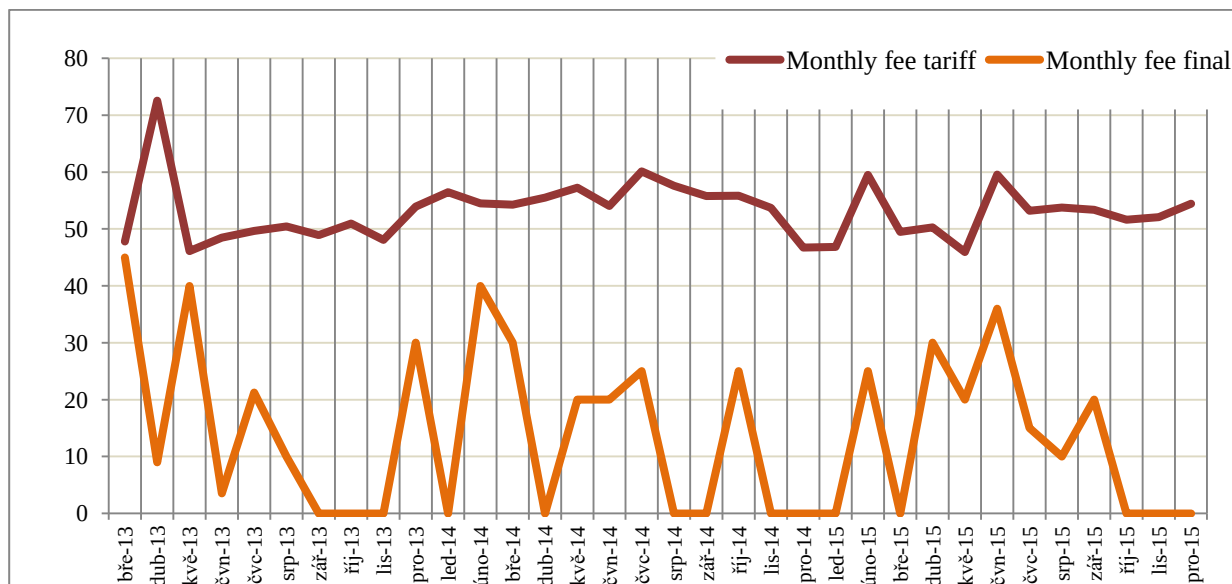


Figure 2: Monthly fee before and after the associated e-auction

Figure 3 shows average prices and savings. In the first e-auctions, the savings were a bit higher. This is probably due to the fact that some households from the first e-auctions were already a part of a second e-auction (see chapter 3.1).

The tariff prices were also getting lower in 2013, as the households with better contracts were associated. Final prices are then relatively stable with slightly decreasing trend, meaning the savings seem to be relatively stabilized, or matching the stability of the initial tariff prices.

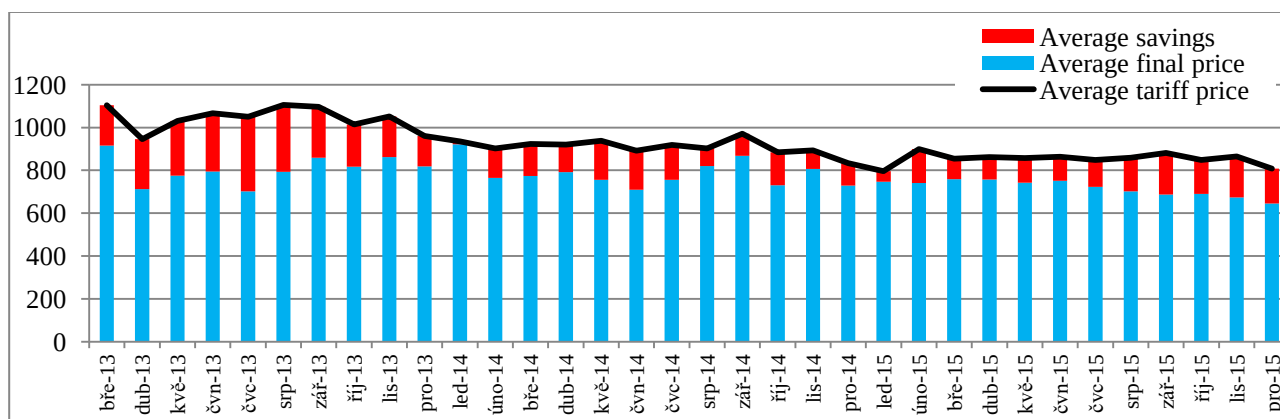


Figure 3: Average tariff price, Average final price and Average savings

4.2. Factors influencing the results

Using the method of Spearman's rank correlation, we tested the three output variables (Average final price, Average savings and Monthly fee savings) against six variables potentially influencing those outputs.

As the Table 3 shows, the variable of Monthly fee savings is perhaps the most unpredictable, as it doesn't correlate with any of the potentially influencing variables.

		Spot price	Forward price	Number of households	Total amount of MWh	EUR Exchange rate	USD Exchange rate
Average final price	Correlation Coefficient	,142	,741**	-,058	-,072	,097	-,498**
	Sig. (2-tailed)	,423	,000	,745	,686	,586	,003
Average savings	Correlation Coefficient	,158	,118	,527**	,525**	-,794**	-,545**
	Sig. (2-tailed)	,371	,506	,001	,001	,000	,001
Monthly fee savings	Correlation Coefficient	,230	,052	-,231	-,220	,129	,064
	Sig. (2-tailed)	,191	,770	,188	,212	,467	,720

Table 3: Correlation table

Average final price shows moderate (0,741) correlation with Forward price. This has rather obvious explanation, as the suppliers use the forward markets to purchase the electricity, which is then further distributed to the households. The Average final price is always lower than the forward price. The Average final price also negatively correlates with the Exchange rate of USD.

Average savings are perhaps the most readable and predictable of the variables: they correlate with Number of households, Total amount of MWh and (negatively) with both Exchange rates (EUR and USD).

5. Conclusion

Statistically significant correlation does not imply causation. We need to further examine the mechanisms that influence the variables. It seems that the mechanism between Average final price and Forward price on the day of the e-auction is perhaps the most clear: suppliers need to be aware of the prices electricity market exchanges so that they can assess the lowest price at which they can be both competitive and profitable. The Number of households and Total amount of MWh, which influence Average savings, could be explained using existing e-auction literature – larger lot sizes with more households attract more competition from the suppliers (for example Beall et al, 2003, Smeltzer & Carr, 2002).

Electricity e-auctions of associated households provide significant savings. On average, the households can save more than 17 % per MWh on the variable price of energy and almost 40 % of the fixed monthly fee. This proves that associated e-auctions are promising tools not only for private companies and public institutions, but also for households. Electricity and natural gas are already procured through them, and other services such as cell phone contracts could follow.

The research presented in this paper is however somewhat limited: first, we didn't know some information that would be quite vital – number and structure of the suppliers and also number of households entering the e-auction repeatedly. Certain limitation is also brought by the fact that over the time period covered in the research, prices of electricity have decreasing trend. This allows suppliers to lower prices for final consumers and brings the question of the sustainability of results when this trend slows down or even reverts.

6. Acknowledgements

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SELECTED VIEW ON THE SLOVAK E-COMMERCE ENTITIES IN THE LIGHT OF REPUTATION ANALYSIS

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Reputation, Net Promoter Score, Customer preferences, e-commerce

Abstract

The paper presents partial results of a comprehensive research of online reputation of selected e-commerce entities operating predominantly in Central European market. The objective of our analyses presented in this paper is to identify (based on the latest rankings) the main players from among the wide range of e-shops operating in the Slovak market, analyze their reputation by selected methodology called Net Promoter Score (NPS), and then identify key factors for success in terms of customer preferences. Based on our findings recommendations for e-commerce entities with emphasis on preferences of their current as well as potential customers will be formulated in order to improve competitiveness and increase efficiency of those key players on the Slovak digital market.

1. The current state of the researched issue

The Internet has changed the way we are thinking about reputation. What was once private is now public. What was once happening on the local level is now discussed on the global level. What was once ephemeral is now permanent. What was once trusted is now unreliable (Delina, Dráb, 2009, Delina, Tkáč, 2010, Delina, 2014). These changes happen because the Internet has modified our interaction with reputation (Dorčák, Štrach, Pollák, 2015, Pollák, Nastišin, Kakalejčík, 2015).

Understanding the unique relationship between technology and online culture is a key to understand how to manage online reputation (Maryška, Doucek., Novotný, 2012, Maryška, Doucek, Kunstova, 2012, Loayza, 2013). Those who apply off-line techniques on their Internet reputation or use off-line assumptions to solve online problems are doomed to failure. Instead, the user must be capable to understand the cultural and technical differences between the Internet and off-line world to effectively protect and improve his online reputation (Fertik, Thomson, 2010). Walter (2012) argues that reputation is a cornerstone of one's life and business. This means that reputation is very fragile and one mistake can sometimes cause irreparable damage (Pollák, 2015). This is especially true in the digital world ruled by radical transparency and high standards of customers (Soviar, 2011, Soviar, Vodák, 2012). Entities must be able to learn to communicate on social networks, follow the "chatter" on social media and effectively respond to such impulses without harming their reputation in line with expectations of their customers (Svetozarovová, Polláková, 2015). Siano et al. (2013) argues that when the Internet allows consumers to share information about businesses and brands, entities have the opportunity to control information published about them. Negative comments on the Internet can quickly and severely damage image and reputation of the brand. There is a wide portfolio of methods for quantifying reputation described in literature.

Speaking about reputation systems, the simplest solution is to sum up all the relevant positive and negative reviews. The total result related to the specific user is the difference between all positive and negative reviews. This principle is used mainly on eBay, one of the largest online markets and community with over 50 million registered users. After each transaction the buyer and the seller can give each other positive, negative, or neutral rating, which in turn adds plus or minus points (1, -1, 0) to their reputation. Users can also leave comments. When people leave negative rating, they usually leave a comment that explains it. Although the eBay reputation mechanism is very simple, empirical results show it supports transactions between sellers and buyers. It is mainly due to the fact that sellers with better reputation are more likely to sell more. Also, this mechanism can prevent people to artificially boost their reputation with each other (Resnick, Zeckhauser 2002).

Another important model for online reputation monitoring is ReGreT model introduced by Sabater and Sierra (2003). ReGreT model is a standard model of trust and reputation system aimed at a SME e-commerce environment where social relations between individuals play an important role. The system takes into account three different sources of information - direct experience, information from third parties, and social structures. ReGreT reputation model is based on three specialized types of reputation:

1. proven reputation - is calculated from the information coming from witnesses,
2. reputation surroundings - reputation is calculated using information based on social relations between the partners,
3. system reputation - is a reputation value based on roles and general characteristics.

Model Flow represents models that calculate reputation using transitive interactions of individual users. Some allocate the entire community (users network) a certain amount of reputation which is gradually redistributed to all users. Thus, the reputation can be increased only at the expense of other users. The most famous example of this algorithm is PageRank from Google. Google has become the most powerful and the most popular Internet search engine. PageRank mechanism evaluates sites on a scale of 0-10. Each page starts from a scratch. Pages having 5 or 6 points are deemed very good. If the page has a score greater than 7, it is among the very big players. It is better to get one link from a Page Rank with a score 5 or 6 than have 20 links from pages with a score only 1 or 2 (Wang, Vassileva 2007).

Correct quantification reputation is necessary in the process of reputation management (Stec, Filip, Grzebyk, Pierscieniak, 2014, Svetozarovová, Polláková, 2015). For the purpose of our research the method of measuring reputation through so-called NPS was selected. Net Promoter Score, or Net Promoter System (NPS) is a system for measuring reputation, which is based on the fundamental perspective that customers of each company can be divided into three categories, according to how much they are willing to recommend products or services of a company to their friends or family (Reichheld, 2011). The reputation ranking system uses direct questioning, relying on the so-called ultimate question: "How likely is it you would recommend us? ". Asking this question enables companies trace the three fundamental groups of customers, while this system produces pure measuring of organizational performance in terms of customers of the company. As already mentioned, the NPS uses direct questioning, while the process itself can be illustrated by the example of the question above: "How likely is it you would recommend us?". Respondents select answers to this question on a ten-degree scale, with 10 representing extreme willingness to recommend the product, company, or service to their friends and 0 represents an absolute unwillingness to recommend this product further.



Figure 1: Net promoter score; Source: Reichheld (2011)

The scale is divided into three parts, where each part represents one group of customers.

1. 10-9: Promoters: this customer group is loyal and enthusiastic, and will always buy products of a particular company and will report on the quality of this company to their friends.
2. 8-7: Passives: a group of customers, which is satisfied with company's products, but is no longer as much enthusiastic as the previous group, their disadvantage is that they are vulnerable to competitive offers.
3. 6-0: Detractors: they are disgruntled customers, who can damage a brand of a company and there is a possibility that they will spread negative testimonials about products of a given company. (Reichheld, 2011)

2. Objectives and methods

The following chapter includes a transparent description of objectives and methods used in the research.

2.1. Objectives of the analysis

The objective of our analyses presented in this paper is to identify (based on the latest rankings) the main players from among the wide range of e-shops operating in the Slovak market, analyze their reputation by selected methodology called Net Promoter Score (NPS), and then identify key factors for success in terms of customer preferences. Based on our findings recommendations for e-commerce entities with emphasis on preferences of their current as well as potential customers will

be formulated in order to improve competitiveness and increase efficiency of those key players on the Slovak digital market

2.2. Object and methods of research

The object of research are selected e-commerce entities / e-shops operating in the Slovak Internet market. Secondary as well as primary data are included in the analysis. Secondary data come from a reference survey conducted by the well-known Slovak agencies SAEC and Pricemania in 2013. The survey focused on the public knowledge of online shops, rate of their using and the overall purchasing process within the framework of e-commerce. The survey was conducted using CAWI methodology on a sample of $n = 1025$ respondents. Data was collected in May 2013 (SAEC and MediaResearch 2013). The key shops from among electronic commerce businesses have been identified based on the results of a survey Shop 2016, in particular the category "Popularity" in order to ensure comparable and relatively identical quality of e-shops with a wide range of products. The online stores involved were as follows: 1. Mall.sk 2. Alza.sk, 3. PredajParfumov.sk, 4. Hej.sk 5. AndreaShop.sk (Shop of the year 2016). Data also serves as an input for the comparison against the primary data accumulated and tested through questionnaires mapping the current situation and trends in online shopping in Slovakia. Data also outlines the current status of the issue. Primary data have been accumulated on the basis of independent questionnaire survey (qualitative research) on non-random sample of 303 people. Data was gathered using CAWI methodology.

3. Results and discussion

The following chapter describes results of primary research as well as its comparison with respect to a reference research conducted in 2013. In the primary questionnaire querying 303 respondents were interviewed – 30% of men and 70% of women. In terms of age the target group were narrowed to respondents aged between 20-40 years old, which represent more than 90% of all the respondents.

3.1. Net Promoter Score of selected e-commerce entities

As stated above, this reputation ranking system uses direct questioning, relying on the so-called ultimate question: "How likely is it you would recommend us to your friends?" Addressing this question enables companies to trace the three fundamental customer groups: promoters, passive customers detractors.

Ranking acc. to NPS	E-shop	Promoters N / %	Passives N / %	Detractors N / %	Results (NPS) %	Ranking acc. to Shoproku 2016
1.	Alza.sk	69/24.73	64/21.86	146/53.41	-28.68	2.
2.	Mall.sk	49/17.56	63/22.58	167/59.86	-42.3	1.
3.	Hej.sk	54/19.35	51/18.28	174/62.37	-43.02	4.
4.	Predajparfumov.sk	30/10.75	43/15.41	206/73.84	-63.09	3.
5.	Andreashop.sk	19/6.81	29/10.39	231/82.80	-75.99	5.

Figure 2: Net Promoter Score of selected e-shops; Source: our own processing according to Reichheld (2011)

We learn from the literature that the NPS of an average company should be between 5-10 percent. This means that promoters of the company barely outnumber detractors. We can argue that many companies and even whole sectors of business have a significantly greater number of detractors than promoters. Even companies like Amazon are within the range of 50 to 80 percent, which means that even such large companies still have room for improving relations with their customers (Reichheld 2011). However, an interesting phenomenon can be seen on the researched market: not one of four finalists in "Popularity award," category of Shop of the year 2016 competition has positive NPS. The greatest number of fans had the online store Alza.sk with a stable reputation on the Slovak electronic commerce market. Alza.sk is not an unknown concept to Slovak consumers and therefore it achieved the most favorable values from the Net Promoter Score. Alza.sk had the lowest number of critics, which is ultimately reflected in its positive score. Based on the NPS percentages values Alza.sk is followed by the e-shop Mall.sk, which, however, was not second in the terms of its fans and supporters but had significantly lower number of critics than Hej.sk – the online store that landed in the third place. Fourth in the list is the online store Predajparfumov.sk. The fifth place belongs to Andreashop.sk due to the huge amount of critics and a low share of supporters.

Our aim was to verify whether there is a positive linear correlation dependence between customers' willingness to recommend a particular online store and his/ her trust towards the given online store. The following figure shows the results of the correlation and regression analysis. As demonstrated on the basis of statistical calculations, there is a very strong positive linear correlation dependence between these variables.

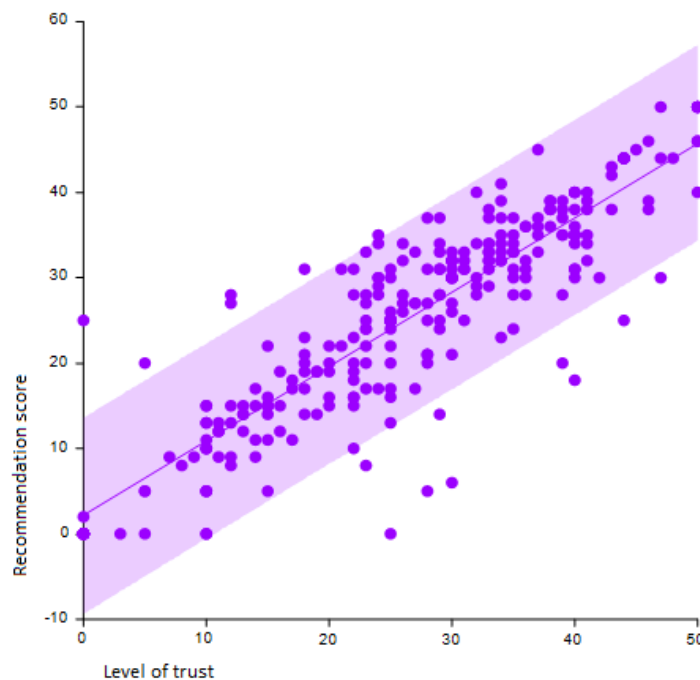


Figure 3: Regression line; Source: our own processing

Individual points of the figure are placed closely together, and also the slope of the regression line is very sharp, indicating strong correlation dependence of variables.

3.2. Key success factors of selected e-commerce entities

Based on the survey of 2013 we analyzed key determinants as price, certificates, reviews and position in search engines. The research showed that the level of importance given to those factors has changed throughout the selected years.

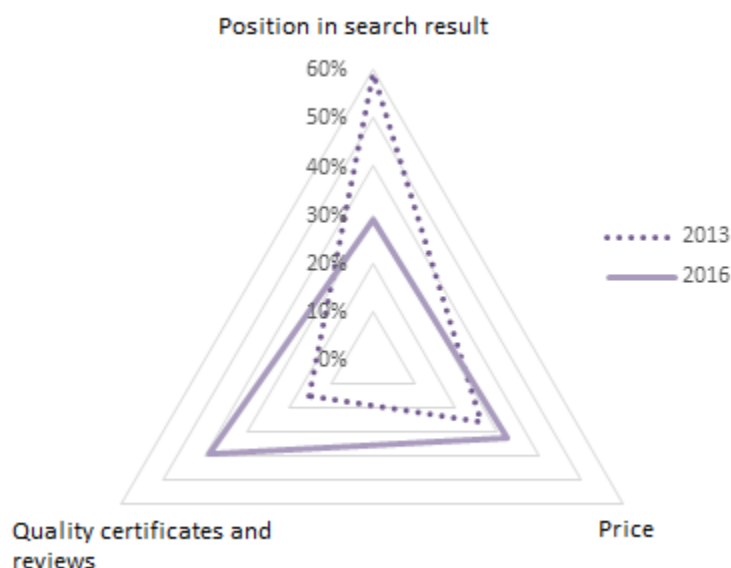


Figure 4: Key success factors; Source: our own processing

Consumers now have a stronger tendency to focus on the fair price of products and whether the e-shops and their products have quality certificates and positive references given by other satisfied customers – the fact that was ultimately confirmed in the question aimed to describe the five most important factors related to trust-building within e-commerce in Slovakia. Based on the responses it is possible to create a list of top 5 factors with the highest levels of perceived importance with regard to establishing and keeping consumers' trust on the electronic market. The first place, with the highest emphasis on trust-building, belongs to reputation of an online store followed by a reasonable price of goods and services. Important role is also played by certificates of quality followed by the feeling of security in connection with the provision of personal data. The fifth place belongs to the presence of well-known and proven brand products on the website. This means that customers put increasing importance on objective indicators of quality over quantity in the form of the first positions in the search results. On the basis of these findings we would definitely recommend e-commerce entities operating on the selected market to focus on actions that support positive reputation building, bearing in mind the factors mentioned above. The following figure shows a shift in customers' perception of the importance of the key success factors in the conducted case study.

4. Conclusion

The paper presents partial results of a comprehensive research of online reputation of selected e-commerce entities operating predominantly in Central European market. More specifically it deals with the issue of online reputation of the main players from among the wide range of e-shops operating in the Slovak market, analyze their reputation by selected methodology called Net Promoter Score (NPS), and then identify key factors for success in terms of customer preferences.

Based on our findings recommendations for e-commerce entities with emphasis on preferences of their current as well as potential customers were formulated in order to improve competitiveness and increase efficiency of those key players on the Slovak digital market.

Finally, it should be noted that shopping via the Internet is highly preferred form of shopping on the global level and online stores attract more and more customers while bringing them countless benefits. This worldwide trend is confirmed by the development of online shopping in Slovakia and its growing potential can be seen especially in the recent years. Online shopping is highly preferred among selected customer groups. The frequency of online shopping is continually increasing and consumers are buying more and more. This situation was also confirmed by the conducted research which compared the values from 2013 with the present survey. On-year comparison of results also revealed that the perception of the importance of factors affecting the level of the perceived trust towards online stores changes over time. When compared to the results from 2013, consumers now see the price of products, quality certificates "Verified by Customer" and good reviews from consumers based on previous experience to be the most important factors when buying stuff on-line. Generally, the reputation of an on-line store is among the top five important factors in relation to trust-building and keeping consumers' trust in electronic commerce. Other factors may include fair prices of goods and services, quality certificates, safety of personal data as well as the presence of well-known products.

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CONCEPTUAL DESIGN OF ONLINE DISPUTE RESOLUTION IN B2B RELATIONSHIPS

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Keywords

Online dispute resolution, Conceptual design, B2B relationships, Genetic algorithm

Abstract

B2B electronic markets represent for companies a huge number of potential partners in e-procurement. It brings great possibilities to the modern commercial world, but also disputes from these relationships. Online dispute resolution (ODR) not only settles disputes but also builds trust among participants. Developing a successful ODR process has become multi-disciplinary, so the application of artificial intelligence in the legal field (AI & Law) is also used for ODR. Using genetic algorithm for disputes from B2B relationships would be useful, but its application is still missing in this area. Therefore, the aim of this paper is to design of ODR process using this approach in B2B relationships. Presented conceptual design consists of a procedure, in which is used a genetic algorithm for selection of the most appropriate resolution to the dispute from the perspective of both parties.

1. Introduction

The globalization of economic activities means a process in which these activities are organized on a global level due to increasing interaction and integration of different entities regarding business investments and international trade. This phenomenon also causes expansion of the Internet into more regions. Companies use the Internet-based services as a channel of communication in their favor to trade among themselves. The mutual interactive connection of communicating parties also brings benefits in terms of providing important information needed for effective business, even in real time (Tolga Saruc, Dorčák, & Pollák, 2013). Each action has a wider audience and consequentially more influence even from foreign places (Otieno, & Biko, 2015). B2B electronic

markets represent for companies a huge number of potential partners in the electronic procurement (e-procurement) where reputation is one of the most important parts of the image of a company (Dorčák, Pollák, & Szabo, 2014). It brings great possibilities to the modern commercial world because it breaks traditional territorial barriers and enables companies to access the global market with incredibly low costs. By using Internet technology, many companies have been able to reduce costs of processing transactions and achieve cost efficiencies with the help of establishing direct contact between buyers and sellers (Kumar, & Sareen, 2011). One of the crucial business success factors in new global and more transparent economy is cooperation and collaboration in the whole business value chain (Delina, 2014).

In relationships arise from time to time conflicts. B2B relationships are no exception. Moreover, there will be more disputes both domestic and international (Saraf, & Kazi, 2013). Traditional courts are not always the best option for resolving disputes, particularly when disputes arise from e-commerce (Cortés, 2011). They are slow, expensive, and difficult to deal with (Tang, 2007), so other ways of dispute resolution have been searched. One possibility suitable for online transactions is online dispute resolution (ODR). It provides the ability for two or more parties to settle their dispute via electronic channels, such as the Internet. Katsh (2007) claimed that ODR process has a dual role - settling disputes and also building trust. Trust plays a key role in e-procurement. Rule (2003) pointed out that B2B transactions may even be a better fit for the full range of ODR services than B2C or C2C e-commerce due to their higher value and savvy participants.

Lodder & Zeleznikow (2005) said that ODR moves alternative dispute resolution (ADR) from a physical to a virtual place and mainly consists of ADR processes. Therefore, these mechanisms are not substantially different from their traditional counterparts (Tang, 2007), but they provide more effective and swift services which are assisted by the speed and convenience of ICT, which is eminently suited to the needs of e-commerce (Cortés, 2011). Based on this definition of ODR, Xu, & Yuan (2009) distinguished four main types of ODR systems: automated negotiation, assisted negotiation, mediation, and arbitration. The difference between automated and assisted negotiation is associated with the fact that disputes can result from different aspects of the contract. Automated negotiation is often based on a system of blind bidding, whereby a computer system automatically generates a settlement when secret bids come within a pre-agreed range of each other (OECD, 2004). For instance, they say they will settle if their offers are within 30%, 10%, or even 5% of each other. This process is simple and efficient, but it is limited to disputes where liability is undisputed and the only issue is to determine the amount to be paid (Kaufmann-Kohler, 2005). For these reasons, assisted negotiation was created. It is a negotiation between two parties with the assistance of a computer. The ODR provider does not have the capacity to decide but provides software for setting up the communication, assistance in developing agendas, engaging in productive discussions, identifying and assessing potential solution, and writing agreements (Schultz et al., 2001). Mediation is a process whereby a neutral third party accepted by both disputants facilitates negotiations between the disputing parties to help them find an agreement. A mediator helps parties to discuss issues and fosters mutual understanding of the underlying interests (Kressel, 2006), so mediation is sometimes referred to as an interest-based procedure. The right-based procedure is arbitration which involves a neutral third party – an arbitrator – who gathers information from the parties and makes a decision based on the appropriate legal rules (OECD, 2004). In fact, the computer software seems to become a neutral third party who drives the parties' strategies (Gabuthy, 2004) as an electronic mediator or arbitrator.

Researchers use different approaches to study this area. The game and economic approach focus on the interdependency and the payoff matrix of the negotiators while behavioral theory takes into consideration the influences of expectations, perceptions, and behaviors (Bahrammirzaee, Chohra, & Madani, 2013). Their adoption in the real world is difficult, and therefore, researchers seek help

from a heuristic approach of artificial intelligence (AI) to solve complex problems. Application of AI in the legal field is known as AI & Law. The goal of AI research in the area of ODR is to attain a technological threshold, resulting in computational systems that are indeed the third party (Carneiro et al., 2014). These authors characterized different technologies (decision support systems, experts systems, knowledge-based systems, intelligent interfaces, legal ontologies, rule-based systems, case-based reasoning, and multi-agent systems) from the conflict resolution point of view. Genetic algorithm is the AI tool for settlement oriented systems which generally deal with negotiation support (Ilter, & Dikbas, 2009). Carneiro, Novais, & Neves (2013) used it for dispute resolution and their model was verified through an experiment involving four negotiation scenarios with four students arguing about four issues. They supposed the model of distributive negotiation, in which a group of resources must be divided (e.g. divorces, winding up of a company), so three issues were associated with indivisible goods and only one had monetary character.

Using genetic algorithm for disputes from B2B relationships would be useful, but its application is still missing in this area. Advantages of using genetic algorithm are particularly the following: resolution is found in large state space in a reasonable time, genetic algorithm is domain-independent and the solutions cover virtually all the search space – see also (Carneiro, Novais, & Neves, 2013). For these reasons, using of genetic algorithm is more convenient than simpler rankings or comparison methods. Therefore, the aim of this paper is to design of ODR process using this approach in B2B relationships.

2. Methodology

In the following section is introduced our own conceptual design of ODR process using genetic algorithm in B2B relationships, thus ideologically-conceived proposal representing a principled process. From a methodological point of view, design science research (DSR) approach is applied. First, according to the DSR is necessary to identify the problem (Peffer et al., 2007), which relates to the identified needs of stakeholders. This is carried out through literature search of relevant sources, defining the problem related to the global B2B trading and the need to resolve potential disputes. In the field of ADR the issue is not sufficiently covered by already created artefacts for ODR process.

In terms of conceptual design of new artefact according to (Peffer et al., 2007), we are interested in the first three phases: problem identification, goals of solution and design; or the first two phases according to (Vaishnavi, & Kuechler, 2015): awareness of the problem and suggestion for or solution of the design. This is the reason why in this paper are not resolved next phases as development, demonstration, evaluation and communication (Peffer et al., 2007); respectively development, evaluation and conclusion (Vaishnavi, & Kuechler, 2015). In the section below are first presented assumptions associated with the conceptual design and related to goals of solution. This is followed by description of the conceptual design, in which genetic algorithm is used to select the optimal solution.

3. Design of ODR process using a genetic algorithm

The introduced design of process is based on three assumptions. The first is that both parties want to resolve the dispute constructively. The second assumption is that it is only bilateral negotiations between Seller and Buyer (business customer). The last assumption is that it is a portfolio of products (more than 2 species) or several contracts, which are negotiated simultaneously.

The proposal artefact has also set the rules affecting both parties. The first is that Buyer determines the maximum time for negotiations, because it is assumed that he must respect obligations to other partners. One iteration of negotiating is fixed to three days. The second implicit rule is that in the 4th phase genetic algorithm favors valuation of Seller, since it is assumed that he will have lower profits from the whole contract in case of dispute resolution (Buyer satisfaction).

On these bases can be implemented a web application accessible from anywhere in the world using the steps below. The aim of such application is to support the negotiation process and enable early resolution of the dispute. The negotiation procedure consists of five phases and is presented in Fig. 1.

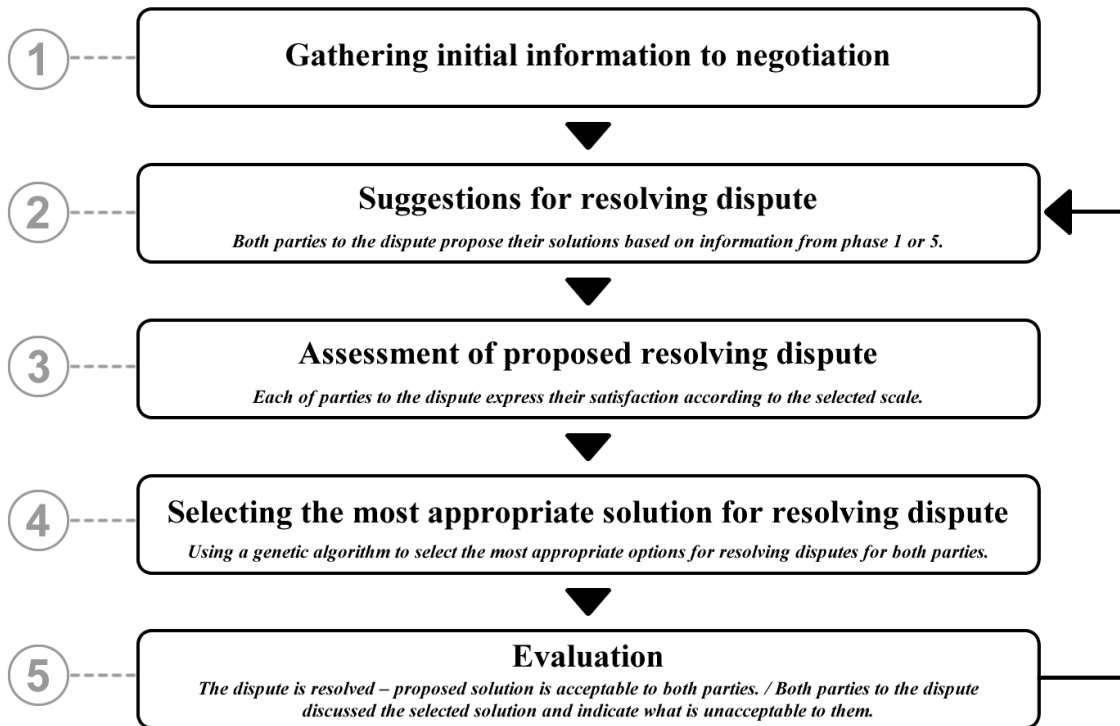


Figure 1: Negotiation process with genetic algorithm involved in the Phase 4. Source: Authors.

Gathering initial information to negotiation (Phase 1)

Each of the parties fill a short questionnaire to clearly define their positions. After filling the results will be made available to both parties, while it will constitute the basis for proposals to resolve the dispute as well as for evaluation of individual proposals (see Phases 2 and 3).

The Buyer answers the following questions for each type of goods (or disputed contract):

- What quantity of goods delivered is defective? – indicates the number of pieces or percentage
- What is the price of defective goods according to the agreement with the Seller? – indicates the price in Euro
- What is the estimated loss for the Buyer caused by defective goods? – indicates the amount in Euros (It can be the case when the Buyer has signed a contract with a wholesaler to a certain number of pieces. If the Buyer will not deliver goods, so the contract will be cancelled and the damage can therefore exceed the purchase price of goods.)

- When the Buyer needs to replace (deliver) the defective goods? – indicates the number of days
- How many days can be devoted to negotiations? – indicates the number of days (one iteration of negotiating is fixed to three days)

Based on Buyer's responses, the Seller answers following questions for each type of goods (or disputed contract):

- When can the Seller deliver the number of (missing) goods? – indicates the number of days (in the case of production is too difficult and not profitable, he indicates N)
- What substituents for the goods is ready to deliver? – indicates a text description of the goods (if the goods cannot be substituted, he indicates N)
- Until what time can deliver a given number of substituents? – indicates the number of days (or N)

When both parties have answered their questions, the results will be made available to both parties of the dispute. Based on this information, they can go to the second phase.

Suggestions for resolving dispute (Phase 2)

Each of the parties proposes its own solution which would prefer for each good. For each product, different number of solution variants can exist - e.g. in case of Product A, the Buyer states three and the Seller two variants that solve the problem (the number of variants of the problem solution may be arbitrary for Seller and Buyer).

Assessment of proposed resolving dispute (Phase 3)

After completion of the proposed variants of solution, all the proposed options are presented to both parties. Each of both parties evaluates the variants on a scale from 0 to 10, while 10 is the most suitable solution. The implicit assumption of this phase is that both parties really want to mutually negotiate. However, in the case of speculative behavior of one party, it is very probable that there will be no agreement, because the final result must be confirmed by both parties.

Selecting the most appropriate solution for resolving dispute (Phase 4)

Based on the assessment of individual variants (by Seller and Buyer), the genetic algorithm selects the best solution based on the following criteria: Both variants of solution must be similarly good or bad for both sides, except the Seller for whom the whole solution could be slightly more acceptable. For example, if the Seller rates the variant by 6 and the Buyer by 5, such variant is more appropriate than the possibility that both rate the variant by 5. Selecting the best solution is made by multiple running of genetic algorithm. The result that will fulfil the criterial function (or will be very close) is declared as the best solution and chosen for the next phase.

Evaluation (Phase 5)

In this phase, each of the parties expresses its opinion of the selected solution as a whole – what is convenient for them and what is still questionable. This information is then shown to both parties. After becoming familiar with the opinions of counterparty, three options can occur: success or failure of resolving the dispute, or the continuation of the negotiations. If the solution is satisfactory for the Buyer, the dispute is resolved. If there is no satisfactory solution, they can continue with the negotiation in the next iteration of Phase 2. In case of continuing the negotiation by further iteration, the selected solution from Phase 4 moves to the next iteration (which starts by Phase 2), where it is supplemented by other variants of solution for the individual items.

The number of iterations is restricted by the Buyer, and after they are depleted, the negotiation is ended. After the third iteration, both parties will have to evaluate their commitment to continue the negotiation on a scale from 1 to 5, where 5 is the big commitment to continue. If both parties indicate 2 or less, so the negotiation is finished and it is necessary to proceed to other options to resolve the dispute.

4. Discussion and conclusion

Until now, there has been little research on ODR process in B2B relationships. The studies in the area of ODR mainly focused on monetary aspect – negotiation the price of one disputed item. Researchers obtained results of this type of negotiation between buyer and seller through experiments (Gabuthy et al., 2008; Johnson et al., 2009; Johnson & Cooper, 2009) with a different type of analyzable negotiation task (Doong, Wang, & Hsieh, 2009). There are also observed purchasing negotiations with three negotiated issues, each of which had four fixed options with different fixed utilities (Lai et al., 2010) or with a computer as a buyer due to a possibility of manipulation (Van Kleef, & Dreu, 2010). The goal of this paper is to design ODR process for disputes relating to the portfolio of products that have been negotiating at the same time, each participant may submit its own proposals, which are then assessed by parties. The main contribution of this study is using a genetic algorithm to select the optimal solution in the negotiation process. The potential of this approach is presented also by Carneiro, Novais, & Neves (2013), but its application in B2B relationships is missing.

The presented conceptual design has the advantage that both parties are going over the entire portfolio of goods and enable to offer complex (and creative) solution, instead of the previous approaches that address every dispute (about one product or contract) separately. The limit of this proposal is that it does not go beyond negotiation process – it is not described in detail what would happen after unsuccessful or successful resolution of the dispute. It can be expected that in case of the parties cannot agree on resolution, this approach should be followed by an alternative approach. In case of failure, the alternative approach would offer a different procedure, using different logic (e.g. based on game theory) towards an agreement.

In this paper we only propose ODR process, therefore, one avenue for further study would be its implementation. As it is usual in ODR research, its verification would be realized through an experiment in which the success of this process may be measured in amicable resolution rates and participants satisfaction as for other ODR programs (Rule & Friedberg, 2005).

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SESSION H: CYBER SECURITY

CYBER SECURITY

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Cyber security, automating security, security configuration, security model metaphor

Abstract

Many incidents in the last years, and their increasing prevalence and damage, showed that cyber security is important. One big problem, which is expected to increase even more in the future, is the large-scale deployment of devices with very little security or a wide default security configuration. Automatization of such configuration is therefore necessary. This paper proposes a security model based on the household metaphor, where every device is assigned a role similar to a person in a household. Default permissions are then assigned to these roles by the manufacturer. In this way configuration of new devices is reduced to assigning it an “owner” it may represent towards other devices. While this is definitely not high security, it allows introducing some restrictions to an area where currently the options are either no security at all, or extensive and complicated manual configuration of each element, which is additionally difficult to understand for end-users.

1. Introduction

Cyber security consists of as many facets as ICT features in today’s world: wherever there is a computer, at least some aspect of security is needed. At the minimum it must be decided that no explicit security is needed and the remaining risks are either accepted or have been mitigated by external means (e.g. keeping the equipment in a locked room³). And while for many systems security is complex and needs professional maintenance (e.g. securing access to the IT parts of a factory workflow; including the communication with storage, work planning, sales etc, or for hospital systems⁴), for others this cannot be expected. An example is a smart home. Many people will “build” it themselves, or even when installed by a professional, might want to implement a few changes themselves or extend it by new devices, like adding a new/replacement electronic door lock, additional smoke sensors, integrating media playback devices and so on. As a result, it can definitely be assumed that these persons are (1) mostly not security professionals, (2) will not pay for restricting access and rendering things “difficult”, when everything is already working, and (3)

³ Note that with the large variety of communication methods, both wired and wireless, this is much less secure than most people would expect.

⁴ See <http://www.heise.de/newsticker/meldung/Ransomware-Neben-deutschen-Krankenhaeusern-auch-US-Klinik-von-Virus-lahmgelegt-3103733.html> (16.2.2016) for two examples, where hospitals had to be practically closed down because of IT security incidents. While no humans seem to have been hurt in these cases, this could differ in the future.

are probably unwilling to take out a special insurance against damages to third persons (or other IT systems they own) caused by their smart home installation.

Therefore cyber security must evolve from an add-on performed by specialists, like anti-virus or firewall software separately installed and maintained by specialists, to an integral part of every device, configured automatically. This is especially important as most publications in this area focus on security from a technical point of view, like Changmin/Zappaterra/Kwanghee/Hyeong-Ah (2014) do: transmission protocols, operating systems, resource constraints etc. While these are necessary for implementing security features, the view on the end user and how they use and maintain these systems is often neglected.

2. Automating security configuration

Security consists of two fundamental issues: identifying (authentication) the entity (user, device etc) and based on this deciding the permissions the entity receives (authorization). This can be arbitrarily complex, e.g. changing over time (access only between 9 and 17, Monday-Friday; only as long as she is an employee; ...), depending on location (access by mobile phone only from within the same country) or differing for various elements (access to folder A is granted, but file X within it can only be read not written).

An example for automating security is the SECURE project (Seigneur/Jensen/Farrell/Gray/Chen 2003), which addresses a similar approach as here, but on the technical level: how can trust be built up towards humans as well as other devices. But their approach seems to be hard to understand for everyone except specialists⁵.

If security configuration should become (more) automatic, both identification and authorization need to be performed without human intervention – ideally both initially and on each access.

2.1. Automatic identification

Identifying humans automatically is problematic, but can e.g. be improved through the context (Covington/Fogla/Zhiyuan/Ahamad 2002) or longer investigation coupled with probabilities (Al-Muhtadi/Ranganathan/Campbell/Mickunas 2003). Technically it is difficult and there are social implications to consider, as automatic identification allows tracing persons, resulting in intense surveillance. This became possible recently in some (potentially extendable) contexts, e.g.:

- Facial recognition (Findling/Mayrhofer 2012): Smart homes may contain cameras for various purposes, ranging from game devices (e.g. Kinect) to security cameras. While their task is typically not to identify persons, this can take place beside their main function. Differently than in explicit identification (“look into the camera”) this is much harder to fake, as the face will be continuously monitored and seen from many angles.
- Gait verification (Muaaz/Mayrhofer 2015): Devices worn on the body (e.g. watch, mobile phone) can verify the identity of the person carrying them through observing their gait. This does not produce an immediate result but requires longer observation. These devices, if known to the smart-home, can then vouch for the identity of their carrier. In this way (not necessarily through the gait, but also any other identification mechanisms) even devices

⁵ See e.g. their example: a friend may enter the house (he has a key), but only after telephoning with the owner and watching TV for some time the kitchen door has built up enough trust to let him enter to fetch something to drink. If he already has a house key, access to food and drinks might be seen by many as not that dangerous any more.

without any user interface but still possessing sensors and communication capabilities can identify humans handling them⁶.

- Fingerprint sensors: Devices might seamlessly incorporate sensors. E.g. light switches, which are currently very “dumb”, possess a unique property: humans will often touch them with their fingers. If their activation surface (in whatever geometry) is covered with a sensor, it might be able to capture a fingerprint and thereby identify the user. This can then be passed on to other devices or simply be used to check the permissions for activating the connected device.
- Wearing an RFID badge (Want/Hopper/Falcao/Gibbons 1992): Apart from privacy issues (ensuring that nobody else can read it), this is cumbersome and might remind some users of dog tags or chipping of pets. Still this is of use e.g. when such tokens are used to unlock doors or perform other high-security functions.

Some of them are not (yet) reliable enough as a single source of identification, but at least are sufficient for verification, i.e. when an identity has been assumed, they can verify whether this is likely correct or not. Depending on the mode of interaction, some signalling to humans should be envisaged. For example video surveillance typically requires “warning” signs to be present. Similar notices could be used for areas where identification takes place. For devices, e.g. when extrapolating the fingerprint sensors to the whole surface of a device⁷ (see also the light switch example above), colours or “stickers” (real or virtual, e.g. a symbol on the lock screen) are a possibility. Then humans would know that touching (entering the area...) would entail identification, or at least recognition.

A significant drawback of such automatic identification is, that it will typically be based on biometrics, sharing its problems (like unmodifiability – except for major surgery your face will stay the same, as your fingerprints or your gait). Other means of identification are not useful here: knowledge (like passwords) cannot be “extracted” automatically, so identification cannot work without explicit interaction (and be it only speaking a password). “Possession” is problematic too, as there not the person is identified but only the device (and we would have to assume that a specific person is the person owning/carrying/... it).

However the latter is still important, as in security humans are not the only actors. Devices might not only be passive recipients, deciding upon access rights, they might request data or issue commands themselves, requiring their identification too. For them the same options exist as for humans: knowledge of some data in the form of a secret/private key is currently the most common variant. But it is also the easiest to steal, i.e. transplant to another device. Possession would be recursive, so it is of little use too. “Being”, i.e. biometrics, is not currently available commercially, although not impossible. Small imperfections in the production process can be used to uniquely identify a specific chip (see e.g. Dey et al 2014 for the identification of accelerometer chips). The problem lies in how to extract this information and how to “prove” it, i.e. the devices not merely “telling” about them, which could easily be faked⁸. A combination of “being” and “knowing” are security modules: data is stored in a way so it can’t be extracted from a physical storage. For automating security this is therefore currently the most promising approach regarding device

⁶ A notion of “closeness” is required in addition, or otherwise exact localization would be required.

⁷ E.g. when the whole surface of a smartphone (or at least the screen) acts as a fingerprint sensor, so touching it in any way or manner allows identification.

⁸ Similar to “life” checks for fingerprints, scanning e.g. for pulsating blood to rule out simple rubber replicas.

identification. They however only solve the identification part, not the “automation” element. Still, one shortcoming remains: while devices in this way can prove their identity, they can trivially assume a new identity⁹ or pretend to be someone else. For a human this is not that easily possible. They might subvert the identification scheme (e.g. wearing a false beard and glasses), but would then generally not appear as someone else (a “new” person which would pass biometric enrolment as a different persona).

As a consequence, when automating security two main problem vectors exist. For humans the case of “identification/verification not possible” (we know for certain someone is present, just not who), and for devices the issue of “arbitrary new identity”. I.e. systems must specifically cope with non-identifiable entities as well as entities that can be identified, but are unknown. If these are attackers or just third parties, no real problem occurs through just excluding/denying them access. But if they actually should be permitted access, or are just not yet known and should be accepted in the future, explicit identification is necessary. This requires a user interface and signalling, which is trivial for e.g. computers, but is problematic for small devices, like the IoT.

2.2. Automatic assignment of permissions

Identification and assignment of permissions are opposites regarding the difficulty of their technical implementation: while identification is hard, permissions are assigned easily. Making decisions is however mostly simple for identification (the person is identified or she is not; some systems might attach a probability and devices can then set a threshold), but difficult for assignments: who should be allowed what, when, in which circumstances? Therefore the latter is a problem of metaphors or organization and subsequent customization by somebody installing it - which can be the end user or someone else, like a professional.

Automatically deciding who receives what permissions would be extremely difficult for the device itself at its installation: it resembles a newborn baby and has no knowledge of the world around it. Therefore this context has to be provided somehow, before even an attempt of assigning permissions becomes possible. Learning is not very useful here, as this might require a long time. Still in some aspects this is a good approach, e.g. to learn about all other devices in the “vicinity” (not necessarily spatial!) and the humans typically around. But this covers only the identity part, i.e. who should receive permissions. Similar to intrusion detections systems however the history could be employed as a prediction of the future: all “uncommon” requests would be denied and only actions performed repeatedly in the past are granted. This assumes a steady state with no large modifications (new persons/devices, changed habits/tasks). Another approach to obtain contextual information is asking other devices. These would need to be explicitly named to prevent trivial attacks. Typical solutions are central servers with extensive knowledge (which has to be accumulated there somehow before and needs to be specifically adapted for the new device!) or similar devices (making a copy of permissions: “one more tablet”). While “central” mostly means “for a single household”, this is not necessarily the case, as e.g. Li/Lu/Liang/Shen (2011) propose a system with a central server for a neighbourhood or small community. From a security point of view such shared systems open up problems, as clear separation is much more difficult, and may cause privacy issues.

If no source of ready-made permission lists exists, a default fall-back is needed. Very often this is “everybody can do everything”, with the following implied assumptions:

⁹ By simply generating a new key and using this instead of the previous/“real” one.

- Everything has to work or customers will complain: While understandably, this is the worst security approach possible.
- Customers should configure it: They will typically lack not only the knowledge to do this, but also any incentive to actually do it and often even the knowledge that something exists which should be configured.
- Experts will do it later: This is only true for very dedicated individuals and security-conscious companies. Even then the initial state is insecure.

A slight improvement of this can be seen from WLAN router configurations: they are intended for end-users, but over time they changed from “everything is open; identical master passwords everywhere” to “mandatory installation wizard which requires a minimum of individualization” and “individual password for each device or mandatory password change on individualization”. As this simple procedure took many years, assigning smart home device permissions cannot be expected in the near future.

3. The household metaphor

Smart homes are an environment where currently security is at a low level, as in most consumer areas. Therefore this was selected as an example. As Saizmaa/Hee-Cheol (2008) argue, smart homes need a focus on Human Computer Interaction, with the three predominant areas of usability, acceptability and the influence on humans. While usability is typically seen regarding the interaction with devices during their usage, the focus lies here on the (limited) interaction regarding security configuration. Acceptability (along with attitude, trust etc) requires using a metaphor which is easily understood: Which normal (=non IT/security specialist) person understands role-based access control? In contrast the metaphor “this device is similar to a guest” is much easier to comprehend.

Because of the problems described a new approach is suggested: pre-configuration of security according to the household metaphor. This is not completely new as similar roles were already suggested by Covington/Moyer/Ahamad (2000). However, they envisaged manual configuration of all elements (which seems unrealistic) and focus on probabilistic identification. Additionally they only support human roles, while devices exist to identify them – no interaction solely between devices is present. Still this could serve as the technological basis. Technically it is an instance of role-based access control, as persons are assigned (potentially multiple) roles, and roles are connected to permissions. Groups are not strictly defined according to technical possibilities or requirements, but rather coarse and from the human point of view, i.e. roles. For instance a specific person is not a member of the group “visitors”, but he/she “is” a visitor – and probably later a guest staying overnight, a family member etc. A similar approach is taken with devices; they are seen as “extensions” of a single/several person(s) and “inherit” their permissions from them. From this follows, than “unpersonal” or “shared” devices are difficult to fit in. But not very many permission options exist for them, as either everyone may use them anyway (like light switches¹⁰), reducing the security needs, or they can be assigned to several roles. Permissions are classified in four main groups: who data is given out to, which roles can be assumed to obtain data, and matching permissions regarding issuing, respectively receiving, commands (see below).

¹⁰ Note that while everyone might give a light switch a command (i.e. “turn on the light”), obtaining data (“when was the light on and who was within the room at that time?”) might be quite a different problem.

This metaphor was selected for several reasons:

1. The household was selected as opposite than e.g. in companies manual configuration of security cannot be expected. Most problematic are therefore those products, which are in private use –typically occurring in the context of a household (which still can vary significantly from a single person in a flat to a large family in a house or other arrangements¹¹).
2. A default configuration might not be very secure, but it is definitely better than no security at all. The counter-argument, that many will then be satisfied with this low level and not strive for a better one is invalid, however. Observation shows that typically no security improvements are performed anyway or only very slowly, even if issues are made very prominent¹².
3. The household metaphor is easily understood by the group most likely to come into contact with it, the end users. This renders it easier to explain why someone may access a resource – or is not allowed to. Customization is easier too, as sorting a person into an arbitrary permission hierarchy is much more complicated than assigning it a household role.
4. Security can be pre-configured: For a device it is typically easy to determine in advance, which role should receive which permissions. This allows producers to configure devices with a full default set of permissions, requiring only an assignment of persons and other devices to these groups. In this way security by design/default becomes possible.

However, not all problems can be solved with this approach. For instance it is difficult to convert this approach to a more secure version – this would entail a significant restructuring, which creates interoperability problems with other devices in the old schema. Additionally security is not very high, as the roles are coarse and therefore permissions have to be assigned generously to prevent switching the system off altogether. An additional potential difficulty is the necessity of standardization: roles should be predefined and interoperable, i.e. the same role should be considered the same (i.e. be marked with the same GUID/identification number/...) even if interpreted by devices from different manufacturers. Otherwise a specific “interface-device” would be required or security must (and will) be turned off in relation to incompatible devices. This is not as unlikely as it seems, because the proposed security model only becomes relevant when there is communication between devices. And if they can successfully communicate at least syntax and semantics of the messages/packets/... must be standardized anyway.

The permissions system is quite simple – so it is easy to understand as well. Four “permissions” exist in this system, in the sense of connecting one or more roles to activities:

- Which roles (humans and devices) may receive data?

¹¹ Even poor areas of the world do own electronic equipment and might possess quite different conceptions of a household than the “western prototype”. These should not be forgotten.

¹² A big retailer chain in Austria sold wireless surveillance cameras last year (pan/tilt + day/night-mode + microphone) cheaply. But they had no security at all, allowing remote access from anywhere without a password, as long as the camera was reachable from the Internet. To ensure ease of use, the camera itself opened a hole in firewalls by UPnP, if possible (by default switched on in most routers). It also allowed (beside all other configuration data) access to the cleartext password of the WLAN the camera was connected to. Updating the security is only possible through end-users manually updating the firmware. <http://futurezone.at/produkte/schwere-luecke-bei-ueberwachungskameras-von-hofer-und-aldi/175.586.501>, <http://derstandard.at/2000029266993/Ueberwachungskameras-von-Aldi-offen-im-Netz-auffindbar>, According to <http://www.heise.de/security/meldung/IP-Kameras-von-Aldi-als-Sicherheits-GAU-3069735.html>, hundreds of cameras (about a third of all that were found) can be accessed without a password.

- Which roles can be represented by devices to obtain data from other devices?
- Which roles (humans and devices) may issue commands?
- Which roles may be represented by devices to issue commands to other devices?

It is useful to note that receiving data and issuing commands is not tied to devices. Both persons and other devices (with their role “inherited” from the owner) are possible here. The other direction however is limited to devices. I.e., an appliance can never “force” a human to give up data through “authority”. It may ask for information or suggest actions, but this is always discretionary.

3.1. The smart home scenario

According to the previous discussions, the smart-home ecosystem is used as an example. For instance a “smart fridge” produces data (the content inside as well as its expiration dates), consumes data (what should be inside based on planned meals, expected presence of family members/guests etc), receives commands (when to switch off and depend on insulation to optimize power consumption), and issues commands (ordering foodstuffs, sounding an “alarm” that something has expired/nears its expiry date).

How should this fridge be classified according to the proposed “household” system? Data production could be modelled as a “family member”, i.e. only persons able to identify as this group can retrieve any data. Consequently vendors cannot successfully query the fridge for its content, they can merely offer things to it and wait for the fridge’s decision. The same applies to guest devices, e.g. mobile phones of visitors. This is easy to comprehend, as typically only family members would be “allowed” (=expected; or otherwise seen as “nosy” or “unfriendly”) to physically open the fridge and rummage through it. Regarding data consumption the fridge can likewise pose as a family member: who is expected to be present in the coming days and what/if special food is planned is data told to family members – and therefore the fridge as well - but no one else¹³. Regarding commands the roles might be slightly different, as e.g. the family is usually not expected to turn off the fridge, so here only the “owner” as well as potentially a “utility provider” receive permissions to issue commands. While the latter is not present as a person, e.g. a smart meter could present itself as the “utility provider” to other devices. If the fridge wants to send commands to other devices, it will have to identify itself as its “owner” or “family”. Here also one weak point of this approach can be seen: although a six year old child is definitely “family” and may investigate the fridge (or even take out things!), ordering in its name is probably not acceptable from the point of view of the store, who wants a single definitive person above the age for concluding a contract, who is then liable for the bill. Similarly, if the same child produces data that 20 kids are going to visit and that lots of ice-cream is therefore urgently needed, this is information the fridge may access (family member!), but should not necessarily use for ordering unless confirmed by an adult.

Already such a “small” security system needs several roles. Still, they can be rather easily understood also by laymen. Also not every system will contain devices/data for all roles.

1. Self/Owner: A specific role for everyone with full access, which is typically the owner of the device or the home. This person always receives full access for everything. Consequently this role should never be delegated to a device (see the “ordering” discussion

¹³ This does not mean that nobody else is allowed to possess this information and at least in some families others may receive this information as well: this is a generalized approach and „exceptions“ would have to be configured manually or approved ad hoc.

above!) – it could do everything. Therefore this is appropriate only for the categories A and C, but not B and D.

2. Partner: Someone you share almost everything with, except perhaps very personal information. Typically this means full access and is therefore similar to “owner”, but it can be used to represent a device as well. For example the “owner” always has full access to all personal diaries, telephone books messages etc, but the partner not. So access might be granted to a shared E-Mail account (e.g. used for ordering supplies or communicating with craftsmen), but not the personal one.
3. Family: Close relatives living together. They may issue lots of commands and can be represented by devices. Not everything is accessible, but they may e.g. issue commands to open the door or request information on the location of other family members.
4. Medical doctor: As a representative of the group who may receive medical data. This is also a good example to show the meaning of the groups: not all members need to be doctors. Rather this is the group whose members may receive all data which we would also typically give to our doctor - who is the “prototype” of these recipients, but not their definition.
5. Craftsmen: These are persons who receive temporary access to the house/flat and may receive technical data in details. Here a limitation of this deliberately simplified system becomes apparent, as every craftsman receives access to all technical data. E.g. for the electrician the load profile during the day might be important, but he can access water/gas/... usage too (or things would get too complicated for users).
6. Utility provider: The biggest distinction to the group of craftsmen is, that utility providers are permanent. Additionally physical access is typically not needed. They might receive wider permission to issue commands, e.g. shutting down devices in emergencies, or more commonly, giving orders to start activities, e.g. when electricity is cheap.
7. Guest: Members of this group have temporary access to the house and may perform several activities, e.g. regarding media devices or other household appliances, but do not get access to any “private” data. So here more “command” access (C) is appropriate than data access (A). Temporary devices might be classified in this group as well.

Other potential groups for different scenarios, but which are not really needed in smart-homes, could be: Friend, Acquaintance, and Work colleague.

3.2. Responsibilities

While the system is not very complex, it still entails quite some classification. It is therefore useful to take a look at who is responsible for which elements. First, data produced by devices has to be classified according to who might receive it (role A). At least in a typical smart-home situation this can be performed by the producer of the device, as these are typically suitable for a single use case known in advance¹⁴. If not, e.g. for a universal “button”, which might be used to switch on the light, open the door, or order arbitrary goods, some configuration is necessary anyway and assigning it a role is then only a small additional step. In reverse, needs for external data (role B) can be assigned to groups by default too. The same applies to commands: Who can issue commands and whom commands can be sent to, is typically predetermined as well. The reason for this is, that recipients/sources are not identified as individual devices (also much too complicated when they need to be replaced),

¹⁴ In contrast to e.g. a „motor controller“, who might end up in all kinds of different machines.

Effectively this means that devices can be completely preconfigured regarding access rights. However, “personalization” remains. This means, that a “family” member may be allowed to access the device, but definitely not any member of any family is acceptable. So while groups are universal, they need to be individualized and the assignment of individuals to groups must be performed too. This cannot be done by the manufacturer, but it could be automated. Especially in a smart-home commonly a central server exists, which could take over this responsibility. When it is installed first, it generates a unique id for each group (technically this could e.g. be a public/private key pair; see below). Through this the “Family” in one house differs from the “Family” in the neighbour house. Upon adding a new device, it retrieves the group assignments from the central server – which need not know anything about the device, just what groups it needs (and if an unknown group is requested, it simply generates a new identification and stores it). Of course custom modification can be introduced easily, e.g. more groups, different permissions for groups etc – so if better security is desired or necessary, the security model is not limited to the coarse default classification – but it guarantees a reasonable first baseline security independent of potentially complex configuration or customization.

Solely the assignment of persons to groups remains for the human user (note that this is not device-specific but applies to the whole smart-home!): he/she must define who is “Family”, “Utility provider” or “Guest”. Most devices will not need to identify human users (and they will have no possibility to do so anyway), only roles. This assignment is important for device configuration too: who “delegates” his/her identity to it. So the utility provider does not prove to the smart meter that he is the utility provider, but e.g. his laptops received appropriate identification by the owner and then presents this data upon initiating electronic communication. For ease of maintenance a central server is useful here again, as such classifications may be temporary, e.g. the “Craftsmen” is member of this group only on a certain day.

3.3. Technical implementation

To enable easy implementation and therefore widespread adoption, the technical solution should be simple to implement. It is similarly desirable to reuse components and existing protocols to improve security. For an implementation of this approach, the following elements are needed:

- Identification of users: As explained above, here a multitude of approaches is possible. The common system of username/password is however not suitable, so innovative solutions and/or new approaches are needed here. As a fall-back, if a device is unable to identify the current user, other more computationally powerful or knowledgeable devices can be questioned regarding the probably identity of the person (e.g. who is currently in the building/recently was somewhere close by etc).
- Identification of devices: This is possible through public/private key pairs. To ensure their identity and belonging to the same household, certificates and a PKI would be needed. But actually a full PKI isn’t really necessary, as no “unknown” devices need to be authenticated. The keys are only there to ensure that the other side of a communication is who he/she/it claims to be. As no “trust” is placed in the identity but only the association “identity – role”, merely a pairing to the central server is necessary, which stores the association “public key” to “roles allowed to be represented”.
- If a central server is assumed, than this may contain a directory of all identities and their roles, both for humans and devices. Whenever a new device is added, it generates a new identity and is manually (or based on its default configuration) assigned one or more roles. If a device communicates, it can be identified through its unique public key – if it is not on

this central list, it is assigned the role “Unknown”, and will typically receive practically no permissions at all. As the assignment of devices/persons to roles changes only very slowly and is mostly not time-critical, even devices with poor communication abilities can obtain a local copy and online checks are unnecessary. The server contains a list of all roles too, and might provide modified access lists for devices, if such have been configured manually.

So every device generates its own key pair, sends the public part to the central server upon “introduction” to the house, and is assigned roles there. This list of “who is what role, and how to verify their identity” is then replicated to all devices or can be queried in real-time. Vice versa the identity of the central server is stored in all devices so they can verify that (signed) updates of the list actually stem from it.

When a device receives a command or data request, this must be signed by the source. Verifying the signature is possible based on the list, which at the same time provides information on the roles assigned to this entity. Using the modified (received from server) or default (built-in) list of permissions access is then granted or denied.

If stronger security is desired, the list can be individually encrypted for each device or an identity check be performed before disclosing it. In this way third parties cannot easily obtain information on who is part of the household, as well as the assignment of permissions. Then they would either have to obtain the data from within a device or infer the permissions through repeated tries or long-term observation.

4. Conclusions

The main advantage of this approach is the ease of understanding, while still providing reasonable security. Through individualization, i.e. the creation of more detailed roles and custom assignment of permissions to roles, security can be increased to a very high level if desired. One drawback is the difficulty of identifying humans: who is standing in front of a device may be very hard or even impossible to ascertain for the device itself. Therefore this approach, while allowing to regulate such human usage, is better suited to the communication between devices – and them being “extensions” of an individual human.

Is the implementation of the system realistic? This question cannot really be answered. While the intention is clearly on standardization and interoperability, it is equally useful for products from a single company, at least if targeting the consumer sector and not commercial use. Technical difficulties should not be too large, at least apart from the basic difficulties of integrating secure communication into devices, which have been in the past extremely simple and contained very little memory and computational capabilities.

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CYBERSECURITY WITHIN CYBERSPACE

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Cyberspace, Information security, Cyber security, ICT, National Security Authority.

Abstract

Introduction of computers in all spheres of life substantially changed the ways of how people communicate and exchange information. It is creating a virtually paperless work environment. Also we can now send a message very easily to anywhere in the world in seconds. Internet and its penetration into the so-called cyberspace puts users at cyber space requirements for information security, ICT security and, finally, cyber security for survival in this cyber space. Most countries in the world developing their own centres dealing with cyber security such as a national security authority, the approach of Czech Republic will be discussed.

1. Introduction and related works

A distinctive growth in usage of information technologies leads on one hand to creation of information society, faster communication and large development of services has impact on the whole society. However, on the other hand, it deepens the dependence of the society on information technologies in all fields. Consequently, the risk of misuse of information technologies that might potentially lead to substantive damages grows significantly.

Cyber security has become a matter of global interest and importance. Already more than 50 nations have officially published some form of strategy document outlining their official approach on cyberspace, cybercrime, and/or cyber security (Klimburg, 2012).

In most literature, cyber security is used as an all-inclusive term for example Solms & Niekerk (2013). Definitions of this term vary, for example the Merriam Webster dictionary defines it as “measures taken to protect a computer or computer system (as on the Internet) against unauthorized access or attack”. The International Telecommunications Union (ITU 2008) defines cyber security as follows:

“Cyber security is the collection of tools, policies, security concepts, security safeguards, guidelines, risk management approaches, actions, training, best practices, assurance and technologies that can be used to protect the cyber environment and organization and user’s assets. Organization and user’s assets include connected computing devices, personnel, infrastructure, applications, services, telecommunications systems, and the totality of transmitted and/or stored information in the cyber environment. Cyber security strives to ensure the attainment maintenance of the security properties of the organization and user’s assets against relevant security risks in the cyber environment.”

Whitman M, & Mattord H., (2009) define information security as “the protection of information and its critical elements, including the systems and hardware that use, store, and transmit that information” So relationship among the terms mentioned above has become a major focus for many scientists.

The paper is organized as follows: on the background of the impact of cyberspace on the nowadays society is focused to information from a security perspective. Next part is dedicated to the rolls of information security, cyber security and ICT security within cyberspace and Czech Republic approach to cyber security. Finally, is described conclusion and future work. The aim of the present paper is to provide readers with insight on the issues associated with cyberspace terms of information security and cyber security, and finally show attitude Czech Republic to solve the problem of national security.

2. Cyberspace

Satti S., & Nour O. M, (2002) argued that over the last two decades, the Internet and more broadly cyberspace has had a tremendous impact on all parts of society Fig.1. Anyone everywhere and at any time can expect attack on everything that is connected with ICT. However, unlike most computer terms, "cyberspace" does not have a standard, objective definition. Instead, it is used to describe the virtual world of computers.

According to Homeland security (2016) “Cyberspace and its underlying infrastructure are vulnerable to a wide range of risk stemming from both physical and cyber threats and hazards. Sophisticated cyber actors and nation-states exploit vulnerabilities to steal information and money and are developing capabilities to disrupt, destroy, or threaten the delivery of essential services. A range of traditional crimes are now being perpetrated through cyberspace. This includes the production and distribution of child pornography and child exploitation conspiracies, banking and financial fraud, intellectual property violations, and other crimes, all of which have substantial human and economic consequences. Cyberspace is particularly difficult to secure due to a number of factors: the ability of malicious actors to operate from anywhere in the world, the linkages between cyberspace and physical systems, and the difficulty of reducing vulnerabilities and consequences in complex cyber networks. Of growing concern is the cyber threat to critical infrastructure, which is increasingly subject to sophisticated cyber intrusions that pose new risks. As information technology becomes increasingly integrated with physical infrastructure operations, there is increased risk for wide scale or high-consequence events that could cause harm or disrupt services upon which our economy depends. In light of the risk and potential consequences of cyber events, strengthening the security and resilience of cyberspace has become an important homeland security mission.” The word "cyberspace" is credited to William Gibson, who used it in his book, *Neuromancer*, written in 1984. Gibson (1989) defines cyberspace as "a consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts. A graphical representation of data abstracted from the banks of every

computer in the human system, unthinkable complexity, lines of light ranged in the non-space of the mind, clusters and constellations of data".

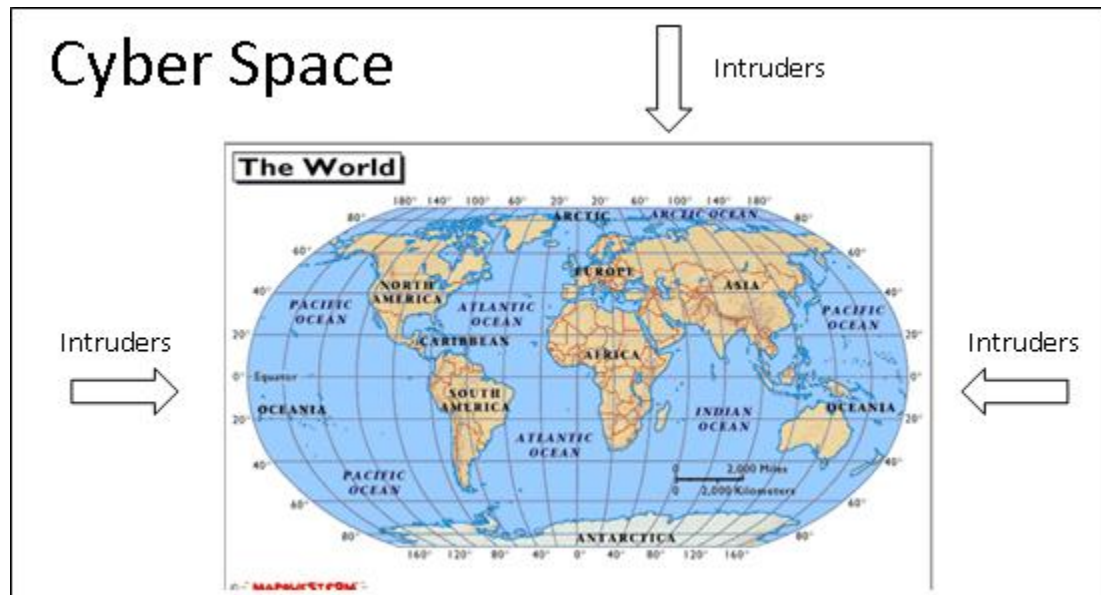


Figure 1: Cyberspace and its tremendous impact on all parts of nowadays society. (Source authors)

3. Information – cyber security

Information from a security perspective Capek (2014), Crawford S., & Piesse D., (2014), basically consist of the three main characteristics (i.e. Security triad Fig.2) - availability, confidentiality and integrity. Information is available when "is accessible to authorized users at the time of her/his needs." Integrity means "to ensure the correctness and completeness of the information" - information is therefore recipients with accurate and reliable, and prevent them from unauthorized modification. Confidentiality is seen as "ensuring that information is accessible or communicated only to those who are authorized to do so." It can thus be understood as the ability to prevent its misuse by someone who has not been determined. Information security and its management (according to Doucek, et al (2008), Drtil (2004), Kostihá, (2006), and KYBEZ (2015)) devote a series of standards. Although most of them contain a number of different characteristics, according to this assesses the level of information security. Standard can also be understood as a set of experiences and good practices adopted by the wider professional community for that particular area of human activity.

Standards for information security are focused on information security management systems, often referred to as the ISMS (Information Safety Management System) Drtil (2004). The main direction in the body of information security is a series of ISO (International Organization for Standardization), namely ISO 27000 family.

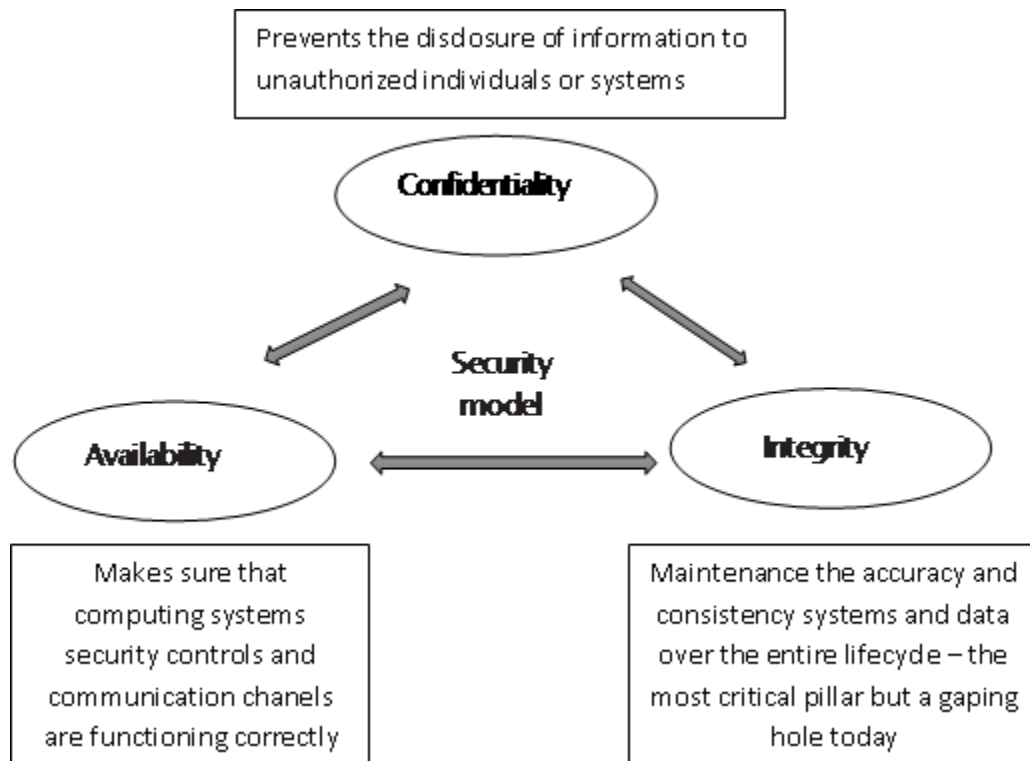


Figure 2: Security triad (Modified according Crawford S., & Piesse D., 2014)

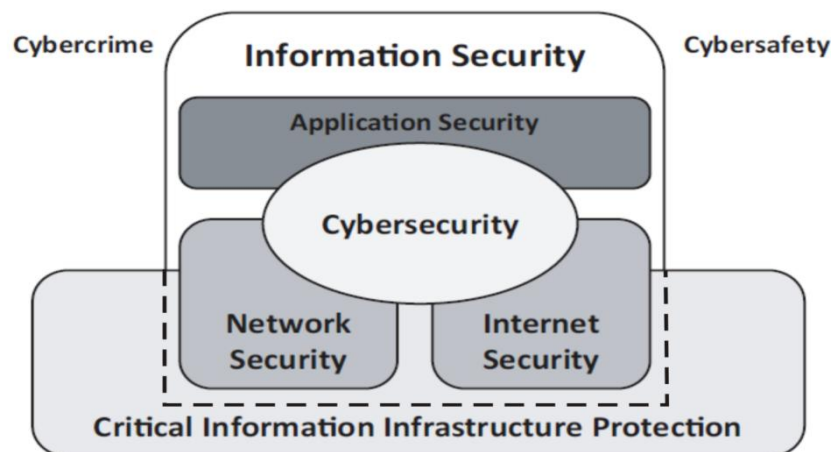


Figure 3: Relationship between Cyber Security and other Security Domains (Adapted according ISO/IEC 27032:2012)

The Figure 3 was modified by Klimburg A., (2012) in that instead of Application Security he used term ICT security due to the fact that it is the set of products, services, organization rules and individual behaviours that protect the ICT system of a company. Klimburg A. (2012) describe some terms within Figure 3, following manner:” Information Security is concerned with the protection of confidentiality, integrity, and availability of information in general, to serve the needs of the applicable information user. Network Security is concerned with the design, implementation, and operation of networks for achieving the purposes of information security on networks within organizations, between organizations, and between organizations and users. Internet Security is concerned with protecting internet-related services and related ICT systems and networks as an extension of network security in organizations and at home, to achieve the purpose of security. Internet Security also ensures the availability and reliability of Internet services. Critical

Information Infrastructure Protection is concerned with protecting the systems that are provided or operated by critical infrastructure providers, such as energy, telecommunication, and water departments. Cybersecurity has been defined as the preservation of confidentiality, integrity and availability of information in the Cyberspace.”

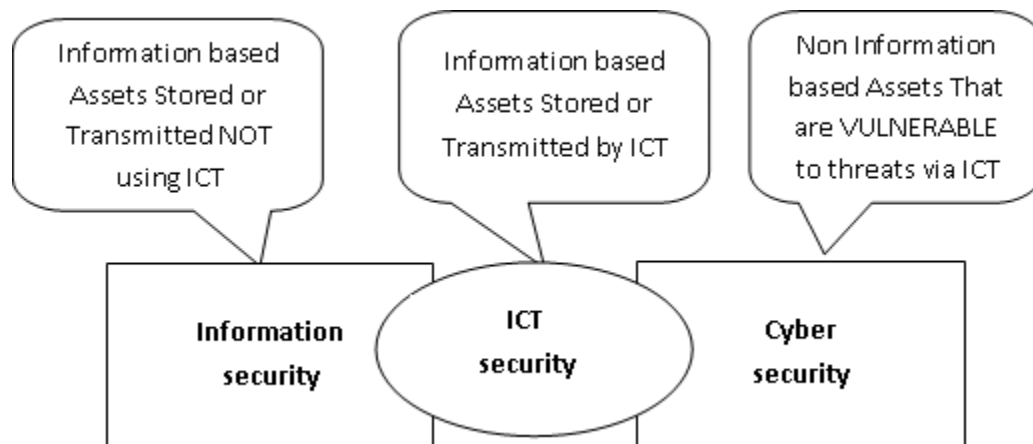


Figure 4: Relationship between Cyber Security, ICT Security Domains and Information Security (Adapted according Solms & Niekerk (2013))

Solms & Niekerk (2013) argued that cyber security, despite often being used as an analogous term for information security, differs from information security. Information security is the protection of information, which is an asset, from possible harm resulting from various threats and vulnerabilities. Cyber security, on the other hand, is not necessarily only the protection of cyberspace itself, but also the protection of those that function in cyberspace and any of their assets that can be reached via cyberspace.

4. Approach to cyber security in the Czech Republic

Seven years ago an electronic documents delivery system was created in the Czech Republic for communication between public administrations, business enterprises and citizens. This was done by the Ministry of the Interior and the Czech Post. On November 1, 2009 the new era of communication within public administration, as well as between public administration, business enterprises and citizens began. Based on Act No. 300/2008 Coll., On Electronic Acts and Authorized Document Conversion, since that time it is obligatory for all public institutions (e.g. government offices, local governments, institutions established by local or state government, etc.) to use data boxes (or the so-called eBoxes) instead of traditional paper forms of correspondence. One of the main goals of creating the information system of data boxes was to guarantee a secure method for publishing official announcements or for processing applications for both government offices on the one side and business enterprises and citizens on the other with “Non-Repudiation” system. Due to this fact, using a data box is not the same as using common email communication (Čapek & Ritschelova (2010)). Only an owner of a data box can access it and for data transmissions are mostly used encrypt system. But with this method of communication, the problem of secure preservation of electronic documents arises. The increasing number of security incidents forced the adoption of other acts and the decrees and setting up special security teams.

4.1. National Security Authority (Czech Republic case)

According to the Decision n. 781 of the Czech Republic Government, from 19th October 2011, the National Security Authority (NSA) was established as a competent national authority for the issues of cybernetic security. The statute of the Council for Cybernetic Security was added to this Decision. The National Cyber Security Centre (NCSC) has been established on the basis of this Decision as a part of the National Security Authority (Legislative Intent 2012).

The main NCSC task is coordination and cooperation on both national and international level to prevent cybernetic attacks, to propose and adopt measures for incident solving and against on-going attacks.

The legislation divides the Czech cyberspace into the area of responsibility of the Governmental CERT, operated by the NSA, which is responsible for the information systems of the public governance and the critical part of the cyberspace (critical information infrastructure) and the rest falling within the cognizance of the National CERT (operated by a private entity on the basis of a contract made with the NSA).

The Act introduces a special state of cybernetic emergency to be used in case of a large-scale cybernetic attack seriously endangering or disturbing security of the Czech Republic. The state of cybernetic emergency might be declared by the Prime Minister on the basis of proposal of the NSA Director.

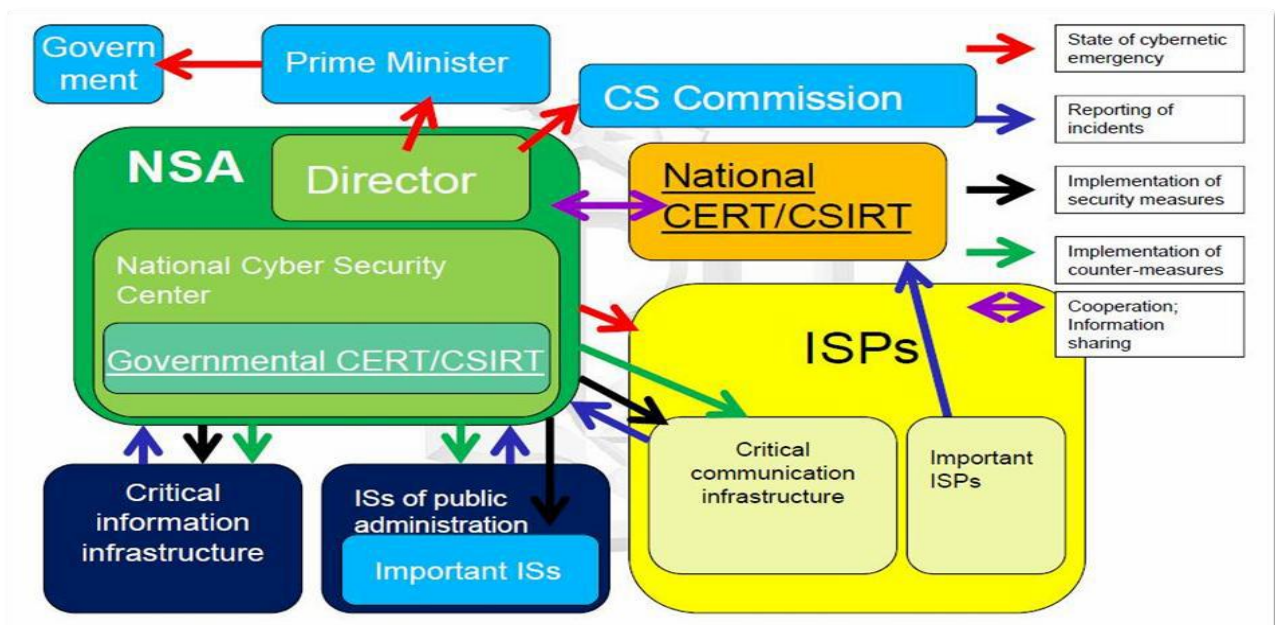


Figure 5: The incorporation Governmental CERT/CSIRT into National Security Authority of the Czech Republic (Source: Legislative Intent (2012))

The problem of cyber security from legislative point of view in Czech Republic is solved by the Act No. 181/2014 Coll., On Cyber Security and Change of Related Acts (Act on Cyber Security (NCSC(2015))). This Act is effective as of January 1, 2015.

National CERT/CSIRT cooperates with centre of expertise for cyber security in Europe ENISA (European Union Agency for Network and Information Security), TERENA (Trans-European Research and Education Networking Association) and FIRST (Forum for Incident Response and Security Teams) to exchange information on security incidents.

Selection of activity to implement the requirements of the Cyber Security Act and external influences with its impacts on the implementation are depicted on Figure 6.

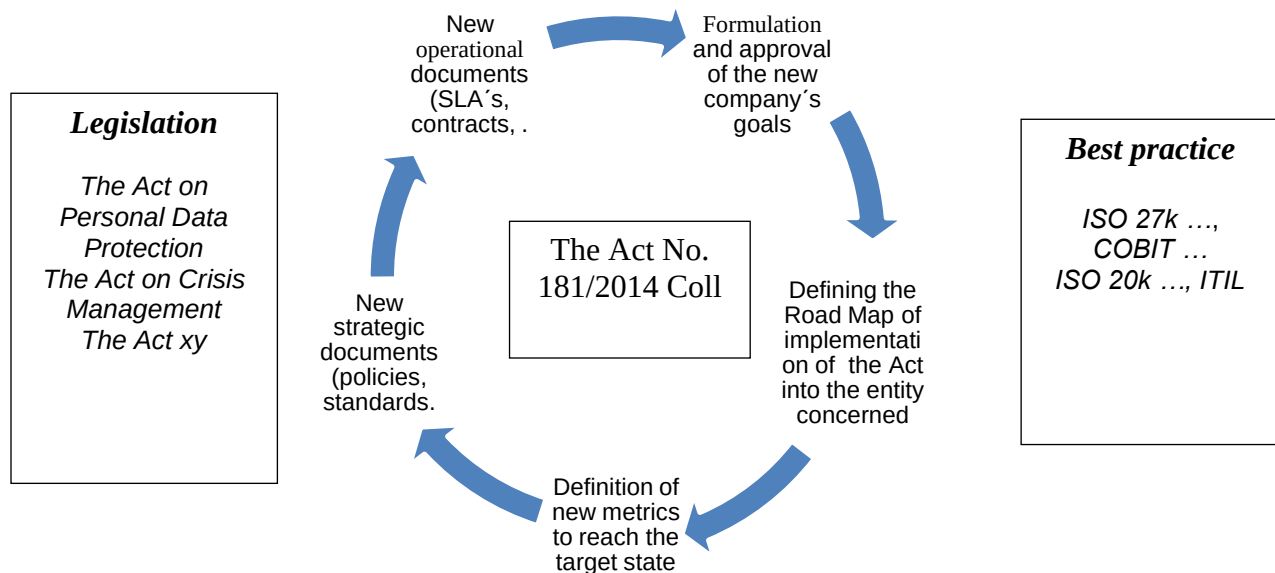


Figure 6: Selection of activity to implement the requirements of the Cyber Security Act and external influences with its impacts on the implementation (Source: Modification according Sedlák (2014))

- Main aims of the Cyber Security Act:
 - Protection of individuals.
 - Protection of State.
 - Fulfilment of international obligations.
- The Cyber Security Act is based on:
 - Requirements of the European legislation:
 - EU Cyber security strategy,
 - The proposal for a Directive on Information Security.
 - Best practice within information security management

5. Conclusion

With rapid development of information technology, e-Government and Internet as well as the extent of ICT processes deepening and networking, more possibilities to losing information in relation to cybercrime occur. As we discussed we can access information for our studies or research very quickly these days. Also the global communications have become unbelievably quick through email services. The cyberspace is overloaded with information, unauthorized attempts to access data information systems, so every day is a growing need to develop the services needed for national security authorities and develop international cooperation of these authorities. The requirements on improving cyberspace security are growing whether we understand under this security the cyber security or ICT security and/or information security.

The cyber security from legislative point of view in Czech Republic was discussed within the paper. Future work will be focused into to suppress information noise.

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SESSION I: CORPORATE AND ICT PERFORMANCE MANAGEMENT

CONTEMPORARY CASE STUDY RESEARCH IN THE FIELD OF MANAGEMENT INFORMATION SUPPORT AND MANAGEMENT CONTROL SYSTEMS

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Keywords

Case study research, filed research, management accounting, management control systems, domain theory, method theory

Abstract

The main goal of this paper is to analyse and map contemporary case study research in the field of management information support and management control systems with focus on publishability of different kinds of case studies in top-quality journals. To achieve this goal, the paper introduces various definitions and key classifications of case study research, which are apart from other things important as an organizing framework for mapping the research. Consequently, contemporary (i.e. published in years 2010-2016) papers in top-quality journals from the field of accounting are analysed and mapped. Last but not least, key active researchers using case study methodology are identified. For identification of the top-quality journals was used database SCImago and as a main source of bibliometric data (numbers of citations) is used Web of Science.

On the basis of the main goals and outlined typology of case studies were set the following specific research questions: RQ 1 – is case study considered to be an acceptable research method by leading journals in the field of management information support and management control systems and if so, which types/designs of published case study research are the most common and on the contrary which are the scarcest? RQ 2 – which high-quality journals are willing to publish case studies? RQ 3 – which method theories are used in case study research published in the analysed journals and which domain theories are addressed? RQ 4 – who are the top contemporary active authors using case study methodology?

1. Introduction

Berg (2009, p. 317) points out that case study method is sometimes considered to be a “weak sister” among social science methods because as a research method it is sometimes considered less rigorous and systematic than other methods. Similarly, Gerring (2007, p. 6) highlights that “case study research design is viewed by majority of methodologists with extreme circumspection”. Yet, at least in some fields (e.g. in operations management, where it is widely used for generation of new theories) case study research is considered to be a respected method of inquiry.

In the field of management accounting case study research is seen as a possibility to create contextually sensitive understanding of actual management practices. Case study research is therefore understood as one of the possible answers to the critique of descriptive nature of the research in the discussed field as well as an answer to the low relevance of research for practice.

The main aim of this paper is to evaluate whether contemporary case study research has prospects to be published in top-quality journals in the field of management information support and management control systems, specifically on the example of top-quality accounting journals. The second goal is to identify characteristics of case studies, which are desirable from the viewpoint of their publishability in these journals. Last but not least, key researchers using case study methodology are identified.

To achieve these goals, the paper is organized as follows. In the rest of this chapter alternative case study definitions are discussed, various classifications of case study research are introduced (necessary for further identification of important properties of the research, which is published in top-quality journals) and finally the role of theory in case study research is discussed. The second chapter explains methodology of our research and criteria for selection of journals and articles, which are analysed in this paper. The third chapter presents results and discussion including key recommendations related to the desirable characteristics of case studies from the viewpoint of their publishability in top-quality journals.

1.1. Definition of case study

Berg (2009, p. 317) highlights that there is no single generally accepted definition of case study and promotes view that case study is “method systematically gathering enough information about a particular person, social setting, event, or group to permit the researcher to effectively understand how the subject operates or functions”.

Dul and Hak (2008, p. 4) define case study as a study in which one case (single case study) or a small number of cases (comparative case study) in their real life context are selected, and scores obtained from these cases are analysed in a qualitative manner.

Yin (2009, p. 18) defines case study as “an empirical inquiry that investigates a contemporary phenomenon within its real life context, especially when the boundaries between phenomenon and context are not clearly evident” and continues with the second part of definition, which basically further specifies case study method by pointing out that case studies are oriented at technically distinctive situations, utilize multiple sources of evidence, data triangulation and are based on prior theoretical propositions.

We suggest that Berg’s definition is rather general, nevertheless it does not provide sufficient distinction of case study from other types of research. The other two definitions according to our opinion unnecessarily limit case studies (e.g. Yin’s definition requires study of contemporary phenomenon within its real life context, which is often understood as requirement to study the case as it occurs in reality, i.e. avoiding any manipulation of that object).

We advocate more broad definition because we consider restrictions like requirements for qualitative character of the research as an unnecessary reduction of diversity. The broader definitions can be found e.g. in Gerring (2007, p. 20), where case study is defined as “intensive study of a single case where the purpose of that study is – at least in part – to shed light on a larger class of cases...”. Case study research may incorporate several cases (i.e. multiple case studies). With growing number of cases decreases emphasis on the individual case and increases emphasis on sample and consequently, “at the point where the emphasis of a study shifts from the individual case to a sample of cases, a study is cross-case” (i.e. the distinction between case study and cross-

case study is a matter of degree). Case under study typically provides more than one observation (diachronically, i.e. over time or synchronically, i.e. by observing within-case variation at a single point in time). Gerring (2007) advocates that case study may utilize and integrate approaches like experimental, observational, qualitative, quantitative or ethnographic. Another broad definition was proposed by Woodside (2010, p. 1), who defined case study as inquiry, which focuses on describing, understanding, predicting, and/or controlling the individual (e.g. person or organization) and by Eisenhardt (1989, p. 534), who characterized case study as approach focusing on understanding the dynamics present within single settings, which uses methods of data collection like archives, interviews, observations and questionnaires.

1.2. Classification of case studies

Classification of case studies is important for this paper because it is possible to expect that some types of case study research have better prospects for publication than other ones. Although there are numerous classifications, we provide overview of ones which are especially important from the viewpoint of aims of this paper.

First of all, it is necessary to distinguish case studies for teaching purposes, which do not need to concern about rigorous and fair presentation of empirical data, and research case studies, which have to follow rigorous rules (Yin, 2009, p. 4-5).

Eisenhardt (1989, p. 535) classified case studies simply according to their aims (e.g. description, theory testing, theory generation).

Another possible classification of case studies is according to their design. Yin (2009, p. 27-35) distinguished five critical elements of case study design: study's question (e.g. who, what, where, how, why), propositions (which narrow the problem and direct research), unit of analysis (i.e. case, e.g. individual, group, organization), linking data to the propositions (e.g. pattern matching, explanation building, analysis of time-series, logic models, case synthesis), criteria for interpreting the findings. Using two criteria, it is possible to distinguish four basic case study designs (Yin, 2009, p. 46-64). The first criterion is number of cases under study, according to which it is possible to distinguish single-case studies and multiple-case studies. Some authors propose that these research designs are so much different that they distinguish "comparative case method" and "case method", nevertheless we will understand these different designs as two variants of case study (Yin, 2009, p. 19; p. 59). Furthermore, both single-case studies and multiple-case studies may include more than one unit of analysis.

Jensen and Rodgers (2001, p. 237-239) distinguished following types of case studies: snapshot (describe single case in single point of time); longitudinal (time-ordered analysis of events); pre-post (deals with outcomes of implementation of a practice, e.g. policy or decision); patchwork (integrate several case studies devoted to one entity at different points of time); comparative (integrates findings of several case studies).

Scapens (1990, p. 265-266) suggested to distinguish descriptive case studies (provide description and possibly comparison of currently used accounting practices), illustrative case studies (provide illustration of new and/or innovative practices developed by particular companies), experimental case studies (examine implementation of newly developed accounting procedures and provide insights into difficulties and benefits of the process under study), exploratory case studies (explore reasons for particular accounting practices and serve primarily for generation of ideas and hypotheses, which are consequently tested by rigorous empirical methods), explanatory case studies (strive explain and understand existing accounting practices with help of existing theories). It is

important to highlight that weak point of this classification is overlapping of different types of case studies.

Kaplan (1993, p. 7-11) distinguished three types of research: “what-is” research, which strives to test existing theories by detailed and intensive fieldwork, “what’s new”, which strives to study process of implementation and change and “to-be” research, which is characterized by active participation of researchers in the process of adoption of new methods.

Keating (1995, p. 68-73) proposed a framework for classifying case research specifically in the field of management accounting with stress on theory (see also chapter 1.3) and characterized his classification as based not on “research design” but on “research scope”. According to this classification it is possible to distinguish three types of cases: theory discovery cases (map novel phenomena for which there are not satisfying theories and possibly tries to develop a new theory); theory refinement, which includes two sub-categories - first, theory illustration case (which has objective to “establish the plausibility of a specific theoretical perspective by demonstrating its capacity to illuminate some previously unappreciated aspect of management accounting practice”) and second, theory specification case (which strives to refine a sparse theory and make the theory amenable to statistical test or critical case test); finally there is a theory refutation case study, which aims to falsify/refute existing, well-specified theory. Again, it is important to notice that one case study may fulfil more than one of the mentioned functions.

Lukka (2005) proposed classification, which is based on distinguishing case studies according to the two criteria – theory linkage and empirical intervention. For theory linkage was utilized and modified Keating’s approach. Modification consist in distinguishing theory discovery, theory illustration, theory refinement and theory testing case research. Theory discovery case research is defined basically in accordance with Keating, but Lukka (2005, p. 382-283) highlights the importance of inductive reasoning and the fact that this kind of case studies often provides buildings blocks of theories instead of comprehensive theories. Theory illustration according to Lukka (2005, p. 384-385) often starts with theory outside accounting domain, e.g. sociology and empirical findings are interpreted on the basis of the selected theory frame using its conceptual system and vocabulary, i.e. connections between accounting and social structures are highlighted. Theory refinement is specific by the fact that refinement of previous theory is explicitly mentioned by the researcher. Last but not least, theory testing is by Lukka basically defined in accordance with Keating. According to the second criterion (empirical intervention) Lukka (2005) distinguished non-interventionist case research (i.e. non-presence of intervention, “invisible researcher”) and interventionist case research (i.e. existence of researcher’s intervention). Interventionist case research can be according to the character of the intervention further divided to “action research”, which is connected with limited intervention and “constructive research”, which is connected with strong intervention.

Altogether, two dimensions suggested by Lukka (2005) theoretically lead to 8 types of case studies (all four types of theory linkage may be connected with non-interventionist research or with interventionist research), nevertheless because relation of interventionist types of research (action research and constructive research) to theory is ambiguous, Lukka (2005, p. 391) prefers distinguishing six types of case studies - theory discovery, theory illustration, theory refinement, theory testing, action case research and constructive case research.

All mentioned approaches to the classification are useful and provide important insights, nevertheless are ambiguous. The classification used in this paper (see chapter 3.2) utilizes some of the above mentioned approaches, nevertheless simplifies them in order to evade unnecessary issues with border-line case studies.

1.3. Role of theory in case study research

In the chapter 1.2 was mentioned the role of theory. From the viewpoint of publishing a paper in top-quality journals is the issue of theoretical contribution of the paper of critical importance because its lack is often sufficient reason for refusal of the paper. Although there are critical opinions, which highlight detrimental effects of insisting on theorizing in every single paper (see e.g. Hambrick, 2007), majority of scholars consider theoretical relevance of a paper to be of critical importance. The emphasis, which is put on the importance of theoretical contribution differs across disciplines (for example Corley and Gioia, 2011, p. 12 emphasized that “every top-quality management journal requires a theoretical contribution before a manuscript will be considered for publication”).

Yet, there is not generally accepted definition of the term “theory” and interestingly, even papers dealing with theories often do not provide explicit definition (Gioia and Pitre, 1990). One of the recent broad general definitions of the term “theory” from the field of management is “statement of concepts and their interrelationships that shows how and/or why a phenomenon occurs” (Corley and Gioia, 2011, p. 12). We propose that highly inspirational and comprehensive discussion of the term “theory” in management accounting was provided by Malmi and Granlund (2009), who highlighted that opinions on this subject differ. Some scholars advocate that “theory” is all the existing literature while others claim that theory is “set of ideas or explanatory concepts”. Malmi and Granlund (2009) distinguished theories that have “theory status” (these theories may be from various fields, e.g. economics, sociology or psychology) and theories which do not have status of theory (e.g. activity-based costing, balanced scorecard, quality costing framework and value based management). Unfortunately, theories with “theory status” are more theories about management accounting than theories of management accounting, which according to Malmi and Granlund (2009, p. 607) leads to “identity crisis” of management accounting, because it has no own theories with theory status. As a solution they propose to develop theories specific for management accounting, which would enable to understand what tools, how and in which situations should be used as well as theories how to change management accounting techniques.

Lukka (2005, p. 382) and Lukka and Vinnari (2014, p. 1309) distinguished “domain theory” and “method theory”. Domain theory is defined as “particular set of knowledge on a substantive topic area situated in a field or domain such as management accounting” and method theory as “meta-level conceptual system for studying the substantive issue(s) of the domain theory”. This distinction is methodologically important because it enables to distinguish whether a paper contributes to method or domain theory (or both or none).

Obviously, there is a question how case study research can be helpful in discovering, refining or refuting theories. Scapens (1990, p. 269) emphasizes that case studies are sometimes understood as “small sample studies” and as such are considered unsuitable for generalizations and as “pre-scientific” type of research, i.e. as a tool for development of hypotheses, which can be consequently tested by “scientific” methods with large samples. Scapens (1990, p. 270-272) nevertheless refuses this view and highlights that there are two types of generalization – statistical generalization and theoretical generalization. From this viewpoint case studies are suitable for theoretical generalizations, which strive to “generalise theories so that they explain the observations which have been made”. It is also possible to add that case study may be also used for refusing theory by finding a case which is in contradiction with given (general) theory.

2. Methodology and sample selection

In order to obtain a relatively comprehensive picture about recent published case study research in top-quality accounting journals we used SCImago (2016) database to identify top 20 accounting journals. As a period for analysis was chosen interval of years from 2010 to 2016.

Consequently, it was necessary to define articles, which are relevant for further research. Our definition of a “relevant article” is as follows:

- the article is from thematic area of management information support and management control systems including issues of reporting and processes of organizational change and at the same time;
- the article is empirical and uses case study methodology.

We conducted a basic bibliometric analysis of the identified literature and results of this analysis are presented in chapter 3.1.

Finally, for the first 20 accounting journals we conducted detailed inspection of their content for years 2010-2016 with the aim to identify relevant articles. Consequently, each of the relevant articles was studied and classified according to the selected criteria in order to identify the most popular case study designs.

3. Results and discussion

3.1. Bibliometric analysis of top-quality accounting journals

Top 20 accounting journals including their bibliometric characteristics are listed in Table together with the numbers of relevant articles published in years 2010-2016.

Journal title	SJR 2015	IF 2015	N of relevant articles in year 20XX							
			10	11	12	13	14	15	16	Total
Journal of Finance	14.546	5.105				1				1
Review of Financial Studies	9.925	3.119								
Journal of Financial Economics	9.92	3.541								
Journal of Accounting and Economics	6.834	3.535		1						1
Journal of Accounting Research	5.733	2.243				1				1
Accounting Review	4.478	1.953	1	4			1	1		7
Journal of Financial and Quantitative Analysis	2.998	1.628								
Contemporary Accounting Research	2.594	1.782		2				1		3
Accounting, Organizations and Society	2.515	2.464	8	11	4	6	5	3	1	38
Journal of Risk and Uncertainty	2.127	1.426								
Review of Accounting Studies	2.039	1.513								
Journal of Money, Credit and Banking	1.973	1.356								
Management Accounting Research	1.913	2.286	7	11	7	12	6	9		52
Real Estate Economics	1.775	0.869								

Mathematical Finance	1.671	2.283								
Auditing	1.652									
Work, Employment and Society	1.631	2.153								
Journal of Technology Transfer	1.518	2.213								
Journal of Risk and Insurance	1.489	1.535								
Journal of Industrial Economics	1.452	1.058								
Total			16	29	11	20	12	14	1	103

Table 1: Analysed journals

It is possible to summarize that relevant articles were found only in eight of twenty top-quality accounting journals. Moreover, in four journals were found less than four articles in the whole period 2010-2016. The journal with the highest number of relevant articles is Management Accounting Research (MAR), which is followed by journal Accounting, Organizations and Society (AOS) and journal Accounting Review (AR). It is important to mention that although according to the number of articles journal AOS is on the second place, according to the number of citations of published articles in Web of Science situation is different (relevant articles published in AOS have in total 580 citations and articles published in MAR have in total 310 citations).

In total we identified 103 relevant articles, which were consequently thoroughly read and evaluated from the viewpoint of their bibliometric data and from the viewpoint of the case-study characteristics. Complete list of these articles is not included in this paper because of space limitations, nevertheless is at disposal upon request.

We identified top relevant articles and top authors of these articles according to the number of citations in Web of Science database.

Top ten relevant articles including domain theory and the number of their citations in Web of Science can be found in Table 2.

Article	Domain theory	Number of citations in Web of Science
O'dwyer, Owen, & Unerman (2011)	Sustainability reporting (assurance)	63
Jorgensen & Messner (2010)	Strategic management accounting	44
Mundy (2010)	Strategic management accounting (BSC)	43
Arena, Arnaboldi, & Azzone (2010)	Risk management	39
Archel, Husillos, & Spence (2011)	Sustainability (stakeholder dialogue)	39
Skaerbaek, & Tryggestad (2010)	Relation of accounting and strategy	36
Mikes (2011)	Risk management	28
Frow, Marginson, & Ogden (2010)	Budgeting	27
Brivot & Gendron (2011)	Impacts of surveillance	26
Chenhall, Hall, & Smith (2010)	Management control system and social capital	26

Table 2: Top relevant articles published in 2010-2016 according to the number of citations

From the Table 2 it is obvious that three of the top ten relevant articles were focused on strategic management accounting, two on sustainability issues (i.e. corporate responsibility – a topic, which

is steadily getting more attention) and two on risk management, the rest of topics was present in one article. It is also interesting to notice that all top ten relevant articles were published in journal Accounting, Organizations and Society.

Consequently, we analysed productivity of the individual authors. For individual authors we counted number of relevant articles and number of citations of these articles by taking into account all authors of every relevant article.

This analysis showed that it is very difficult to differentiate authors according to the number of published relevant articles because only one author published (i.e. was author or co-author) four relevant articles (Bol, Jasmijn C.), one author published 3 relevant articles, 27 authors published two relevant articles and 175 authors published one relevant article. Top five authors according to the number of citations of their relevant articles are listed in Table 3.

Rank	Author	Number of citations	Number of articles
1	Owen, David; O'dwyer, Brendan; Unerman, Jeffrey	63	1
2	Messner, Martin	59	2
3	Arnaboldi, Michela	45	2
4	Bol, Jasmijn C.	45	4
5	Jorgensen, Brian	44	1

Table 3: Top authors according to the number of citations, years 2010-2016

From Table 3 can be noticed that first three authors are co-authors of the same relevant article and three authors published more than one relevant article. Interesting fact is that among top authors according to our methodology does not belong Kari Lukka, who is an important scholar in the field of case study research. This fact can be explained by the fact that his articles are mostly conceptually/methodologically oriented and we examine only empirical research published in top 20 accounting journals in years 2010-2016.

3.2. Characteristics of analysed case studies

We read through all 103 relevant articles and classified them according to the selected criteria. Classification according to the case study design can be found in Table 4. In contrast Yin's (2009) classification (see chapter 1.2) we used simplified classification in the sense that we do not use the second classification criterion (single unit and multiple unit analysis).

Journal title	Single-case design	Multiple-case design	Total
Journal of Finance	1	0	1
Journal of Accounting and Economics	1	0	1
Journal of Accounting Research	1	0	1
Accounting Review	7	0	7
Contemporary Accounting Research	3	0	3
Accounting, Organizations and Society	32	6	38
Management Accounting Research	37	15	52
Total	82	21	103

Table 4: Single-case design and multiple-case design, years 2010-2016

From Table it is obvious that prevalent design is single-case design, which was used approximately in 80% of studied articles. This fact is quite interesting, because e.g. Yin (2009) seems to prefer multiple-case design. As a reason for single-case study design longitudinal character of studies was often mentioned.

Consequently, we classified relevant articles according to their relation to theory. It is possible to summarize that majority of studies was aimed at theory discovery or theory refinement. In Lukka's terminology, we did not find any studies with significant contribution to their "method" theory. In regard to the utilization of terms "method theory" and "domain theory" (see chapter 1.2), we did not find any articles using these terms. Nevertheless, if we would accept this terminology, we could conclude that among the most popular method theories belong various social theories, especially institutional theory (mentioned in 30 articles) and Latour's actor-network theory. Psychological theories were used sporadically, as an example it is possible to mention theory of planned behaviour.

In chapter 1.2 was mentioned distinction of non-interventionist case research and interventionist case research, which can be further divided to "action research" and "constructive research". Nevertheless, it is quite difficult to distinguish between action and constructive research and we therefore used only distinction of research to non-interventionist and interventionist; findings can be found in Table 5.

Journal title	Non-interventionist case study	Interventionist case study	Total
Journal of Finance	1	0	1
Journal of Accounting and Economics	1	0	1
Journal of Accounting Research	1	0	1
Accounting Review	7	0	7
Contemporary Accounting Research	2	1	3
Accounting, Organizations and Society	37	1	38
Management Accounting Research	47	5	52
Total	96	7	103

Table 5: Non-interventionist and interventionist research, years 2010-2016

From Table 5 is obvious that interventionist case-study research is relatively scarce and it constitutes only 6.80% of the total number of the analysed case studies. We hypothesize that researchers hesitate doing interventionist research especially because of two reasons. First, organizations may be reluctant to enable interventionist research and therefore it is very difficult to gain access. Second, interventionist research is still considered to be controversial because any intervention may be seen as harmful from the viewpoint of validity and reliability. On the other hand, interventionist research has potential to generate new and deep understandings of management accounting practices (Lukka, 2005, p. 388).

Last but not least, it is important to notice that journals differ in regard to the type of published case-study research. It is possible to generalize that while AOS and MAR published mostly qualitative case studies, Journal of Finance (JoF), Journal of Accounting and Economics (JoAE), Journal of Accounting Research (JoAR) and Accounting Review (AR) published solely quantitative case studies. Contemporary Accounting Research (CAR) published both types of studies, one study in this journal presented interventionist type of research. It is also interesting to notice that while numerous authors in AOS and MAR mention interviews or observation as their primary source of

data (often triangulated with document analysis or with surveys as “supplementary” data source) and for analysis use qualitative methods like text coding, authors of articles in JoF, JoAE, JoAR and AR as the main source of data use large datasets and interviews and observations are used only as “supplementary” data sources; datasets are analysed by advanced statistical methods.

3.3. Concise summary of desirable characteristics of case-study research in top-quality accounting journals

Study of relevant articles in top-quality accounting journals showed or corroborated several recommendations related to writing about case study research and here we shortly summarize crucial findings.

First, the key for the success is interesting and important research question. Yin (2009) highlights that case study research is suitable especially for questions “how” and “why”. This claim was confirmed, typical research questions in relevant articles were e.g. “How, why, and when the design of TD-ABC system results in operational improvements?” or “Why performance measurement participation is related to employee initiative?”.

Second, various designs (single-case or multiple-case) are acceptable for top-quality journals as well as interventionist and non-interventionist research. Therefore, it is not rational to be afraid of some designs, but the research design must fit to the research question.

Third, a study has to be related to theory. We did not find any article, which would be purely descriptive. The role of theory is twofold. First, the research should be theoretically well informed and consistently use appropriate theories to shape the whole research – the theory should be used throughout the whole case description (sometimes expressed as “going back and forth between empirical observation and theory”, Dubois & Gadde, 2002, p. 555). Triangulation should be used not only for data collection but also for data analysis. Second, case study research is not suitable for statistical generalizations, but it can be used for theoretical generalizations. Of the critical importance is a clear and persuasive explicit statement, what is contribution to the existing knowledge.

Fourth, different journals prefer to accept articles with different methodological accents and it is therefore necessary to carefully consider, for which journal is a given case study best suitable.

Finally, distinction of method theory and domain theory is useful because it helps to identify theoretical contribution. The most often are used various social and economic theories, but it is possible to point out that theories from the field of psychology are not sufficiently employed. As promising tools for organizing research and for generation of testable hypotheses we suggest especially goal setting theory and self-determination theory.

4. Conclusions

Analysis of 20 top-quality accounting journals proved that it is possible to publish case-study research in these journals and various research designs are fully acceptable, critically important is appropriate use of theory. The answer to the first research question is therefore positive.

In regard to the second research question, we analysed top 20 accounting journals and relevant articles (i.e. empirical articles using case-study research and addressing issues of management information support and management control systems including issues of reporting and processes of organizational change) were found (ordered according to the number of relevant articles) in journals “Journal of Finance”, “Journal of Accounting and Economics”, “Journal of Accounting

Research”, “Accounting Review”, “Contemporary Accounting Research”, “Accounting, Organizations and Society” and “Management Accounting Research”.

The third research question was related to the utilized method theories. We can summarize that different method theories are used, mostly from the area of sociology and also economic theories. On the contrary, underused are theories from the field of psychology and specific recommendations in this area are given in chapters 3.2 and especially in chapter 3.3.

The fourth research question was aimed at finding top authors publishing case-study research. We found that it is very difficult to differentiate between authors according to the number of published relevant articles, which is partially caused by our attention only to the latest research, i.e. research published in years 2010-2016. Nevertheless, we tried to differentiate authors using bibliometric data and results can be found in chapter 3.1,

Finally, we must point out to the limitations of this paper and outline possibilities of further research into case study methodology. It is possible to propose broadening of the research in two directions. First, it may be fruitful to examine not only top 20 journals, but a broader group of literature including journals from other fields. Second, for identification of leading authors from longitudinal viewpoint it is necessary to deepen the research also in regard to the examined time period.

5. Acknowledgements

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USE CASES FOR COBIT 5 ADOPTION

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Keywords

Cobit 5 adoption generic model, process prioritization, goals cascading, compliance analysis, risk scenarios, pain points

Abstract

Organizations are facing problem to develop a single integrated governance framework and thus to effectively connect all implemented regulations, best practices and frameworks. Cobit 5 adoption can be one way how to attain this goal. The problem is, that Cobit 5 currently represents a complete set of documents with many best practices and guidelines that cannot be implemented at one time. The article shortly describes five ways of scoping (analysis), then provides their synthesis (generic model of Cobit 5 adoption phases) and finally the generic model is verified by the help of use case.

1. Initial Situation

Over the years, many organizations have used a number of frameworks such as the Project Management Institute's A Guide to the Project Management Body of Knowledge (PMBOK guide), Information Technology Infrastructure Library (ITIL), ISO 20000, ISO 27000 and The Open Group Architecture Framework (TOGAF)) for various purposes and activities. This has developed into a unique scenario where most of the global frameworks and standards are present and each is managed by individual departments. Examples of such a objectives based on global frameworks and managed by separate functional departments are quality management, risk management, project management, performance management, compliance management, strategic planning. Frequently, many components of these various frameworks are relevant to other functional areas or departments. However, there is a need for a more effective integrating framework to enhance the benefit realized by these best practices.

In this situation it is obvious that management will appreciate a single integrated governance framework and system working across the organization that could connect all the implemented best practices in the organization and deliver value to entire organization. Practically there exist one recommended integrated framework that has potential to solve this problem – Cobit 5. So the problem is not to choose the best fitted framework, but to choose the most relevant parts of it that can bring value to specific business with specific strategy and overall situation. Based on this situation the research question is: How to choose the most relevant parts of Cobit 5 within different organization's situation and state of EGIT? Article explains different perspectives of scoping based

on enablers, then presents the generic model of Cobit 5 adoption phases and applies it on one chosen way of Cobit 5 adoption.

2. Cobit 5 Framework

In general, Cobit 5 adoption which implies the level of Enterprise IT Governance is based on adoption of seven enablers. COBIT 5 enablers are (Framework, 2012, p.27) “factors that, individually and collectively, influence whether something will work—in the case of COBIT, governance and management over enterprise IT”. The COBIT 5 framework describes seven categories of enablers:

- Principles, policies and frameworks are the vehicle to translate the desired behaviour into practical guidance for day-to-day management.
- Processes describe an organised set of practices and activities to achieve certain objectives and produce a set of outputs in support of achieving overall IT-related goals.
- Organizational structures are the key decision-making entities in an enterprise.
- Culture, ethics and behaviour of individuals and of the enterprise are very often underestimated as a success factor in governance and management activities.
- Information is pervasive throughout any organization and includes all information produced and used by the enterprise. Information is required for keeping the organization running and well governed, but at the operational level, information is very often the key product of the enterprise itself.
- Services, infrastructure and applications include the infrastructure, technology and applications that provide the enterprise with information technology processing and services.
- People, skills and competencies are linked to people and are required for successful completion of all activities and for making correct decisions and taking corrective actions.

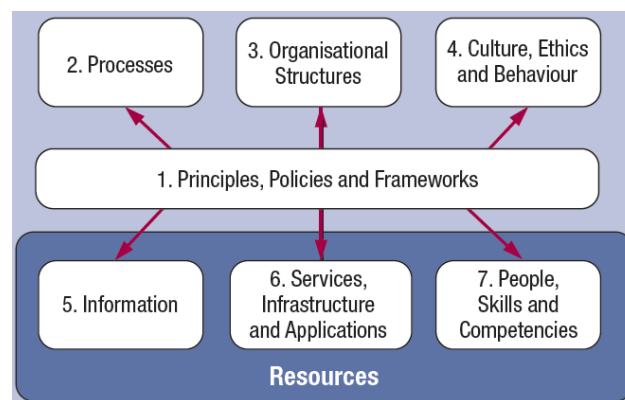


Figure 1: Cobit5 Enablers (Framework, 2012)

Cobit 5 enablers cannot be viewed separately, but they are interconnected via their inputs and outputs. E.g. processes need information and organizational structures need skills and behaviour. Although Cobit 5 proposes within holistic principle to focus on 7 enablers and states, that (Framework, 2012, p.27) “enablers are driven by the goals cascade, i.e., higher-level IT-related goals define what the different enablers should achieve“, it gives the impression, that process enabler is the most important and other enablers should be derived from the process enabler.

This impression is supported by two facts:

- first document which is published within both the versions Cobit4 and 5 is the document introducing process framework (in Cobit 4 named Cobit 4 Framework; in Cobit 5 named Cobit 5 Enabling processes),
- goals cascading, which is in both the versions of Cobit the important tool supporting the mutual business and IT strategy alignment follows the goal levels: stakeholder needs – enterprise goals – IT goals nad IT process goals. There exist tables mapping these levels each other.

This fact is compliant with process management theory, where process management is used to be defined as the application of different resources (knowledge, skills, information, techniques, systems, principles, policies) to define, visualize, measure, control, report and improve processes with the goal to meet customer requirements profitably. Knowledge and skills are in the same time organized around the organizational structures.

3. Ways of Cobit 5 Adoption

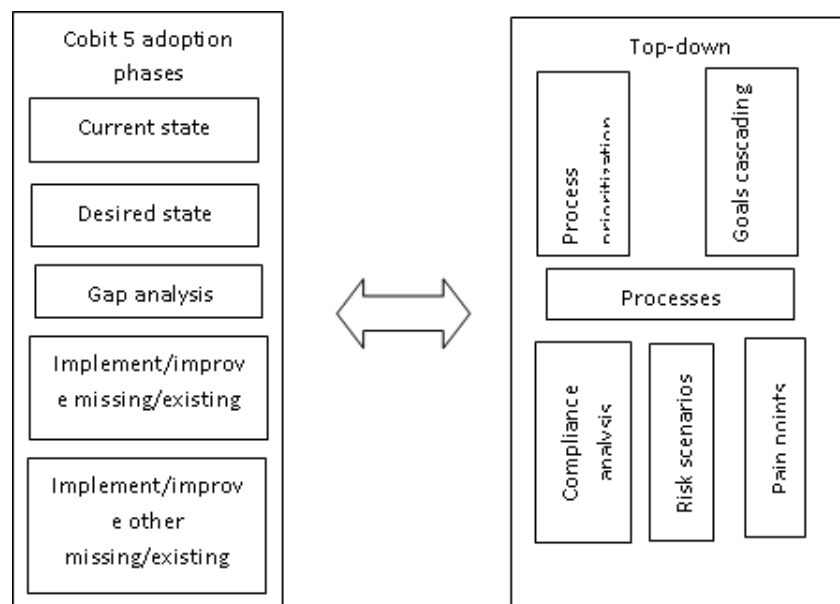


Figure 2: Generic stages of top-down and bottom-up methods of Cobit 5 adoption (source author)

Cobit 5 itself offers and describes three ways of its adoption/implementation. These are based on goals cascading, risk scenarios and pain points. Other ways were experienced by many organizations through the projects of GEIT¹⁵. Examples of such ways are process prioritization or compliance analysis. The main aim of all those approaches is the same: understand the current situation (stakeholders needs) in specific organization, identify the most relevant Cobit 5 processes and customize them to the enterprise's specifics.

Figure shows the mutual relationship between the generic stages of Cobit 5 adoption and five different methods in identification of the most relevant Cobit 5 processes. The generic phases (on the left side) are common for all the different methods that are visualized on the right side.

¹⁵ Governance of Enterprise IT

Methods/ways are divided into two categories according to the approach they prefer: top-down approach and bottom-up approach. In a top-down approach an overview of the system (enterprise) is formulated (in case of process prioritization it is provided by the help of system demand on process efforts and relevance; in case of goals cascading by the help of stakeholder's needs identification). In a bottom-up approach the individual base elements of the system are first specified in great detail. These elements are then linked together to form larger subsystems, which then in turn are linked, sometimes in many levels, until a complete top-level system is formed (in case of compliance analysis method the elements are separate Cobit 5 processes – practices - activities; in case of risk scenarios the elements are potential risk scenarios, in case of pain points the elements are pain points). The final system GEIT then consists of the processes that react on partial symptoms perceived by stakeholders.

Even to the fact, that processes are the cornerstone for all the methods of Cobit 5 adoption, there is still need to remember that they are the only one of the 7 enablers. With more time and resources, one might consider adding to the above processes, in similar degrees of detail, data on the remaining enablers: Principles, Policies and Frameworks; Organizational Structures; Culture, Ethics and Behaviour; Information; Services, Infrastructure and Applications; and People, Skills and Competencies.

3.1. Top-down Approach - Process Prioritization

Process prioritization can be based on several different attributes and the analysis can follow more or less the similar approaches as in project prioritization within the portfolio management. The attributes can be: impact and relevance in the organization, dependency on other processes and efforts required for implementation, process implementation risk and expected benefits (both the financial and non-financial), process maturity level and compliance needs, etc. Attributes must be described by the scales (semi-quantitative or qualitative) and then process maps can show that for instance the best process candidates for adoption are those with low and very low dependency and efforts and high and very high impact and relevance.

3.2. Top-down Approach – Goals Cascading

COBIT 5 and supporting material in this guide provide an effective way to understand business and governance priorities and requirements, and this knowledge can be used when implementing improved governance and management enablers. This approach also enhances the preparation of business cases for governance improvements, obtaining the support of stakeholders, and the realisation and monitoring of the expected benefits (ISACA, 2012, p.59). The main support in understanding business and governance priorities is goals cascading.

Cobit 4.1 Goals Levels	Cobit 5 Goals Levels
N/A	1. Governance goals (3)
N/A	2. Stakeholder's needs
1. Business goals (17) categorized according to 4 perspectives of BSC	3. Enterprise goals (17) categorized according to 4 perspectives of BSC
2. IT goals (28)	4. IT goals (17) categorized according to 4 perspectives of BSC
3. Process goals (34)	5. Enabler Goals (7)
4. Activity goals	N/A

Table provides differences between Cobit 4.1 and Cobit 5 goals cascading support. More detailed description of this method of Cobit 5 adoption see Chapter 4.

3.3. Bottom-up Approach - Compliance Analysis

Many enterprises have already implemented IT processes and controls according to other frameworks except Cobit. These frameworks can be COSO, ITIL/ISO 20000, PMBOK, TOGAF. Now they are unaware of their current state of governance. In this situation they can apply 3 high-level methods that can be used to get a feel for the degree of compliance in their enterprises (Focus, 2015):

- Process level compliance analysis – we can use the 37 Cobit 5 processes, with descriptions and goals in a workshop format. By ensuring the appropriate business owners, IT and executives are present, one can quickly determine a good feel for the level of governance via a review of each process and determination of the general understanding of the enterprise's compliance with GEIT.
- Practice level compliance analysis - for a more detailed analysis, we can use the 210 Cobit 5 practices instead and follow the same path as above, only at this more discrete level of detail.
- Activity level compliance analysis – we can do an in-depth analysis using the 1,111 Cobit 5 activities. This obviously requires more time and numerous workshops, but can readily supply a level of detail that allows the enterprise to focus its governance efforts while understanding what it is already doing right.

3.4. Bottom-up approach – Risk Scenarios

Risk optimization together with benefits realization and resource optimization are the main stakeholder's needs within the project of EGIT. So the next use case deals with situation that the stakeholders decide to focus on this need. In this case the initial step in the generic Cobit 5 adoption stages (Current state) is identification of the hypothetical scenarios. The definition of risk scenarios is (Risk, 2013): "A risk scenario is a description of a possible event that, when occurring, will have an uncertain impact on the achievement of the enterprise's objectives. The impact can be positive or negative." Risk scenarios must be relevant and linked to real business risk. COBIT 5 for Risk provides a comprehensive set of generic risk scenarios (111 risk scenario examples across 20 scenario categories). These should be used as a reference to reduce the chance of overlooking major/common risk scenarios. After identifying acceptable number of risk scenarios through high-level analysis of generic risk scenarios, we can provide risk scenario to process mapping. Cobit 5 offers supporting tables for such mapping. The final step, is again to add data of remaining enablers.

3.5. Bottom-up Approach - Pain Points

Pain Points are one of the factors or trigger events that can serve as launching point for Cobit 5 adoption and implementation initiatives for improved governance and management of enterprise IT. Pain Points represent "practical, everyday issues being experienced". (Framework, 2012, p.36) furthermore states, that Pain points can "improve buy-in and create the sense of urgency within the enterprise that is necessary to kick off the implementation". In addition, quick wins can be identified and value-add can be demonstrated in those areas that are the most visible or recognizable in the enterprise. This provides a platform for introducing further changes and can

assist in gaining widespread senior management commitment and support for more pervasive changes. Therefore the first phase within the generic Cobit 5 adoption phases consists in identification of the requirements based on current Pain Points and drivers and these should be accepted by management as areas that need to be addressed. The list of generic Pain Points offered by Cobit 5 can serve as inspiration for their choice. COBIT 5 for Risk provides a number of examples on how the Cobit 5 enablers can be used to respond to risk scenarios. Using the tables of Pain Points mapping to processes practices we can identify process enabler and for each of the 20 risk scenario categories, potential mitigating actions relating to other COBIT 5 enablers are provided, with a reference, title and description for each enabler that can help to mitigate the risk.

4. Use Case of Goals Cascading

After the explanation of the basic principles of the different ways of Cobit 5 adoption let us focus on one of them – goals cascading. Officially there is no research declaring the importance and level of application for above mentioned way of Cobit 5 adoption. But from different unofficial resources published on the ISACA web (Cobit Focus, webinars, virtual conferences) it is apparent, that this way is the nerve centre of COBIT 5. It supports the identification of stakeholder needs and enterprise goals through the achievement of technical outcomes which, in turn, support the successful use of enabling processes, organizational structures and other enablers. The generic goals and their mapping to processes is based on research projects used in-depth interviews in different sectors together with Delphi surveys of subject matter experts. This research established a generic list of enterprise goals, IT-related goals, and their inter-relationship or “cascade.” This cascade now constitutes the core entry point for COBIT 5 (Haes, 2013).

Cobit 5 goals cascading is slightly different from the Cobit 4.1 version. See

Cobit 4.1 Goals Levels	Cobit 5 Goals Levels
N/A	1. Governance goals (3)
N/A	2. Stakeholder's needs
1. Business goals (17) categorized according to 4 perspectives of BSC	3. Enterprise goals (17) categorized according to 4 perspectives of BSC
2. IT goals (28)	4. IT goals (17) categorized according to 4 perspectives of BSC
3. Process goals (34)	5. Enabler Goals (7)
4. Activity goals	N/A

Table for comparison.

Cobit 4.1 Goals Levels	Cobit 5 Goals Levels
N/A	1. Governance goals (3)
N/A	2. Stakeholder's needs
1. Business goals (17) categorized according to 4 perspectives of BSC	3. Enterprise goals (17) categorized according to 4 perspectives of BSC
2. IT goals (28)	4. IT goals (17) categorized according to 4 perspectives of BSC
3. Process goals (34)	5. Enabler Goals (7)
4. Activity goals	N/A

Table 1: Differences in goals cascading between Cobit 4.1 and Cobit 5 (source author)

For more detailed description of the content of the generic Cobit 5 phases in context of goals cascading we can apply recommended steps for assurance engagements (specifically Step A: Determine scope of the assurance initiative (ISACA, 2013, p.66)). The similarity between the Cobit 5 adoption phases and Assurance phases resides in the fact, that in both the cases there is a need to specify the most relevant processes (and other enablers) but in case of adoption for their implementation/improvement and in case of assurance engagements for their assessment.

Generic phases	Steps tailored to the goals cascading method according to (ISACA, 2013, p.66)	Use case
Current state	1. Determine the stakeholders of the governance initiative and their stake 2. Define the governance objective in simple language. Input: (Framework, 2012), Figure 7 Governance and management questions on IT	Internal stakeholder, external stakeholder, CIO Is the information I am processing well secured?
Desired state	3. Identify the enterprise goals that are most related to the high-level governance objective. Input: : (Framework, 2012), Figure 24 Mapping Cobit5 Enterprise Goals to Governance and Management questions	4. Compliance with external laws and regulations 7. Business service continuity and availability 15. Compliance with internal policies
	4. Use the mapping table between enterprise goals and IT goals to identify potential IT Goals that need to be achieved.	4. Compliance with external laws and regulations: IT Goals 02, 10 7. Business service continuity and availability: IT Goals 04, 10, 14 15. Compliance with internal policies: IT Goals 02, 10, 15
Gap analysis	5. Refine—taking into account the specific environment—the set of potential IT goals to a manageable set of key IT goals and additional IT goals.	IT Goals 10 – Security of information, processing infrastructure and applications
Implement/improve missing/existing processes	6. Use the mapping table between IT goals and COBIT 5 processes to identify potential processes that support the IT goals. Input: (Framework, 2012), Figure 23 Mapping Cobit 5 IT Related Goals to Processes	EDM03 Ensure Risk Optimization APO12 Manage Risk APO13 Manage Security BAI06 Manage Changes

	7. Refine the list of selected processes to a manageable list.	APO13 Manage Security APO12 Manage Risk
Implement/ improve other missing/ existing enablers ¹⁶	8. Use the RACI charts of the selected processes to identify potential organizational structures in scope, and refine the list.	APO13: Chief Information Security Officer, CIO; APO12: Chief Risk Officer, CIO
	9. Use the RACI charts of the selected processes to identify potential people, skills and competencies in scope, and refine the list.	APO13: Chief Information Security Officer is accountable for establishing and maintaining an ISMS, definition and management an information security risk treatment plan, monitoring and review the ISMS APO12: Chief Risk Officer is accountable for maintaining the risk profile and defining a risk management action portfolio; Chief information officer is accountable for collecting data, analysing risk, articulating risk, responding to risk
	10. Use the input/output tables of the selected processes to identify potential informatik items in scope, and refine the list.	APO13 outputs: ISMS policy, ISMS scope statement, Information security risk treatment plan, Information security business cases, ISMS audit reports, Recommendations for improving the ISMS APO12 outputs: data on the operating environment relating to risk, Data on risk events and contributing factors, IT risk scenarios, Aggregated risk profile, including status of risk actions, etc.
	11. Identify which other enablers support the achievement of the selected IT goals.	Principles, Policies and Frameworks,
	12. Consolidate the list of enablers in scope and remove redundancies.	Processes, Organizational Structures, Information, Principles, Policies and Frameworks

Table 1: Detailed description of the Cobit 5 adoption phases in the context of goals cascading (source author)

5. Conclusion

Organizations can follow the designed model of Cobit 5 generic stages and based on current state of the organizations (clear strategy articulation; available resources: time, money, people; current EGIT maturity level, known trigger events) can adopt either top-down approach or bottom up-approach each of them represented by different ways. Even to the fact, that Cobit 5 identifies seven different enablers, the process enabler is the central point of each adoption method and other enablers are derived from it. The results of the different ways adoption analysis imply the complexity of the problem and future perspectives - possible research on what are the most important aspects of organizations influencing the way of Cobit 5 adoption.

In each case there is a need to stress the fact, that above explained ways/use-cases of Cobit 5 adoption represent just one initial phase in GEIT implementation, improvement or assurance

¹⁶ Examples in the Use case column are not exhaustive, they were shortened

program which should be a continuous journey. (Radhakrishnan, 2015) recommends that treating COBIT 5 adoption as a one-time project, using a third party to implement it or having the GEIT project owned by a single individual within IT are the most common mistakes of Cobit 5 adoptions.

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PLANNING PROCESSES AND THE REFERENCE MODEL FOR COST ALLOCATION AND PROFITABILITY MANAGEMENT

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Keywords

Performance management, business informatics, planning, process

Abstract

The proposed model deals with planning in business informatics. This paper provides information about selected key principles, factors, architecture and overall business concept of the proposed Reference Model for Cost Allocation and Profitability Management and especially about part of planning processes used in this model. Architecture is based on Business Intelligence principles and main – core logic is based on Corporate Performance Management. Important part of the designed model is data model that store all data used with the Reference Model for Cost Allocation and Profitability Management.

1. Introduction

Business informatics defined in our conception is based on the (Retzer, 2007). Modified definition describes Business Informatics as processes, equipment and employees providing IT services in the company indisputably became one of the key components of the business success in majority of business sectors. Research works conducted in the area of managing business informatics economics (Chen & Zhu, 2004; Kenneman, 2009; Loebbecke & Wareham, 2003; Maanen & Berghout, 2002; Omorogbe, 2014; PricewaterhouseCoopers, 2016; Wegmann, 2013; Workie, 2006) confirm that companies make substantial investments in business informatics and their volume is still increasing. Therefore the management of business informatics tasks related to budget, expenses and effects, defined by author of this paper as “business informatics economics”, becomes vital in order to assure, that such investments will bring the expected business value (Kenneman, 2009; PricewaterhouseCoopers, 2016; Wegmann, 2013).

Importance of this area is confirmed by private companies (Oracle, SAP, IBM) that are producing software solutions that are supporting cost management activities – especially this software helps with automatization of cost allocation.

Measuring results and performance has a very long tradition. Over the last decades there has been rapid development of tools for measuring results and performances with the support of information and communication technologies (ICT). (Cokins, 2009; Neely, 2002; PricewaterhouseCoopers,

2016) Managers, under the pressure of economic trends related to a detailed analysis of all investments, increasingly concern themselves with the cost and expenses sides (a cost may or may not be an expense, see (Delina & Tkac, 2010; Kral, Fibirova, & Matyas, 2012) which plays the key role in the area of analyses, but also with the impact of IS/ICT investments for the company (Delina & Tkac, 2010). The impact may be identified either through proprietary procedures worked out based on the needs of a specific business or by using processes in ready-made reference models adapted to suit the specific requirements of a company.

Problem of available solutions and approaches is, that these solutions/approaches are created in form of general software, they are really expensive and has to be adjusted according to the company requirements and it needs a lot of money and time. (Wegmann, 2013) The lack of these solutions is that they don't contains specifics of ICT cost allocations (Maanen & Berghout, 2002; Vorisek, Pour, & Buchalcevova, 2015)

This paper aims to present a conceptual Reference Model for Cost Allocation and Profitability for efficient management of corporate informatics (REMONA) based on the principles of Corporate Performance Management (CPM), especially one part devoted to the planning and planning processes used in ICT and in general implemented in this model. The REMONA model is proposed as part of an academic project of the Faculty of Informatics and Statistics at the University of Economics in Prague in association with the companies Profinit, s. r. o., Lodestone Management Consultants, A.G., AM-Line, GmbH. This model is developed as a general solution with predefined values, dimensions and measures that can be adjusted according to the companies' requirements during a short time (less than 2 months).

2. State of the art

Cost allocation, pricing, profitability and planning are growing in importance, especially when the company is undergoing a negative economic development or when company is rapidly growing. It is in such periods that managers demand detailed, accurate and up-to-date information about all individual parts of the company (Kral et al., 2012; Omorogbe, 2014; Zehbold, Schmidt, & Fleischmann, 2013)

This paper provides crucial information regarding planning and planning processes in ICT and try to answer questions as follows:

- What are the most important planning tasks that have to be solved in Business Informatics?
- What are the most important part of planning process in Business Informatics?
- Is it possible to define planning workflow in Business Informatics? What are the most important points of this workflow?

3. Methodology

The design of the model follows from using of several scientific approaches:

- Analysis of current state of the art that is proved by cited literature and synthesis and deduction,
- Case studies and qualitative research (Hendl, 2016; Ochrana, 2013; Yin, 2009) – we realized 7business projects and consultations with 31 Chief Financial Officer in different

companies (12 in the area of ICT) during year 2011-2014 that help us with formulation of lack of current solution and gaps that are felt by managers.

- Final solution was tested by way of two case studies in selected international companies (Maryška, 2014)

4. The REMONA

The aim of the model is to offer a solution for three important tasks solved in all companies: ‘cost allocation’, ‘profitability management’ and ‘**planning**’. These tasks are closely connected with definition of ‘Dimensions’, ‘Metrics’, ‘Drivers’ and ‘Activities’. Another requirement for the model is the possibility of its rapid and easy adaptation to a specific company in which it will be implemented. This is achieved in the case of the REMONA model by its logic being implemented as much as possible through appropriate links between data cubes and related dimensions.

The proposed model is based on basic requisites, limitations and requirements which must be fulfilled to ensure that REMONA can be easily and quickly implemented in a company. The model design is based on the following:

- The overall design of the model must be a general.
- The proposed model must support easy and quick integration into corporate architecture.
- The model will support easily modifications.
- The necessary dimensions and key metrics must be pre-defined.

The design of the model is based on answers to the most important financial questions see (Maryška & Doucek, 2014).

The proposed REMONA model is designed to permit easy and quick adaptation (modification) of the solution according to the character of the answers to these questions by parametrization without high costs of additional alterations.

4.1. Architecture

The basic view of the architecture is represented by individual layers integrated in the model. It is a layer of:

- primary data sources,
- data integration – Data Stage (addressing questions of data pumps (ETL) and data quality),
- core of data warehouse and data marts – partly addressed in REMONA,
- application layer and user interface layer (object of REMONA),
- a metadata layer passes through all the layers which is of key importance for end users as it guarantees a standard language and description of all indicators and attributes which are part of REMONA and the other layers of the company information system.

The model is primarily based on consolidated data sources, which are in an organization normally represented by the data warehouse (Company’s DWH). If the structure, detail and contents of the data in the data warehouse are not sufficient for analytic tasks to be performed in the designed model, other data sources will be used (Transaction Data Sources, External Data). Very important part is a data integration tools which allows us import data and processed them according to the

requirements and needs of the target system that is represented by the REMONA in this case. Processed data stored in REMONA DWH are used by the REMONA application which contains ICT support for Cost Allocation, Profitability and Planning tasks.

4.2. Application Platform Layer – Planning

General definition of the Planning can be defined as a process of estimating the capital required and determining its competition. It is the process of framing financial policies in relation to procurement, investment and administration of funds of an enterprise (Management Study, 2016). If we want to define concept of Planning in business informatics, we have to define the most important tasks (areas) that have to be solved in management of business informatics. These areas are identified in Fig 1. There are mentioned not only basic planning tasks in the Fig 1, but we identified also several the most important business drivers and forms, that can be used for planning and in some cases also in reporting. Note: The Fig 1 covers areas of cost allocations, because cost allocations and planning are mutually interconnected.

The core of the planning process is processing of primary data (input data) into form that is suitable for planning, cost allocation and profitability analysis. All input data have to be on the required level of details that permits realization of planning tasks. Input data are usually divided into data about General Ledger (GL) balance, business data, core data, costs etc. All input data are sorted based on defined rules into groups like unit costs, balance sheet, cash flow etc. This division allows to realize defined tasks with the same pool of data which structure is changing in time. This is important for long-time comparison which is one of crucial accounting principles. The last important component of input data are parameters that can be used for adjustment of general solution to requirements of any company. One of examples is definition of business drivers.

Authors will not describe all components in detail because the length of the paper is limited and all of these details can be found in (Maryska & Novotny, 2013; Maryska & Wagner, 2015).

Process

The ICT Planning process is relatively specific. The ICT Planning process displayed in Fig 3 indicates, that financial plan can be prepared in more than one version. Situation when company prepares more version of plans is not unusual situation. Activities defined in Fig 3 also identifies the most important activities in planning process in Business Informatics.

The first version of the plan is usually prepared for Top management that formulate change requests. These are usually considered in the second version of the plan etc. The standard process (with support of ICT tools and REMONA model) is that the first version of the plan is copied into the second one which is adjusted by the users according to the Top Management Requirements. One of the precondition is that the newer version of the plan is filled-in with the same forms. This precondition helps to ensure that all logic and relations among business models are not upset.

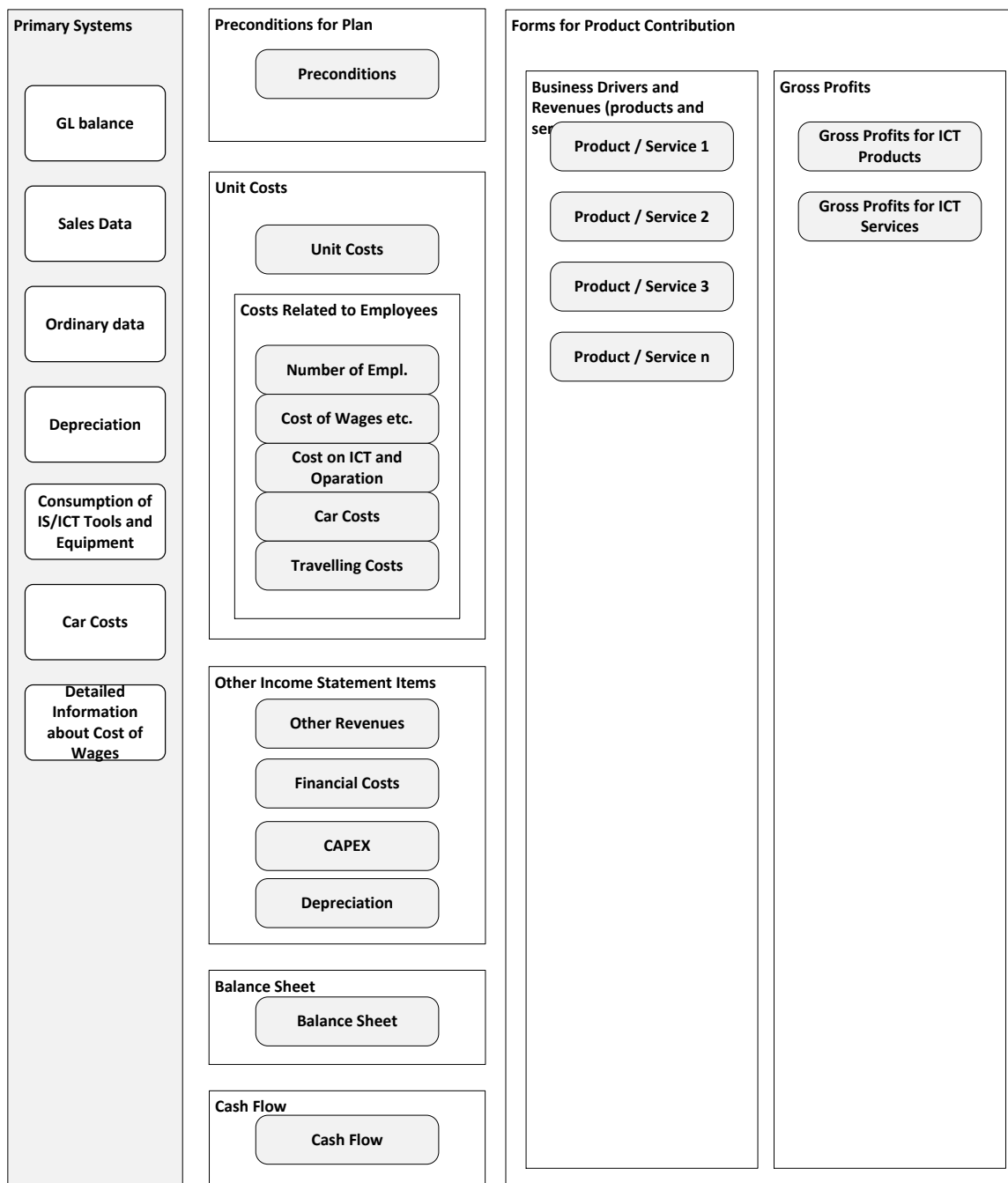


Figure 1: Basic Planning Tasks and Related Areas in ICT, source: author

When second version is finished then this version is approved by the Top Management. When version is approved then this one is copied into „Approved plan for period XY“ which is locked for any changes. In case of some new requirement for changes the Planning process is repeated. The schema of ICT Planning process is in Fig 2.

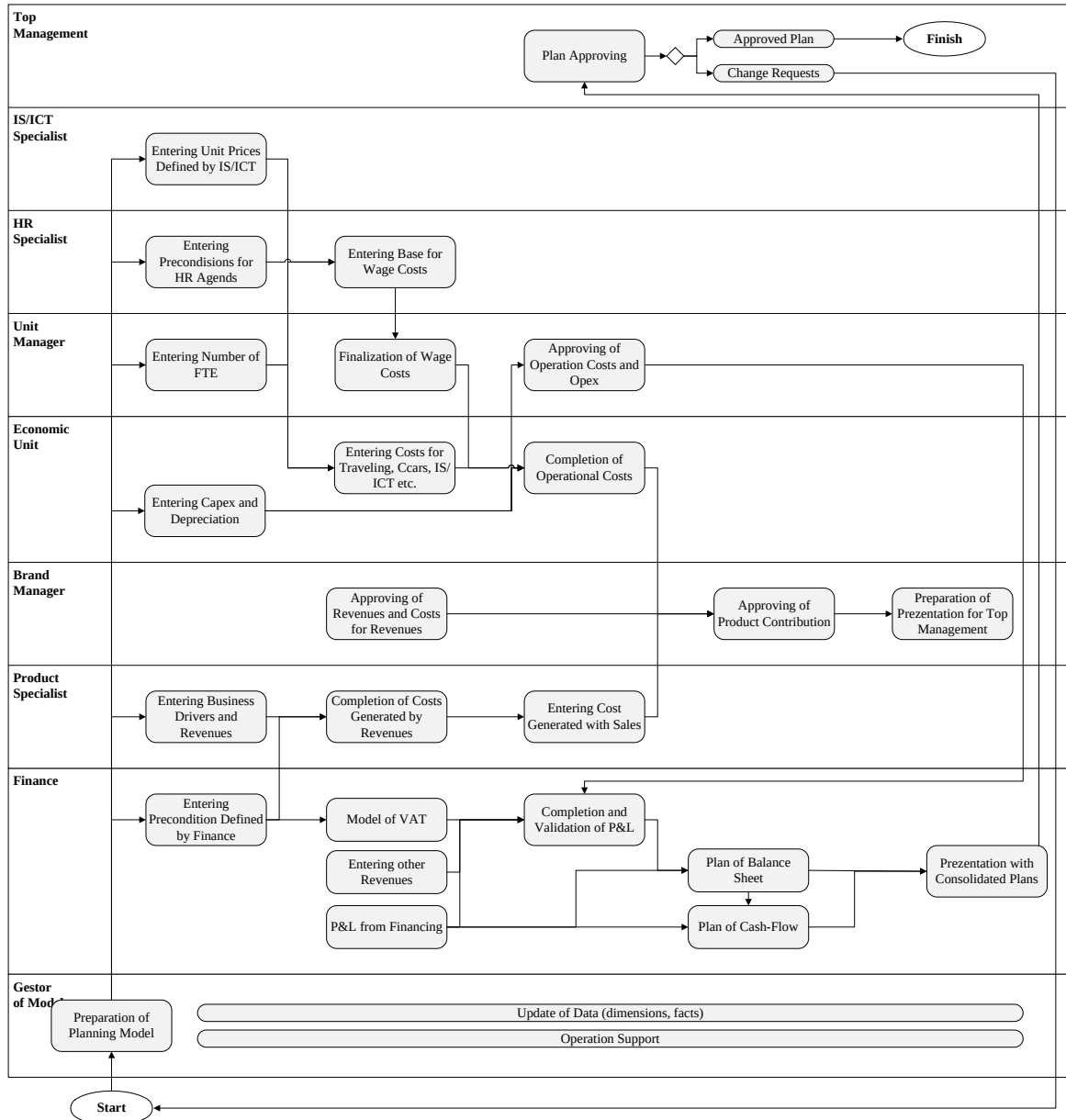


Figure 2: Workflow Planning Process in ICT, source: author

When we are talking about planning model then workflow is one of precondition. Workflow in the context of planning means: defined process that conduct user through whole planning process. This workflow for planning process, which is based on the previous picture, is in case of REMONA prepared in tool IBM Cognos Express.

Work Flow

Essence of the workflow stays in the definition of all activities in planning process and their mutual dependencies. Except definition of all activities/steps in the planning process is very important part of definition rights and responsibilities for defined activities/steps. That means definition of those who can add values, edit values, approve values etc. The second essence of a workflow is that workflow helps with information exchange because users usually can put their comments to the whole plans or to the selected value in the plan.

Workflow is closely connected with dimensions that are defined for planning. We used following dimensions in our REMONA model for planning workflow. These dimension are used the most frequently: Product and Organization.

Structure of workflow is usually dependent on the type of company, planning expectations, size of company etc. During our research, we identified following parameters in the workflow that are general and solved in majority of companies:

- Preparation (actualization) of planning workflow/model,
- Adding preconditions for the plan
- Plan of number of employees and personal costs,
- Revenues plan based on the business drivers, costs and revenues,
- Plans for investments and depreciation,
- Plans for unit operational cost,
- Financial costs' plan,
- Balance Sheet plan,
- Plan of Cash Flow.

Very important is that all of the above mentioned areas can be planned in parallel, actually they parallel planning is desirable.

Our solution supports all of the planning activities by way of predefined data cubes, forms, approval hierarchy and rights.

- Data Cubes contains data for plan (reality, last version of the plan, preconditions etc.) and at the same time these cubes allow to user fill-in new planned values. For one step in planning workflow can be used more than one data cubes.
- Forms are user interface. These forms are used by the users that are adding/editing values or approving/rejecting existing values. It can happen that in one step in planning workflow can be needed fill in data by way of more than one form.
- Approval Hierarchy take into account relations between planner and approver. The approval hierarchy is typically based on company hierarchy (for filling unit operational costs) or product hierarchy that is more suitable when we are planning numbers for brand managers etc.
- Rights are defined as roles to which are assigned users. These roles are linked to each items in approval hierarchy.

5. Conclusions

Practical verification and the proposed model was used both for practical application in two companies and is further available to students, who will able to visualize the issues of planning in the model and support of these tasks by hardware.

We have for practical use:

- Key metrics which are useful to address the issue of cost allocation, profitability, and related analytical tasks.

- Dimensions necessary to carry out the economic tasks.
- Methodology for implementation of the proposed model in a company – determining implementation milestones and possibilities of adaptation of the proposed model according to the characteristics of the target company.

The benefits of the proposed model for theory can be formulated in these aspects:

- Research into planning in the context of Business Informatics.
- Expansion of the theoretical basis of planning in Business Informatics.
- Determining appropriate dimensions and their characteristics.
- Design of the model and its architecture.

Definition of workflow process for planning process in ICT is important. The workflow helps to share data among users, check the data, keep defined planning process and ensure the same rules and processes in time.

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THE APPROACH TO THE INTEGRATION OF THE IT GOVERNANCE FRAMEWORKS FOR SME

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Keywords

Cobit, ITIL, TOGAF, small and medium-sized enterprises, SMEs, framework

Abstract

Information technology (IT) helps organizations to realize their business and achieve goals. A typical small enterprise manages an increasing complex system of information technologies. The ability to apply IT effectively and the ability to optimize all enterprise resources need appropriate management approaches. There are several frameworks that solve related issues. The paper presents important issues concerning IT governance in segment of small and medium-sized enterprises. Such a group of companies has specific characteristics and for them it is least problematic to implement the existing frameworks for maximization of the value of IT. The question is whether it is possible to find a reasonable penetration among the existing frameworks to be able to cover the core requirements of companies.

1. Introduction

It is obvious that the use of information technology (IT) is a common matter. IT works as an enabler for business as well as a source of threats. The companies have to implement and use IT effectively so they have to keep a balanced relationship between two contradictory directions: maximization of value of IT and minimization of risks. Nowadays there are several frameworks (methodologies) focused on these issues. We talk about IT management, better about IT governance (ITG). More generally companies need to ensure support of IT for the core business. It is not a simple task because IT are strongly intertwined with processes (system complexity is increased) and each functionality can be provided in different ways (e.g. consider cloud services). As Pochyla (2012) discusses the use of intranet in companies it has to be considered wider context (where are data stored, who is responsible for them, what role does information play etc.). That is why authors would like to map three main areas: 1) Enterprise architecture (EA), 2) IT governance and 3) IT service management (ITSM). The knowledge of the IT use context may be an important advantage also in similar areas like performance management (Maryska, 2013) or business analysis (Bhaskaran, 2013) etc.

No doubt, micro, small and medium-sized enterprises (SMEs) have played an important role in economy. It is not crucial which definition of the SMEs term we use although it is possible to find several different definitions. Different countries use various criteria or values. There are some

common characteristics among typical SMEs. The term SMEs is defined in this way (EU, 2003) in European Union. The authors consider that usability of presented approach is the most suitable for small and medium-sized firms (see classification of SMEs in EU (2003)). The smallest firms (mentioned as micro) probably have no such complex information technology systems to be able to profit from approach advantages. These differences influence the behavior, capabilities and other aspects of SMEs. As we can see in literature, such aspects are important for application of information technology (IT) as well.

As mentioned below in chapter 2 published approaches are not suitable for SMEs. The goal of this paper is to discuss and describe some issues important for IT in SMEs segment. The aim of the paper is to show that the core of selected frameworks is similar and there is a potential to simplify and join the best of each framework to fulfill the main SMEs needs.

The basic research approach consists of three pillars. The first pillar is based on fundamental characteristics of SMEs and their needs. The second pillar is built on the principles of frameworks and methodologies applied in the selected area. In the third pillar authors analyse the main aspects and suggest possible new approach based on these findings for practical use. With respect to SMEs characteristics authors would like to discuss how to use these frameworks in companies of such sizes. Further authors do not map selected frameworks with each other but follow the same issues of frameworks with effort to integrate frameworks to one solution.

2. The main affected areas

In this chapter authors are going to introduce the main areas that are important for the paper. There are SMEs characteristics and frameworks operating in IS/IT.

2.1. SMEs characteristics

Specific features of SMEs are widely discussed in literature. The main aspects that are different can be divided into following areas: 1) economy, 2) strategy, 3) organizational factors, 4) human resources, 5) technologies and 6) external factors. (Rozeňal, 2013). It is possible to find a lot of other publications that discuss this topic Antlova (2009), Plumb & Zamfir (2008), Milne & Mathys, 2009, Chitura et al. (2008) and others. These general aspects include specifics that Ayat et al. (2011) summarizes as follows:

- High unit costs – issues concerning costs per employee, but more generally also a financial strength.
- Relying on individuals, Quick communication, Responsive SMEs – key role of individual and better communication channels due to simpler organizational structure.
- Flexible, Nowhere to hide, Informal culture – fewer employees and often informal atmosphere lead to less formal processes.
- Wide knowledge, Limited knowledge – employees combine their roles because it is necessary to ensure appropriate functions.
- Complexity of interpretation – holistic view is important, e.g. although generally the scope of business is smaller, it doesn't mean that the situation is easier.

In our survey that was realized in 2014 in Moravian-Silesian region we focused on the current level of use of information systems and information technologies (IS/IT). The results support the argument that the complexity of IS/IT is problematic for SMEs. (Tvrdikova et al., 2013) They

prefer simple tools with strong support of developers, mostly do not use complete systems such as enterprise resource planning (ERP). Moreover, SMEs typically do not use any methodology to maximize IT value. The same results are presented by Kuller et al. (2012) and this is added: “SMEs often don’t know how IT contributes to their business“.

2.2. Current situation of IT governance

The authors mentioned above proclaim new approaches to the value of IT maximization as a general goal. There are several science disciplines that deal with the area of IT management and related domains. Companies need to manage their services (IT service management, ITSM), need to govern their IT (IT governance), understand context and key perspectives of IT in business (Enterprise architecture). And even more. We may indicate project management, IT development and life cycle. It is not possible to handle all dimensions that have to be solved in one single paper. Moreover, we want to discuss SMEs and their specifics. The authors are going to deal with three main domains in the following text: IT governance, IT service management and enterprise architecture because they play a crucial role. Although the authors understand a different focus of each framework, it is clear that they handle IS/IT in a sense of support business finally. And there can be found a lot of common elements as well. The frameworks are interconnected and complement each other. The position of frameworks within the context of corporate is described by Lankhorst (2009, p. 14). Internationally recognized frameworks discussed at this paper are:

- ITIL – best practice framework for service management (Axelos, 2016).
- COBIT – best practice framework for the IT governance and management (ISACA, 2016).
- TOGAF – framework for enterprise architecture (Open Group, 2016).

More methodologies or frameworks can be found in literature (Renard, 2016; Zachman, 2008; Vorisek, 2008). There are also series of ISO standards that operate in a selected area (ISO/IEC 38500 Corporate governance of information technology, ISO/IEC 20000 Service management and others).

Considering main principles we could mention: 1) Stakeholder needs. The goal is to maximize the value, so it is necessary to consider sources, benefits and risks. 2) Holistic approach. It is necessary to include all important factors for making decisions about the future development. It is evident that all three frameworks try to solve the situation in context. 3) Step by step application respecting continuous improvement. The frameworks do not describe how to realize implementation. Generally, they recommend an evolutionary approach rather than a revolutionary one. Also, they emphasize continuity. 4) Definition of models and relevant elements. Frameworks typically operate with models, artifacts and elements to be able to describe a reality. 5) Measure and manage. All frameworks are based on the ability to measure. The ability to manage is derived from the ability to measure.

Outside the main principles we can analyze the core of the frameworks. Common feature and elements should be defined and used. Just these elements are important in implementation in a particular organization. Let’s look at it in more detail. Cobit works with enablers (frameworks, principles and policies; structures; processes; culture, ethics and behavior; services, infrastructure and applications; people and skills; information). Cobit defines relationships among elements and describes the most important processes in more detail (differs between terms governance and management) (ISACA, 2012). ITIL defines term service and all related issues comprehensively. ITIL uses terms like: service, process, function, asset, role, owner, data, resource, environment, metric, model etc. The links, relationship, consequences and other aspects are discussed. (AXELOS, 2011a; AXELOS, 2011b). TOGAF as a framework for enterprise architecture describes

all important elements of organization from different views. Definitions of various views and elements are a strong feature of framework.

All frameworks are complex, best practice so their practical application is not easy. If we take into account the SMEs characteristics (needs) on the one side and main features of frameworks on the other side we can see they mismatch. Kuller et al. (2012) solves this discrepancy by simplifying of ITIL framework. The only core processes approach is discussed in (Staler, 2006). It's possible to find similar scientific papers that try to build an integrated approach via combining the current frameworks. Gama et al. (2015) integrates TOGAF and ITIL. Vicente (2013) discusses ability to build a common model for EA and ITIL.

3. Integrated approach

Based on the findings in literature it can be summarized that SMEs have different needs in IS/IT application. Additionally, there are several approaches/frameworks that operate in the area of value of IT managing but it is very difficult for SMEs to apply them. There are also several areas that need to be managed. From IT services management to a general IT and business alignment. Available publications typically map the frameworks each other (ITGI, 2008; The Open Group, 2007). Indeed, for SMEs segment it is not important to know how frameworks overlap but how to join them to satisfy their specific needs.

Let's discuss briefly the reasons for more sophisticated level of IT governance and management in SMEs. The authors have mentioned that even SMEs maintain more complex system of IT assets. Although it doesn't mean they are as complex as in large companies. The core needs are as follows:

- the ability to consider effectiveness, efficiency and risks,
- the ability to measure and audit, certification,
- decide to upgrade / implementation of a new technology,
- the ability to provide the necessary functionality.

To satisfy all these requirements the basic information about "as-is" situation in IS/IT infrastructure (functionality, interdependencies, individual assets etc.) together with business views (to know how it works) are required. To achieve these requirements we need to apply more than only one framework. To illustrate the needs of holistic approach (EA versus ITSM area) we can cite from (Axelos, 2011b, p. 60): "The real benefit and return on investment of the enterprise architecture comes not from the architecture itself, but from the ability of an organization to design and successfully implement projects and solutions in a rapid and consistent manner". As the authors have described the main similarities of frameworks in the chapter above, it is possible to work with these issues further. The goal is to define common, similar elements from each framework as a basics for their integration. If it is possible to define common elements, we are able to use it in designing a universal model. The authors work with two layers model (see Figure 1). The first layer of a model is based on common elements. The second layer task is to satisfy the needs and requirements associated with managing the company. On the second layer different areas (EA, ITG, ITSM) are respected.

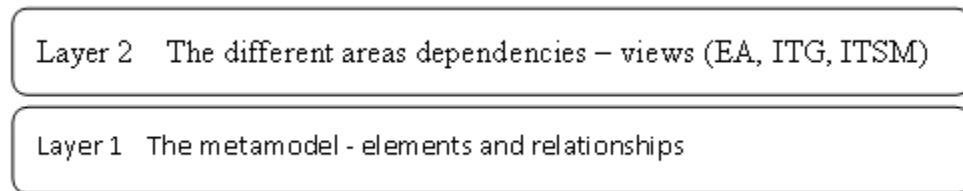


Figure 1 The layers of suggested model (source: authors)

Let's start with TOGAF (The Open Group, 2016) which describes a metamodel with core entities and relationships. Note: the framework works also with metamodel with an extension so there is a different level of details. The essential idea is that we know the main entities and their roles and relationships. The main entities from core metamodel are placed in TOGAF column in the table 1.

TOGAF	COBIT	ITIL
Business service	Services	Service
Process	Process	Process
Function	Activities	Functions, Activities
Actor	People	Customer, User, Provider and others
Organizational unit	Organizational structures	Organization
Role		Roles
Data entity	Information	Information
Capability	Skill, Competences	Asset
Application component	Applications	Application, software, Assembly, Information technology
Technology component	Infrastructure	Servers, Configuration items, Information technology
Features that affect capability	Culture, Ethics, Behavior and other	Aspect that affect service realization

Table 1 The core entities of frameworks (source: authors)

TOGAF defines artifacts for describing dependencies between various views (mainly in two dimensional matrix or in various types of diagrams). A full description of these elements creates a model of enterprise architecture. The more views are used the better description of the organization and its key elements is obtained. Zachman (2008) concisely describes EA purpose as an ability to answer six questions: what, how, where, who, when and why. The authors believe that selected entities allow answering such questions if they are used in the context of proper views. Similar entities are used also in Cobit and ITIL although each framework defines and works with entities in different ways. Entities are listed in Cobit and ITIL columns in table 1.

We start the process of simplification and integration for SMEs needs by definition of own metamodel that uses the core elements (see figure 2.). The core entities, their relationships and general features are described in suggested model. There is no space to introduce model in more detail. The basic metamodel describes the relationships like: *Service X* uses *Processes A* and *B* that are realized in *Organizational unit M* supported by *Application D* through *Function 2*.

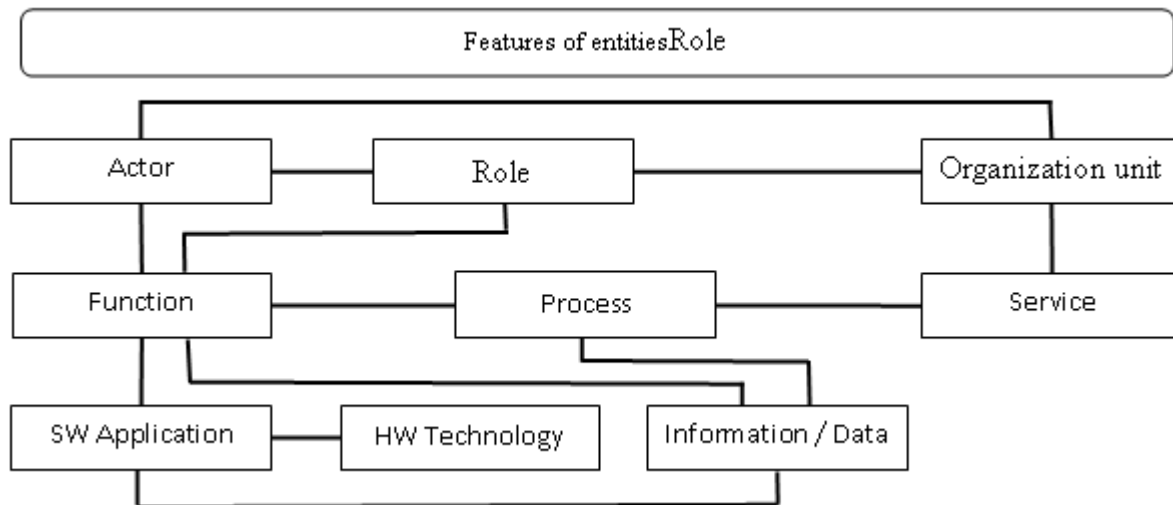


Figure 2 The model of core entities of new approach (source: authors)

Once common elements are defined, it is necessary to add other issues to the new model. Here the authors take into account the original focus of frameworks. The authors suggest to enrich:

1. The description of entities of additional features. Typically see the last row of the table 1 – aspects that affect capabilities, behavior, metrics, goals, triggers and so on. For example: *Service X* supports *Goals 1* that are measured by *Metrics A*.
2. 2) Description of dependencies of others processes and their context. For more detail see description of processes in (ISACA, 2012) and description of services in (AXELOS, 2011a, AXELOS, 2011b). In ITG area we can handle goals, risks assessment and maximizing of the value through features of each entity. In ITSM area we need to manage services via information of the service's context (metrics, processes, actors etc.).

After defining the model it can be used for the particular purpose. We have a lot of different requirements considering areas of EA, ITG and ITSM. The interests are represented by views. The views depend on a viewpoint and selected links from model while abstracting others. Considering the above mentioned Zachman's questions we are able to build a different views. For example: what software application is important to realize the service? Where is the process realized? Regarding ITG or ITSM areas we have the necessary information as well.

4. Conclusions

The authors of the paper want to integrate three areas which supplement each other in one unit. The main reason is that target companies do not need (and are not able) to apply them separately. Moreover, the authors suggest that they need to apply them in a simplified way. However, it is important to govern IT systematically. As stated in (Axelos, 2011b, p. 36) "A holistic approach should be adopted for all service design aspects and areas to ensure consistency and integration within all activities and processes across the entire IT technology, providing end-to-end business-related functionality and quality". Nevertheless, integration and simplification cause a number of negative aspects as well. Above all, it is not possible to achieve quality and completeness of original approaches. The authors understand this fact but do not consider it crucial with regard to supposed application. The ability to apply them is crucial, as it is written in (Axelos, 2011b, p. 48) "Architectures and designs should be kept clear, concise, simple and relevant. All too often, designs and architectures are complex and theoretical and do not relate to the 'real world'".

The authors have expressed the main idea of the solution in this paper. There are several areas for further research. Practical application of the proposed approach should be based on the software. Thus, it is possible to work with the model and its elements easily. It is necessary to define the features of core elements in more detail as well and design a different views (with respect to Cobit and ITIL). Software application with predefined elements, relationships and views facilitates the use of the idea in a particular organization.

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USE OF DECISION TREES FOR PREDICTION OF PROJECT PERFORMANCE

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Keywords

Decision tree, variable importance, confusion matrix, project performance, World Bank, Independent Evaluation Group (IEG)

Abstract

In today's changing world, the project management risks have to be taken into account by all project focused organizations. One big risk associated with project is a risk of project failure. To increase likelihood of project success, it is important to be able to identify drivers of success. Big advantage of decision trees is possibility of identification the importance of variables. Decision makers have thus a powerful tool in their hands and can determine which project characteristics are important for project success and can focus efforts of project team on them. Another advantage of decision trees is the easiness of visualization, implementing into existing systems and understanding by non-technical people. Decision trees are simply a set of IF-THEN rules. In this study decision trees are used to predict success of development projects of the World Bank. The most important variables identified are Overall Bank Performance, Overall Borrower Performance, Bank Quality of Supervision, Bank Quality at Entry, Implementing Agency Performance and Government Performance. Other variables play only a minor role. Performance of predictive decision tree model was high with accuracy 93.13 % and specificity 89.17 %, so the benefit of decision tree usage was proven.

1. Introduction

Project success can be defined as a project that meets its budget, delivery and business objectives. Project failure refers to a project that has either been cancelled or does not meet its objectives. The hypothesis is that projects with similar characteristics are likely to have the same outcome in terms of success (Wohlin and Andrews, 2005). There are many project characteristics that influence project success. It is important to be able to identify similar projects, since they would likely lead to similar project outcomes. Organizations have to understand the most important project characteristics for them to ensure successful projects. Examples of project characteristics include stability of requirements, knowledge of project team and management, inherent difficulty of the project, techniques and tools used (and how appropriate they are), tightness of schedule and type of application, required levels of reliability, fault tolerance, security etc.

In order to predict project success reliably, it is first necessary to find a method to identify similar projects. Projects are similar, if they show similar project characteristics and/or similar project outcomes. For example Wohlin and Andrews (2005) investigates three methods to identify similar projects: nearest neighbor method (based on computing the distance to each project in the base set), Principal Components Analysis (PCA) and key success driver analysis (since not all project characteristics are equally important in predicting project success). They concluded that the third method - identification of key success drivers is the most suitable for predicting project success.

The goal of this study is to propose a tool (predictive model) for prediction of project success and for determining important factors affecting project success using decision trees and verify its predictive performance using real project data from World Bank projects.

2. Data description

The data for verification of applicability of decision trees for predicting project success was obtained from *Independent Evaluation Group (IEG)*. *IEG* independently validates all completion reports that the World Bank prepares for its projects (known as Implementation Completion Reports, or ICRs). *IEG* performs for a subset of completed projects (target coverage is 25%) in-depth project evaluation. The World Bank Project Performance Ratings database is the collection of more than 10,000 project assessments covering about 8,400 completed projects, since the unit was originally established in 1967. It is the longest-running development project performance data collection of its kind. The dataset also includes references to over 5,000 source evaluation documents, including 2,500 recently declassified reports.

The rating criteria has evolved through the years, from a single "Outcome" rating used early on, through the inclusion of additional ratings like "Bank" and "Borrower" performance, to the ten indicators used today. In 2005, *IEG*'s project performance ratings criteria and scales were harmonized with those used by World Bank operations, to ensure greater consistency between independent- and self-assessment of projects.

For this study were used only projects with approval in years 2000 to 2016. The number of projects - input data for decision tree model – was 2335. Also projects with outcome rating "NOT RATED" and "Not applicable" were excluded from the data set. For simplicity, six possible outcome ratings - highly satisfactory, satisfactory, moderately satisfactory, moderately unsatisfactory, unsatisfactory and highly unsatisfactory were shrunk to satisfactory and unsatisfactory. Among variables, which are used to predict project success, belong Region (Europe, Africa, South America etc.), Country, Approval Year, Sector Board (Transport, Education, Urban development etc.), Lending Project Cost, Net Commitment, Lending Instrument Type, Bank Quality at Entry, Bank Quality of Supervision, Overall Bank Performance, Implementing Agency Performance, Government Performance or Overall Borrower Performance. Detailed description of the variables can be found in IEG (2014).

3. Decision trees

Decision trees use a tree-logic to make predictions. Classification and regression trees are known under their acronym CART. Classification trees are used, when the response is categorical and regression trees are used if the response is continuous. Regression trees try to predict a numeric mean response at the leaves of the tree, e.g. demand for given product. Classification trees try to

predict the class probabilities at the leaves, such as the probability of customer churn or defaulting on a loan (Ledolter, 2013).

Decision trees are used in many different fields, such as medicine, problem solving, and management science. The tree is generally presented upside down, with the root at the top and the leaves at the bottom. Starting from the root, the tree splits from the single trunk into two or more branches. Each branch itself might further split into two or more branches. This continues until we reach a leaf, which is a node that is not further split. We refer to the split of a branch as a node of the tree. The root and leaves are also referred to as nodes (Williams, 2011).

Recursive binary splitting is a method to grow a classification tree. Criterion for the splitting is classification error rate (1). Since we plan classification to assign an observation in a given region to the most commonly occurring class of training observations in that region, the classification error rate is simply the fraction of the training observations in that region that do not belong to the most common class:

$$E = 1 - \max_k (\hat{p}_{mk}). \quad (1)$$

In the equation (1) $\hat{p}_{mk}$ represents the proportion of training observations in the m th region that are from the k th class. More sophisticated measure for growing the tree is e.g. *Gini index*:

$$G = \sum_{k=1}^K \hat{p}_{mk} (1 - \hat{p}_{mk}). \quad (2)$$

Gini index is referred to as measure of node *purity* – a small value indicates that a node contains predominantly observations from a single class.

Advantages of the decision trees prevail over its disadvantages (James, 2013). Advantages of decision trees are:

- Easiness to Understand - decision tree output is very easy to understand even for people from non-analytical background. It does not require any statistical knowledge to read and interpret them. Its graphical representation is very intuitive and users can easily relate their hypothesis.
- Usefulness in Data exploration - for example, when we are working on a problem where we have information available in hundreds of variables, there decision tree will help to identify most significant variable.
- Less data cleaning required - it requires less data cleaning compared to some other modeling techniques. It is not influenced by outliers and missing values to a fair degree.
- Data type is not a constraint: It can handle both numerical and categorical variables.
- Non Parametric Method - decision tree is considered to be a non-parametric method. This means that decision trees have no assumptions about the space distribution and the classifier structure.

On the other side decision trees have also some drawbacks:

- Overfit - over fitting is one of the most practical difficulties for decision tree models. This problem gets solved by use of random forests.
- Not fit for continuous variables - while working with continuous numerical variables, decision tree loses information when it categorizes variables in different categories.

4. Model for predicting project success

In the Figure 1 there is a decision tree created in *R* using *rpart* function (Therneau et al., 2014). For the creation of the tree training data set was used and test set was left for testing the predictive performance. Training and testing sets were created with the use of stratified sampling to ensure, that the ratio of successful/unsuccessful projects in both datasets is the same. In *R* package *caret* function *createDataPartition* divides data using stratified sampling (Kuhn, 2015). 80 % of the data were used for training (1869 rows) and remaining 20 % for testing (466 rows). In the first decision node, when Overall Bank Performance is highly unsatisfactory, moderately unsatisfactory or unsatisfactory, then the project will probably ends as unsuccessful. When the Overall Bank Performance is highly satisfactory, moderately satisfactory or satisfactory, then we proceed to another decision node, where Overall Borrower Performance is assessed. Further we continue in the same fashion until we reach the leaves of the decision tree. The values in the bubbles mean number of satisfactory (1) and unsatisfactory (0) projects in each region. Under the first decision node we can see that at the beginning of the decision tree 481 projects ended as unsatisfactory and 1388 ended as satisfactory.

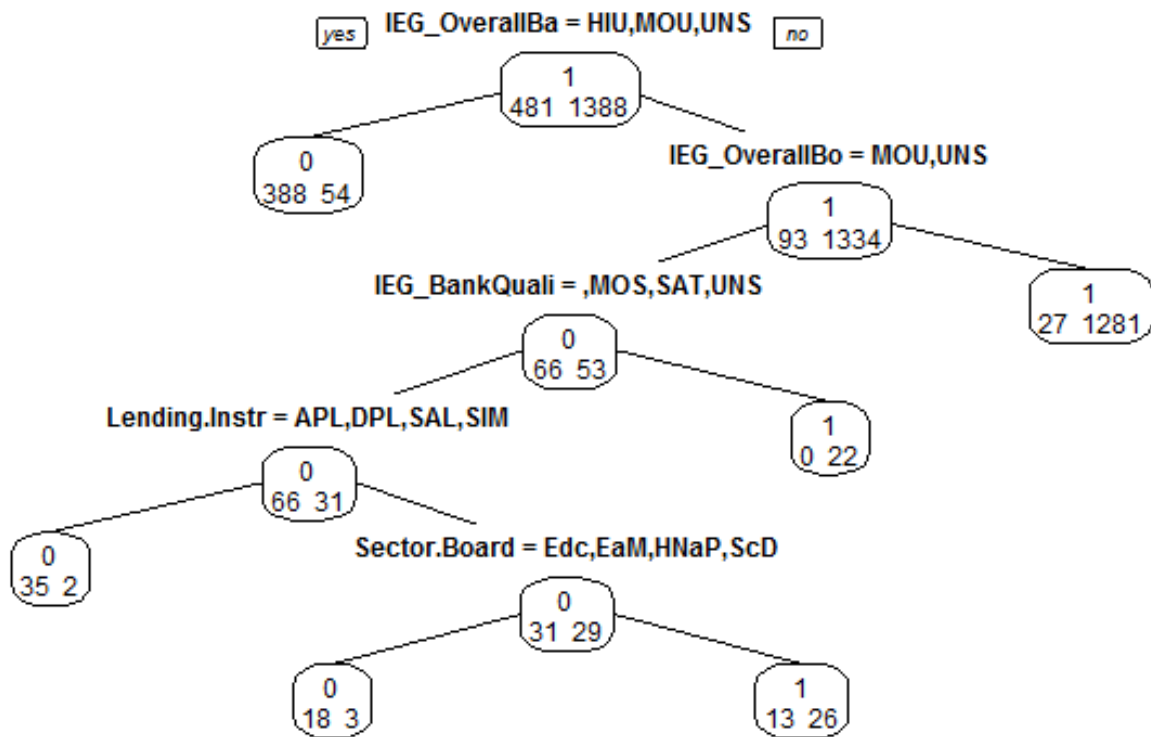


Figure 1: Decision tree for prediction of project success

Besides the prediction that is an obvious use of decision trees, the tree can be also used for various data analyses. One of the key properties of the constructed decision tree algorithms is an ability to compute the importance (relative decisive power) of each variable (Lantz, 2013). Variable importance might generally be computed based on the corresponding reduction of predictive accuracy when the predictor of interest is removed (with a permutation technique, like in Random Forest) or some measure of decrease of node impurity (measured e.g. by *Gini index*). In this case,

the second option is used since it is available within *rpart* object in *R*. In the Fig. 2 it is clear that e.g. the three most important variables for estimating project success are Overall Bank Performance, Overall Borrower Performance and Bank Quality of Supervision.

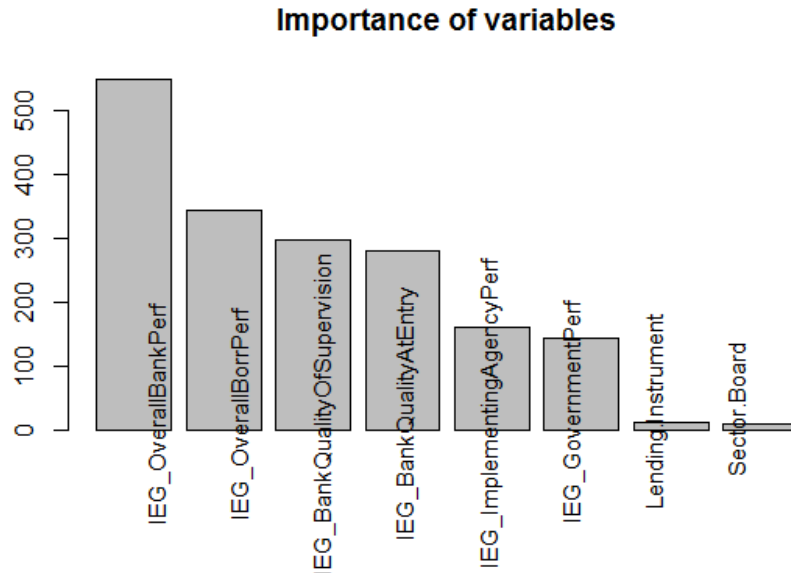


Figure 2: Eight most important variables in decision tree

Model trained on train data set is tested against data unseen by the model in the test data set. In Table 1 each column of the matrix represents the instances in a predicted class while each row represents the instances in an actual class. The name stems from the fact that it makes it easy to see if the system is confusing two classes (i.e. commonly mislabeling one as another). It is a special kind of contingency table, with two dimensions ("actual" and "predicted"), and identical sets of "classes" in both dimensions (each combination of dimension and class is a variable in the contingency table). In *R* we can use e.g. *table* function, which gives us simple contingency table or more detailed function *confusionMatrix* from *caret* package (Kuhn, 2015), where additional performance measures like *accuracy*, *sensitivity* or *specificity* are computed.

		Predicted	
		Failure	Success
Actual	Failure	107	13
	Success	19	327

Table 1: Confusion matrix

Accuracy is a measure, which says what percent of values were correctly predicted by decision tree and is computed as:

$$Accuracy = \frac{107 + 327}{107 + 13 + 19 + 327} = 93.13 \% \quad (3)$$

However accuracy is not a reliable metric for the real performance of a classifier, because it will yield misleading results if the data set is unbalanced. In our case 25.74 % of projects were unsatisfactory and 74.26 % satisfactory. In project management, predicting projects with high

probability of failure is probably more important than predicting successful projects. Let's define performance measure *specificity*, which says what percent of projects, which in reality ended as unsatisfactory, decision tree correctly predicted. Specificity is defined as:

$$\text{Specificity} = \frac{107}{13 + 107} = 89.17 \% . \quad (4)$$

Decision tree was able to predict correctly 89.17 % of the projects, which were unsatisfactory. Stopping highly risky projects can save a lot of money of stakeholders and effort of the project team.

5. Conclusions

The purpose of this study was to show the possibility of using decision trees for predicting projects success. One important prerequisite of the creation of such a tree is a database of historical projects with common characteristics and indicator, whether a given project ended with success or failure. Using this data project focused organizations can create a predictive decision tree model and use this model before the start of a given project. This model is used to determine, whether project will probably be successful or not and decision makers can stop projects high likely to fail and save money and efforts. Another advantage of usage of decision trees is its ability to determine key drivers of project success/failure. Usability of decision trees in predicting project success was tested using *World Bank* projects data. Performance measures were pretty high, accuracy with value 93.13 % and specificity 89.17 %. *World Bank* could use this model to predict, which development projects are likely to success and failure. Most important variables for classification of projects as satisfactory and unsatisfactory were also identified. Among these variables belong Overall Bank Performance, Overall Borrower Performance, Bank Quality of Supervision, Bank Quality at Entry, Implementing Agency Performance and Government Performance.

6. Acknowledgements

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METHODOLOGY OF CONTENT ANALYSIS OF CR INFORMATION IN ANNUAL REPORTS OF THE LARGEST CZECH AND SLOVAK COMPANIES BY MEANS OF CATA

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Keywords

Corporate responsibility reporting, annual reports, standalone corporate responsibility reports, content analysis, computer-aided textual analysis

Abstract

Corporate responsibility reporting is becoming a standard practice worldwide. Moreover, practice of inclusion of information on corporate responsibility (also called “corporate sustainability”) into annual reports is growing. Naturally, a question arises, whether this trend is present also in the Czech Republic and Slovak Republic. This paper aims at design of a research methodology, specifically quantitative content analysis of corporate responsibility disclosures in the annual and standalone corporate responsibility reports of the largest for-profit organizations in the Czech and Slovak Republic. Key value brought by this paper consists in proposed coding scheme and in proposed rules related to the coding procedure.

1. Introduction

Corporate responsibility (hereinafter abbreviated “CR”) reporting is steadily gaining on importance. KPMG (2015, p. 30-36) claimed that CR reporting (also called “corporate sustainability reporting”) became norm and it was driven by regulation. They concluded that CR information becomes a standard feature in annual reports (hereinafter abbreviated “AR”), which is caused by several reasons; two dominating reasons are regulation (by governments and stock exchanges) and importance of CR related information for shareholders.

In the Czech Republic and Slovak Republic (hereinafter abbreviated “CZ” & “SK”) regulation is quite low and it is interesting to investigate whether and how much organizations report about CR. We therefore decided to prepare a research aimed at contemporary CR reporting by the largest for-profit organizations domiciled in the CZ & SK, focusing on annual reports in first phase and other reporting media (especially standalone reports) afterwards.

As a basic method for our research we decided to use content analysis (hereinafter abbreviated as “CA”). The aim of this paper is to describe design of research methodology in details. First, CA principles (with special emphasis on computer-aided text analysis, abbreviated “CATA”) and its application for ARs’ analysis are discussed. Second, sample selection, coding scheme and procedure for coding are argued. Finally, possibilities for further research are considered.

2. Content analysis as a research method - literature review and application

2.1. Types of content analysis

Content analysis may be defined as a “Research technique for making replicable and valid inferences from texts (or other meaningful matter) to the context of their use.” (Krippendorff, 2013, p. 24). Drasko and Maschi (2016) distinguished three types of CA - quantitative content analysis, which is aimed at manifest content and employs statistical analyses, interpretive CA aiming at both manifest and latent content and finally qualitative CA with the same focus as the interpretative CA. They pointed out that these types of CA have important common features (structured approach with emphasis on replicability and validity of inferences) as well as specifics (for quantitative content analysis are crucial especially validity, reliability and objectivity). We advocate that they are not mutually exclusive, but complementary.

Quantitative CA uses quantitative analytic techniques (e.g. counts of words) to analyse data (Neuendorf, 2002). This technique is relevant for textual disclosures as AR or standalone CR reports because it can objectively reveal attention, which is paid to individual themes. The central idea of quantitative content analysis is data reduction, which is achieved through classification of the text into substantially fewer categories enabling identification of key topics of interest as well as quantitative expression of text proportion dedicated to given topics. These findings may be used for comparisons in time and/or space.

One of the key methods for building knowledge about data and data reduction is coding. Different types of codes can be distinguished (Bazeley and Jackson, 2013), for our purposes we use codes as labels for topics or themes and also descriptive codes showing e.g. location of the text in the document. Once the text is “coded” we can find out occurrence of the individual codes as well as the amount of text categorized under a specific code. There are various approaches to coding, which can be classified according to various classification criteria. First, it is possible to distinguish inductive and deductive approach to the creation of a coding scheme (Silver and Lewins, 2014). While inductive coding is more typical for qualitative CA, in quantitative CA deductive coding is usually used, which is more explicit at the outset about the themes and categories to be considered. Another important distinction can be made between broad-brush coding and detailed coding (Bazeley and Jackson, 2013). While broad-brush coding looks for overarching themes, detailed coding tends to split the text into fine-grained themes. Both approaches have strengths and weaknesses, one of the significant weaknesses of the detailed coding is that it may be extremely time-consuming and coders may sometimes become unsure about which code should be used. Moreover, in case of computer-aided CA, if the coding scheme is not rigid, it is very easy to make coding more detailed alternatively.

2.2. Computer-aided text analysis

Li (2010, p. 145-147) points out that there are basically two approaches to CA - manual and computer-based. Manual CA can be more precise, detailed and tailored to the specific research settings but often suffers from several disadvantages (costliness, applicability for small sample sizes only, limited generalizability, low power of empirical tests, difficulties with replicability because of subjectivity). Li (2010, p. 146-147) proposes that computer-based CA primarily uses computer programs to do the CA (i.e. understand and reduce the text). This can be accomplished via dictionary-based approach, which uses dictionaries to classify the words or phrases into different categories (codes), or via statistical approach, which uses statistical techniques to conduct CA. Li (2010) consequently compares these approaches, nevertheless it is beyond the scope of this paper to discuss this topic in detail because we do not suppose use the software this way.

Nowadays there are numerous software packages for content analysis. Among the most famous programs belong (in alphabetical order) AnSWR, AQUAD, ATLAS.ti, CAT, Dedoose, DiscoverText, HyperRESEARCH, INTERACT, MAXQDA, Nvivo, QDA Miner, Qualrus, Quirkos, Transana, V-Note, Weft and WordStat (Saldana, 2016, p. 31-32). In our research we decided to use NVivo 11 Plus software as a tool, which is primarily used for support of manual CA. Key benefits are following: better data management, more flexibility in development and potential changes of coding scheme (including possibility to conveniently make coding more detailed if necessary), possibility to visualize data, support for teamwork and evaluation of intercoder reliability, convenient coding of text with multiple codes without making the text unclear. Last but not least, software brings the possibility to query data and conduct in-depth analysis. Although some “automatization” functions will be used their benefit is supposed to be minor.

2.3. Teamwork in coding

While in qualitative content analysis coding is usually a solitary act (Saldana, 2016, p. 36), in quantitative analysis harmonization of coding in case of multiple coders is critically important because of increasing objectivity of coding. With utilization of multiple coders an issue of intercoder reliability appears (Lombard, Snyder-Duch & Bracken, 2002).

NVivo 11 Plus supports teamwork and enables three evaluation methods of intercoder reliability. First, method of percentage of agreement, which is simple but has several weaknesses as discussed e.g. in (Lombard, Snyder-Duch, & Bracken, 2002, p. 590-591). Second, Cohen's Kappa coefficient, taking into account the likelihood of the agreement between users occurring by chance, which is considered to be a “conservative” measure of intercoder agreement (Lombard, Snyder-Duch, & Bracken, 2002, p. 591-592), because relatively low levels of this coefficient are acceptable. Although there are any hard criteria, as a rule of thumb, value 0.9 is acceptable even for less conservative coefficients. Last but not least, NVivo 11 Plus enables a convenient “visual check” of intercoder agreement by so called “coding stripes”, i.e. colourful stripes displayed next to the coded text (different for each coder).

3. Literature review on content analysis of AR and standalone CR reports

Content analysis has a long tradition as a tool for analysis of accounting textual disclosures and it is therefore impossible to provide a comprehensive literature review in this paper. Instead, we list and shortly discuss contributions that were crucially important for the design of our research.

Content analysis as a methodology for ARs analysis was used in seminal articles by Cole (1990) and by Bryan (1997). Although methodology of these studies is relatively simple, important questions and research standards for CA of ARs were set. Despite abundant articles using CA for analysis of ARs in general, articles dedicated to quantitative content analysis of CR topics within ARs are not so numerous. Crucially important are methodological articles by Gray, Kouhy and Lavers (1995a; 1995b), analysis of environmental disclosure in the ARs of British companies by Harte and Owen (1991), analysis of industry specific social and environmental reporting by Guthrie, Cuganesan and Ward (2008) and analysis of determinants of voluntary CR disclosure by Cowen, Ferreri and Parker (1987), Gamerschlag, Möller and Verbeeten (2011) and Fifka (2013).

Gray, Kouhy and Lavers (1995b) noticed that content analysis in the area of CR reporting took different levels of complexity, from simple count of the number of instances of a particular event like CR disclosure to attempts for assessment of the volume of disclosure. Gray, Kouhy and Lavers (1995b, p. 82) stressed the importance of ARs as communication media about corporate social and environmental responsibility by distinguishing CR reporting through ARs and through “other media” (because AR is “used as the principal focus of reporting”) and referenced to work of Kirkman and Hope (1992) who suggested that important is also location of information within AR (e.g. because some parts of annual reports are more likely to be read). Gray, Kouhy and Lavers (1995b) consequently highlighted that the number of disclosures or amount of disclosure may be researched, nevertheless we would like to stress that thanks to utilization of computer-aided CA both tasks may be easily performed simultaneously. Another issue is decision about unit of analysis (usually word, sentence, paragraph or page) and it is possible to summarize that each of these approaches has strengths and weaknesses.

Cowen, Ferreri and Parker (1987) analysed ARs of 134 U.S. companies to identify impact of corporate characteristics on social responsibility disclosure and explored characteristics including corporate size (larger organizations are more “visible”), industry (companies from customer-oriented industries and from industries under governmental pressure are expected to report more on social issues), corporate profitability (nevertheless there are disputes about direction of causality), presence of social responsibility committee. Gamerschlag, Möller and Verbeeten (2011) explored the following characteristics: share ownership structure, visibility (measured by quantity of their press coverage), profitability, shareholder structure (CR disclosure should be positively associated with more dispersed share ownership structure), positive association of CR disclosure with company’s relationship with US stakeholders.

Last but not least, it is possible to notice movement from attempts of individual researchers to prepare their own coding scheme to utilization of the standardized coding schemes, especially the Global Reporting Initiative G4 Guidelines, hereinafter abbreviated “GRI G4” (Global Reporting Initiative, 2013), which is also used in specialized software solutions (Hrebicek, Soukopova, & Trenz, 2014). In our research we also decided to utilize this framework, nevertheless a modification was made to better fit with ARs.

4. Research methodology design

4.1. Sample selection

In the CZ & SK regulation of CR reporting is quite low and previous research (Kašparová, 2011) shows that the extent of reported CR information is limited. Moreover, it is often supposed that size of the company is positively correlated with the quality of responsibility reporting. Therefore, we decided to analyse ARs of the 50 largest for-profit companies (measured by sales turnover) located

in the CZ and in the SK and other CR reporting media (esp. standalone CR reports) of all large companies afterwards. We expect that such choice shows “better than average practice” in reporting of CR information.

4.2. Coding scheme

The coding scheme is inspired by the GRI G4. Nevertheless, there are several issues with utilization of these guidelines for coding of ARs. First, the GRI Guidelines were prepared for standalone CR reports and it is possible to predict that in the ARs of companies domiciled in the CZ and SR majority of the GRI indicators are not reported. Second, the GRI G4 are very comprehensive and detailed, coders must learn these comprehensive guidelines. Third, the latest revision of the GRI Guidelines (G4) is sometimes a bit counter-intuitive (for example total number of employees is classified as “general disclosure”, while new hires are classified at indicator LA 1). Fourth, there are overlaps between some indicators and we wanted our coding scheme to be as unambiguous as possible.

Compared to the GRI G4 our coding scheme reduces the number of codes, removes some ambiguities, and it should be better fitted for the analyzed reports. In the scheme several types of codes are included. First, codes which describe location of a given information within the AR (chapter 4.2.1). Second, codes which serve as “labels” for specific themes (chapter 4.2.2). Third, codes on important characteristics of the disclosed information (chapter 4.2.3). Finally, residual codes which should catch unclear and problematic disclosures (chapter 4.2.3). Last but not least, developed were also coding rules ensuring unambiguous coding (chapter 4.3).

Due to utilization of NVivo 11 Plus it is possible to conveniently create “queries” and answer important questions by combining codes (e.g. do organizations disclose negative information from the social and environmental area?). These questions together with quantity of disclosed information and frequency of disclosure are of high importance because indicate willingness of organizations to inform about their environmental and social activities.

4.2.1. Parts of annual reports

We prepared the codes for various parts of the analyzed ARs (see Table 1).

Code	Description, typical examples
Introduction	Introduction undersigned by CEO or another top manager.
Body	Residual code.
Basic financial statements	Balance sheet, profit & loss statement, cash flow statement, statement of changes in owners' equity.
Notes	Notes to the financial statements.
Non-coded parts	Content of the annual report, report on relations between related parties, procurations, text in the second language (in case of multilingual reports), title pages (envelope) of the annual report, pages with photos without relevant content, auditor's report, supervisory boards' report, board of directors' report.

Table 1: Codes for different parts of annual reports

The aims of these codes are several: to reduce text which will be the subject of further coding (non-coded parts); to mark text which is essentially oriented on economic information (financial statements and usually also notes); and to distinguish subjective statement of top manager (introduction) and body which aims to be more “common” statement about company.

4.2.2. General and Specific disclosures

Structure of codes denoted as “General disclosures” (Table 2) and “Specific disclosures” (Table 3) was inspired by the GRI G4, but we tried to make it more “intuitive”.

Code	Description, typical examples
Strategy and analysis	Strategy (e.g. microeconomic and macroeconomic trends, key risks, threats and opportunities).
General information about company	Company's name, primary brands, products, services, location of headquarters, countries where the company operates, markets, ownership and legal form, supply chain. Customer relations.
Stakeholder engagement	Stakeholder engagement into CR reporting and/or CR management (e.g. types of stakeholders, frequency of engagement, key topics).
Governance	Governance structure, responsibilities and competencies, implemented management approaches (e.g. lean manufacturing, PMS).
Ethics	Ethics and integrity (e.g. description of codes of conduct, ethics and other values, principles, standards and norms of behaviour).
External initiatives	Commitments to external initiatives (e.g. AA1000, EMAS, GRI Guidelines, ISO, SA8000, UN Global Compact, BellagioSTAMP).
Recognition	Corporate responsibility related rewards obtained by the organization.
Acc. methods	Information on the implemented accounting methods.
External link	Information about any references to other CR related documents.

Table 2: Codes for “General disclosures”

The final structure of codes denoted as “Specific disclosures” can be found in Table 3.

Code	Description, typical examples
Economic	Direct and indirect economic value generated and distributed (e.g. employee wages and benefits, jobs in the supply chain).
Environmental	Impacts of the company on the environment and vice versa (e.g. consumption of materials, energy, water; impact on biodiversity; env. fines and sanctions).
Social	
Labour	Labour (e.g. numbers of employees, employee turnover, remuneration, notice periods, HR management, education and training; health and safety; diversity, equal opportunities and remuneration). Fines and sanctions.
Human rights	Human rights including assessment procedures. Training on human rights. Discrimination. Freedom of association, labour unions, collective bargaining. Child labour, forced or compulsory labour. Fines and sanctions.
Society	Impacts on local community, engagement of local community and other management practices related to this topic. Corruption. Anti-competitive behaviour. Fines and sanctions for non-compliance (excluding ones explicitly related to the environment). Financial and non-financial donations, volunteerism. Relations with educational sector and research, own university.
Product responsibility	Management of health and safety impacts of products during their life-cycle. Customer satisfaction. Products and services labelling. Non-compliance of products and services with regulations and voluntary codes. Banned products and services. Customer privacy, losses of customer data. Fines and sanctions.

Table 3: Codes for “Specific disclosures”

All CR related text should be coded, i.e. relevant are also practices over and above borders of a given corporation (throughout supply chain).

4.2.3. Cross-topic codes and residual codes

We defined several cross-topic codes, which can be used simultaneously with codes listed in chapters 4.2.1 and 4.2.2 to supplement analysis by some additional features. Code “Negative information” enables to consider whether the company communicates any information as negative or not. Code “Quantitative” shows if text focusing on environmental and social topics includes quantitative (not necessarily financial) information or not. Code “Goal setting” refers about explicit formulation of future goals of a company. Code “Image” indicates images (e.g. graphs, photos).

We also included residual codes “Non-coded text” and “Text for discussion” (difficult to classify text). It is possible to summarize that these codes have three basic functions: first, a “discovery” function (discovering new corporate responsibility themes not covered by the coding scheme); second, a “psychological” function (for coders it is psychologically easier to left a text without coding than code it as “non-coded text”); third, a “technical” function (NVivo does not offer possibility to easily display all non-coded text).

4.3. Coding procedure, coding rules

It is possible to sum up that the recommended coding procedure is as follows:

- AR should be divided into parts (see chapter 4.2.1).
- Parts coded at “Basic financial statements” or “Non-coded parts” are not coded at any other codes.
- The basic unit for coding in coded parts of AR is one sentence.
- Every sentence located in coded parts of the AR has to be coded at one of the codes described in chapter about general and specific disclosures (4.2.2) or be coded at code “Non-coded text” or “Text for discussion”.
- In case that a coder is not sure about correct coding of the text, it is possible code the text as “Text for discussion” for later discussion.

Key rules related to measurement of data quantity are: first, basic unit of measurement is one word; second, images are not taken into account.

4.4. Teamwork

We decided to address the issue of subjectivity in coding by ensuring that each report will be coded by two coders; all coders will be trained at coding scheme. After coding of the first batch of documents (10 annual reports) intercoder reliability will be assessed by all methods provided by NVivo 11 Plus (see chapter 2.3) by coders under supervision of head researchers. Moreover, coders are supposed to discuss their experiences on regular basis to ensure unified coding. Leading researchers will check the final coding, provide feedback to coders and coordinate the group so that all have up-to-date information about coding rules. The same procedure will be carried out repeatedly.

5. Discussion and proposals for further research

We believe that proposed methodology has several strengths. First, proposed coding scheme starts as a broad-brush one, which is convenient for coders, but thanks to technical realization (computer-aided text analysis) it is easily possible to granulate the proposed coding scheme (e.g. create more detailed codes for topics which are reported comprehensively). Second, utilization of several code types (descriptive codes for different parts of report, unique general and specific disclosures and codes characterizing additional properties of the text) enable to formulate relatively complex queries very conveniently. Third, the coding scheme is applicable for both ARs and standalone SRs and we can basically sum up the frequency and amount of the reported information. Fourth, utilization of codes “Non-coded text” or “Text for discussion” enables us to easily discover potential flaws in our coding scheme or new CR topics. Finally, our research methodology addresses also intercoder reliability, which is an advanced practice in the area of content analysis.

On the other hand, we are going to analyse only annual reports and standalone CR reports while organizations disclose CR related information by various means (web pages, social media etc.). We propose that web pages, social media etc. are quite different tool of communication than ARs and standalone reports because they often do not have regular periodicity and are not audited. On the other hand, standalone CR reports are quite similar to ARs both regarding regular periodicity and auditability. To solve mentioned issue, we suppose to conduct a follow-up research, within which we are going to check whether large organizations disclose CR related information on their web sites.

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APPLICATION OF SPECIALIZED ICT TOOLS FOR MEASURING STRATEGIC PERFORMANCE: EMPIRICAL EVIDENCE OF CONTINGENCY FACTORS

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Abstract

This study examines the association between using specialized ICT tools – such as Business Intelligence – strategic management accounting techniques and contingency factors, e.g. company size, market characteristics and the company's perception of itself and others. Empirical data collected from Czech and Slovak companies was analyzed using Spearman's rank correlation coefficient. The analysis revealed that the bigger a company is, the more likely it is to use specialized ICT tools for measuring strategic performance. Market characteristics don't seem to play such an important role in this regard. Using specialized ICT tools for measuring strategic performance is positively correlated with using integrated financial and non-financial metrics. ICT tools also seem to be typically used for addressing a wider range of decision-making needs, rather than for addressing individual and unrelated tasks.

1. Introduction

In order to support their everyday activities, companies commonly rely on a wide range of tools and applications from the realm of Information and Communication Technologies (ICT). Company owners and managers are often motivated to invest into ICT under the notion that it may have positive effect on the company's performance. While this notion is supported by many studies, such as Muhammad et al. (2013) or Lee et al. (2011), there still exists a certain ambiguity in this matter. It may be caused by a number of factors, among others by: the use of data from specific and

relatively narrowly defined industries or segments; the research being carried out in diverse geographies; the length of time covered; focus on different parts and aspects of a heterogeneous group of information technologies etc.

In addition, Grabski et al. (2011) identified many other links among ICT and the factors determining its implementation, such as size of the companies, countries, cultures, and industries of the implementing companies. In their exhaustive review of ERP systems, Grabski et al. (2011, p. 52) also point out: "To realize the full benefits of centralized information and use of integrated systems, ERPs are also often augmented with BI and other analytics applications. Management must provide some guidelines as to the type of questions it will want answered, as the ERP system is transaction-based and is built on a database that can consist of thousands of tables, whereas the BI system is query-based and is built on a data warehouse database that needs to be optimized for various BI-oriented queries. Organizational benefits can be accrued when DSS are used in a collaborative manner by using integrated ERP and DSS, such as CRM and SCM. This integration can be accomplished with Enterprise Application Integration (EAI) technology."

Yeoh (2014, p. 105) offers similar statement about the importance of BI and related ICT systems when defining corporate performance management (CPM): "CPM comprises a combination of performance management practices and business intelligence (BI) technologies that helps managers to better set and monitor business-performance metrics and to know what is happening in the organization and why it is happening. It also includes such BI functionalities as real-time monitoring, performance reporting, and support for exploring the solution space with statistical models and visualizations. Hence, a CPM system based on enterprise-level BI infrastructure allows management to formulate and align business strategies with operational plans and measure progress against business goals."

The two quotations pinpoint the importance of BI and related ICT applications in strategic management of the company. In other words, ICT serves as a tool in managers' hands through which they steer their companies towards the predetermined objectives. In the literature stream of performance measurement, Taylor and Taylor (2014) offer similar picture by highlighting strategy processes supported by an appropriate information systems infrastructure as the key factors next to the other less significant factors. They also identified different importance of ICT on effectiveness of PMS implementation in small and large organizations.

1.1. Aim of this study

In this paper, we attempt to expand the existing knowledge on BI and its link to corporate performance management. Especially, we focus on strategic performance measurement systems (SPMS) because strategy and its support seem to play central role according to the trends identified above. Finally, there is a growing body of literature emphasizing the influence of contingency factors such as company's size, environment, technology, or culture (Chenhall, 2003). That is why we take into account some of the most frequently cited contingency factors.

The aim of our study is to find out how strong is the association between the use of specialized ICT tools (such as BI) and strategic management accounting (SMA) techniques applied by the company. Furthermore, we attempt to answer the question whether there is an association between using specialized ICT tools and contingency factors such as company size, market characteristics, the company's perception of itself and others.

The remainder of the paper is organized as follows. In the next section, the main concepts are introduced. Then the methodology of empirical survey and characteristics of respondents' sample

are described. The third part presents our findings, which are discussed in the final part of the article.

2. The main concepts and methodology applied

2.1. SMA techniques and other concepts

The concept of SMA techniques – sometimes also called as management accounting practices, management accounting areas – was derived in question "q27" from Cadez & Guilding (2008) who enhanced the former classification of Guilding et al. (2000).

The subsequent central question ("q29") asked to which extent specialized ICT tools (such as BI) support the SMA techniques usage.

The investigated contingency factors were selected based on studies done by Chenhall (2003), Garengo and Bititci (2007), Albu and Albu (2012), Taylor and Taylor (2014) and consisted of:

- company size measured by the exact number of employees reported by respondents (answer to question "q8");
- environment uncertainty and market position ("q14") – inspired by Widener (2007);
- emergent nature of the strategy followed by the respondent's company ("q25") – drawing on Mintzberg's (1994) distinction between intended and emergent strategy operationalized by Cadez and Guilding (2008);
- stakeholder focus projected into the strategy ("q26") – inspired by Šiška et al. (2013).

The precise wording of the questions and sub-questions is in Appendix.

2.2. Data collection and sample statistics

A web-based questionnaire using GoogleDocs technology served as the tool for data collection. Each questionnaire started with a covering letter explaining the study's purpose and a glossary of terms used, which are in the appendix. The questionnaire operationalized the SMA categories. The exact wording of the particular questions of the questionnaire and its sub-questions are presented in Appendix, together with the range of Likert-scales used.

Students of Masaryk University helped with distribution of the questionnaire and randomly contacted managers from the profit seeking companies. The preferred targeted recipients were top managers, especially financial managers.

Total of 99 answers was gathered within the period from December 2015 to February 2016. The count of top managers or owners amounted to 45, middle managers to 43 and 11 respondents were without managerial rank. Subsequent Kruskal-Wallis test did not identify statistically significant differences among answers of top, middle and non-managers.

As far as the functional structure is concerned, the sample of respondents consisted of 27 general managers (CEOs) or owners, 23 people from finance departments, 16 from marketing and selling department, 14 from technical or operations department, 5 from procurement and 14 from other departments of profit seeking companies.

From the sectoral point of view, 53 out of 99 responding companies were industrial ones. Trade organizations amount to 19 and 27 provided services as their main activity.

Regarding the size of the companies in the sample, 25 of them were classified as "Large" with more than 250 full-time employees (FTE), 33 as "Medium" with FTEs in interval from 50 to 250, and finally 41 companies were "Small" businesses with FTEs ranging from 10 to 50.

From territorial point of view, the respondents were from companies domiciled in the Czechia (the majority of 77 %) and Slovakia. The number of standalone companies was 53 the remainder reported to be part of the group of companies.

2.3. Data processing

All data processing was done in IBM SPSS 23. Since the majority of data had ordinal character and non-normal distributions, the non-parametric Spearman's rank correlation coefficient was used to assess the association among variables.

The strength of association was interpreted based on De Vaus (2002, p. 259) as "low to moderate" for correlation coefficients 0.10–0.29, as "moderate to substantial" for 0.30–0.49 correlations, as "substantial to very strong" for correlations within 0.50–0.69 and finally as "very strong to very large" for correlations 0.70 and higher.

The cases with missing data were excluded pairwise. That is why some correlation analyses were conducted on less than 99 observations (at least 93).

3. Findings

3.1. Specialized ICT tools versus SMA techniques

Answer to the main research question is presented in Table 1. The SMA techniques (see Appendix for details) are in columns and specialized ICT tools applied by the company are in rows.

	q27a	q27b	q27c	q27d	q27e	q27f	q27g	q27h	q27i	q27j
q29a	.573**	.352**	.449**	.309**	.589**	.307**	.323**	.305**	.263**	.244*
q29b	.297**	.459**	.481**	.031	.513**	.224*	.135	.331**	.347**	.208*
q29c	.409**	.357**	.714**	.266**	.616**	.376**	.320**	.483**	.365**	.307**
q29d	.366**	.259*	.489**	.355**	.546**	.348**	.335**	.391**	.228*	.148
q29e	.402**	.309**	.482**	.277**	.770**	.247*	.248*	.329**	.217*	.248*
q29f	.356**	.346**	.464**	.199*	.483**	.451**	.320**	.308**	.257*	.262**
q29g	.356**	.278**	.363**	.238*	.377**	.291**	.383**	.225*	.204*	.220*
q29h	.261**	.317**	.430**	.289**	.503**	.217*	.268**	.589**	.394**	.300**
q29i	.180	.292**	.275**	.137	.373**	.208*	.205*	.297**	.553**	.466**
q29j	.138	.228*	.311**	.135	.444**	.253*	.228*	.236*	.409**	.504**

*, Correlation is significant at the 0.05 level (2-tailed). **, Correlation is significant at the 0.01 level (2-tailed).

Table 1: Spearman's correlations between application of specialized ICT tools and SMA techniques

Source: Authors. Computations done in SPSS based on data from own empirical survey.

Substantial to very large bivariate correlations indicate that SMA techniques are often accompanied by ICT support. The strongest relationships are between Balanced Scorecard (q27e) and q29e, respectively between Value Chain Analysis including Activity Based Approaches (q27c) and q29c.

The correlations on diagonal (in bold) are expected to be the highest in the row if the ICT tool specifically designed to support the particular SMA area is applied. It is true in case of q29c (Value Chain Analysis), q29e (Balanced Scorecard), and q29g to q29j monitoring the competitive position, shareholders value and customers. The correlations outside the diagonal show the more/less connected areas of SMA and ICT tools. From that point of view, e.g. column (q27e) of Table 1 reveals that SMA technique Balanced Scorecard is supported by the majority of specialized ICT tools which corresponds to the interdisciplinary nature of the Balanced Scorecard.

The correlations among the application of specialized ICT tools (q29a to q29j) range from 0.523 to 0.824, i.e. there exists a very strong correlation between using specialized ICT tools for one of the observed purposes and using it also for other observed purposes at the same time.

3.2. Specialized ICT tools versus contingency factors

Correlation between using specialized ICT tools for strategic performance measurement (q29) and company size (q8) seems to have been confirmed according to correlations depicted in Table 2. The correlation seems to be stronger especially between the company size and using specialized ICT tools for measuring Costs of Quality (q29b), Benchmarking (q29d) and Integrated financial and non-financial metrics (q29e).

	q29a	q29b	q29c	q29d	q29e	q29f	q29g	q29h	q29i	q29j
q8	.380**	.501**	.384**	.409**	.399**	.379**	.268**	.361**	.268**	.295**

**. Correlation is significant at the 0.01 level (2-tailed).

Table 2: Spearman's correlations between application of specialized ICT tools and company size

Source: Authors. Computations done in SPSS based on data from own empirical survey.

Table 3 depicts correlations between specialized ICT tools application and environment variables (q14). The non-significant environment variables were left out.

	q29a	q29b	q29c	q29d	q29e	q29f	q29g	q29h	q29i	q29j
q14b	.046	-.051	-.030	.006	-.030	.016	.091	-.047	.241*	.046
q14e	.130	.244*	.189	.100	.278**	.166	.033	.227*	.153	.130
q14k	.283**	.370**	.374**	.322**	.297**	.378**	.304**	.355**	.251*	.283**
q14l	.145	.231*	.245*	.249*	.222*	.158	.202*	.233*	.212*	.145

*, Correlation is significant at the 0.05 level (2-tailed). **, Correlation is significant at the 0.01 level (2-tailed).

Table 3: Spearman's correlations between application of specialized ICT tools and environment

Source: Authors. Computations done in SPSS based on data from own empirical survey.

Correlation was found in the case of strong market orientation (q14l) and the use of specialized ICT tools for most of the observed applications; the only exceptions being the use of specialized ICT tools for measuring Strategic costs of products/services (q29a), Competitor Cost Assessment (q29f) and Customer Equity (q29j), where no correlation was found. A correlation was found also between using specialized ICT tools for performing Customer Profitability Analysis (q29i) and the notion that strong price competition is typical on the market(s) where the companies sell their products (q14b). The notion that it is not easy for the companies' customers to leave and go to the

competition (q14e) was also found to be correlated with using specialized ICT tools for measuring the cost of quality (q29b), integrated financial and non-financial metrics (q29e) and measuring Shareholder Value Generation (q29h).

Table 4 shows the findings that the more emergent nature of strategy (q25), the less often the specialized ICT tools are in use. Again, non-significant factors were left out.

	q29a	q29b	q29c	q29d	q29e	q29f	q29g	q29h	q29i	q29j
q25c	-.240*	-.288**	-.195	-.172	-.258*	-.238*	-.219*	-.303**	-.361**	-.354**
q25d	-.148	-.168	-.182	-.200	-.204*	-.223*	-.206*	-.335**	-.275**	-.254*
q25e	-.005	-.138	-.132	-.129	-.059	-.079	-.070	-.243*	-.196	-.147

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

Table 4: Spearman's correlations between application of specialized ICT tools and nature of strategy

Source: Authors. Computations done in SPSS based on data from own empirical survey.

Finally, the stakeholder focus projected into the strategy (q26) and its association with ICT tools is depicted in Table 5. Non-significant stakeholders were left out.

	q29a	q29b	q29c	q29d	q29e	q29f	q29g	q29h	q29i	q29j
q26a	-.225*	-.067	-.060	-.084	-.185	-.035	-.142	.035	-.036	-.078
q26b	.104	.234*	.154	.122	.059	.169	.138	.207*	.036	-.027
q26f	.124	.221*	.215*	.241*	.079	.279**	.185	.184	.045	.024
q26g	.303**	.248*	.281**	.235*	.032	.300**	.336**	.216*	.049	.097

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

Table 5: Spearman's correlations between application of specialized ICT tools and stakeholder focus

Source: Authors. Computations done in SPSS based on data from own empirical survey.

Negative correlation was identified between using specialized ICT tools and having a strategy that reflects the requirements of owners (q26a). On the other hand, positive correlations were found between using specialized ICT tools for measuring Cost of quality (q29b), resp. Economic Value Added (q29h) and having a strategy that reflects the requirements of creditors (q26b). Positive correlations exist between many ICT tools applied and having a strategy that reflects the requirements of the state and regulators (q26f) or a strategy that reflects the requirements of the community in the immediate vicinity (q26g).

4. Discussion

The analysis showed that when companies use specialized ICT tools for measuring strategic performance, they would usually also tend to use integrated financial and non-financial metrics and the apparatus offered by ICT tools in its full complexity, rather than for addressing individual and unrelated tasks.

From the findings it seems to be apparent that the bigger a company is, the more likely it is to use specialized ICT tools for measuring its strategic performance and supporting its strategic decision-making activities.

On the other hand, the analysis has shown that the market situation overall doesn't play such an important role when it comes to using specialized ICT tools for measuring strategic performance as almost no correlations were found in this regard.

The analysis results reveal an interesting fact when it comes to the use of specialized ICT tools and the company's target orientation. On the one hand, the results seem to indicate that – if paraphrased – when the companies use more sophisticated ICT tools for strategic performance measurement, they also tend to prepare their strategy carefully and follow it. Thus, one may expect that – since the companies are putting a lot of efforts into preparing their strategies – all strategic actions would be carefully assessed and considered in advance. However, the analysis results don't support this notion as no correlation was found in this case.

Another unexpected finding is that the more a company uses specialized ICT tools for measuring strategic costs of products/services, the less does its strategy reflect the requirements of owners. It is also rather counter-intuitive, that the companies generally use sophisticated ICT tools to follow a strategy that would reflect the requirements of state, regulators and subjects in their immediate vicinity, but at the same time would not do so in relation to their customers.

Overall, the undertaken correlation analysis seems to have revealed some perhaps not very expected relations between the use of specialized ICT tools for strategic performance management, company size, general characteristics and performance that may in some cases contradict the assumptions one may glean intuitively.

5. Acknowledgements

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7. Appendix: List of selected survey questions

The approximate number of employees on the date of filling in this questionnaire.

To what extent do you agree with the following statements:
0-fully disagree ... 10-fully agree

- There is strong rivalry on the market we sell to primarily.
- Strong price competition is typical on the market(s) we sell to primarily.
- Our company faces very strong competition on the markets we sell to primarily.
- It is very difficult for new competitors to enter our industry.
- It is not easy for our customers to leave us and go to our competitors.
- Our competitors are fragmented (there are many competitors with small market shares).
- It is easy for our company to replace any of our suppliers.
- The majority of our activities is of a routine nature.
- Our company understands our customers.
- Internal departments cooperate closely in order to create great value for the customer.
- Our company permanently observes and selects markets with consistent growth and profit potential.
- Our company is strongly market-oriented.

To what extent do the following statements characterize your company?
0-not at all ... 10-perfectly

- People making strategic decisions in our company usually consider all strategic actions beforehand.
- Strategic orientation is decided from the centre of our company (top management).
- Strategy in our company is formed gradually by trial and error based on our behaviour patterns in typical situations.
- In our company the strategy is rarely realized according to the original intention.

- Our strategy undergoes frequent changes, it cannot be considered to be stable.

To what extent does the strategy of your company reflect the requirements of the following stakeholders?

0-not at all ... 10-it is fully focusing on them

- Owners
- Creditors
- Employees
- Customers
- Suppliers
- State and regulators
- Community (subjects) in the immediate vicinity

To what extent are the following tools/methods for aiding strategic management used in your company?

0-not used at all ... 10-dominant tool for strategic management

- Integrated financial and non-financial metrics (e.g. Balanced Scorecard)

To what extent are specialized tools (such as Business Intelligence) used for measuring strategic performance in your company:

0-not at all, at most MS Excel ... 10-fully specialized tools

- Strategic costs of products/services (e.g. Target Costing, Life Cycle Costing)
- Quality cost collection
- Value Chain Analysis
- Benchmarking with other competitors
- Integrated financial and non-financial metrics (e.g. Balanced Scorecard)
- Competitor Cost Assessment
- Competitive Position Monitoring
- Shareholder Value Generation (incl. Economic Value Added)
- Customer Profitability Analysis
- Customer Equity

SESSION J: HIGHLY AUTONOMOUS SYSTEMS AND VEHICLES: SOCIETY, ECONOMY, TECHNOLOGY

AUTONOMOUS VEHICLES AND AUTOMATED DRIVING: STATUS, PERSPECTIVES AND SOCIETAL IMPACT

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Keywords

Automated driving, ADAS, road safety, connected car, cyber-security, Cyber-physical Systems, Safety, Security, Systems-of-Systems, societal impact, liability, ethical aspects, legal aspects

Abstract

Autonomous systems, automated vehicles in general and particularly the most popular concept of Automated Driving are not just a vision of a remote future – rather closed systems like metros and similar rail systems, air traffic, large logistic systems in storehouses and highly automated production lines have already autonomous systems in use. In open systems like road traffic, only first trials are under way, under severe restrictions. But all large automotive OEMs are active in this field since many years, building on the increasing number and capabilities of ADAS, Advanced Driver Assistance Systems, already in use or implementation.

Topics addressed are the European and national Roadmaps on Automated Driving or general on automated vehicles, the impact on transport in general (not only road traffic but also intermodal transport modes), and the potential benefits and threats to society and business. This includes increase of mobility to people not allowed or able to drive, the environmentally fascinating aspect of considerable reduction of the number of vehicles because of better utilization of vehicle fleets, new chances for transport optimization and reduction of resource usage, but also severe threats expected from the safety, cyber-security and privacy side of such highly automated, connected systems. Businesses will change dramatically, some becoming obsolete, but also new ones will be created. Additionally, legal, liability and even ethical aspects have to be taken into account.

1. Introduction – Autonomous Systems on the Rise

Automated driving and automated vehicles are not just a vision of a remote future – rather closed systems like metros and similar rail systems, air traffic, large logistic systems in storehouses and highly automated production lines have already autonomous systems in use. In open systems like road traffic, only first trials in public transport are under way, mainly on separated or predefined lanes, and prototypes of several manufactures in small numbers as trials.

There are several European and national Roadmaps on Automated Driving or general on automated vehicles around, including three from Austria, a short overview will be provided discussing state-of-the art, challenges for Research, Development and Innovation and, in the end, practical implementation for public use. A five-level approach from the conventional car to the fully

automated autonomous (driverless) car is already defined e.g. by SAE International, formerly called “Society of Automotive Engineers” (USA). This will have huge impact on road transport in the future, but also on multi-modal transport with free interchange between modes of transport, since the driver is no longer bound to his own car he is owing but can take any transport mode, e.g. high speed trains for long distance transport, and call for an automated vehicles at his final destination for the “last mile”. Besides comfort and enabling efficient road transport particular in cities even for people not being allowed or able to drive, another fascinating aspect to achieve a sustainable urban transport system is the chance to reduce considerably the number of vehicles required because they could be called on demand and after a drive do not occupy parking space for a long time because they will continue with their next order. This requires not only a considerable amount of functionality, sensors, actuators and control devices, situation awareness etc. but also integration into a new type of critical infrastructure based on communication between vehicles, and vehicles and infrastructure, and regional traffic control centers to optimize traffic as a whole and not just locally in the environ of the vehicle. A similar, but not so drastic effect is to be expected in other domains of application of highly automated or autonomous systems (industrial, rescue, health). This will make several businesses obsolete, but also create new ones which are taking up the new chances.

The author has used the example of Autonomous Vehicles for his lecture on “Emergent and Convergent Technologies” at the University of Applied Sciences FH Technikum Vienna as the topic for the scientific homework of his students, under the assumption that autonomous vehicles are operational in use with a very high coverage, raising the questions:

- Which markets will be disrupted?
- Which new markets will emerge?
- What are the major societal impacts and consequences? (benefits, risks)
- Liability, ethical and legal aspects
- What would you address for your (potential) business (niche) in this context?

which received high interest and raised some discussions and interesting answers.

Demanding challenges have to be met by research, engineering and education. Smart (embedded) systems (CPS – Cyber-physical Systems, combined building “Systems-of-Systems”) are regarded as the most important component and driver for industry in this area. They are a targeted research area for European Research Programmes in Horizon 2020, particularly in the industry-driven ECSEL Joint Undertaking Initiative (ECSEL JU, 2014), and in several dedicated Programmes (PPPs – Public-Private Partnerships like the “Green Cars Initiative”, euRobotics and the Electric Vehicles Initiatives). The European Commission has created the concept of the JTI (Joint Technology Initiative) ECSEL (Electronic Components and Systems for European Leadership) as a Joint Undertaking (JU), which in fact is integrating the three ETPs (European Technology Platforms) ARTEMIS-IA (ARTEMIS-IA 2016), EPoSS (EPoSS, 2009) and ENIAC (ENIAC, 2010).

In Austria, an Action Plan “Automated Driving” was initiated by bmvit (bmvit 2016), the Federal Ministry of Transport, Innovation and Technology, jointly initiated by experts from the Mobility and the ICT Division, based on the available work particularly in Austria on Roadmaps towards automated driving as mentioned before, including all major players in Austria, among them the ECSEL Austria Association. The Action Plan identified 7 “Use Cases”, and in the first Call for Automated Driving Proposals for “Testenvironments for Automated Driving” three Use Cases were selected:

- Safety by “Look-around” (vehicle-centric, sensors, actors and situation awareness, ADAS Testlab using simulation and a real environment))
- “New Flexibility”: automated and connected vehicles allowing high flexibility in intermodal transport
- “Well supplied”: automated and networked freight transport and logistics improving supplies and reducing critical resource requirements for a higher quality of life.

In the first Call several studies are expected how to best address these issues (probably five), in September a follow-up Call is planned for full project proposals (probably three). These three use cases meet very well what will be expressed as benefits of automated driving in this paper.

2. Evolution towards Fully Automated Vehicles – Roadmaps

The Austrian Research, Development and Innovation Roadmap for Automated Vehicles (see ECSEL Austria (2016)) took into account several existing roadmaps from different organisations with different focus and derived particularly for the Austrian situation what is relevant for R&D&I in Austria to meet the challenges of the future for Austrian industry. In the Automotive sector, Austria has no large OEM but a very strong industrial supplier base for international OEMs which is an enormous economic factor in Austria. Before the growth of the supply industry in Austria, which started a few decades ago, Austrian imports of automotive vehicles contributed very much to a negative export/import balance, but nowadays the automotive sector provides a positive contribution.

The main roadmaps taken into account were:

- EPoSS –European Roadmap on Smart Systems for Automated Driving (EPoSS (2015))
- ERTRAC – Automated Driving Roadmap (ERTRAC (2015))
- AustriaTech – C-ITS Strategy Austria (in publication), (AustriaTec (2016))
- A3PS – Austrian Eco-Mobility Technology Roadmap 2025plus (A3PS (2016))

Of course, there are some other visions and recommendations, e.g., from the AIOTI Alliance for Internet of Things Innovation, who provided several reports with recommendations for upcoming EC-programmes in the IoT sector, among those one of WG 09 on “Smart Mobility” (Oct. 2015), or from the 5G groups on “5G Automotive Vision” (ERTICO ITS Europe, 5G-PPP (2014)), arguing that 5G is a most important precondition for extensive Vehicle-to-Vehicle and Vehicle-to-Infrastructure communications in densely populated areas. Besides Automotive, the roadmap is in general on automated vehicles, e.g. it includes sections on railways, UAVs (Unmanned Aerial Vehicle) and Aerospace, waterways, off-road equipment and mobility infrastructure, the last being important for effective regional traffic optimization. A few selected typical results of these documents will be explained.

The basis for most considerations are the five levels of Driving Automation for On-Road Vehicles as defined by SAE (according to SAE J3016 (2014)), (see Figure 1). Most ADAS systems are on level 2, a few may be considered having reached level 3 (automatic Jam-Control, Parking Assistant, Emergency Stops, Lane Keeping):

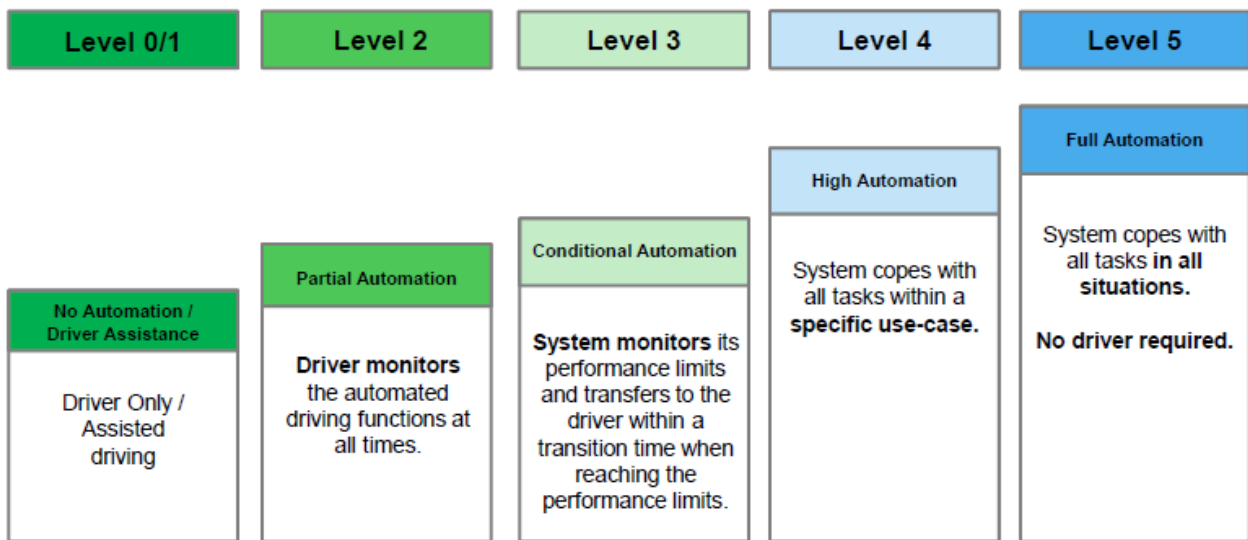


Figure 1: Levels of Automated Driving (SAE J3061) (see SAE (2014))

In more detail, the levels are described in the following table:

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/Deceleration	Monitoring of Driving Environment	Fallback Performance of Dynamic Driving Task	System Capability (Driving Modes)
Human driver monitors the driving environment						
0	No Automation	the full-time performance by the <i>human driver</i> of all aspects of the <i>dynamic driving task</i> , even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	Driver Assistance	the <i>driving mode</i> -specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	Human driver and system	Human driver	Human driver	Some driving modes
2	Partial Automation	the <i>driving mode</i> -specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	System	Human driver	Human driver	Some driving modes
Automated driving system ("system") monitors the driving environment						
3	Conditional Automation	the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> with the expectation that the <i>human driver</i> will respond appropriately to a <i>request to intervene</i>	System	System	Human driver	Some driving modes
4	High Automation	the <i>driving mode</i> -specific performance by an automated driving system of all aspects of the <i>dynamic driving task</i> , even if a <i>human driver</i> does not respond appropriately to a <i>request to intervene</i>	System	System	System	Some driving modes
5	Full Automation	the full-time performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> under all roadway and environmental conditions that can be managed by a <i>human driver</i>	System	System	System	All driving modes

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Table 1: Role of Human Driver and Automation in Automated Driving, Levels 0 – 5.

State-of-the-Art is at the moment Level 1 and 2, and partially Level 3 ADAS systems and combination of such systems. Claims of some car manufacturers to provide more capabilities in a serial production car are not proven to fulfill these functions under all foreseeable environments and

conditions, or are not sufficiently tested, as the recent TESLA incident demonstrates which happened in Autopilot mode and the driver not taking care of his duty to be attentive as was expected under the current law and driver's manual of Tesla. It proves that the functional safety requirement for high ASILs which are still dependent on the property of "controllability" (of the driver in a failure situation) may not be sufficient if such a "foreseeable misuse" of a driver over-relying on the a long time sufficiently working autopilot really happens (and this is "foreseeable"). The incident is still under investigation in detail, but it seems that the vision system is under certain conditions not able to identify properly a vehicle passing from the side on a crossing (see report on <http://www.nts.gov/investigations/AccidentReports/Pages/HWY16FH018-preliminary.aspx>). The only slightly damaged semi-trailer is shown in Figure 2), the Tesla went under this trailer without identifying the obstacle as such, killing the driver.



Figure 2: Shows the right side of the semitrailer at point of impact

This incident, although the first of this kind, which happened after about 100 Mio km of autopilot usage in total, which is not worse than the statistical average, drew a lot of attention on the subject and the trust in fully automated driving was at least shaken. The unfortunate vehicle after the accident is shown in Figure 3.

Some serious calculations resulted in the fact, that about 100 Mio km automated road driving is necessary to provide statistically relevant trust that the fully automated vehicle drives not less safe than a human driver! This is a severe barrier to real-world testing, and additional test by simulation and virtualization are necessary (the Austrian Automated Driving Test Environments Projects in the current Call mentioned before are aiming at that).



Figure 3: The unfortunate Tesla S - Passenger car damage from impact with semitrailer. (Source: Florida Highway Patrol.)

3. Stepwise Implementation and Legal Situation

The implementation therefore is planned stepwise – first automated functions will be enabled and allowed stepwise for use in low speed and well-structured environments:

1. Low speed: parking, jam control
2. Structured environment: Highway pilot (on highways only)
3. Urban traffic, the most complex one because of many non-automated systems (vulnerable road users like bicycles, people, many crossings and intersections etc.)

The legal situation is not appropriate for a short-term take-over of high-level automation in driving. The “Vienna Convention” from 1968 assumes and requires full control of the driver over his vehicle at all times, no automation systems interfering (not available at this time). An UN-Update (UN R 79) for steering equipment allows automated steering only at speed up to 10 km/h, aiming mainly at parking maneuvers. For autonomous cars with automated driving special conditions are set for prototypes, but always a human driver with driver’s license has to be on board and be able to take over control if necessary. Even for the testing environments on public roads in Austria some adaption and legal preconditions will be set up.

The Vienna Convention is not ratified in all countries, but vehicles have to be built according to these rules for export purposes and de facto it is accepted in most national laws (see Figure 4).

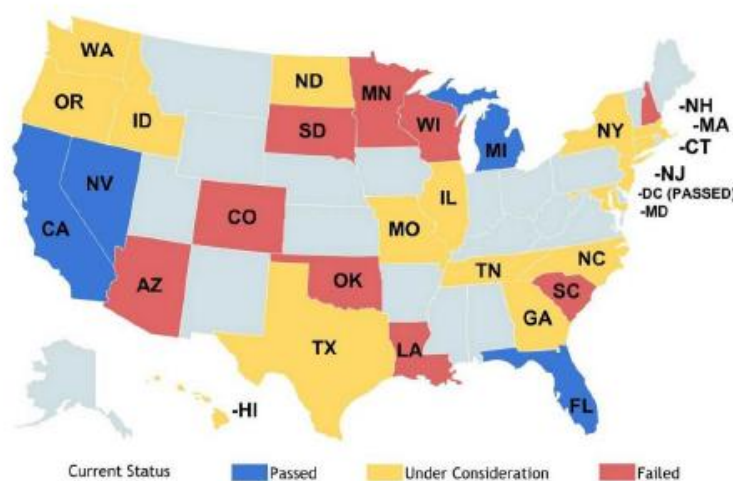
For partial automation, when the driver monitors continuously and can take over control anytime, no conflict with the Vienna Convention is encountered. For higher automation, an adaptation or interpretation is necessary for legal reasons.

In US, there is the situation quite different in different states: In some states, highly automated cars are allowed, but under certain restrictions (see Figure 5):

- Presence of driver able to take over
- Easy to switch between driving modes
- Data logging (to be able to reconstruct incidents and clarify rather complex liability issues)
- Different license plates to signal to other road users that automated mode may be used
- Additional/different insurance conditions



Figure 4: Status of ratification/signed of the Vienna Convention (Austria ratified 1981), Source Wikipedia 2015



[Source: Wikipedia, October 2015]

Figure 5: Current status in US: Automated Driving passed, under consideration and failed (2015)

A nice example of different license plates is shown in Figure 6 (source: Wikipedia 2015)



Figure 6: License plates in Nevada: left regular, right „Autonomous Vehicle“

4. Highly Automated and Autonomous Systems – the Cybersecurity Threat

4.1. Highly automated systems – Cyber-security Vulnerability and Privacy Violation

We have to tackle particular aspects of the three levels of software-intensive networked, highly integrated embedded systems which build the autonomous systems. These levels are known as

- Embedded systems (software-intensive systems, integrated in a hidden or visible manner in everyday devices, mobile or fixed, inside or outside us)
- Cyberphysical systems (combined complex embedded systems with sensors, actuators, integrating physics, mechatronics, intelligence, decision-making and perception)
- Systems – of – systems (aggregation of systems, composed of interconnected autonomous systems originally independently developed to fulfil dedicated tasks).

The design, operation, and protection, but also risk assessment, validation, verification and certification, maintenance and modification throughout the life cycle of these systems have to take into account the interplay between humans, environment and systems. Systems must be robust to cope with these problems in an adaptive manner (“resilient systems”) (Schoitsch, (2013), (2015)).

Massively deployed autonomous or highly automated systems applications of high potential for safety, security and privacy risks are arising in context of

- The grid control approaching private homes: smart grids for efficient power distribution, but our civilisation is very sensitive on loss of power because of almost all services and protective measures depend on appropriate power availability – on the other hand a lot of data on individual behaviour, habits, information on presence and absence etc. become available, endangering privacy, in:
 - Building automation and control (heat, cooling, elevators, fire alarm and fire fighting, doors/entrance and rescue), at least with remote maintenance access,
 - AAL (Ambient Assisted Living) and health-care (from remote monitoring to automatic or triggered intervention),
- Highly automated process industry plants, power plants and manufacturing plants, even with remote “control via internet”, and particularly autonomous but interconnected systems, e.g. robots, cooperating with each other and humans,
- Large machinery and construction vehicles operating (semi-) autonomous, service robots in human populated environment and robotic farms, off-road vehicles and equipment,
- Transport, particularly road vehicles utilizing car2car and car2infrastructure communication for (semi-) autonomous driving, platooning and road safety in general; security and particularly privacy are endangered.

For the purpose of this paper, particularly the last two bullet points are of interest: The highly automated car (not only the connected one in Car2Car and Car2Infrastructure, but already single cars with some IP-based connections for human communication and entertainment) has shown sever vulnerabilities because of incomplete separation of driving/car automation & control systems and entertainment, communication and maintenance systems.

4.2. Integration into a critical infrastructure – Safety and Privacy Violation

V2V and V2I (often generalized by V2X or C2X) are expected to make future road traffic much more efficient and safe, and many (research) projects, prototypes and evolving communication standards are engaged in this direction, with the final goal of truly autonomous driving; the first step would be platooning of “car trains” on high ways (“Highway Pilot”), i.e. a bunch of vehicles following a lead vehicle autonomously, controlled by information via V2V communication, and supported by a number of sensors controlling near distance behavior and safety.

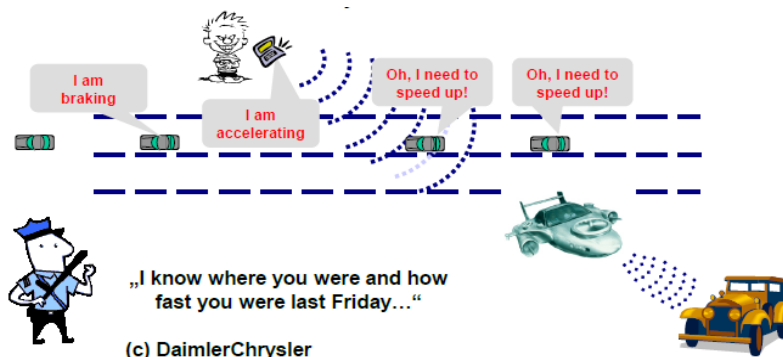


Figure 7: Platooning road traffic: safety, security and privacy issues

This concept implies a number of safety, security and privacy issue – and the liability issue is far from being resolved legally (who is responsible in case of an accident? The first driver? How strong is the individual driver in control of his vehicle, how can alertness be guaranteed?). An additional problem is the long-term guarantee of security, keys can be broken, electronics can wear out partially, there must be alternatives in case a car is used ten years or longer, with the same devices inside or not, etc.).

4.3. Safety and security risks through Maintenance

Imagine that manufacturers of cars see advantages in doing of remote maintenance (update) of in-car software (updates, error corrections) in the field via wireless communications to avoid expensive call-back. It works (sometimes) with space vehicles and satellites – why not for cars? (see Figure 8) (Schoitsch (2015)).

Here again, the hazards and risks need very thorough analysis – it has to be guaranteed that only in a safe situation and in a secure manner downloads of proven updates for the actual configuration of software in the individual car are possible, taking into account many complex scenarios – just to download when the car is not moving is for sure not sufficient, since many scenarios can be imagined where cars stop, but have to restart immediately if required by the traffic situation (Schmittner, 2015).

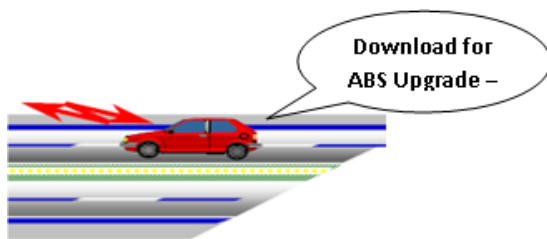


Figure 8: Software download in the field?

At the moment, this is only possible in a standardized way via diagnostic interfaces in a qualified maintenance station. But several automotive OEMs already supply critical updates via over the air update systems. As an example, the security vulnerability in the BMW ConnectedDrive was resolved by sending a security patch via the BMW ConnectedDrive system (BMW, 2015).

5. The Highly Automated and Connected Car: A Hacker Paradise?

The most fascinating aspect of connected cars and highly autonomous driving is the chance to achieve a sustainable urban transport system by reducing considerably the number of vehicles required because they could be called on demand and after a drive do not occupy parking space for a long time because they will continue with their next order. This requires not only a considerable amount of functionality, sensors, actuators and control devices, situation awareness etc. but also integration into a new type of critical infrastructure based on communication between vehicles and vehicles and infrastructure, and regional traffic control centers to optimize traffic as a whole and not just locally in the environ of the vehicle.

5.1. Modern Cars: Increased attack surface of an “open system”

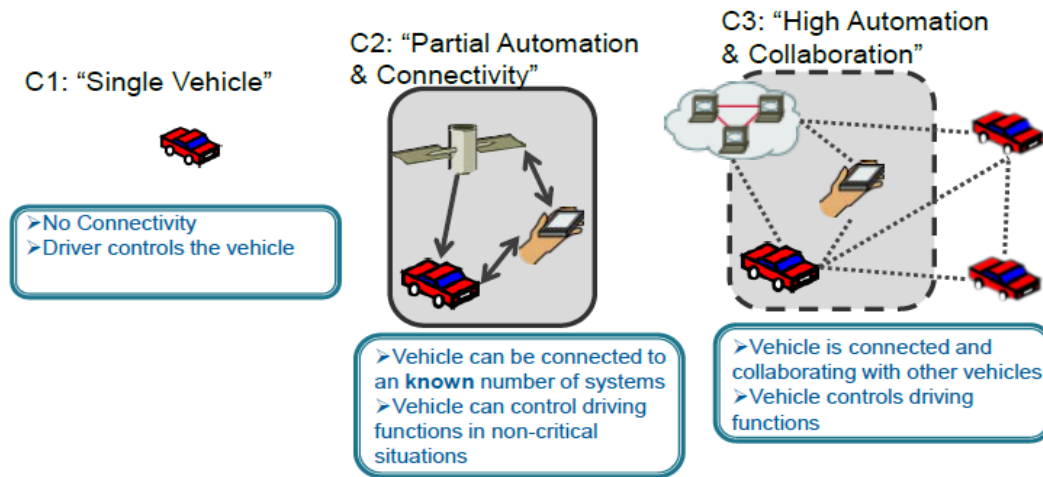
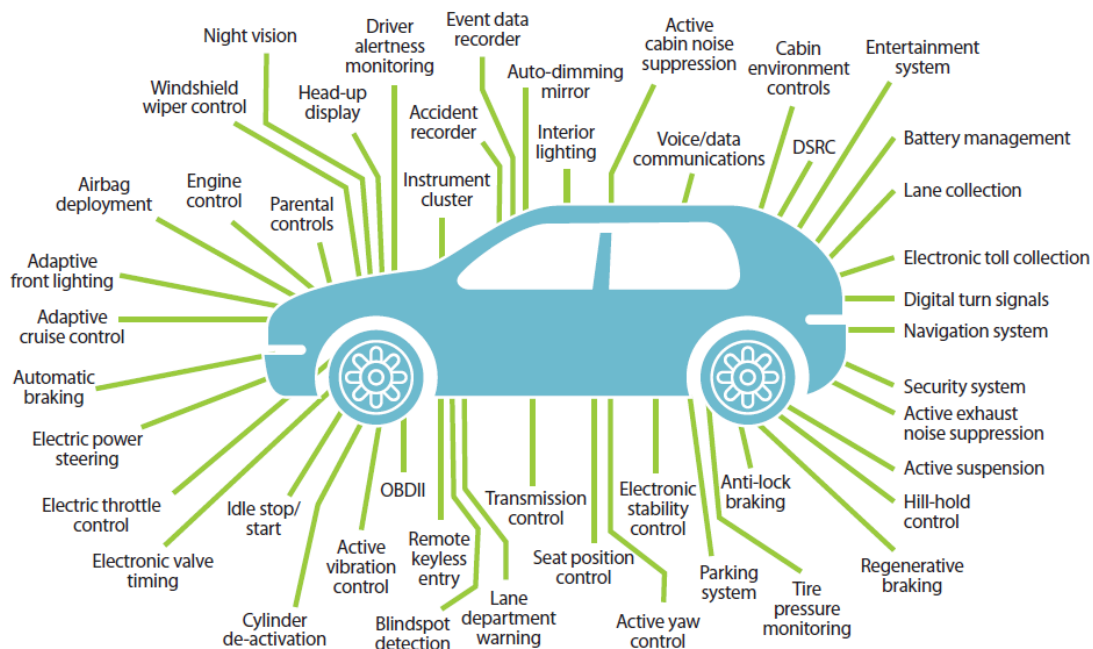


Figure 9: „Open System“ car – single vehicle and connected vehicles - increased attack surface, privacy

Any modern car, even if not “connected” or “highly automated”, has many access points for control from outside with safety and security impact (Figure 9). We have to consider three different levels of automation with increasing order of complexity and risk of cyber-attacks.

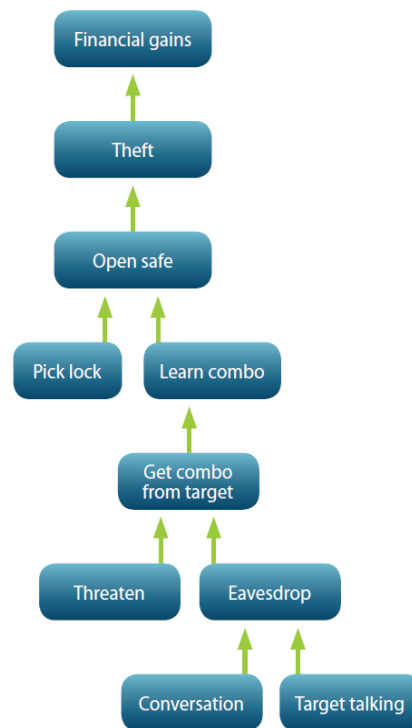
In TU-Automotive (2016), an example map of electronic systems in a modern car is shown – all of them connect in various ways and potential targets of attacks, often via curious paths and accidental knowledge (see Figure).



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Figure 10: Example map for E/E/PE functional units in a modern car – connected and potential attack targets

A model to understand hackers’ motivation and draw a conceptual diagram of threats is provided by Schneider (1999), which should help to systematically describe the problem (Figure 10).



Adapted from Schneier (1999)

Figure 11: Attack tree documenting a safe-cracking as an example

The report analyses the hackers motivations (different hacker types: Tuners (of engines etc. by electronic means), academic security researchers (mainly positive to detect vulnerabilities or develop countermeasures), white hat hackers (often employed to identify weaknesses), black hat hackers (use similar tools as white hat hackers, but with criminal intent), grey hat hackers (ethically questionable), vehicle theft (stolen by order), financial theft and damage (and blackmail), remote surveillance of people and spying) and attack targets. These are units, buses and communication means and are analyzed in some detail: Bus bridges, infotainment, OBD-II (diagnosis and maintenance), Bluetooth, Wi-Fi, CAN Bus, dedicated smart phone interfaces, TPMS (Pressure Monitoring System), Immobilizer (see Schoitsch (2013), several possible attack targets), telematics manufacturer and after-market telematics (adds additional risk afterwards by using legally interfaces), passive keyless entry and start systems, e-Call, various ADAS system features, DSRC (Digital Short Range Communication) and Sensor Networks. If we look at this list and the detailed discussion what already has happened in the past we have a rich menu for Hackers – an ideal Hacker Paradise!

5.2. Some popular examples of “Hacks”

5.2.1. The Jeep Cherokee Case

In “Wired”, 2015, Andy Greenburg reported his experience on sitting in a hacked car (although he knew that it will be hacked, so there was no real surprise – only the surprise how far this is possible to manipulate his Jeep Cherokee via remote hacking) in an article „Hackers remotely kill Jeep on the highway – with me in it“. Imagine, if that happens unexpectedly! Panic is the least result!

<http://www.wired.com/2015/07/hackers-remotely-kill-jeep-highway/>

It was done stepwise: The hackers, Charlie Miller and Chris Valasek, started with uncritical effects, then increased the pressure on the driver via remote control:

- Stepwise take over: driver could not interfere by manual control of vents, radio ultra loud, wind shield wipers
- Photo of hackers appeared on car display
- Interstate 64 ramp: speed control, braking lost
- Commandeered steering wheel
- Then stopped action when Alan cried for help.



Figure 12: The hackers in action – and the end of the story (fortunately done in a controlled manner)

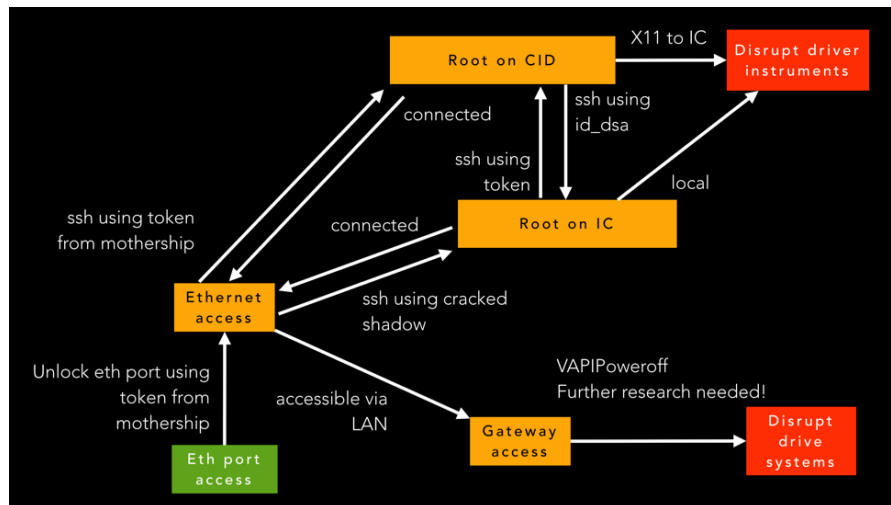
5.2.2. A few other examples

Corvette: Control brakes via insurance OBD dongle



<http://www.wired.com/2015/08/hackers-cut-corvettes-brakes-via-common-car-gadget>

Tesla: Remote manipulation of instruments or drive systems



<https://blog.lookout.com/blog/2015/08/07/hacking-a-tesla/>

VW: Disable Airbags via manipulated USB flash drive



http://www.theregister.co.uk/2015/10/23/hackers_pop_mechanics_laptops_to_silently_disable_car_airbags/

Nissan Leaf Electric Car Hack Vulnerability disclosed

BBC Sign in News Sport Weather Shop

NEWS

Home Video World UK Business Tech Science Magazine

Technology

Nissan Leaf electric cars hack vulnerability disclosed

By Leo Kellon
Technology desk editor

24 February 2016 | Technology



<http://www.bbc.com/news/technology-35642749>; <http://www.troyhunt.com/2016/02/controlling-vehicle-features-of-nissan.html>

Vulnerability communicated to Nissan on 23. Jan by Troy Hunt - remote Access to charging, climate control, driving history... Vulnerable Service deactivated on 25 Feb.

6. Existing and Upcoming (Automotive and Industrial) Security Standards

Security standards like ISO 15408 (Common Criteria - CC) defines EALs (Evaluation Assurance Level EAL 1 - 7, quite different from the ISO/IEC 61508 group probabilistic risk levels (SIL 1-4), which are not applicable to security). This standard helps evaluate, validate, and certify the security assurance of a technology product against a number of factors, such as the security functional requirements specified in the standard. Hardware and software can be evaluated against CC requirements in accredited testing laboratories to certify the exact EAL (Evaluation Assurance Level), i.e. its product oriented. Requirements for evaluation become stricter from EAL1 - Functionally tested, EAL2 - Structurally tested, EAL3 - Methodically tested and checked, EAL4 - Methodically designed, tested and reviewed, EAL5 - Semi-formally designed and tested, EAL6 - Semi-formally verified, designed and tested, to EAL7 - Formally verified, designed and tested.

ISO 27002 (formerly ISO/IEC 177799) establishes guidelines and general principles for initiating, implementing, maintaining, and improving information security management in an organization. It contains best practices of control objectives and controls in information security management and looks at security from a systems perspective, not only IT devices.

IEC SC65C Standards: Industrial networks (covering industrial communications security)

This subcommittee handles an enormous number of standards and subparts of standards on (industrial) buses (field bus standards, real-time Ethernet, etc.). Very important for the safety and security aspect is the series IEC 61784 (Industrial communication networks – Profiles), particularly (1) Profiles for real-time networks (IEC 61784-2), (2) functional safety fieldbuses (IEC 61784-3-xx) and (3) IEC 61784-4 - Profiles for secure communications in industrial networks

IEC TC 65 WG 10 – IEC 62443 and ISA 99 standards: a major activity is centred around the series of IEC 62443 - Industrial communication networks - Network and system security, consisting of several parts, including e.g. System security requirements and security assurance level, Patch management, and Certification of IACS supplier security policies and practices, focused on system level security (not fieldbuses). This work is now done in close co-operation with ISA (Instrument Society of America, ISA 99 committee). IEC 62443 defines 4 SLs (Security Levels) which are of qualitative nature based on the level of efforts and skills required to successfully attack a system:

- SL1: casual or coincidental violation
- SL 2: simple means: low resources, generic skills and low motivation
- SL 3: sophisticated means: moderate resources, IACS-specific skills and moderate motivation
- SL 4: sophisticated means: extended resources, IACS-specific skills and high motivation

Functional Safety Standards for several domains based on the generic basic safety standard ISO/IEC 61508 have evolved since 2000 after IEC 61508 Ed. 1 was completed. The automotive functional safety standard ISO 26262 Ed. 1.0 was published 2011 (parts 1-9) and 2012 (part 10).

The functional safety standards of the first generation did not tackle the challenges of highly connected “systems-of-systems”. Security in an open vehicle system will now become a new factor to be considered in system engineering and safety analysis.

IEC 61508 Ed. 2.0, finished 2010, took as first functional safety standard into account that security may impact safety of a system. Therefore it requires consideration of security threats (*“malevolent and unauthorized actions”*) in risk and hazard analysis, with accompanying measures to be undertaken throughout all lifecycle phases. A security threat and vulnerability analysis should be conducted if a security threat is identified as a potential cause for a hazard in order to specify security requirements (IEC 61508, Part 1, 7.5.2.2). Security has then to be reflected in the safety manual as well (Part 3, Annex D 2.4). In notes are definitely addressed IEC 62443 and ISO/IEC TR 19791 (Part 1, 1.2, k) for guidance on details.

In the preparation phase of IEC 61508-3 Ed. 3.0 (Software part) it was decided to look at the ongoing activities in IEC with respect to “security-aware safety” and to provide more mandatory and informative guidance on a coordinated approach to security in context of functional safety.

In IEC TC65 (Industrial-process measurement, control and automation) considerable concerns arose with respect to the safety impact of security issues in industrial automation systems. An Ad-hoc Group (AHG1- “Framework towards coordination of safety and security”) was founded to look into the issue and provide recommendations how to handle the co-ordination of security issues in functional safety standards. It has finished its work with a report and recommendations, and started as IEC TC65 WG 20, “Bridging the requirements for safety and security”, writing a TS (Technical Specification) on this topic.

David Strickland, Chief Administrator for the National Highway Traffic Safety Administration (NHTSA), stated: *“...electronics systems are critical to the functioning of modern cars, and are becoming increasingly interconnected, leading to different safety and cyber security risks. (...) With electronic systems assuming safety critical roles in nearly all vehicle controls, we are facing the need to develop general requirements for electronic control systems to ensure their reliability and security”*.

The Austria proposal for ISO 26262 to include the interface between safety and security in the functional safety standard for road vehicles was taken up and led to contributions of a task group to ISO 26262 Part 2 (Management of functional safety) and Part 4 (Product development at system level) , now included in the DIS (Draft International Standard).

Additionally, ISO TC 22 SC 32 started TWO new work items on the same topic, one from the German DVA and DIN on “Road vehicles – Automotive Security Engineering” and SAE on “Road vehicles – Vehicle Cybersecurity Engineering”, based on the existing SAE Guideline J3061 (Cybersecurity Guidebook for Cyber-Physical Vehicle Systems). Both were accepted, but only one standard is envisaged, and the most important question is which approach to follow. Whereas the German proposal tends towards an independent Cybersecurity Standard, not considering the safety impact, the SAE proposal takes up both: a safety-related part where both sides (safety and security) are taken into account following ISO 26262 life cycles, and a security related part, where issues like privacy and confidentiality without safety impact are handled. In the procedural vote, the Austrian group from AIT proposed the following, tending to the SAE approach:

“Austria approves the resolutions C893(explanation: merge both NWIP) and C894 (explanation: NWIP should fall under PSDO – Partner Standard Development Organization Agreement – between ISO and SAE, to get highest acceptance in the world) but would like to remark that the combined approach should follow mainly the direction proposed in NWIP3586. It is of utmost importance to consider safety in the cybersecurity process and to follow an engineering approach suitable for the automotive domain. While cybersecurity may require some extensions, especially in the maintenance and operations phase it should, in our opinion, in general follow the ISO26262 lifecycle. Safety and Security is required for issues like advanced driver assistance systems with communication features. While additional issues are also relevant for security the primary goal are

safe vehicles. The approach proposed in SAE J3061, to describe a combined process for safety and security critical systems and only use a stand-alone cybersecurity process for systems without safety relevance should be adapted for the new standard.

Austria disapproves resolution C895 (explanation: German lead, kick-off in Munich) and would prefer a Kick-Off Meeting organized by the US. US led the effort on the J3061 which has been well received and should therefore also lead the Cybersecurity NWIP.”

Hopefully, the new standards, ISO 26262: 2018 for functional safety and the Vehicle (Automotive) Cybersecurity Engineering Standard will facilitate safe as well as secure automotive systems!

7. Business, Legal and Societal Impact

In this chapter, a short overview is given on some business, legal and societal issues that will be impacted by autonomous vehicles if they are massively deployed and used.

7.1. Disrupted Markets and New Business

Several markets will be disrupted – services connected with driving a car will be reduced if automated vehicles fulfil their missions without any staff – only when loading and unloading people will still be necessary, but only the sender and receiver of freight need to be there. Taxi drivers will oppose such changes (as they do now with respect to Uber, or in the past the coachmen against railways). Public transport will change as well – bus lines in areas which are not densely populated will be replaced by “automated cars on demand”, the structure of public transport networks will change. The role of traffic police will change as well – maybe they will have to become support staff for the automated vehicles in case of defects etc.

OEMs have already started to think about their changing role: the result of a large number of autonomous vehicles used on demand should reduce considerably the number of vehicles, but on the other hand require particular fleet management and “short-term leasing”, so they could become car sharing and fleet management organizations. Service of the now more critical infrastructure will be another challenge with a positive business effect.

The service sector could change as well: Instead of people going to a shop, or to a doctor, or to a therapy, these people could come to you or even do services in the car (if equipped properly). One particular possibility could be the “emergency response” – autonomous vehicles could in case of an emergency switch to an emergency mode and transport a person as fast as possible to the nearest available hospital. A lot of nice ideas have been brought up in the discussions and the homework in my lecture at the University of Applied Sciences FH Technikum, Vienna, on “Emerging and Converging Technologies”. New business models will emerge, and new products needed for these markets (besides the development, production and integration of technologies for autonomous driving!). Things we would not even imagine today could become quite normal in the future!

7.2. Liability, Ethical and Legal Aspects

One of the questions raised was on the potential impact on liability and insurance. Today, the driver has to learn and train to get a drivers’ license (but since although almost everyone gets it, so the qualification is not as high as for pilots, as an example). If the autonomous car can be used by everyone, who has to get the drivers’ license? Since the driver in the extreme case does no longer exist, the liability lies with the OEM (manufacturer), i.e. “the car has to do the examination to get a

driver's license". Liability will be mainly with the manufacturer – VOLVO Trucks was one of the first OEMs declaring that the company will take responsibility and liability in this case.

The most critical phase will be the transition phase between conventional driving and autonomous driving which will happen continuously but need some time. There are studies in the US saying that a "conventional" driver will need particular awareness training instead of the general driving training to be able to operate the highly, but not fully automated car, because (as demonstrated by the Tesla S2 accident) alertness (and therefore controllability) is considerably reduced.

For insurance companies, the scenario will change considerably. Since today, 90% of accidents are claimed to be caused by humans, ADAS will reduce considerably number of accidents (hopefully). The consequence should be that the cost of insurance should be reduced for the driver because of reduced risk. For fully automated vehicles, the user will no longer be responsible and liable (as today in public transport means), the liability and as consequence the insurance cost will be with the OEM (manufacturer). In the long term, the insurance business in the automotive sector will be considerably reduced. The German KPMG believes that the turnover in this business will be reduced by 45% within a decade.

The legal aspects with transport safety and rules like the "Vienna Convention" have been discussed as well before.

At the moment, most effort and thoughts are on technological and liability issues – but there could be ethical issues as well, when the computers take decisions. If we construct a scenario, that the automated vehicle identifies a situation, where either the vehicle with the driver or a person on the street (or several persons, old or young) are endangered in any case – which risk to take? Is the "programmer" responsible if somebody is killed because of the decision (e.g., rather hit the older person than the younger one, or endanger the driver and the car? Can a computer be "selfish"? That's only a sketch, but it should just draw attention to this issue.

7.3. Societal Impact (Benefits and Risks)

These topics have partially already been covered in previous chapters. This includes benefits like reduction of overall resource usage, social inclusion of people like elderly ones, people with special needs and the like into the world of high mobility, transport optimization, less parking space needed in cities, better utilization of road capacity, positive environmental impact e.g. by lower emissions because of moderate automate driving behaviour. "Demographic change" is another important issue – hopefully, the new technologies allow us to be kept longer in the loop as independent living persons! Safety and comfort are declared goals of the autonomous systems development – but this can become a threat as well!

Risks are changes in business and labour markets which are not compensated by alternative businesses and jobs, and the risk of additional safety, security and privacy violations. It is difficult today to understand and foresee how "disruptive" autonomous driving (and autonomous systems in general) will be for our society – we are now starting to hand over tasks, responsibilities and decisions to machines without being in the loop any longer!

8. Conclusions

Automated (autonomous) driving is a most significant change for society, economy, the automotive and public transport industry in its history. National programmes, particularly in Germany and Austria, but also in other European countries, and the EC in its H2020 Research Programmes

(including several PPPs and the ECSEL JU) and the US National Science Foundation have both identified autonomous vehicles and systems as key research areas. Developments towards autonomous systems and vehicles are becoming increasingly important, in the first steps mostly called “highly automated”. Advances are expected with respect to intervention (collision avoidance), and co-ordination (traffic management and control in air, sea and ground), with huge impact on environment and reduction of resource usage and consumption, for a better sustainable economy (ECSEL MASRIA 2014 and 2015, ARTEMIS-IA SRA 2016). Nevertheless, we have to take care that potential threats to safety, security and privacy are avoided and ethical as well as liability and legal issues resolved in time.

Just now, effort is undertaken to consider security in context of safety-critical systems and functional safety standards, particularly in IEC 61508, Ed. 3.0, in ISO 26262 (automotive) - 2018, and on a general basis in the IEC TC 65 WG 20 “Bridging the requirements for safety and security” as well as for ISO TC22 SC 32 for “Road vehicles – Vehicle (Automotive) Cybersecurity Engineering”, hopefully aligned and contributing to safe and secure automated driving systems for the benefit of society and environment.

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SEARCHING FOR TRAFFIC ACCIDENT CLUSTERS TO INCREASE ROAD TRAFFIC SAFETY

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Traffic accident, cluster analysis, early warning system about a traffic accident, data mining

Abstract

This paper deals with issues related to creation of clusters of traffic accidents in order to increase road traffic safety. The motivation for the search of such clusters is their subsequent utilization in a system of an early warning about a risk of a traffic accident, whose concept is also explained in this paper. Selected methods of cluster analysis and the possibility of their usage in creation of traffic accident clusters in geographical data are described. Results obtained by these methods are discussed for selected examples of dangerous locations.

1. General

Recent events keep proving that it is necessary to look for new approaches to increase road traffic safety. Apart from approaches aiming to effectively reduce consequences of critical events which already happened, it is important to look for new approaches which would prevent such situations from happening in the first place. Available data show that 1,2 million people die in traffic accidents globally every year and more than 50 million more are injured (1,7 million of which in the EU) (Toroyan, 2013). The proof of these unfavorable statistics can be the multiple-vehicle collisions which happened in Slovenia and Egypt at the end of January 2016 (“Four die in Slovenian 50-car pile-up”, 2016). The high rate of traffic accidents results an enormous economical loss, which accounts for 1 % – 3% of GDP in most countries. Similar loss is also caused by unexpected situations on roads, which take away a very precious and economically expressible commodity from road users – their time. Drivers are more and more frequently forced to stop or drive extremely slowly because of road blocks caused either by accidents or simply too much traffic, while the intensity of traffic keeps increasing. Current standard as well as “sophisticated” channels aiming to increase drivers’ awareness of situation on the road do not provide the necessary information support in most cases. We will try to introduce our solution to this problem in a form of an early warning system about a high risk of a traffic accident in this paper. The system is based on historical traffic accident data and searching for clusters of traffic accidents in geographical data. Other researchers of our department also deal with issues of risk and emergency management in other perspectives, e.g. Podaras (2016) handles mitigation of long lasting crisis risks.

2. Basic Concept of a System of Early Warning about Traffic Accidents

The conceptual design of the solution we suggest can be described as a system which predicts the risk of a traffic accident in real time using recent conditions and other attributes describing the situation. Models created with data mining algorithms are used to predict the risk of a traffic accident. The basic principle of such system has already been described in (Lamr & Skrbek, 2015). One of the main pillars of the concept is the availability of traffic accident data. The data are provided by the Ministry of Transport of the Czech Republic within the framework of Unified Traffic Map project. This project is available at <http://www.jdvm.cz>. Because of this project it is possible to search through accidents on the web, obtain a detailed report for each accident and to plot it on a map. There is a possibility to transform the traffic accident data from the web of the Ministry of Transport to a form where it can be utilized further – for example by data mining techniques. Currently there are about 600 000 records of traffic accidents in the Czech Republic, each containing 44 attributes. More information about the dataset you can find in our previous article (Lamr & Skrbek, 2015).

The concept of our system of early warning about a high risk of a traffic accident comprises of two fundamental parts. The first – control part – gathers, processes and distributes data on traffic accidents. The second one – user part – creates and distributes prediction models. The user part of the system evaluates situation in real time and informs drivers about a possible risk in a suitable way. The basics of the system are shown in figure 1.

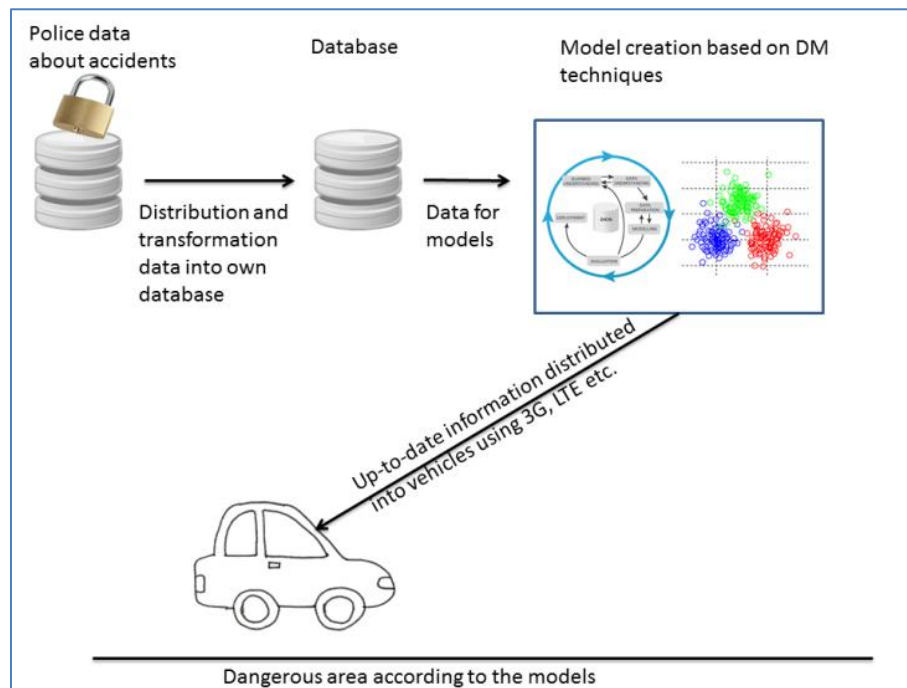


Figure 1: Draft of the most important parts of the system (Lamr & Skrbek, 2015)

2.1. Control Part

The control part of the system gathers and processes heterogeneous data on traffic accidents from the police of the Czech Republic. It is currently possible to obtain data from the Unified Traffic Map using scripts written in Linux software cURL, which is a tool used to transfer data over protocols such as HTTP, FTP etc. The data obtained this way must be imported in a database for further processing by additional scripts. Therefore, the database of traffic accident reports is

incorporated in the control part and used not only for data mining. For now the data are saved in MySQL relation database running on a Linux device. A custom database model was designed to save the data, which respects traffic accident circumstances recorded by the police. The data are transformed to a suitable form and saved in the database using scripts. In the beginning the database should be used to develop and create suitable models which describe traffic accident aspects. Complex models predicting the risk of a traffic accident in real time and place would be developed later.

2.2. User Part

The user part of the system is supposed to use prediction models in a special device inside a vehicle (client), which evaluates the risk of a traffic accident in real time, based on time, location, road condition, vehicle condition, weather and other attributes reflecting the situation. Most modern vehicles are already equipped with sensors, which can provide necessary information. The device in the vehicle compares the current situation with prediction results and if the similarity between these two is high the driver is warned. The warning occurs if there were multiple similar traffic accidents at that particular location under similar conditions. In practice, however, we encounter dangerous locations which are not specific (for example by time, weather or other attributes). These locations are called general clusters and they are created solely based on a frequent occurrence of traffic accidents in a given location. In theory, the operation of the user part can be realized in 3 different ways. All communication of the prediction device in the vehicle with the control part should be carried out via WIFI or LTE 4G networks. Further information and details about the communication between the user part and the control part can be found in (Lamr & Skrbek, 2015).

3. Selected Algorithms for Creation of Clusters of Geospatial Data

Cluster Analysis is one of many methods of obtaining knowledge from databases. Cluster analysis methods belong to a group of data mining algorithms based on learning without a teacher. The aim of data clustering is to divide a set of objects located in a modeling matrix to several clusters based on the similarity between their properties. The similarity of objects is determined based on attribute values of studied objects. Objects should be divided to clusters to make the resulting clusters full of objects as similar to each other as possible. So called distance functions are used to determine the similarity very often. There are, however, many clustering algorithms and it is important to select a suitable one for a given task. Clustering algorithms are most commonly divided to hierarchical methods, divisive (e.g. k-means), density based methods (DBSCAN, OPTICS) and methods based on models or grids (Han & Kamber, 2006).

Clustering algorithms which appear to be the most suitable for searching for clusters in geographical data are DBSCAN and OPTICS. These belong to a group of algorithms based on density. Density based algorithms are able to look for clusters of any shape. The advantage of these methods is the fact that unlike division based methods, they can find clusters of any shape, not only spherical. Clusters formed by density based algorithms are understood as areas with high density and they are separated from each other by areas with low density – noise. This results in the fact that some objects do not have to be assigned to a cluster.

At first we chose DBSCAN (Density-Based Spatial Clustering of Applications with Noise) algorithm to create clusters of traffic accidents. This algorithm was selected because of its good applicability for special data. In order to outline the principle of operation of this algorithm we need to define at least some terms first.

The input parameter of DBSCAN algorithm is a data set D , in which we will look for clusters and the size of ε -environment. Furthermore let us define $d(p; q)$, which is the distance between points p and q . Environment of object p , defined by the radius of ε can be noted as $N_{\varepsilon}(p) = \{q \in D | d(p, q) \leq \varepsilon\}$. We call object p a core if its environment contains at least a selected number of objects $MinPts$, which can formally be noted as $|N_{\varepsilon}(p)| \geq MinPts$.

The DBSCAN method operates as follows: first, it searches through the input data set and for each object in the set it checks ε -environment. If the ε -environment contains at least as many objects as the set $MinPts$ value it creates a new cluster and subsequently it iteratively searches for objects which are directly reachable based on density from the core of the cluster. If it is impossible to attach any more objects to the cluster it continues searching through the data set and repeats the procedure for all objects which have not been assigned yet.

The strength of DBSCAN algorithm is the fact that it does not require any information regarding the number of required clusters in the beginning. DBSCAN takes noise into account, it can find clusters of any shapes and sizes and it can even pinpoint clusters which surround each other perfectly. Because of these properties it can locate clusters which cannot be located by other algorithms, such as K-means. Only two parameters are required in the beginning in order to create clusters and it is usually not sensitive to the order of points in the database (Ester, 1996).

Unfortunately the algorithm is sensitive to both input parameters ε and $MinPts$. When parameter ε is reduced it is usually necessary to change $MinPts$ as well. The geometrical shape of located clusters is affected when different distance functions are used. The most common metrics is Euclidean distance, which is, however, not very suitable for highly dimensional data. It is also difficult to define density for such data. DBSCAN algorithm does not operate very well with data sets with changing density.

Another suitable algorithm for searching for clusters of traffic accidents is OPTICS (Ordering Points to Identify the Clustering Structure), which is very similar to DBSCAN. OPTICS tries to solve one of the problems of DBSCAN – it is able to locate meaningful clusters in data with various densities. To solve this problem, the algorithm orders the input data linearly to a sequence so that the closest points are adjoined. Furthermore, additional information is saved to each object, which is later used during the algorithm (coreDistance and reachability distance) (Ankerst, 1999).

4. Model Situations and Searching for Traffic Accident Clusters

The operation principle of the early warning system can be illustrated on a turn which is labeled as the most dangerous turn of all A-roads by the Centre of Traffic research of the Czech Republic. The situation is shown in figure 2.

The on-board device in the vehicle evaluates the situation as potentially dangerous (it is very similar to conditions in the past when an accident happened) and warns the driver immediately

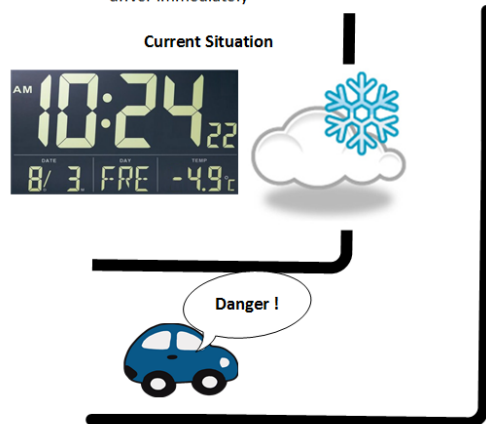


Figure 2: Operation of the system in a dangerous location

This turn is located on an A-road nr. 27 near municipality Pšov in Podbořany region in the north of the Czech Republic. This road is a vital connection between the north and Pilsen and it is frequently used by trucks. During overtaking, drivers frequently enter the opposite lane with a part of their vehicle and thus put themselves as well as drivers coming from Pšov in danger. Furthermore, most cars exceed speed limit of 30 km/h only a few meters before the turn. If the road is wet, or even frosted, their cars easily slide and a collision is almost inevitable. (“Toto je nejnebezpečnější zatáčka v zemi”, 2016). It is clear, that despite multiple traffic signs drivers underestimate this turn. If vehicles were equipped with the early warning system about a high risk of a traffic accident, which compares actual weather conditions with prediction results, it would be possible to warn drivers only in situations which are really dangerous. We believe that if drivers receive only adequate information, which is truly crucial for their safety, they will trust this system and adjust their driving style accordingly.

To illustrate cluster searching we selected a geographical area which belongs to Podbořany region according to the Czech police. This set contains 430 records of traffic accidents from 2007 to 2013.

The area of the dangerous hairpin turn is labeled as Cluster 55 by DBSCAN algorithm and it contains 71 cases. Let us take a detailed look at this set. Most accidents occurred between 14:00 and 15:00, luckily most of these accidents were not tragic – there were no fatal ones and only in two cases people were severely injured. In about 30 % of cases people got slightly injured and usually only 1 person was injured in a single accident.

The fact that a half of the total accident count happened during June, July and August is also interesting. If we examine this group of accidents further, we will find out that in 90% of all accidents the cause was speeding, specifically not adjusting the speed to road conditions. In 63 % of cases the situation was worsened by weather conditions in the form of rain. In more than 75 % cases the road surface was marked as wet. In 55% of cases the visibility was marked as reduced due to weather conditions by the police.

The results obtained by density based algorithm (DVSCAN) and hierarchical algorithm (K-means) can be compared in fig. 3 and 4. The clusters in fig. 2 were created using DBSCAN algorithm in KNIME software. The clusters were created on a data matrix containing 431 records of traffic accidents in the vicinity of “the most dangerous” turn in the Czech Republic near municipality Pšov. Setting parameters of $\text{eps}=0,025$ and $\text{MinPts}=2$ for DBSCAN algorithm appears to yield the best results. For this setting the algorithm locates 87 clusters in this area, or more precisely 86

because the last cluster is noise. Remote values are labeled as noise in most cases, which is correct. Records of traffic accidents belonging to the same cluster are shown in the same color on the following figures.

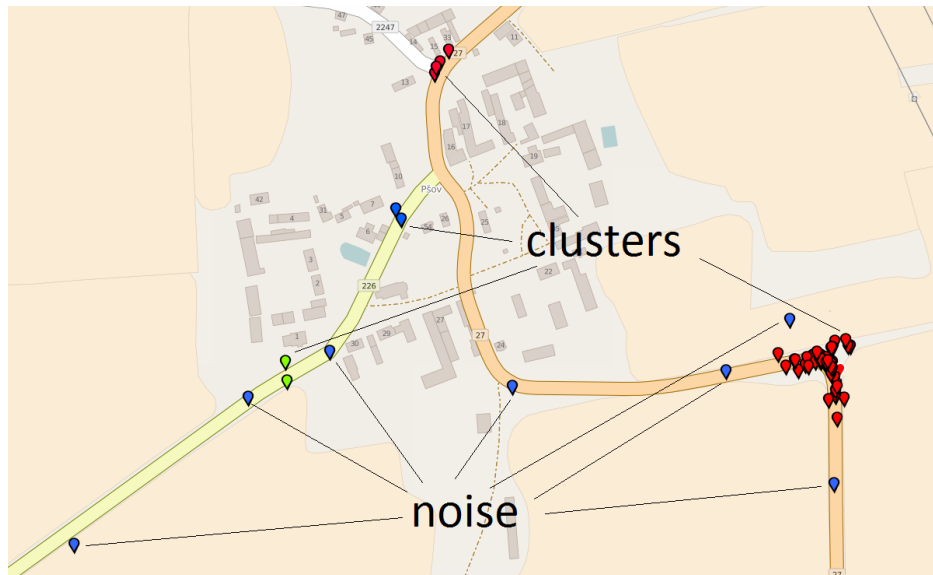


Figure 3: Clusters of accidents in the vicinity of the most dangerous turn in the Czech Republic (DBSCAN $\text{eps}=0,025$, $\text{MinPts}=2$)



Figure 4: Clusters of accidents in the vicinity of the most dangerous turn in the Czech Republic (K-means $k=87$)

Clusters of traffic accidents created by K-means algorithm are shown in figure 4 for comparison. In order to reach the same number of clusters as in the previous case we set $k=87$. K-means does not take noise into account and the clusters it created are not defined as well as the ones originating from DBSCAN. It created several clusters from accidents which occurred in the aforementioned turn, which obviously belong in the same cluster. Therefore, the algorithm failed in a location with a higher concentration of traffic accidents. In locations with lower concentration of accidents the algorithm created some clusters as was expected. Furthermore, there are 2 locations marked in figure 4, which were marked as a single cluster despite the fact these accidents were obviously not

related to each other. The main disadvantage of the K-means algorithm when it is used to locate clusters in geospatial data is the necessity to input the anticipated number of clusters.

The early warning system should be useful in cases where drivers are in an area they do not know well. Another location where the early warning system could prevent traffic accidents is on R35 expressway, specifically on its 44th kilometer. Vehicles need to change their driving direction by nearly 270 degrees in a short period of time here, as shown in figure 5. The most common cause of traffic accidents at this location is speeding. Drivers unaware of the risk of this turn can evaluate the turn as mild, and without reducing their driving speed they can easily lose control of their vehicles. If these drivers were warned about a high risk of a traffic accident before entering this turn the number of similar accidents could be reduced.



Figure 5: Dangerous location in Ohrazenice near Turnov

5. Conclusion

Searching for clusters of traffic accidents is a vital part of the development of an early warning system about a high risk of a traffic accident. Clustering algorithms based on density yield good results while creating clusters of traffic accidents based on geographical data. The principle of an early warning system outlined in this paper should contribute to prevention of frequent traffic accidents and even prevent tragic accidents from happening. The system is still a concept in its early development stages. In this moment we focus on preparation of data for modeling, data analysis and testing of algorithms to create clusters based on selected parameters.

6. Acknowledgments

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PREPARING ONE'S OWN ELEMENTS FOR HOME AUTOMATION SYSTEMS – ADVANTAGE OR DISADVANTAGE

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Keywords

Home automation system, Internet of things, Smart home

Abstract

This paper describes possibility of creating one's own elements for home automation systems. Pros and cons of this process are discussed there. The focus of the paper moves from aspects of security, price and difficulty of construction to future service of this solution. All of these are described on the example of the Domoticz that is one of the most popular home automation systems. In the last part of the work is discussed important question, whether it is the right time to build smart home system now.

1. Preamble

Main goal of this paper is to discuss the preparation of one's own elements for smart home systems. These elements are compared with matching commercial elements.

First, the systems for home automation are discussed, mainly the open-source systems openHAB and Domoticz. Closed and open systems are compared and suitability of using each of these systems in different cases is described.

Next, the questions of security problem and difficulties of the construction of the both solutions are compared. Further, the text deals with the price - on the one hand in relation to purchase, on the other hand in relation to the services and persistent suitability - of both solutions.

Both solutions are also discussed in relation to possibility of building a new building or reshuffling the existing one. There is also big question whether to use wired or wireless solution.

And finally, the biggest question: Is it time to build the smart home now? Answer to this question is not definite. It depends on all the facts and questions outlined in this work.

2. Smart home system

2.1. Definitions

First, we have to define the terms *Smart home systems* or *Home automation*. The following definition from Wikipedia serves our purposes best:

Home automation is the use and control of home appliances remotely or automatically. Early home automation began with laborsaving machines like washing machines. Some home automation appliances are stand alone and do not communicate, such as a programmable light switch, while others are part of the Internet of things and are networked for remote control and data transfer. Hardware devices can include sensors (like cameras and thermometers), controllers, actuators (to do things), and communication systems. Remote control can range from a simple remote control to a smartphone with Bluetooth, to a computer on the other side of the world connected by internet. Home automation systems are available which consist of a suite of products designed to work together. These typically connected through Wi-Fi or power line communication to a hub, which is then accessed with a software application. Popular applications include thermostats, security systems, blinds, lighting, and door locks. Popular suites of products include X10, Z-Wave, and Zigbee all of which are incompatible with each other. Home automation is the domestic application of building automation. (Wikipedia 2016)

2.2. Possibilities of solutions

We can use either a *commercial solution* or an *open-source system* for the creation of the smart home. The solution from one vendor is meant under the term commercial solution in the following text. On the contrary, open-source system is open system build from different parts, which is generally created by owner of the house or by any maker.

In the following table, we can compare both solutions economic aspects:

Characteristic	Commercial solution	One's own solution
Vendor	Commercial	One's own solution, open source
Price	Big	Medium
Warranty	Yes, but limited	By the particular elements
Customization	Minimal	Yes
Upgrading	Difficult	Easy
Support	Limited	Yes
Elements	Homogeneous	Heterogeneous
Typical application	New building	Old building

It seems to be obvious from this table that using one's own system is a good choice, mainly in older houses or if we have the different kinds of the elements. But the answer is not so simple. We have to discuss lots of other questions.

3. Construction and connection

The smart home systems consist of *control unit* and *end elements* (effectors). These must be somehow connected together. In this part we will discuss the possibilities of the construction and connection of both types of systems.

3.1. Commercial solutions

3.1.1. Construction

Control unit of the commercial solutions usually is the closed unit, as it is shown on the picture 1 on the left side. This is control unit for the Cue systems, which is typically used for preparing automation of classrooms. The user usually does not know how the unit works and what is inside. The unit must be commonly set up by the special software or hardware. When the user wants to change something, then new unit or wide upgrade is usually needed.



Figure 1. Typical elements of commercial solution

There is potentially big security problem. User does not know how the unit works and if something goes wrong, he does not notice this e. g. if the unit is attacked by any intruder.

End elements are mostly closed devices. On the right side of the picture 1 we can see the elements made by Czech company Jablotron. In the front, there is the motion detector JA-83 and behind it, there is the remote control wall plug AC-88.

3.1.2. Connection

The elements used for the connection are the closed solution, too. Both, wired and wireless solution can be used, so let's discuss them separately.

- *Wired solution* – usually RJ-45 connection (Ethernet) or the serial connection (old standard RS-232 and newer RS-422 or RS-485) are used. The solution with RS-422/285 is often used for creating separate network, which is completely closed and it is secure. On the other

hand, it is very difficult or sometimes impossible to add one's own new element to the network without the help of the vendor.

- *Wireless solution* – there could be used a common Wi-Fi network but more often blue tooth, radio waves (Jablotron) or zig bee are used. The communication is usually encrypted. There is the same problem with adding new elements as when using wired connection. There are also attempts to use Li-Fi technology now.

3.1.3. Summary

The commercial solution is complex and close. It is good choice to use it either in new building or if we could prepare the wired network. There are big problems with changing or upgrading the solution, especially, when several years passed from the construction. In that case two situations occur quite often:

The solution is not supported yet. The vendor will force the user to change the solution completely. I have to say that although new buildings are designed for 50 – 80 years, anticipated durability of the smart home systems could be maximally 10 years.

The vendor of solution does not exist anymore and nobody knows used system. Then the user must buy new complex solution.

3.2. One's own systems

Many users solve the problems mentioned in previous text by their own construction. Sometimes owner of the house constructs the system himself or any IT able friend helps him. The typical elements for this solution are shown on the picture 2 and they are described in the next chapter.

3.2.1. Construction

A *single-board computer* as the *RaspBerry Pi* and its derivatives, or *Intel Edison* etc. is mostly used for the control unit. The normal home PC could be used, too, but then it must be still switched on. It is also possible to use home Wi-Fi router as a control unit. The Linux operating system is used in most cases. The types of controlling software are described further. In the picture 2, on the left side, there is single-board computer RaspBerry Pi 2 B with attached 7" display, used as control unit for Domoticz system.

It is possible to use lot of different devices for construction of end elements. It is even possible to use *single-board computer*. But in the present, the *micro controllers* as the *Nodemcu*, *Particle Photon*, *ESP 8266 boards* etc. are used most often. Big advantage of these elements is their low price. In the picture 2, you can see some of them. From the front, there are Olimex ESP-8266 EVB (with attached relay), Particle Photon, Nodemcu, common relay and RaspBerry Pi 2 B with attached mini display.

When using this method, it is very easy to add next element to the working system. There are lots of manuals on the Internet, but they are of very unbalanced quality.

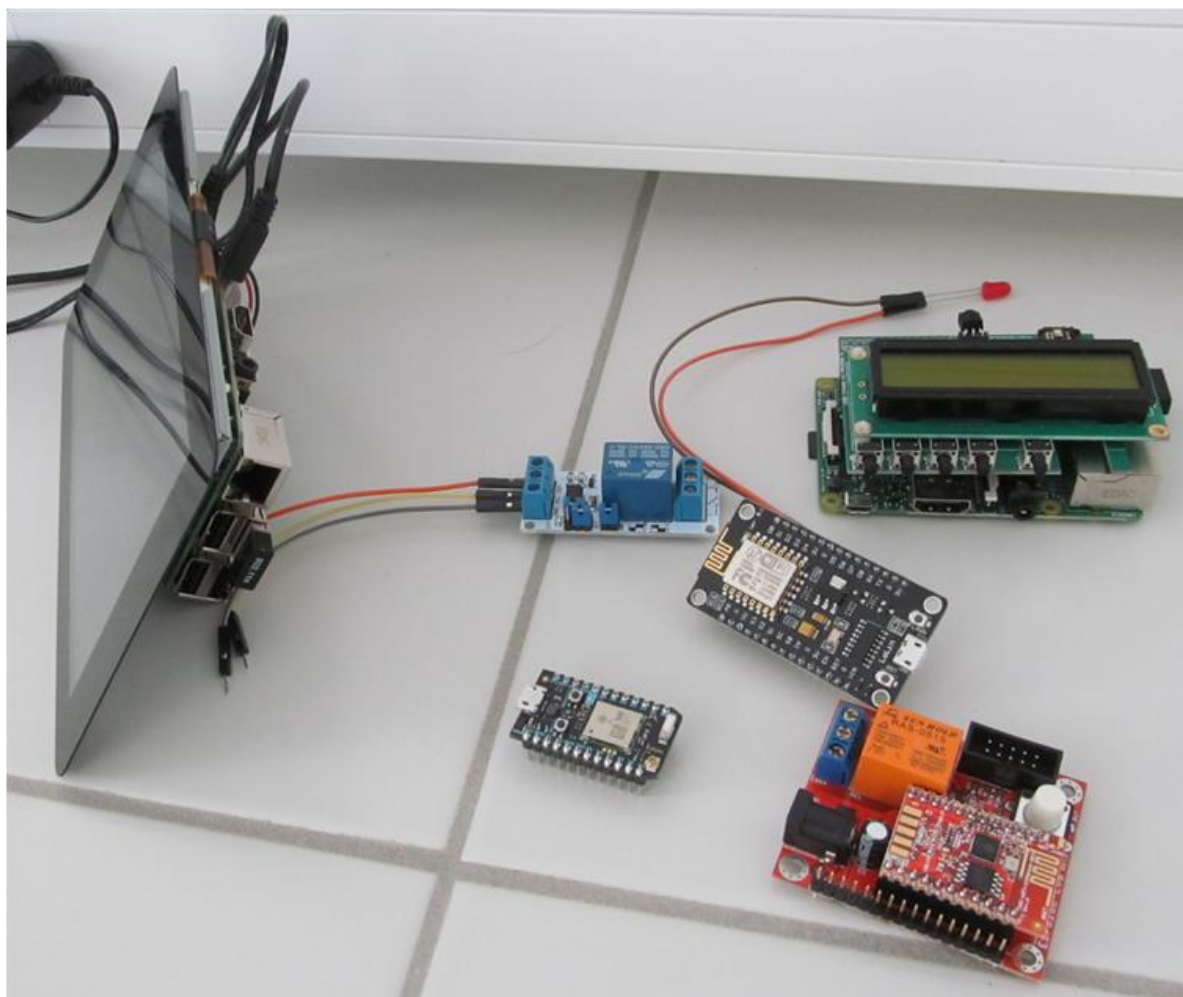


Figure 2. Typical elements for one's own solution

3.2.2. Connection

Wi-Fi technology is often used for the connection of the system, because most of these elements cannot be connected to the wired network. Only RaspBerry Pi and its derivatives could be connected to the Ethernet network. It is also possible to connect single-board computers and micro controllers by the Wi-Fi and then connect any other parts by the wire to them.

The problem is that any micro controllers cannot use WPA2 enterprise encryption, which is standard on most networks. Other problem is low reliability of using Wi-Fi chips. E. g. it is usual that the element cannot reconnect to the Wi-Fi network after power fallout.

3.2.3. Controlling software

One of the following three kinds of systems: *openHab*, *Domoticz* and *Home Assistant* is mainly used as the controlling software of the control unit. I have tried only first and second one so I will describe only these two. All of them are the systems for automation *heterogeneous smart home systems*. It means that in the system there are different kinds of end effectors from different vendors connected.

- OpenHab – the automation system based on Java programming language. For every end element the driver must exist, which is named the bind. There are lots of prepared binds on

the web page of the project. If there is not a bind for your device, you can easy create your own. (openHab 2016)

- Domoticz – very simple but useful system, created as the web page. Everything is controlled via webpage. You can include your devices through the web interface. If there is not setting ready for your system, you can simply add it using the manuals from the web page. The scripts for including new kind of elements are written in the Lua or in the Python. (Domoticz 2016)

4. Creating one's own elements

4.1. When we create our own elements

As we said in the previous text, creating of one's own elements is possible only when using one's own system. Creation of one's own element in the commercial system is difficult or more likely impossible.

User has to solve next things:

- Whether this creation is possible
- Whether this creation is worth energy and time spent
- Whether he has the knowledge for this kind of construction
- Whether it is possible to easy upgrade or service this construction in the future

In case user does not answer resolutely yes to any of these questions, than he should not do it.

4.2. How to create your own elements

When creating new element, I strongly advice you to go to the web page of your automation system and study manual for your kind of element. If there is not exactly your device, then you can search the nearest similar device and adapt the described method for your device.

Do not forget to periodically upgrade your elements, because security problems could emerge and any intruder could use it to attack your system.

4.3. Pros and cons

4.3.1. Pros

- User saves some expenses.
- User has absolute control over the element
- User can easily upgrade or replace the element, in the case of any crash

4.3.2. Cons

- The cheaper devices are often unstable. E. g. PIR sensor announces intruder although there is none.
- These devices are also breakable and it is usually problem to apply warranty in the Asian e-shops.

- There is often a problem to connect to the secure Wi-Fi network. Lots of devices have problems with reconnection to the Wi-Fi network in case of restart.
- Most of the devices have high power consumption. You have to use appropriate power supply with the sufficient output. This basically makes it impossible to run on the battery.
- There are no strict rules, how to prepare such elements. So when somebody creates some kind of element, the others may be confused by the solution.

5. Summary

From the previous discussion following recommendations imply:

- If you plan the new building, then better choice is to get commercial solution and use wired connection.
- If you have the old building, then the best solution is to wait for new technologies. But if you still need to create smart home then:
 - Use Wi-Fi solution
 - If you do not have IT skills – choose commercial solution
 - If you are good at IT – once more think about choosing commercial solution and when you are confident, you can try building your own solution with your own elements
- Build your system so that control over smart home system is not only one option. You must have possibility to control your house without smart home system.

Generally I think, that is not time for creating smart home systems yet, with the exception of the new buildings. In the present, this technology develops very quickly and it is possible to wait for new and better possibilities.

If somebody decides to create his own smart home system, it is possible that the advantage of the low cost would be suppressed by disadvantages described in the previous chapters. One and only possibility how to create one's own elements for smart home system is in case the user is good at IT and he is also great fan of IT.

So that is the answer to the question from the headline.

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INVITED CONTRIBUTION: DIGITALIZATION

DIGITALIZATION: HARDWARE - SOFTWARE - SOCIETY

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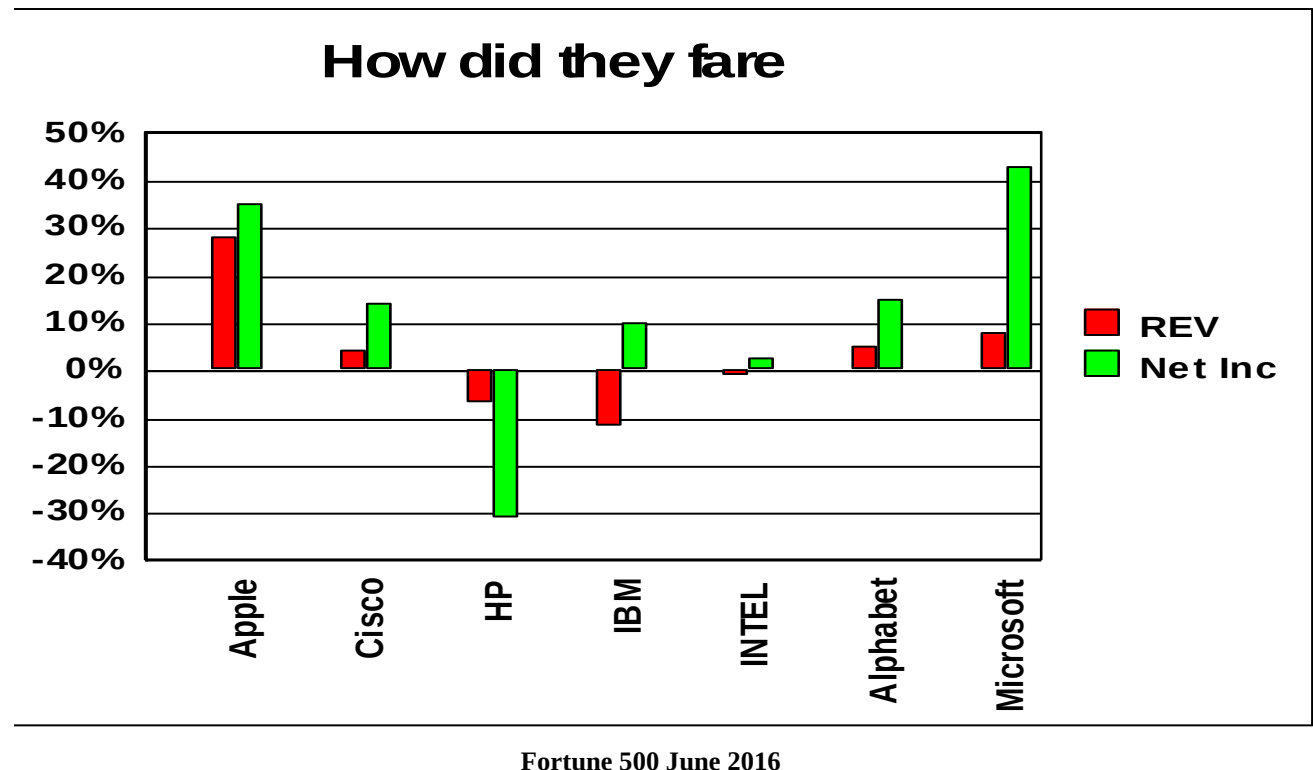
Abstract

Passing through a period of paradigm change, it is advisable to take stock and see where we stand and peruse state and outlook of ICT and the options available regarding hardware, software and the interdependent societal development. We shall examine how some of these developments are affecting both the technological, economic and societal scenario and look at the reactions and preventive actions by the key players to meet the upcoming scenario.

1. ICT some business aspects

1.1. Key players in 2015

Revenue and Net Income 2014 to 2015:

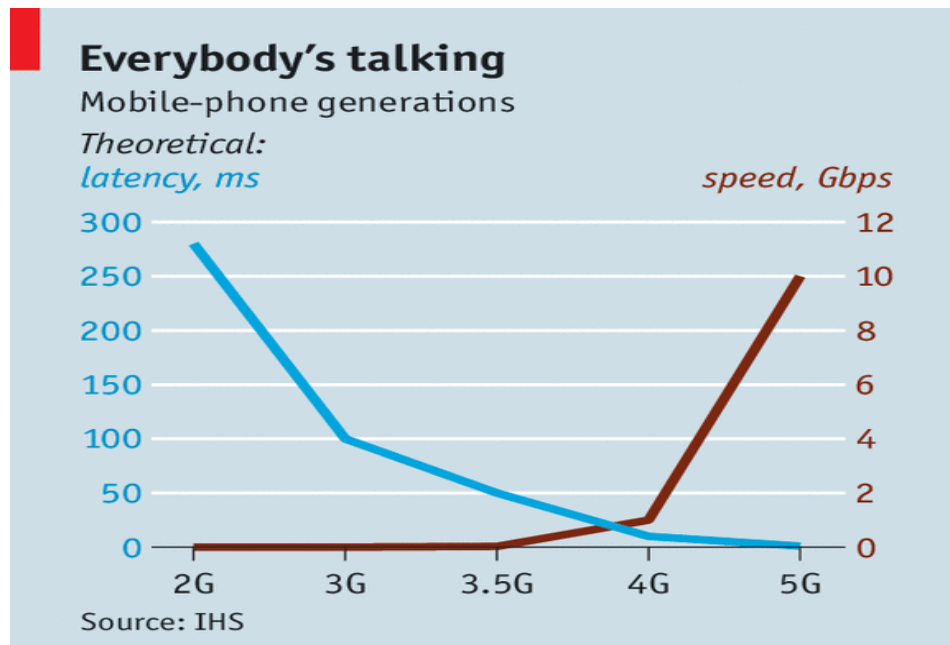


The prevailing phenomenon seems to be the paradigm change from the previous concentration on the core business to diversification and buying all missing expertise, accompanied by actions to meet future profit and dividend exposures.

We will discuss how the key players are meeting these challenges and their results.

1.2. Is the success story of mobile repeating?

- Smartphones and tablets are getting faster and more capable
- Smartphones and tablets have taken over many of the PC tasks
- The symbiosis of smartphones and AI is showing the future direction
- The demand on communications



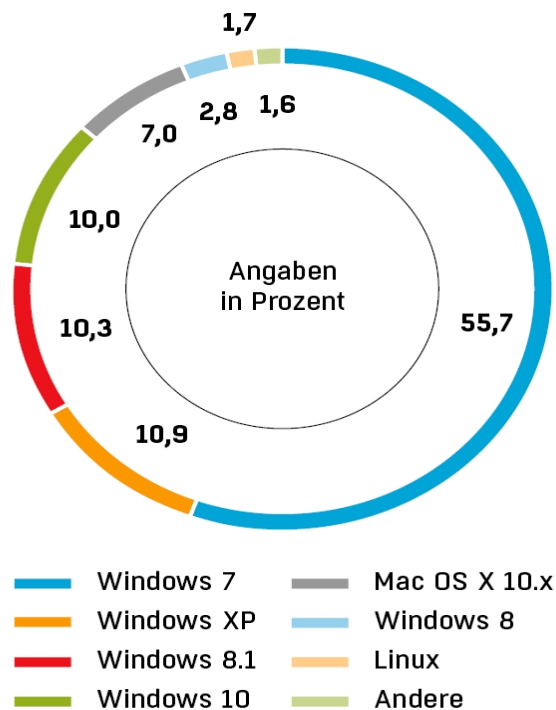
2. Software

The state of the industry

Rank	Company	Country HQ	2014 Software revenue (US\$M)	2014 Total revenue (US\$M)	Software revenue as % of total
1	Microsoft	USA	\$62,014	\$93,456	66.4%
2	Oracle	USA	\$29,881	\$38,828	77.0%
3	IBM	USA	\$29,286	\$92,793	31.6%
4	SAP	Germany	\$18,777	\$23,289	80.6%
5	Symantec	USA	\$6,138	\$6,615	92.8%
6	EMC	USA	\$5,844	\$24,439	23.9%
7	VMware	USA	\$5,520	\$6,035	91.5%
8	Hewlett Packard	USA	\$5,082	\$110,577	4.6%
9	Salesforce.com	USA	\$4,820	\$5,274	91.4%
10	Intuit	USA	\$4,324	\$4,573	94.6%

PwC Global 100 Study

2.1. Operating systems market share (PC)



NetMarketShare, Dec 2015

- Windows 10 usage has been doubling in six months, reflecting marketing efforts of Microsoft.
- The lifespan of PCs are going to last a long time as SSDs replace hard drives
- New releases of Windows are not driving sales anymore
- The coming back of powerful mainframes/servers
- Applications will increasingly need to be concurrent to exploit exponential CPU gains.
- Windows and Android dominating (exp. splitting)

2.2. PC use - how is the time spent?

Games 32%

Entertainment 8% together 60%

Facebook 18%

News 2%

Source: FLURRY analytics, Comscore, NetMarketshare

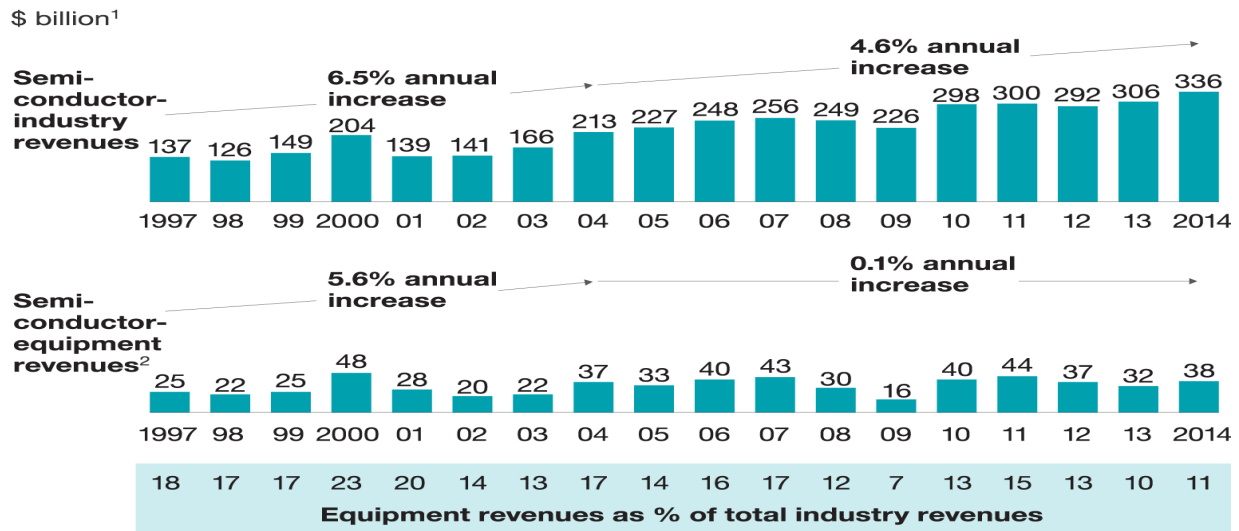
The fact that nearly 60% are spent on games, Facebook, entertainment and news may cause the rise of some eyebrows.

3. Semiconductor industry

3.1. Semiconductor and semiconductor equipment revenues

It is indicative to evaluate not only semiconductor industry but as well especially the semiconductor equipment industry, which is watching the ICT developments based on an intrinsic knowledge of technological developments is an excellent indicator.

Semiconductor industry and semiconductor equipment industry revenue:



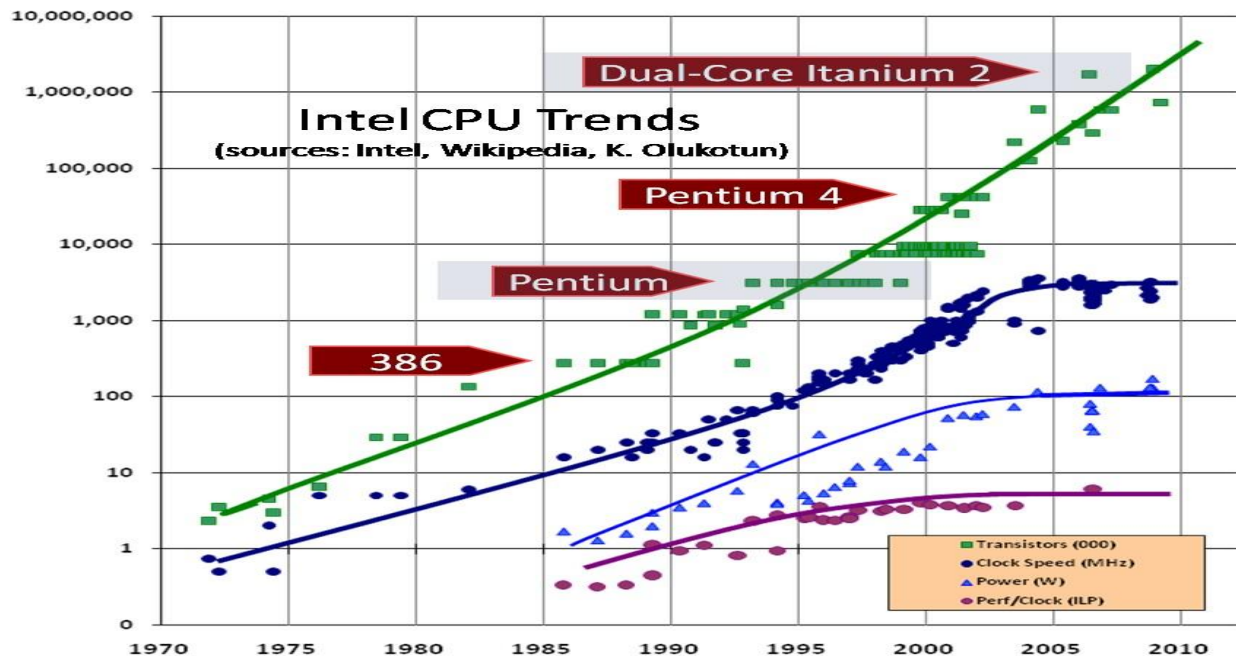
Source: SEMI, WSTS, McKinsey analysis

3.2. Technology

Many technological developments as shown below have enabled and enable the extension of Moore's law. Increased complexity must be offset by improved density, making the heat problem becoming again a central issue as Moore asked decennia ago „will it be possible to remove the heat“

To enable more function, power reduction is critical and will cause the shift of the R&D focus from speed to power, further on, to the quest the quest for cost reduction.

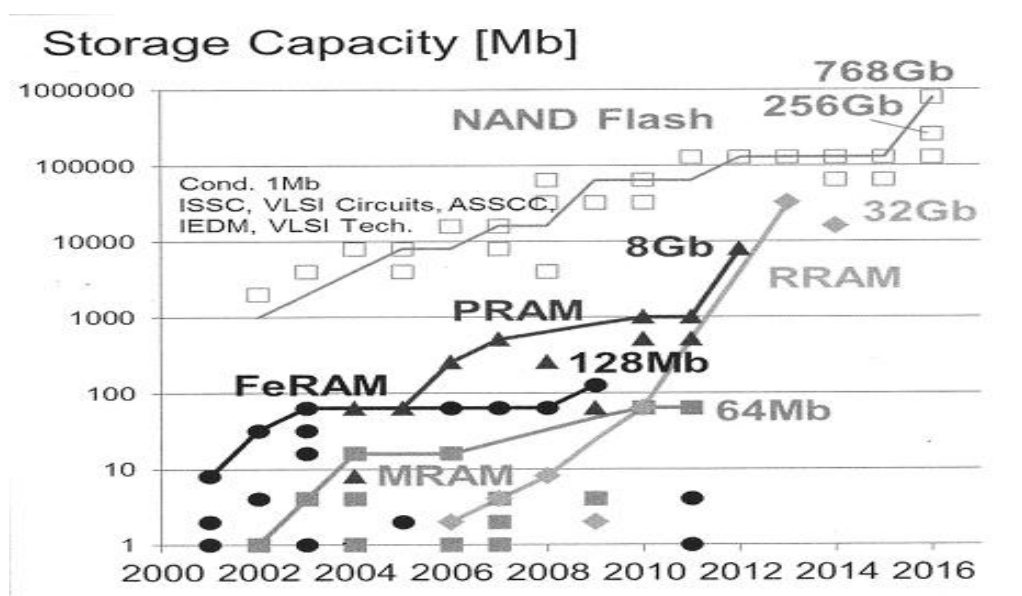
Approaching the end of the Moore laws final phase we encounter the shift that future developments will depend more and more on financial rather than on technological aspects. The question is whether we can afford to continue.



According to Intel, the maximal extension of the law, in which transistor densities continue doubling every 18-24 months, will be reached in 2020 or 2022, around 7nm or 5nm.

Technologies in the pipeline are continuing to improve; a foreseen 30-fold advance in the future years is still significant. Nevertheless, the old way a perpetually improving technology is gone. Nobody thinks graphene, III-V semiconductors, or carbon nanotubes are going to bring it back. Further gains will be incremental, with performance edging up perhaps thirty fold in the future years. DARPA has investigated 30+ alternatives to CMOS, but only 2 or 3 of them show long-term potentia. The decline of Moore strengthens the emphasis on high performance computing and developments like cloud computing and AI. (Google bought Deepmining not just for AlphaGo).

The scenario for storage shows a quite different situation



Source: ISSCC 2016

NAND flash memory continues to advance to higher density and lower power with still scaling down 2D technology. Recently 3b/cell NAND with up to 768 Gb have been reported extending the number of layers from 32 to 48.

Let us look at some other probably influential developments.

3.3. Supercomputing

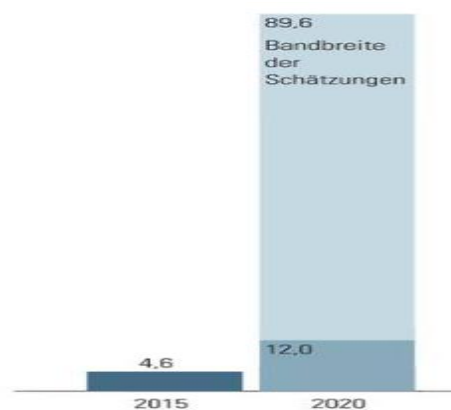
We can observe astounding progress and strategic competition in the field of Supercomputing. China's latest supercomputer, a monolithic system with 10,65 million cores is built entirely with Chinese microprocessors. No U.S.-made system comes close to that performance of China's new system, the Sunway TaihuLight with its theoretical peak performance is 124,5 petaflops.

3.4. KiloCore

Researchers at the University of California, have created a new processor with 1000 CPU cores. The "KiloCore" processors can be independently clocked to a maximum of 1,78 GHz, and shut down independently when not used. The 1000 processors can execute 115 billion instructions per second while dissipating only 0,7 watts, making the KiloCore 100 times more power-efficient than a laptop despite being built on old 32nm CMOS processor technology of IBM. By contrast, current Intel chips are much higher-clocked and built using a 14nm process, which achieve millions, not billions, of instructions per second.

What would be the use of a chip with 1,000 cores? The same as any other modern multi-core chip, i.e. video processing, encryption and decryption, and scientific tasks.

3.5. 4.5 IoT



NZZ Infographic: No. of connected units

However, it is not an easy and clear win, as the width of the forecasts show. A survey by Gartner shows that 39 % of companies do not intend to implement IoT in the next future and 9% have no intention to implement IoT at all. There are significant variations between different industries. Leading are asset-intensive industries as gas, oil and utilities as well as manufacturing, while less asset intensive industries and service industries as insurance or media show less interest. Gartner estimates that until the end of next year 56% of the first group will have projects implemented, where as light industries group will be in the range of a third only.

Crucial for the implementation of IoT is the solution of the energy supply. There are many ideas around but a newly emerging idea is energy from TV emitters, according to Kurzweil they could deliver 10-100s μ W.

The widening of the thrust from vertical to lateral developments will bring additional sensors and new features as for vibration, drift, pressure, ultrasonic transducers, highly precise temperature measurement using the spectral information of radiation (change of resonance frequency with temperature of MEMS), displays as LCO panels and touch screens with thinner layers and higher sensitivity at lower cost.

3.6. Cognitive Computing (combining digital ‘neurons’ and ‘synapses’)

IBM research presented a new generation of experimental computer chips designed to emulate the brain’s abilities for perception, action and cognition. This is move beyond the von Neumann architecture that has been ruling computer architecture for more than half a century. Neurosynaptic computing chips try to recreate the phenomena between spiking neurons and synapses in biological systems, through advanced algorithms and silicon circuitry. The technology should yield orders of magnitude less power consumption and space than today’s computers. Its first two prototype chips are currently undergoing testing.

Cognitive computers will not be programmed the same way as traditional computers today, they are expected to learn through experience, find correlations, create hypotheses, and remember and learn from the outcomes, mimicking the brains structural and synaptic plasticity.

3.6.1. Neurosynaptic chips

The ambitious long-term goal is a chip system with ten billion neurons and hundred trillion synapses consuming merely one kW of power and occupying less than two liters of volume. While they contain no biological elements, these cognitive computing prototype chips use digital silicon circuits to make up a “Neurosynaptic core” with integrated memory (replicated synapses), computation (replicated neurons) and communication (replicated axons).

IBM has two working prototype designs. Both cores were fabricated in 45 nm SOICMOS and contain 256 neurons. One core contains 262,144 programmable synapses and the other contains 65,536 learning synapses. The IBM team has successfully demonstrated simple applications like navigation, machine vision, pattern recognition, associative memory and classification.

3.7. Hewlett-Packard's futuristic 'Machine'

HP claims that a prototype of the futuristic „Machine“ computer should be ready for partners to develop software on by next year, though the finished product is still half a decade away. HP is placing a huge bet on a new type of computer that stores all data in vast pools of non-volatile memory. HP says the Machine will be superior to any computer today and claims system the size of a refrigerator will be able to do the work of a whole data center. The single-rack prototype will have 2,500 CPU cores and an impressive 320TB of main memory; this is more than 20 times the amount of any server on the market today.

3.8. AI (artificial intelligence or cognitive computing)

3.8.1. AI and the Future of Business

The symbiosis of microelectronic, sensorics and AI is enabling a leap in the development of robotics.

After many false dawns, AI has made extraordinary progress in the past few years, thanks to the technique of “deep learning”. Given enough data, large (or “deep”) neural networks, modeled on the brain’s architecture, can be trained to do a range of things from search engine, to automatic photo tagging, voice assistant, shopping recommendations or Tesla’s self-driving cars. However, this progress has also led to concerns about safety and job losses. Many wonder whether AI could get out of control, precipitating a conflict between people and machines. Some worry that AI will cause widespread unemployment, by automating cognitive tasks previously be done only by people. After 200 years, the machinery question is back and needs to be answered. John Stuart Mill wrote in the 1840s “there cannot be a more legitimate object of the legislator’s care” than looking after those whose livelihoods are disrupted by technology. That was true in the era of the steam engine, and it remains true in the era of artificial intelligence.

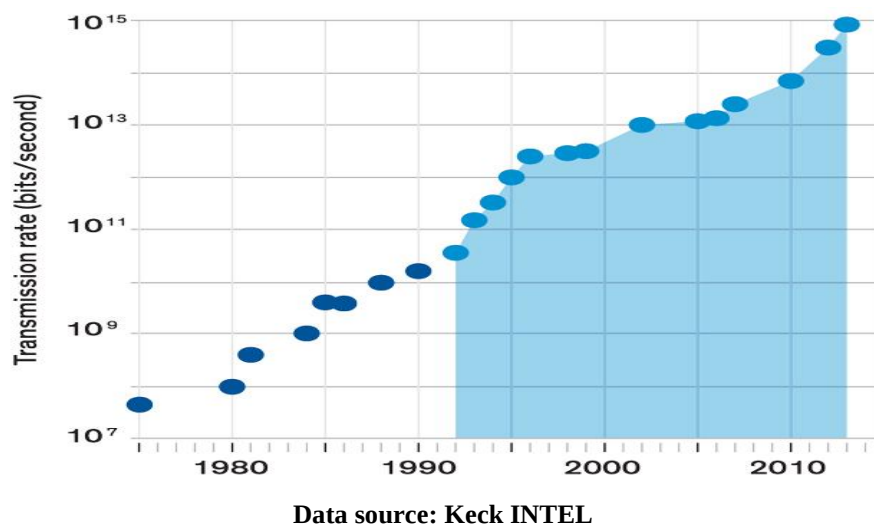
Google’s concept of the ‘device’ to fade away, will lead the computer, whatever its form factor, to be an intelligent assistant helping through the day. We will move from mobile-first to an AI-first world your phone should proactively bring up the right documents, schedule and map your meetings etc. Google by its investments in AI is preparing itself for such a world, aiming to be there, offering “assistance” to their users so they do not have to type anything into a device.

4. Fiber Optics

Moore’s Law gets all the attention, but it is the combination of fast electronics and fast fiber-optic communications, that has created “the magic of the network” of today.

Since 1980, the number of bits per second sent in an optical fiber has increased 10 million fold. That is remarkable even by the standards of 20th century electronics. It is more than the jump in the number of transistors on chips during that same period, as described by Moore’s law. Electronics has enormous challenges to keep Moore’s Law alive; fiber optics is also struggling to sustain its momentum. The past few decades, a series of new developments and break-throughs have allowed communications engineers to push more and more bits down fiber-optic networks. However, the easy gains are history. After decades of exponential growth, fiber-optic capacity may face a plateau.

4.1. The Fiber Optic Exponential



Fiber-optic capacity has made exponential gains over the years. The data in this chart show the improvement in fiber capacity by the introduction of wavelength-division multiplexing.

The heart of today's fiber-optic connections is the core: a 9-micrometer-wide strand of glass that is almost perfectly transparent to 1.55- μm , infrared light surrounded by more than 50 μm of cladding glass with a lower refractive index. Laser signals are trapped inside by the cladding and guided along by internal reflection at a rate of about 200,000 km/s. The fiber is almost perfectly clear, but every now and then, a photon will bounce off an atom inside the core. The longer the light travels, the more photons will scatter off atoms and leak into the surrounding layers. After 50 km, about 90% of the light will be lost, mostly due to this scattering. To keep the signal going, repeaters were used to convert light pulses into electronic signals, clean and amplify them, and then retransmit them down the next length of fiber.

The physicist D. Payne opened a new avenue. By adding and exciting erbium atoms with a laser, he could amplify incoming light with a wavelength of 1.55 μm , where optical fibers are most transparent. Today, chains of erbium-fiber amplifiers extend fiber connections across continents or oceans.

The erbium-fiber amplifier enabled another way to boost data rates: multiple-wavelength communication. Erbium atoms amplify light across a range of wavelengths, a band wide enough for multiple signals in the same fiber, each with its own much narrower band of wavelengths.

This multi-wavelength approach, dubbed wavelength-division multiplexing, along with further improvements in the switching frequency of fast laser signals, led to an explosion in capacity. The classical way to pack more bits/s is to shorten the length of pulses or lack of pulse. Unfortunately, the shorter the pulses, the more vulnerable they become to dispersion, and will stretch out traveling through a fiber and interfere with one another. Fortunately, scientists had two techniques previously used to squeeze more wireless and radio signals into narrow slices of the radio spectrum.

Together, quadrature coding and coherent detection, with the ability to transmit in two different polarizations of light, have carried optical fibers to allowing a single optical channel to carry 100Gb/s over long distances, in fibers designed to carry only 10 Gb/s. Since a typical fiber can accommodate roughly 100 channels, the total capacity of the fiber can approach 10 Tb/s.

Global Internet traffic increased fivefold from 2010 to 2015. The trend is likely to continue with the growth of streaming video and the Internet of Things.

5. 3D Printing has arrived

During the past years in several IDIMT's we have been discussing the coming potential of 3D printing. Now let us look at results that surpassed expectations. This does not include the potential by extending its use to organic or other new fields of applications.

Morris Technologies had been experimenting with metal sintering and super alloys for several years. In 2011, the firm zeroed in on the fuel nozzle as the part most appropriate for a makeover.

The result is a monolithic piece, that has replicated the complex interior passageways and chambers of the nozzle down to every twist and turn, thanks to direct metal laser melting where alloy powder is sprayed onto a platform in a printer and then heated by a laser, and repeated 3,000 times until the part is formed converting a many-steps engineering and manufacturing process into just one.



Image: GE

Before 3D printing and modeling, this fuel nozzle had 20 different pieces. Now, just one part, the nozzle is 25% lighter and five times more durable all of which translates to a savings of around US \$3 million per aircraft, per year for any airline flying a plane equipped with GE's LEAP engine. Finally, it took three to five months to produce; now it is about a week.

6. Society and Digitalization

There are some things that machines are simply better at doing than humans are, but humans still have plenty going for them.

Machine learning, AI, task automation and robotics are already widely used. These technologies are about to multiply, and companies study how they can best take advantage of them.

Google's CEO Pichai believes that devices will completely vanish, to be replaced by omnipresent AI. "Looking to the future, the next big step will be the concept of the 'device' to fade away,"

Most of us know and use positive effects of ICT ranging from social networking to participating in a wider, even worldwide, society, increasing opportunities for education, real-time information sharing and free promulgation of ideas. A development enjoying unparalleled acceptance.

6.1. Personal Impact of ICT

In spite of the plethora of positive effects of the use of ICT and networks, there is also another side of these developments. As Marcus Aurelius wrote: “The brain takes in the long run the color of the thoughts”. We should not only enjoy the benefits but also monitor the negative effects of social networking, ranging from neuro-physical effects to loss of privacy.

Social networks (SNW) pretend to an individual to have thousands of “friends.” However, these supposed “friends” are no more than strangers. SNW became the market place (“Bassena”) of today and watching the mobile phone a substitute for searching rewards. Research has also proven deteriorating influence on:

- storage capabilities in the working memory
- capability of multitasking
- judgments of order of magnitude (Columbia disaster, financial products, mm/inch)
- differentiation between important and unimportant information

This is not just speculation; it can be measured and is related to the volume of the amygdale or the size of the prefrontal cortex as it relates to the size of social group. Is there Digital Dementia on the horizon?

Healthy men have a sound warning; you may call it feeling for saturation. Men as “Informavoris rex” as carnivores successor, shows a kind of digital Darwinism based on the belief that the best informed survives and SNW brings advantages. Because many think that, the exchange of information brings additional value and it facilitates their participation and social acceptance. Being afraid to miss something, compulsion to consume and swallow every information, leads without any inhibitors or a saturation point to the loss of the capability to distinguish between import and unimportant information (Paris Hilton, Boris Becker) and thus independent thinking. We do not even apply the rational animals apply. Animals do not use more energy than prey will bring (Lions are not hunting mice, but buffaloes), but we are hunting information without evaluation and we do not know what is hiding behind information. We seem to follow an “All you can eat to all you can read” trend.

Network structure is not accidental; it follows “laws”. Search machines are rank high if a page is read/consumed by many people and creates much traffic (is this comparable to the idea that a species is important if it eats many different things and is eaten by many different species.). The number of links not content gives importance, not quality but number. Google page ranking has implications called Mathew effect (MT.25, 29).

In addition, the selection of content is shifting from established journalists, newspapers, and TV- and radio stations to uncontrolled secret search algorithms and private companies.

With ICT, many new legal issues arise ranging from copyright to personal privacy. Major technological evolutions triggered an adequate legal framework, as the industrial revolution led to labor law, motorization to traffic law, and the Digital Revolution to...? (see a special session).

6.2. Privacy

IC-Technology should be used to create social mobility, productivity and improve the lives of citizens. However, it added also new dimensions of surveillance.

In the wake of the Snowden revelations, the question was repeatedly asked: Why would governments wiretap its population? One of the answers may be: it is very cheap. Many people have compared today's mass spying to the surveillance of East Germany's Stasi. An important difference is dimension. Stasi employed one snitch for every 50 or 60 people it watched. Today a million-ish person workforce could keep six or seven billion people under surveillance, a ratio approaching 1:10,000. Thus, ICT has been responsible for the two to three order of magnitude "productivity gains" in surveillance efficiency.

Many companies try to profit from diminishing privacy and lure people into giving away their privacy for short-term financial benefits as price difference in medical cost or insurance, discounts for disclosure as of personal health data, living or driving habits.

6.3. ICT and Society

There have been an increasing number of studies on the impact of ICT on the present and future job market predicting that up to 45% of German employment being exposed within the next two decades. Many major companies reacted to economic challenges in the last decennia by personnel reduction, statistics show 44% of firms reduced H/C by automation. It is a worldwide phenomenon Foxcomm replaced recently 60 000 jobs with robots. Are we prepared for this?

John Stuart Mill wrote in the 1840s "there cannot be a more legitimate object of the legislator's care" than looking after those whose livelihoods are disrupted by technology. That was true in the era of the steam engine, and it remains true in the era of artificial intelligence.

7. Outlook

Having pursued some parts of the prevailing and future scenario, let us combine it with an outlook on some options arising. The continuation of Moore's law is not over, the extension of the law, in which transistor densities continue doubling every 18-24 months, will be hit in 2020 or 2022, around 7nm or 5nm.

We have entered a phase of further improvement of present technologies and fascinating lateral developments. We may expect not only 30 to 50 fold improvements of present technologies but also new technologies beyond CMOS and lateral amplifications based on developments being already integrated or as entering in the test phase, and there is already a beyond CMOS scenario visible.

BEYOND CMOS COMPUTING (present and future technology)

Material	Si	III-V, correlated oxides, High-Z metals
Devise	MOSFET	Tunneling FET, MESO (mag-electr/spin orbit torque)
Circuits	CMOS	Electronic, Spintronic
Memory	SRAM/DRAM	Electronic, Spintronic

Innovation is continuing. With many technologies in the pipeline, potential advance in future years could be significant, but it will depend more on financial rather than on technological aspects, but in all that excitement let us not overlook the societal effects.

Beyond CMOS ICT will not be the same but again, offering an exciting outlook full of opportunity,

The question is whether we can afford to continue.

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MEMORIES

In Memoriam - Leo Vodáček



In February of this year came to the end the fruitful and harmonious life of our colleague, a man who not only articulated the basic vision of the IDIMT conference in its early days, but also the vision of 'Information Management', Professor Leo Vodáček, Doctor of Science. The professional career of Professor Vodáček began with the study of management in the United States with Professor Peter Drucker and subsequently in the former Soviet Union. He followed his university studies with longstanding scientific activities in Czechoslovak industry, in particular in the company ČKD Prague, where he led the research section. Besides working in the Czech industry, he held important positions in the integration of the Czech economy into the structures of international cooperation. In his career in science and research he also did teaching. Professor Leo Vodáček was one of the major Czech experts in the theory and practice of management. He made use of his wealth of experience as a top manager in the Czech and foreign corporate, scientific and research sphere in educational and consulting activities. During his life he wrote more than thirty books published in the Czech Republic, as well as Austria, Germany, Russia, and Slovakia. Above and beyond his own publishing activities he participated in the development of the discipline of management in the Czech Republic through his activities in the publishing house Management Press. Here he selected the latest international publications on management for translation into the Czech language and he participated actively in their marketing in the Czech Republic. By this he helped to standardise not only the basics of the Czech technical terminology, but also the school teaching the Czech management concept. With the advancing of time he began to replace the practical professional activity with teaching at the University of Economics in Prague and commercial study programmes for the practical training of specialists. In the early 1990s, after he joined the Department of System Analysis of the Faculty of Informatics and Statistics, he proposed and implemented the discipline of Information Management. Through this discipline he developed his ideas on the possibility of conjoining Managerial Skills, System Sciences and Information Technology. He divided his tenure at the University of Economics between master's study and doctoral study. His pedagogical activity was characterised by a warm relationship with the students, with whom he shared his many years of practical experience of management of people and scientific projects. In addition to expertise and skills he imparted to the students such human qualities as patience and support in resolving problems. The students recall him not only as an expert, but as a man who could help them and give advice for writing their theses. He made good use of his experience in particular in the area of MBA study programmes, where he taught experts from many sectors of the Czech economy. In the early 1990s he was one of the organisers of the conference 'Interdisciplinary Information Management Talks' (IDIMT). After the first session held in 1993 under the name Information Management Workshop he proposed the name IDIMT and this was accepted by all the participants. In collaboration with Professor Ehleman he took part in the preparation of the sections focused on the application of modern managerial approaches to the management of corporate informatics. During the IDIMT Conferences he was an integrating factor, always trying to strike a balance between the economical, cultural and initially also societal differences between the participants. Throughout his life he would interconnect purposefully and effectively the learning and the progressive ideas of the West with the reality of the East and succeeded in uniting the advantages of the two systems in the concept of Information Management. We are thankful for having been able to meet you and to work with you.

In memoriam - Antonín Rosický



“Understanding the natural milieu and one’s place in it, or at least respecting it, and understanding one’s individuality on the basis of real experiences is one of the prime goals of education, and perhaps of the targets of our efforts.”

Antonín Rosický

Last year our close colleague, a good pedagogue, eternal optimist and co-founder of the conference ‘Interdisciplinary Information Management Talks’, Antonín Rosický, left us after a long illness. In his work in the Faculty of Informatics and Statistics at the University of Economics, Prague, he exemplified in a friendly and constructive manner the enthusiasm for new theoretical findings and their pragmatic application in practice. He drew on many theoretical works by prominent personalities of system sciences. He was able to present them to students and the public-at-large in a creative fashion in the business environment. His appearances met with a lively response at scientific encounters and conferences in the field of system sciences in Europe and outside. He brought into the teaching process topics of current interest and explained those that were more difficult to grasp but helped students to decide critically and see things in proportion. By this he contributed to the dissemination of critical thinking and provided students with guidelines for becoming good observers of the system milieu and to shape it actively on the basis of their observations. His enthusiasm stimulated students to independent thinking and shaping their views of reality. This brought him not only popularity in student circles; it also made him the subject of many critical discussions, in particular from those that preferred a simple and undemanding approach to study. In personal life he was an avid tourist with a great predilection for mountains and mountain hikes. Rambling on mountain massifs went hand in hand with another of his great passions, photography, which he pursued in practice at professional level. To this day his photos adorn a number of publications exhibited in different places, both public and private. At the beginning of the 1990s he was one of the initiators of the first hesitant steps in the collaboration between Johannes Kepler University Linz and University of Economics, Prague. He was one of the participants of the first IDIMT conference and took part in many of the following meetings. He was always a very active, outspoken participant in the discussions. From the first IDIMT conference in 1993 he supported it and actively contributed to debates on diverse subjects, bringing new insights to the world of informatics, system sciences and philosophy, on whose boundaries his thoughts always moved. At numerous conferences he was the leading personality and the soul of the section ‘Computer Human Interaction’. His eternal themes included seeking one’s place in this world, where in his approach and application of theoretical cybernetics to ordinary life situations he succeeded in reaching surprising and inspiring conclusions. He managed to find his place not only in personal life but also in teaching and scientific research. Thanks, Tonda

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Statement of the Publication Ethics and Publication Malpractice

IDIMT's Publication Ethics and Publication Malpractice Statement is based, in large part, on the guidelines and standards developed by the Committee on Publication Ethics (COPE).

We expect all parties commit to these publication ethics. We do not tolerate plagiarism or other unethical behaviour and will remove any manuscript that does not meet these standards.

The relevant duties and expectations of authors, reviewers, and editors are set out below:

1. Author Responsibilities

Authors must certify that their manuscripts are their original work.

Authors must certify that the manuscript has not previously been published elsewhere.

Authors must certify that the manuscript is not currently being considered for publication elsewhere.

Authors must notify us of any conflicts of interest.

Authors must identify all sources used in the creation of their manuscript.

Authors must report any errors they discover in their manuscript.

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Reviewers must notify us of any conflicts of interest.

Reviewers must keep information pertaining to the manuscript confidential.

Reviewers must bring to the attention of the Editor-in-Chief any information that may be reason to reject publication of a manuscript.

Reviewers must at any time evaluate manuscripts only for their intellectual content without regard to race, gender, sexual orientation, religious belief, ethnic origin, citizenship, or political philosophy of the authors.

Reviewer who feels unqualified to review the research reported in a manuscript or knows that its prompt review will be impossible should notify us and excuse himself from the review process.

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The Editorial Board must keep information pertaining to submitted manuscripts confidential.

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