Scientific Papers 34 (2/2015)

of the University
of Pardubice

Faculty of Economics
and Administration

Series D

SCIENTIFIC PAPERS OF THE UNIVERSITY OF PARDUBICE

Series D

Faculty of Economics and Administration

No. 34 (2/2015)

Vol. XXII

SCIENTIFIC PAPERS OF THE UNIVERSITY OF PARDUBICE

Series D

Faculty of Economics and Administration

No. 34 (2/2015)

Vol. XXII

Registration MK ČR E 19548

ISSN 1211-555X (Print)

ISSN 1804-8048 (Online)

Contribution in the journal have been reviewed and approved by the editorial board.
Contributions are not edited.

© University of Pardubice, 2015

ABOUT JOURNAL

Scientific Papers of the University of Pardubice, Series D journal aims to be an open platform for publication of innovative results of theoretical, applied and empirical research across a broad range of disciplines such as economics, management, finance, social sciences, law, computer sciences and system engineering with the intention of publishing research results, primarily academics and students of doctoral study programmes in the Czech Republic and abroad.

The journal is published every year since 1996 and papers are submitted to review. The paper is included in the List of reviewed non-impacted periodicals published in the Czech Republic, it is also indexed in Scopus, EBSCO Publishing and ProQuest. The journal is published 3x per year.

CONTENTS

ASSESSMENT OF E-GOVERNMENT IN EU COUNTRIES
ARDIELLI EVA, HALÁSKOVÁ MARTINA **4**

SELECTION OF A FORECASTING METHOD: ANALYTICAL HIERARCHY PROCESS APPROACH
BARTUSKOVÁ TEREZIE, PAPALOVÁ MARCELA, KRESTA ALEŠ **17**

EVALUATING THE IMPACT OF OPEN DATA USING PARTIAL LEAST SQUARES STRUCTURAL EQUATION MODELING
BÍLKOVÁ RENÁTA, MÁCHOVÁ RENÁTA, LNĚNIČKA MARTIN **29**

HISTORICAL ASPECT OF THE INDIVIDUAL-FOCUSED TRAINING OF THE PROFESSIONAL TUTORSHIP IN XXI CENTURY
DYUZHEVA MARINA **42**

PRODUCTION-CONSUMPTION PATTERNS OF BEHAVIOUR OF EUROPEAN REGIONS
KRAFTOVÁ IVANA, MATĚJA ZDENĚK **52**

EFFECT OF CONTROLLING ON THE ECONOMIC PERFORMANCE OF SMES IN THE CZECH REPUBLIC
KRUML LUKÁŠ, DUSPIVA PAVEL **63**

E-GOVERNMENT DEVELOPMENT INDEX AND ITS COMPARISON IN THE EU MEMBER STATES
LNĚNIČKA MARTIN **75**

AN ANALYTICAL HIERARCHY PROCESS MODEL FOR THE EVALUATION OF THE E-GOVERNMENT DEVELOPMENT
MÁCHOVÁ RENÁTA **88**

MACROECONOMIC AND CAPITAL MARKET DETERMINANTS OF INITIAL PUBLIC OFFERINGS: A TIME-SERIES ANALYSIS IN THE POLISH CAPITAL MARKET
MELUZÍN TOMÁŠ, ZINECKER MAREK, MELUZÍNOVÁ JANA **101**

ASSESSING THE DEGREE OF BALANCE BETWEEN STAFF DISPOSITIONS AND THEIR JOB POSITIONS USING FUZZY LOGIC
MYŠKOVÁ RENÁTA **113**

LEAN: 4W & 1H OF LEAN IN MEDICAL FACILITIES
VAVRUŠOVÁ VERONIKA **125**

IS CZECH HEALTH CARE GOING TO BE LEAN?
VITÁSKOVÁ EDITA **137**

ASSESSMENT OF E-GOVERNMENT IN EU COUNTRIES

Eva Ardielli, Martina Halásková

Abstract: *E-government is one of the priority trends of public administration modernization in the EU countries (28). The paper deals with the evaluation of the e-government state, because of the importance of e-government as a tool of progressive modernization of public administration. The presented research is specifically focused on the comparison of the current state of e-government in the European Union and the assessment of the position of the Czech Republic on the basis of e-government indicators. The attention is paid to e-government indicators monitored by international institutions (United Nations, European Union and Eurostat) using TOPSIS method. Evaluated data describe the state of e-government in EU countries in the year 2013. In the research, there was selected the final list of variants (monitored EU countries) and criteria (e-government indicators - User Centric Government, Transparent Government, Citizen Mobility, Business Mobility, Key Enablers, Online Service Index, E-Participation Index, Individuals Using Internet and Enterprises Using Internet). The results of the evaluation of the EU countries in terms of the state of e-government by TOPSIS method in the 2013 acknowledged, that the best ranking in this field obtained Estonia, then the Scandinavian countries (Finland, Sweden) and Malta. The worst state of e-government was reported in Romania, Bulgaria and Croatia. The Czech Republic then in the evaluation of e-government occupied the 24th position across all EU countries (28).*

Keywords: *Assessment, E-government, EU Countries, Public Administration, TOPSIS.*

JEL Classification: *H11, H83.*

Introduction

E-government belongs to important current trends of modernization efforts of public administration [19, 28] and it is also the subject of various international comparisons, as discussed by [2] or [5]. Interpretation of the term "e-government" is quite broad and divergent. The general definition describes e-government as the use of information and communication technologies (ICT) in a way of government transformation for the purpose of increasing availability, effectiveness and accountability. According to United Nations (UN) [29] e-government is the use of ICT and its application by the government for the provision of information and public services to the people. On the other hand the European Union (EU) defines e-government as the use of ICT in public administration combined with organisational change and new skills in order to improve public services and democratic processes and strengthen support to public policies. The importance of e-government in the context of the modernization of public administration is dealt also by domestic authors such [16, 17 and 24]. E-government here does not simply represent the direction of public administration modernization, but it is also discussed as a tool for modernizing public administration. Also [29, 22] highlight the role of e-government to provide significant opportunities to transform public administration into an instrument of sustainable development.

The aim of this paper is to compare the current state of e-government in accordance to the theoretical and empirical approach in the EU based on indicators of e-government.

The evaluation is focused on indicators monitored by international institutions (UN, EU and Eurostat) using TOPSIS method. The state of e-government is evaluated in the EU (28) including assessment of the position of the Czech Republic (CR) in the year 2013. This stated objective is supported by the research question whether are in average the results of e-government state in the original EU countries (EU-15) better then results of e-government state in the EU countries accessing the EU in 2004 (EU-10).

The structure of the article is devoted into introduction and theoretical statement, where attention is paid to the importance of information and communication policy and e-government as one of the important tools to the development of the information society. The results of empirical research then evaluate e-government in EU countries and in the CR by usage of TOPSIS method. Unlike other studies, the evaluation of e-government is performed not only for individual EU countries (EU-28) but also for the average of different groups of EU countries (average of EU-28, EU-15, EU-10 and EU-25).

1 Statement of a problem

When talking about computerization of public administration in the international dimension, there has been steadily working with the designation “e-government”, as stated in [24]. The involving of ICT in public administration activities is the standard part of the of public administration modernization nowadays both in developing and transition countries. A significant role is attributed primarily to Internet access to general public. In [28] is highlighted especially the role of web-based technologies to deliver the government services. There are many advantages to promote new technologies in public e-services. They are in opposite to traditional structures non-hierarchical, two-way, and available 24 hours a day, seven days a week. This character of Internet delivery helps citizens to seek information in more comfortable way, not just when a government office is open [32]. The interactivity of the Internet is also expected to improve government accountability as it makes government more responsive to the needs and demands of citizens. In the EU, the e-government has also high priority in the modernization of public administration. E-government is one of the measures that are aimed to take advantage of information and communication technologies across Europe [27]. In times of considerably limited public resources ICT can help the public sector to find innovative ways of services delivery to citizens while increasing efficiency and reducing costs [6, 7].

1.1 E-government as a part of the European Information Policy

Fundamentals of the political decision to invest in e-government services have been established in the Lisbon Strategy, which was approved by EU member states in the year 2000. Contemporary concept of e-governance in the EU is based on the original eEurope initiative, which has been promoted in the EU since 1999 [23, 24].

E-government is in the European Information Policy considered as one of the tools for building an information society. Prospectively, it is assumed here the certain standardization of supply range of electronic public services and the way of services providing, which should ensure interconnectivity of some e-government solutions across EU member states. In this connection there is spoken about “Pan-European e-services”, as shown in [13, 24]. In 2002 was introduced continuing eEurope 2005 initiative, where e-government also played significant role. Currently is the essential European strategic framework for e-government development called “Digital Agenda for Europe”. This

document was adopted in the year 2010 and it is one part of the Europa 2020 initiative. This strategy primarily highlights the current variability of the e-government services provision across the EU, the lack of cross-border coverage and low utilization by citizens. To the promotion of e-government and its enforcement in practice across EU member states there are created so called "Action plans". These documents contain specific measures and recommendations for the successful implementation of specified measures. The current action plan is called „The European eGovernment Action Plan 2011-2015" and it was adopted in 2010, see [12]. The European Commission has specified here the objectives of the "Digital Agenda" strategy in the field of e-government. The main tasks and objectives of the "Action Plan", as stated in [21], have been defined in cooperation with professional and scientific community dealing with research and development of e-government services. They are in line with European trends, concretely:

- Services designed based on users' needs.
- Common creation of public services and public administration (the principle of WEB 2.0).
- Re-use of public sector information.
- Strengthening of public administration transparency and participation of public in decision-making processes.
- Development of so called "Cross-border public services" and the simplification of citizen's and entrepreneur's mobility.
- General streamlining of organizational processes in public administration.

These selected targets show that the political priority of the EU is the increase of accessibility of public administration services to citizens and the private sector which can be regarded as a positive development. Another important trend of contemporary European e-government is the development of e-participation. This is the introduction of innovative electronic tools that enable basically anyone to involve actively in decision-making processes of government.

1.2 Approaches to the evaluation of e-government at the supranational level

E-government has been monitored as a part of the activities of many organizations. Approaches to e-government monitoring differ considerably across organizations, for example Eurostat [14] processes and evaluates data in the field of e-government by indicators measuring the interaction of citizens and businesses with public administration. The OECD has been involved in monitoring of the usage of ICT in EU member countries, see [21] or [7], but e-government as a specific area is not measured here. OECD also deals with economic analysis of e-government, see [22], focusing on identification of the e-government impacts in terms of costs and benefits comparison. In contrary European Commission's approach to e-government evaluation is connected with the effectiveness evaluation of European Information Policy [9]. This activity is based on the obligations of the European institutions. For the purpose of European Information Policy evaluation, there was designed the evaluation framework of basic e-services by the organization Capgemini [4]. These services are evaluated annually in the EU. The evaluation of selected aspects of e-government is at the international level also dealt with benchmarking of UN. There is evaluated the practice and progress of UN member countries in e-government. UN [30] deal with the evaluation of e-government on the basis

of the annual evaluation of "eGovernment Readiness index" and "E-participation index". In contrast, on the distinction of different levels of "overall maturity scores" of e-services is based the evaluation of the organization Accenture from 2000, see [1].

However, e-government data of international organizations and other institutions are not consistent with each other, as they have been monitoring different time periods using different methodologies of data collecting and data processing. They have been also focusing on description of different sub-areas of e-government services according to the specific needs and purpose of the organizations. The paper focuses therefor on the synthesis of these approaches. In this way is possible to achieve the comprehensive information on the state of e-government in the EU countries. The bases to the e-government evaluation are the e-government indicators monitored by Eurostat, UN and European Commission, see [9], [14], [30].

2 Methods

The method used in the comparison is TOPSIS method (The Technique for Order Preference by Similarity to Ideal Solution). It is one of the methods of multi-criteria evaluation of alternatives. According to [26] the aim of the methods of multi-criteria evaluation of alternatives is to determine the ranking of individual variants in terms of selected criteria, wherein the variant with the best ranking represents the best compromise variant. Methods for the selection of compromise variant under no dominant variants differ in approach to the definition of what is "compromise variant" and further according to complexity and usability for different types of multi-criteria problems. The results obtained by various methods are therefore subjective and may differ. These methods can be divided according to the type of information required. TOPSIS method is based on the selection of variant that is closest to the ideal variant and furthest from baseline variant. It is assumed the maximizing character of criteria. According to Bhutia and Phipon, see [3], TOPSIS is the simple concept enabling determination of the best variant through the mathematical calculation. Application of TOPSIS method is as follows [33]:

- Creation of normalized decision matrix R according to (1):

$$r_{ij} = \frac{y_{ij}}{\sqrt{\sum_{i=1}^{m} y_{ij}^2}}, \tag{1}$$

  where r_{ij} are elements of matrix R; $i = 1,2, \dots m$; $j = 1,2, \dots r$; y_{ij} are the original input data for variant i and criterion j; m is the number of variants.

- Calculation of weighted decision matrix W by (2):

$$w_{ij} = v_j * r_{ij}, \tag{2}$$

  where w_{ij} is weight normalized value and v_j is weight of criterion.

- Determination of the ideal variant H_j and basal variant D_j relative to the matrix values W, see (3) and (4):

$$\mathrm{H_j} = \max(\mathrm{w_{ij}}), \tag{3}$$
$$\mathrm{D_j} = \min(\mathrm{w_{ij}}), \tag{4}$$

  for $i = 1,2, \dots m$ and $j = 1,2, \dots r$.

- Distance calculation of variants from the ideal variant, respectively basal variant, see (5) and (6):

$$d_i^+ = \sqrt{\sum_{j=1}^{r}(w_{ij}-H_j)^2}, \quad (5)$$

$$d_i^- = \sqrt{\sum_{j=1}^{r}(w_{ij}-D_j)^2}, \quad (6)$$

for all $i = 1, 2, \ldots m$; and $j = 1,2, \ldots r$.

- Calculation of the relative distance indicator of variants from basal variant by (7):

$$c_i = \frac{d_i^-}{d_i^+ + d_i^-}, \quad (7)$$

where $i = 1,2 \ldots m$.

- Arrangement of variants by non-growing values of c_i.

Based on the results of TOPSIS method was possible to determine ranking of EU countries in terms of the functioning of e-government and to verify the position of the CR in the international comparison in the year 2013. In the research there was selected the final list of variants (the EU-28 countries) and criteria (9 e-government indicators.) The selected e-government indicators ($i_1 – i_9$) included:

- User Centric Government (i_1) - shows the extent to which the service is provided online and how is delivery perceived by the user.
- Transparent Government (i_2) - shows the extent to which governments are transparent in terms of: their own responsibilities and performance, process of service delivery and personal data.
- Citizen Mobility (i_3) - indicates the extent to which EU citizens can use online services in another country.
- Business Mobility (i_4) - indicates the extent to which businesses can use online services in another country.
- Key Enablers (i_5) - indicates to what extent are available on-line technical requirements: eID, e-Documents, authentic sources, eSafe and SSO.
- Online Service Index (i_6) - describes the range and quality of online services.
- E-Participation Index (i_7) - monitors on-line services and information provided to citizens by governments, interaction among stakeholders and involvement of citizens in decision-making process.
- Individuals Using Internet (i_8) - describes the percentage of individuals using Internet in relation to public administration.
- Enterprises Using Internet (i_9) - describes the percentage of enterprises using Internet in relation to public administration.

The research is based on data set across multiple data sources. These are “eGovernment Benchmark” study from 2014, see [9], data processed by Eurostat, see [14] and data managed by UN, see [30]. Evaluated data describe the state of e-government in the year 2013. In the first step there were inserted the input data into the decision matrix Y, where each element y_{ij} according to [20] requires the value of *i-th* variant and of the *j-th* criteria, see in Tab. 1.

Tab. 1: Input data for 28 variants and 9 criteria - decision matrix Y

Country	i_1	i_2	i_3	i_4	i_5	i_6	i_7	i_8	i_9
Austria	82	68	35	59	82	0.62745	0.74803	92	54
Belgium	72	51	37	44	58	0.62745	0.67716	89	50
Bulgaria	60	38	24	52	23	0.25480	0.23622	83	23
Cyprus	60	36	48	75	46	0.31372	0.47244	85	30
CR	57	29	33	48	25	0.25490	0.37007	94	29
Germany	65	30	29	66	49	0.70588	0.66929	83	49
Denmark	80	59	47	67	72	0.54901	0.66141	95	85
Estonia	84	75	79	70	87	0.76470	0.77165	95	48
Greece	50	23	16	18	11	0.80392	0.60629	84	36
Spain	87	66	12	59	77	0.78431	0.94488	82	44
Finland	83	63	81	76	60	0.70588	0.77165	97	69
France	75	64	38	31	69	0.96078	1.00000	96	60
Croatia	54	40	31	38	7	0.33333	0.46456	93	25
Hungary	45	23	13	27	30	0.45098	0.55905	84	37
Ireland	84	48	68	76	18	0.64705	0.67716	95	45
Italy	75	49	30	37	42	0.78431	0.74803	85	21
Latvia	73	67	26	57	63	0.64705	0.75590	99	34
Luxembourg	62	36	39	68	41	0.54901	0.62204	90	56
Lithuania	73	61	65	54	74	0.70588	0.70078	93	35
Malta	94	96	87	89	95	0.47058	0.40157	88	32
Netherlands	81	51	42	76	36	1.00000	0.92913	90	79
Poland	72	37	23	40	62	0.49019	0.54330	90	23
Portugal	90	71	32	73	83	0.64705	0.63779	92	38
Romania	45	17	20	17	12	0.47058	0.44094	65	5
Sweden	81	59	64	61	64	0.60784	0.70078	95	78
Slovenia	70	53	48	36	46	0.39215	0.42519	93	52
Slovakia	44	17	22	54	8	0.62745	0.48818	92	33
United Kingdom	70	38	49	85	27	0.96078	0.89763	91	41

Source: Authors according to [9], [14], [30].

All criteria are maximizing nature (the higher the value, the better the rating). In calculations using TOPSIS there are considered also the weights of individual criteria. The weights of individual criteria were determined by scoring method. All the criteria were the same weight as all criteria are equally relevant to the assessment of the state of e-government. The calculations were processed in SANNA software, see [18].

3 Problem solving

The above mentioned input data were processed using TOPSIS method. Evaluation of the state of e-government in the EU was based on values assessment within the set of criteria for e-government evaluation in each country, which was based on the synthesis of e-government evaluation approaches of major international organizations. E-government was evaluated based on the e-government indicators (i_1 – i_9) describing the on-line services of governments, transparency of governments, possibility to use the on-line service abroad by citizens and enterprises, technical enablers, quality of online services on governmental

webpages, participation of citizens, utilization of Internet by individuals and enterprises when communicating with public authorities.

The results indicate the state of e-government in the EU countries (28). It's shown here the e-government state of individual EU countries compared with the EU (28) average. There are compered the averages of country groups EU-28, EU-25, EU-15 and EU-10. The research is aimed also to evaluation of the e-government state in the CR in international context and there are pointed out the shortcomings and possible solutions of the situation.

3.1 Evaluation of e-government in the EU countries using the TOPSIS method

On the basis of TOPSIS method there was performed distance calculation from ideal and basal variant. Distance coefficient of variant *i* from the ideal variant d_i+ was calculated from (5). Distance coefficient of variant *i* from basal variant d_i- was calculated according to (6). Subsequently there was calculated the relative distance indicator c_i. The relative distance of variant *i* from the basal variant is given by (7). Values of individual variants are summarized in Tab. 2.

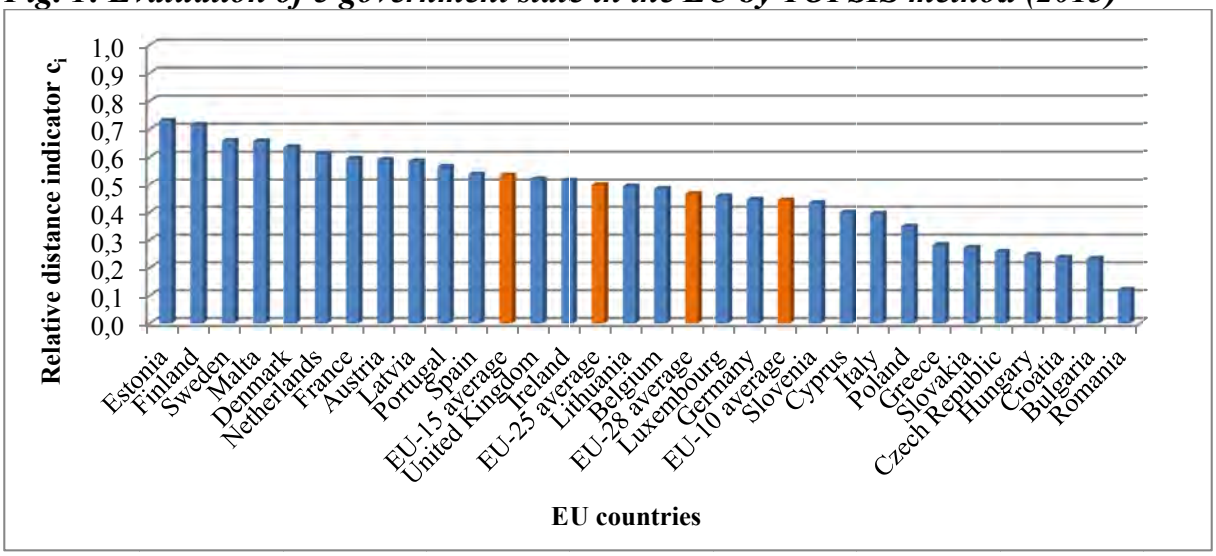
Tab. 2: Values of distance coefficients and of relative distance indicator

Country	**d_i+**	**d_i-**	**c_i**	**Country**	**d_i+**	**d_i-**	**c_i**
Austria	0.03755	0.05317	0.58607	Ireland	0.04574	0.04869	0.51562
Belgium	0.04600	0.04067	0.46923	Italy	0.05218	0.03769	0.41941
Bulgaria	0.06917	0.02068	0.23020	Latvia	0.04454	0.04591	0.50760
Cyprus	0.05405	0.03736	0.40871	Luxembourg	0.05080	0.03765	0.42562
CR	0.06683	0.02133	0.24195	Lithuania	0.03309	0.05389	0.61959
Germany	0.05197	0.03886	0.42785	Malta	0.03175	0.07397	0.69970
Denmark	0.03642	0.05266	0.59116	Netherlands	0.04065	0.05526	0.57616
Estonia	0.02037	0.06739	0.76787	Poland	0.05755	0.03262	0.36173
Greece	0.07189	0.02578	0.26392	Portugal	0.03855	0.05468	0.58648
Spain	0.04571	0.05464	0.54449	Romania	0.07772	0.01173	0.13110
Finland	0.02637	0.06221	0.70235	Sweden	0.03266	0.05420	0.62400
France	0.04007	0.05556	0.58097	Slovenia	0.05223	0.03532	0.40343
Croatia	0.06846	0.02001	0.22614	Slovakia	0.07041	0.02404	0.25453
Hungary	0.07086	0.01936	0.21456	Unit. Kingdom	0.04611	0.05168	0.52848

Source: Authors

The values of the calculated indicator c_i range between 1 and 0. Value 0 corresponds to the basal variant; value 1 corresponds to the ideal variant, as shown in e.g. [33]. Based on the result, it is possible to determine the order of the EU countries in terms of the e-government functioning, from the best to the worst, as shown in Fig. 1. In Fig. 1, there are presented also the averages of different EU country groups (EU-28, EU-25, EU-15 and EU-10 average). Assessment of the state of e-government in the EU countries in 2013 showed that on the best place ranked Estonia and the Nordic countries - Finland and Sweden, while the worst e-government state was detected in Croatia, Bulgaria and Romania.

Fig. 1: Evaluation of e-government state in the EU by TOPSIS method (2013)



Source: Authors

Based on the c_i values of EU averages of different country groups can be deduced the difference in e-government state between original EU-15 countries and the EU-10 countries of EU enlargement in 2004. The average value of c_i indicator in EU-15 countries reached 0.53, while the average value of c_i indicator in EU-10 countries reached 0.44 (17 % lower value). To complete the value of indicator c_i in EU-25 countries reached 0.50 and in EU-28 countries 0.46 (without Bulgaria, Romania and Croatia).

EU countries were based on the c_i values divided into 3 groups (clusters): Countries with above-average state of e-government, countries with average state of e-government and countries with below-average state of e-government, see Tab. 3.

Tab. 3: Clustering of EU countries according to the e-government state (2013)

Above-average countries	Average countries	Below-average countries
Austria, Denmark, Estonia, Finland, France, Latvia, Malta, Netherlands, Portugal, Sweden,	Belgium, Cyprus, Germany, Ireland, Italy, Lithuania, Luxembourg, Poland, Slovenia, Spain, United Kingdom	Bulgaria, Croatia, CR, Greece Hungary, Slovakia

Source: Authors

Hierarchical cluster analysis was performed in the software IBM SPSS using Ward´s method. The CR is according to the results of cluster analysis included into the cluster containing the countries with the below-average state of e-government.

4 Discussion

Based on the use of methods of multi-criteria evaluation of alternatives there was done the evaluation of the current state of e-government in the EU-28 countries and the verification of the position of the CR in international comparison in the year 2013. Results of this own research dealing with evaluation of the e-government state reflect to a considerable extent the current results obtained on the basis of international benchmarking activities of major international institutions such as World Forum [25, pp. 510-516] or European Commission [9].

The summary evaluation of the level of e-government in the EU is carried out annually according to the DESI index (The Digital Economy and Society). DESI is a composite index. It aggregates a set of relevant indicators structured around 5 dimensions (Connectivity, Human Capital, Use of Internet, Integration of Digital Technology and Digital Public Services). The own evaluation of e-government by TOPSIS method in our research showed the similar results as results obtained by index DESI evaluation. According to "Digital Agenda Scoreboard" [8], Romania is placed on the 28. position, Bulgaria on the 27. position and Croatia on the 24. position across the EU countries (28). The CR ranks on the 17. position out of the EU (28) countries. The best results in the evaluation of e-government according to DESI obtained the Scandinavian countries (Denmark – 1. place, Sweden – 2. place and Finland – 3. place). Similar evaluation results were demonstrated also in our research. The results of the evaluation by TOPSIS showed that apart from Sweden and Finland are the best rated countries also Estonia and Malta. But when evaluated by DESI Estonia occupied the 7. place and Malta the 12. place in the EU (28).

The result of TOPSIS method can be also compared with the results of other multi-criteria decision making methods. For example the evaluation of the e-government state in EU for 2013 according to WSA method (Weighted Sum Approach) confirmed the ranking of TOPSIS method. On the best place ranked also Estonia, then Finland and Malta. Similar on the worst place ranked Romania. Other countries with the worst state of e-government were Greece, Bulgaria and Hungary. The CR ranked on the 22. position when using WSA method. So both methods TOPSIS and WSA gave very close result to each other.

As follows from the results of comparative studies of e-government in EU countries [10, 11] within the implementation of e-government priorities were defined several typologies of countries: Pioneers (Malta, Finland, Estonia); Silo-topplers (Austria, Denmark, Spain, Lithuania, Portugal); Steady performers (Belgium, France, Italy, Latvia, Poland, Sweden, Slovenia); Business oriented (Cyprus, Germany, Ireland, Luxembourg, Netherlands, United Kingdom); Castaways (Bulgaria, Croatia, CR, Greece, Hungary, Romania, Slovakia). The division of states into groups is in most cases confirmed by the results of our research by TOPSIS method. The countries in the group "Pioneers" are in our research the top rated states in the field of e-government. Conversely, countries with the worst results in our survey (Bulgaria, Croatia, Romania) are likewise included in the same cluster. The results of "e-Government Benchmark" study in EU countries (28) show that the Nordic countries and Estonia are characterized by high level of citizens' internet skills and online availability of public services. Malta is achieving high level of online availability of public services, but lower-level of citizen's internet skills. The lowest level of citizen's internet skills and online availability of public services is achieved by Croatia. CR then in this assessment reaches medium online availability of public services and the relatively low level of citizen's internet skills. Similar results were demonstrated by our research.

Conclusion

The results of the e-government evaluation in EU countries (28) by TOPSIS method in the 2013 acknowledged, that the best ranking in this area obtained Estonia, then Finland, Sweden and Malta. The worst state of e-government was reported in Romania, Bulgaria and Croatia. Based on comparison of relative distance indicator in EU countries is possible to conclude that in terms of the e-government state are reached on average significantly

better results in EU-15 countries than in EU-10 countries. The value of the relative distance indicator in the EU-10 countries is about 17 % lower than the value of this indicator in the EU-15 countries. This indicates the worse state of e-government in the countries EU-10 in contrast to countries EU-15. It is also possible to note the exceptional status of Estonia, which, though also belongs among the EU countries of the eastern enlargement in 2004, showed the best state of e-government across the whole EU-28.

One part of the research was also the evaluation of e-government state in the CR. Based on the evaluation results was found highly unsatisfactory position of the CR in the field of e-government. The CR ranked among the five worst countries in the EU-28, and thus belongs into cluster with below-average EU countries in terms of the e-government state. Same as other V4 countries (Slovakia, Hungary) except Poland, which is placed in the group of countries with the average level of e-government. As indicated in the latest surveys of e-government in the EU countries, see [6], V4 countries (particularly the CR, Slovakia and Hungary) are doing in the area of e-government alike. In comparison with other EU states digitization of public administration is not very successful here. According to experts, this can be explained by the similar culture, public administration or a common feature of the lack of coordination of state activities. However Poland is for the other V4 countries in some areas the example of good practices. Only Poland from the V4 countries has performed comparable results with Western and Nordic EU countries in this area, as stated by index DESI and was also confirmed by own research. In the CR the e-government activities focused primarily on building large systems in recent years, which became the basis for the functioning of e-government. The cause of the inadequacy of the e-government state in the CR is mainly lack of the basic concept and long-term lack of interest by the Czech government. In the country there are serious shortcomings, particularly on the side of public digital services providers [15, 31]. Changing the attitude of government officials in this area is therefore required. E-government is a useful tool for reducing the cost of public administration and it is also the benefit for the residents in the form of time savings. This area remains for the CR the main challenge to the future. The good example of e-government practice for the CR can be Estonia that is on the top of EU in the field of digital services. As a good practise can serve British “gov.uk server”, that is an integrated, user friendly portal to access to all the services of the public administration or the using of intelligent forms to citizen´s communication with the public administration, as is the case in Poland now.

Acknowledgement

This paper was supported within Operational Programme Education for Competitiveness (Project No. CZ.1.07/2.3.00/20.0296).

References

[1] ACCENTURE. *Implemeting eGovernment – Rhetoric and Reality.* 2000. [cit. 2015-07-20]. Available from WWW: <http://m.epractice.eu/files/media/media _ 848.pdf>.

[2] BANNISTER, F. The curse of the benchmark: an assessment of the validity and value of e-government comparisons. *In International Review of Administrative Sciences,* 2007, Vol. 73, Iss. 2, pp. 171–188. ISSN: 0020-8523.

[3] BHUTIA, P. W., PHIPON, R. Application of AHP and TOPSIS Method for Supplier Selection Problem. *In Journal of Engineering*, 2012, Vol. X, Iss. 2, pp. 43-50. ISSN: 2051-3305.

[4] CAPGEMNI. *The User Challenge Benchmarking The Supply Of Online Publice Services*. 2007. [cit. 2015-07-21]. Available from WWW: <http://www.ut.is/media/utvefur-skjol/CapGemini_2007.pdf>.

[5] DEMMKE, Ch., HAMMERSCHMID, G., MAYER, R. *Decentralisation and Accountability as Focus of Public Administration Modernisation.* 2006. [cit. 2015-04-28]. Available from WWW: <http://www.eupan.eu/files/repository/05_ Decentralisation_and_Accountability_Study_2nd_Edition.pdf>.

[6] EURACTIV. *Úroveň e-Governmentu ve státech Visegrádské skupiny (V4) je hluboko pod průměrem EU*. 2015. [cit. 2015-04-28]. Available from WWW: <http://www.egov.cz/clanky/uroven-egovernmentu-ve-statech-visegradske-skupiny-v4-je-hluboko-pod-prumerem-eu>.

[7] EUROPEAN COMMISSION. *Jak je na tom vaše země s digitální transformací*? *Nová čísla ukazují, jak se pokročilo na cestě k digitální Evropě. Press Release Database.* 2015. [cit. 2015-04-25]. Available from WWW: <http://europa.eu/rapid/press-release_IP-15-4475_cs.htmIndex>.

[8] EUROPEAN COMMISSION. *Digital Agenda Scoreboard. 2015*. [cit. 2015-07-15]. Available from WWW: <http://ec.europa.eu/digital-agenda/en/digital-agenda-scoreboard>.

[9] EUROPEAN COMMISSION. *E-Government Benchmark: Insight report.* Publications Office of the European Union. 2014. [cit. 2015-02-20]. Available from WWW: <https://ec.europa.eu/digital-agenda/en/news/eu-egovernment-report-2014-shows-usability-online-public-services-improving-not-fast>.

[10] EUROPEAN COMMISSION. *Delivering on the European Advantage?How European governments can and should benefit from innovative public services. eGovernment Benchmark. Insight report.* Luxembourg: Office for Official Publications of the European Communities. 2014. 48p. ISBN: 978-92-79-38051-8.

[11] EUROPEAN COMMISSION. *Public Services Online. 'Digital by default, or by Detour?'* Assessing User Centric *eGovernment performance in Europe – 2012. Benchmark Insight report.* Luxembourg: Publications Office of the European Union. 2013. 72 p. ISBN 978-92-79-29949-0.

[12] EUROPEAN COMMISSION. *The European eGovernment Action Plan* 2011-2015. 2010 [cit. 2015-02-26]. Available from WWW: <http://ec.europa.eu/information_society/activities/egovernment/action_plan_2011_2015/docs/action_plan_en_act_part1_v2.pdf/>.

[13] EUROPEAN COMMISSION. *European Interoperability Framework for Pan - European eGovernment Services.* 2004. Luxembourg: Office for Official Publications of the European Communities. 26p. ISBN: 92-894-8389.

[14] EUROSTAT. *Statistical database.* 2013. [cit. 2015-02-20]. Available from WWW: <http://epp.eurostat.ec.europa.eu/portal/page/portal/information_society/introduction>.

[15] FISCHER, J., VLTAVSKÁ, K., DOUCEK, P., HANČLOVÁ, J. Vliv informačních a komunikačních technologií na produktivitu práce a souhrnnou produktivitu faktorů v České republice. *In Politická ekonomie,* 2013, Vol. 61, Iss. 5, pp. 653-674**.** ISSN: 0032-323.

[16] GROSPIČ, J. Reforma, transformace či modernizace veřejné správy? *In Úvod do regionálních věd a veřejné správy*. Praha: IFEC, 2001. ISBN: 80-86412-08-3, pp. 237-250.

[17] HENDRYCH, D. *Správní věda – Teorie veřejné správy*. 3. vyd. Praha: Wolters Kluwer ČR, a. s., 2009, 232 p. ISBN: 978-80-7357-458-1.

[18] JABLONSKÝ, J. Software Support for Multiple Criteria Decision Making Problems. *In Management Information Systems,* 2009*,* Vol. 4, Iss. 2, pp**.** 29–34. ISSN: 07421222.

[19] KHOSROW-POUR, M. *Practicing E-Government: A Global Perspective.* Hershey: Idea Group Publishing, 2005. ISBN: 1-59140-638-2.

[20] MILANI, A. S., SHANIAN, A., El-LAHHAM, C. A decision-based approach for measuring human behavioral resistance to organizational change in strategic planning. *In Mathematical and Computer Modelling*, 2008, Vol. 45, pp. 1765-1774. ISSN: 0895-7177.

[21] OECD. Guide to Measuring the information Society 2011. 2011. [cit. 2015-06-25]. Available from WWW: <OECD Publishing, August 2011, online. http://browse.oecdbookshop.org/oecd/pdfs/free/9311021e.pdf>.

[22] OECD. E-Government Project – Proposed Outline for Assessing E-Government Benefits. 2006. [cit. 2015-06-25]. Available from WWW: <http://webdomino1.oecd.org/COMNET/PUM/egovproweb.nsf/viewHtml/index/$FILE/GOV.PGC.EGOV.2006.1.doc>.

[23] PEKÁREK, A. Analýza současných evropských trendů v oblasti e-governmentu. *In Knihovna* 2012, Vol., 23, Iss. 1, pp. 51-62. ISSN: 801-3252 [cit. 2015-04-30]. Available from WWW: <http://knihovna.nkp.cz/knihovna121/12_151.htm>.

[24] POMAHAČ, R. at al. *Veřejná správa.* 1. vyd. Praha: C. H. Beck, 2013. 336 p. ISBN: 978-80-7400-447-6.

[25] SCHWAB, K., WORLD ECONOMIC FORUM. *The Global competitiveness report 2013-2014*. Geneva: World Economic Forum. 2013. 569p. ISBN-13: 978-92-95044-73-9.[cit. 2015- 03-23]. Available from WWW: <http://www.weforum.org/reports/global-competitiveness-report-2013-2014>.

[26] SHIH, H., SHYUR, H., LEE, E.S. An extension of TOPSIS for group decision making, Mathematical and Computer Modelling, 2007, Vol. 45, pp. 801-813. ISSN: 0895-7177.

[27] TICHÝ, O. Information and Communication Technologies their Benefits for Medium and Large-Sized Enterprices. *In Scientific Papers of the University of Pardubice*, 2012, Vol. XVIII, Iss. 24 (2/2012), pp. 199-211. ISSN: 1211-555X.

[28] TORRES, L., PINA, V., ROYO, S. *E-government and the transformation of public administrations in EU countries: Beyond NPM or just a second wave of reforms?* Zaragoza: University of Zaragoza. 2005. 33p.

[29] UN. *Global E-Government Readiness Report.* 2004. [cit. 2015- 04-20]. Available from WWW: <http://unpan3.un.org/egovkb/portals/egovkb/Documents/un/2004-Survey/Complete-Survey.pdf>.

[30] UNPACS. *Data Center - Government Development Index.* 2014. [cit. 2014- 08-02]. Available from WWW: <http://unpan3.un.org/egovkb/en-us/Data-Center>.

[31] VLCEK, P., MIKULECKY, P. Connecting Data Boxes with Document Management System in an Academic Environment. *In Global Journal of Information Technology,* 2014, Vol. 4, Iss. 2, pp. 87-93. ISSN: 2301-2617.

[32] WEST, D. M. E-Government and the Transformation of Service Delivery and Citizen Attitudes. *In Public Administration Review*, 2004, Vol. 64, Iss. 1, pp. 15-27 ISSN: 0033-3352.

[33] YOON, K. P. HWANG, Ch. *Multiple Attribute Decision Making: An Introduciton,* California: Sage, 1995. ISBN: 9780803954861.

Contact Address

Ing. Eva Ardielli
VSB-TU Ostrava, Faculty of Economics, Department of Public Economics
Sokolská Street 33, 701 21, Ostrava, Czech Republic
Email: eva.ardielli@vsb.cz
Phone number: +420 597 322 310

doc. Ing. Martina Halásková, Ph.D.
VSB-TU Ostrava, Faculty of Economics, Department of Public Economics
Sokolská Street 33, 701 21, Ostrava, Czech Republic
Email: martina.halaskova@vsb.cz
Phone number: +420 597 322 315

Received: 01. 05. 2015
Reviewed: 11. 06. 2015, 23. 06. 2015
Approved for publication: 02. 09. 2015

SELECTION OF A FORECASTING METHOD: ANALYTICAL HIERARCHY PROCESS APPROACH

Terezie Bartusková, Marcela Papalová, Aleš Kresta

Abstract: *Describing the future development of an organizational environment is crucial for the goal setting and strategy selection of an organization. In today's rapidly changing times it is not easy to predict how the internal and external surroundings of a company will change. Predicting the future development of an organization is not an easy task for managers but they must adopt it to succeed in market competition. Specifically managers must be familiar with forecasting methods which can help to predict the uncertain developments of the environment. There are many forecasting methods which are available, differing in their time requirements, financial demands, and in predictive accuracy. The goal of this paper is to characterize the most commonly used methods and to select the most appropriate one from the point of view of small and medium sized enterprises. These companies are usually limited in the finances that they can spend for strategy setting. They also do not employ a large number of experts, who can apply these methods. In this paper, a suitable forecasting method will be chosen by utilizing the Analytical Hierarchy Process (AHP) approach.*

Keywords: *Forecasting, Strategic management, Strategic planning, Forecasting methods, AHP method.*

JEL Classification: *C38, L10.*

Introduction

The existence of an organization and its success is influenced by outlined goals. Strategies are usually formulated based on objectives. An organization, after it determines the direction of its development, regularly faces complex decision-making problems. The definition of strategy implies that it tries to define the direction that an organization will take in the long term with respect to the environment and market conditions. Fulfillment of this requirement is difficult for several reasons. Environment is in some areas very variable, especially with regard to technological, legal and social influences. For example, due to technological progress, some sectors are completely suppressed and it is not promising to further invest. On the other hand, new demand is created by market [5, 13].

For the future development of external and internal environment, forecasting is used. There are several methods, which can be applied for forecasting. We distinguish between judgmental or statistical methods and each of these is different in financial and time demands. This paper presents an overview of forecasting methods with a brief description of their utilization and barriers of application. Application of the analytic hierarchy process (AHP) is proposed for the selection of an appropriate method for the small and medium sized company.

Paper is structured as follows. In the first part, forecasting and its methods are described, including the impact of a particular method and its properties. In the second part, selection of appropriate method for forecasting is proposed. For this selection the AHP method is applied.

1 Forecasting

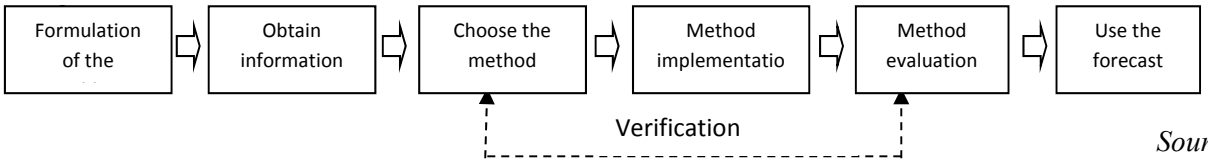
A scientific estimate of future events is called forecasting. Forecasting helps managers to assess factors affecting the future evolution of the environment of the organization. It is necessary to use a formal approach if the decision problems of the organization are complex. Formalization of procedures in the form of methods or techniques helps primarily to remove uncertainty. Forecasting is often reduced to statistical or econometric models [6] but its content is undoubtedly wider. Forecasting methods are used during strategic management, especially in the first part, which is strategic analysis. We analyze the environment of the company in order to be able to formulate the strategic goals and then organization's strategy.

Strategic goals should be simple, consistent, and long-term [3]. Long-term goals have an impact on strategic decision-making and they are formulated in changing conditions at a particular level of information uncertainty. It is essential to ensure concentrating on the long term period. The objectives with respect to basic principles must rely on a thorough understanding of the current status and future status projection. The strategy formulation must be based on the available resources of the organization. According to the possibilities of the organization, it is consequently decided on the investments that will achieve the objectives.

Forecasting is primarily used to support strategic decisions [5]. These decisions have an impact on the long-term management of the company. Strategic decisions will concentrate mainly on defining the extension or reduction boundaries of business, the impact on the values and expectations of the market, and whether are socio-demographic trends respected. The forecast usually expresses development as the tendency, trend or an ongoing process, change (as the cause of development) as the events of the phenomenon [2, 14]. The first step in creating forecasts should be identifying the problem. The second step is the solution via a strategic conception. The third step is predicting the future by some of the methods [1].

The process of finding an appropriate goal for business or non-business entities is challenging – see Fig. 1. In order to determine the long-term objectives, forecasting methods are frequently used. There are numerous kinds. They vary according to the time horizon, business, environment, technology used, etc.

Fig. 1: The forecast process



Source: [1]

The basic distribution of forecasts is based on the time horizon. To common resolution of short, medium and long-term forecasts; some authors have also added even extremely long period [14]. The authors differ in the length of time - short-term forecasts are usually in the range of 1-2 years, medium-term of 3-6 years, long-term of 7-15 years and extremely long term over 15 years (Tab. 1).

In terms of approach to forecasting, we distinguish the explorative (research) approach (where alternatives are searched trends) from the normative approach (where alternatives to given goals are found) [2, 14].

Tab. 1: Distribution of forecast methods depending on time horizon

The vertical division of forecasts (according to the degree of aggregation)	Horizontal division of forecasts (according to the time horizon)	Classification according to approach to forecasting	
The National Economics	Short term	Explorative (research)	Active
Industry	Medium term		Passive
Branch	Long term	Normative	
Company	Extreme long term		

Source: [14]

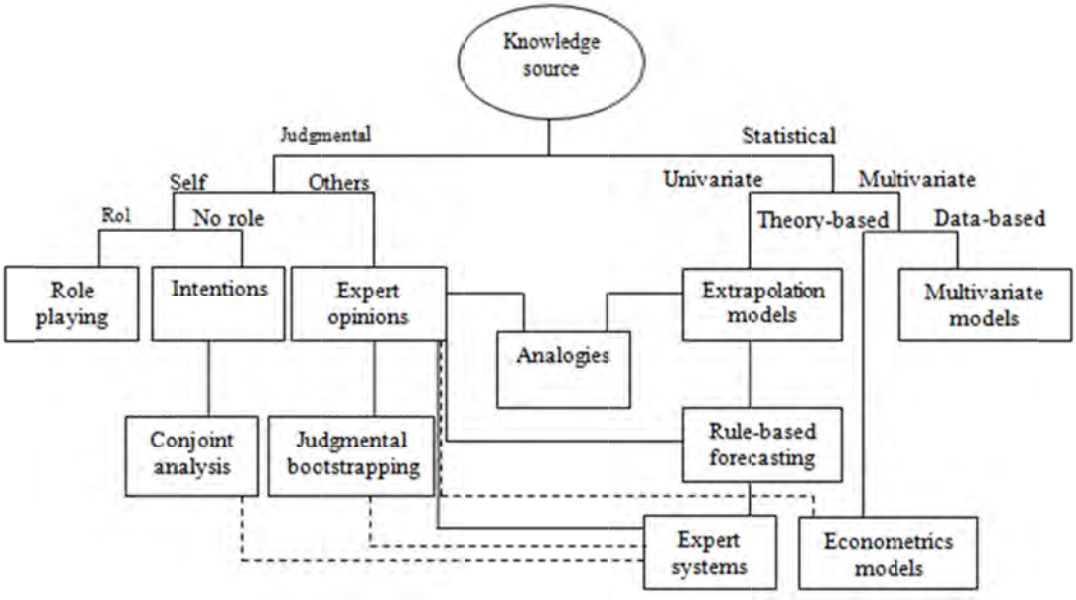
2 Selection and characterization of forecasting methods

In this section, the breakdown of the methods is done and particular methods are characterized.

2.1 Selection of methods

As already mentioned in the introduction, there are a number of forecasting methods. Armstrong [1] in his fundamental literature distinguishes two groups: judgmental and statistical methods. See the Fig. 2.

Fig. 2: Breakdown of forecasting methods by Armstrong



Source: [1]

Among judgmental methods belongs, according to Armstrong [1], role playing, expert opinions, conjoint analysis, judgmental bootstrapping etc. Among statistical methods are extrapolation models, econometric models, expert systems, multivariate models, etc. The analogy method is assigned to both groups. Although, as described above, the analogy method should be included more in the group of the judgmental methods. Some of these methods do not appear in Czech literature or they are given only minimal attention. These include role playing, conjoint analysis, and judgmental bootstrapping. Furthermore, methods such as the scenario method, Delphi, the morphological method or causal layered analyses, which are sometimes applied for forecasting, are not included in the Fig. 2.

2.2 Characteristics of selected methods

For further evaluation these forecasting methods were selected: Delphi, the analogy method, the scenario method, conjoint analysis, extrapolation models, the morphological method, econometrics and mathematical models (multivariate models). Brief characteristics of selected methods are given with regard to the necessary criteria (see Tab. 2).

Delphi technique is used to build long-term and extremely long-term forecasts (7 years or more). It uses a structured group of experts who support their forecast by arguments. During an anonymous questioning of experts, opinions should be converged but it can achieve more than one solution. Using this method is appropriate in a technical area as well as in a technological, social and multidisciplinary area. It is expensive and time-consuming [11, 1].

Analogy method is based on using the similarity of elements, features and structures. It finds and applies personal, symbolic and surreal similarity. For the use of analogy, a team is assembled that is usually led by an expert on the application of this method. The team is usually set up for a longer period of time. The method is expensive. It is used to determine the normative objectives [1, 8].

Scenario method uses systematic thinking about the future. With the participation of experts in the branch, it creates a passive prediction. It is used in the fields of technology and economics. It is not expensive, but it is time-consuming [13, 7].

Conjoint analysis is used to determine what combination of characteristics has the greatest influence on the decisions of the respondents. It is mainly used for short-term or medium-term forecasts, which are to create a model of market. It is expensive and time-consuming [4].

The extrapolation models use data about trends primarily in the technology field. Experts using this method extrapolate projections of possible future development. This model belongs to the less demanding methods of time and resources but it is necessary to have a thorough knowledge of the industry in terms of historical context [1, 13].

Morphological technique involves the process of analyzing the forms and structures of the product. Experts carry out the analytical study of various parameters (constants) of the product - the appearance, the materials and function. The result is a normative identification of new alternatives. It is mainly used in the field of technology. It is moderately expensive and time consuming and requires the participation of experts from the industry [10].

Econometrics (statistical, quantitative) methods such as analysis of trends and cycles, time series analysis, statistical trend test, correlation analysis, mathematical extrapolation based on the assumption that the future will match the previous development. The advantage of these methods is that they are usually less time and finance consuming. The disadvantage is that they fail to respond flexibly to changes in the environment. Armstrong shows that econometric models are more accurate than other methods for long-range forecasts. Evidence also suggests that the principles described for econometric methods can improve short-term forecasts [1, 6].

Mathematical models enable the expression of interdependences among many independent variables. Relationships between dependent and independent variables are examined by using multiple regressions. Subsequently, an obtained equation for forecasting future developments is obtained on the basis of the previous development. The method is

time consuming, but financially affordable [1, 6]. For our analysis the econometrics and mathematical models were put together.

3 The selection of appropriate method

Selection of a suitable method for predicting strategic goals should be based on needs, opportunities, and specific conditions of the organization. The criterion for the choice of method will surely be time horizon: short term (S), medium (M), long (L) or extremely long (EL). Further priority may be given to judgmental (J) or quantitative (Q) method. The crucial benefit is the possibility of using experts, and whether the aim of the strategy is explorative (E) or is known and identified normatively (N). Other criteria for selection can be time and financial disposition. The most demanding (+++) methods can be selected when sufficient time and financial resources are available. In contrast, the restrictive policy of the company will prioritize cost-saving (+) methods. See Tab. 2 for evaluation of selected methods.

Forecast will never be perfectly accurate, as it is always encumbered by certain error. Prediction accuracy decreases significantly with the length of time and with the speed of environmental variability.

Tab. 2: Evaluation of selected methods

Method/ criterion	Judgmental/ quantitative (J/Q)	Participation of experts Yes/No	Normative/ Explorative N/E	Time horizon	Finance /time demand
Delphi	J	Y	E	EL, L	+++/+++
Analogy	J	Y	N	M	++/+
Scenario method	J	Y	E	S, M	+/++
Conjoint analysis	J	Y	N	S, M	+++/+++
Extrapolation model	Q	Y	E	S, M	+/+
Morphological method	Q	Y	N	M, L	++/++
Econometrics and mathema-tical models	Q	N	E	S,M, L	+/++

Source: own elaboration

SME seem to have certain specifics that must be respected. Conducted research shows (Baurová, Janečko, Papalová, 2013) that managers in SME relize the importance of managerial thinking in the long term period. The research also shows trend that the larger the organization is, the greater weight is given to forecasting of environmental future. Czech specific includes frequent change in the legislative. This also causes that the period in which SME plans, is shorter. Other specific is the lack of funds that the company is able to and is willing to invest in the forecasting process. Also, the possibility of participation of experts is limited. None of the researched organization uses the service of external consulting organizations to set their strategic plan. As these organizations stated the reason is fear of possible misuse of sensitive information, and also high cost of this service.

The most frequent reason for the long term foresight is the rapid growth of the organization and thus the need to systematically predict and plan. SME usually do not need their forecasts longer than in medium time horizon. Some organizations were led to the need for the long term foresight by the economic crisis in 2008-2010.

4 Using AHP method for decision making

AHP is a method of multi-criteria decision making, developed by Thomas L. Saaty and is designed to solve complex decisions [12]. It is based on mathematical techniques and human psychology. The AHP is a systematic procedure for representing the elements of any problem, hierarchically. It organizes the basic rationality by breaking down a problem into its smaller and smaller constituent parts and then guides decision makers through a series of pairwise comparison judgments to express the relative strengths or intensity of impact of the elements in the hierarchy. The AHP includes procedures and principles used to synthesize the many judgments to derive priorities among criteria and subsequently for alternative solutions. Therefore, it is possible and appropriate to use it in this case.

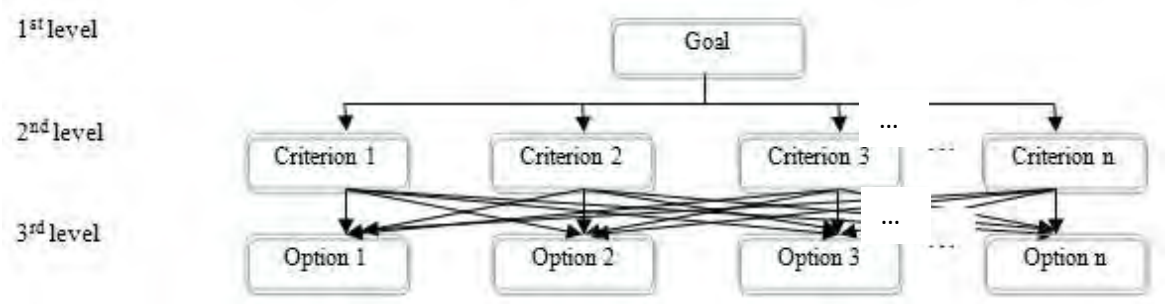
4.1 Description of AHP method

The hierarchy represents a complex problem in a multilevel structure. In the first level, there is the goal followed by criteria and sub-criteria. It can decompose a complex problem in search of cause-effect explanations into steps which form a linear chain [9].

Users of AHP firstly decompose their decision problem into a hierarchy of more easily understood sub-problems, each of which can be analyzed independently. The elements of the hierarchy can be related to any aspect of the decision problem. They could be tangible or intangible carefully measured or just roughly estimated.

Once the hierarchy is drawn, the decision makers systematically evaluate its elements by comparing them one to another with respect to their impact on the element above in the hierarchy. The AHP then converts these evaluations to numerical values, which can be processed and compared over the entire range of the initial problem. A numerical weight or priority, which is derived for each element of the hierarchy, allows that often incommensurable elements can be compared to one another in a rational and consistent way. Process of the drafting of the hierarchy does not perform only to identify all the relevant elements but also to identify the links between them. It is shown in Fig. 3.

Fig. 3: Hierarchy on three levels



Source: [12]

In the second step, the weights are set for each criteria and sub-criteria with regard to the object of decision. Method of pairwise comparisons will be used to determine these weights. For the correctness of the overall decision-making process, it is necessary to express the

weight of individual criteria. To calculate the weights of the criteria, it is necessary to build Saaty's matrix (1) of size $n \cdot n$, where c_i (i = 1,2, .., n) are the individual criteria.

$$\begin{array}{c|cccc} & c_1 & c_2 & c_3 \cdots & c_n \\ c_1 & 1 & s_{12} & s_{13} \cdots & s_{1n} \\ c_2 & 1/s_{12} & 1 & s_{22} \cdots & s_{2n} \\ c_3 & 1/s_{13} & 1/s_{23} & 1 \cdots & s_{3n} \\ c_n & 1/s_{1n} & 1/s_{2n} & 1/s_{3n} \cdots & 1 \end{array} \quad (1)$$

Certain rules are applied in the matrix. It is reciprocal, it means $s_{i,j} = 1/ s_{j,i}$. The elements on the diagonal of the matrix are always equal to the value of 1. Elements of Saaty's matrix are interpreted as estimates of the proportion of weights i^{th} and j^{th} criteria:

$$s_{ij} \approx \frac{w_i}{w_j}, \quad (2)$$

i, j = 1,...,n, w_i is the weight of the i^{th} criteria and w_j is the weight of the j^{th} criteria.

For the matrix compilation are individual criteria pairwise compared. Dominance of individual criteria can be expressed by a number in the range of values [1/9; 9]. To express the size of preference, it is recommended to apply a point scale (Tab. 3).

Tab. 3: Scale of marks for rating criteria

Points	Description
1	equal importance
3	moderate importance of one over another
5	essential or strong importance
7	demonstrated importance
9	extreme importance
2,4,6,8	Intermediate values between the two adjacent judgments

Source: [12]

4.2 The calculation of the individual criteria

The weights (w_j) can be obtained via quadratic programming or logarithmic version quadratic programming. One of the simplified methods that are well resolved in practice is a method of determining the standard of weights (w_j) using the weighted geometric mean of the matrix's lines [12]:

$$w_i = \frac{\left[\prod_{j=1}^{n} s_{ij}\right]^{\frac{1}{n}}}{\sum_{i=1}^{n}\left[\prod_{j=1}^{n} s_{ij}\right]^{\frac{1}{n}}}, \quad (3)$$

where i = 1,...,n.

In the third step, it is necessary to check the consistency coefficient of the Saaty's matrix. The sign of relevant evaluation is that the matrix is consistent, meaning the elements fulfill the condition of transitivity. The consistency can be evaluated by the coefficient of consistency CR (4), where the consistency value is considered $CR \leq 0.1$. Saaty defined the consistency ratio as follows,

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

where *CI* is the consistency index and is expressed as

$$CI = \frac{\lambda_{\max} - n}{n-1}, \tag{5}$$

where *n* is number of criteria (number of rows of the matrix) and λ_{max} is characteristic number of matrix - the eigen value and is calculated according to

$$\lambda_{\max} = \sum_{i=1}^{n} \frac{(\mathbf{S}\cdot\vec{w})_i}{n\cdot w_i}, \tag{6}$$

where $\vec{w}$ is vector and $(\mathbf{S}\cdot\vec{w})_i$ is i^{th} element of vector. *RI* is an index of randomness (random index) and assumes values in dependence on the number of selected criteria, respectively variants, and is derived from empirical research (Tab. 4).

Tab. 4: RI values for different number of elements

N	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

Source: [12]

If the value of *CR* is ≤ 0.1, then Saaty's matrix of pairwise comparisons can be considered sufficiently consistent and it's possible to continue calculating the weights of individual criteria.

The calculated weights of sub-criteria are not final. In order to proceed to the actual assessment of the options the weights must be on the ends of the branches of the hierarchical tree and they must be multiplied by the weight of the parent criteria. Then the determination of the weights is final and can be used in decision making.

4.3 Selection of the optimal alternative

In decision-making methods with partial criteria preferences we assume that it is possible to determine these partial preferences of criteria and also evaluate them. The most used method is weighted sum approach.

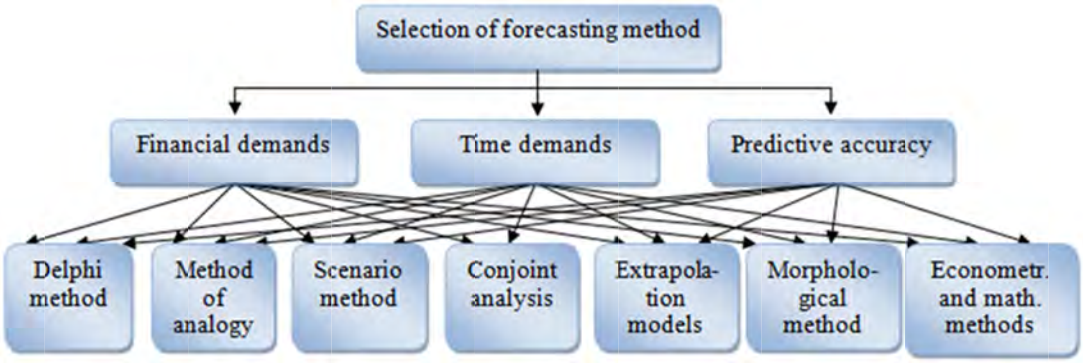
$$U_i = \sum_{j=1}^{n} w_j \cdot x_{i,j}, \tag{7}$$

where w_j is the normalized weight of j^{th} criteria and $x_{i,j}$ is normalized evaluation of i^{th} variant due to j^{th} criterion.

5 Application of AHP in the selection of forecasting methods

With respect to the characteristics of SME, three criteria were determined that may significantly affect the enterprise's managers in the selection of forecasting methods. They are financial demands, time demands (these two should be small) and the predictive accuracy (this should be high). Financial requirements and time requirements can be seen in Tab 2. To determine the accuracy of the predictions is the most difficult task in this evaluation. Although it is not reported in the table, mainly due to the extensiveness of the comments, we use in the processing the same sources as those used for the determination of other characteristics [1, 2, 4, 7, 10, 11]. Schematic illustration of the situation, including the linkages is shown in Fig. 4.

Fig. 4: Schematic presentation of selecting the method of forecasting using AHP



Source: own elaboration

Solving procedure was as follows. First, the weights of individual criteria using the AHP method were computed. Pairwise comparisons were performed for each criterion. It was found that the weight of financial demand is 20%, weight of time demand is 31% and weight of predictive accuracy is 49%. As was noted the determination of the prediction accuracy of the method is very difficult. For certain methods the accuracy increases with the amount of time and money needed to get information of various kinds, the involvement of experts or security of information and software systems. This discourages managers of SME from using methods of forecasting and strategic planning application.

On the basis of available resources pairwise comparisons of methods, in respect to all criteria, were conducted by authors. Computations were made in MS Excel. In the paper are included only the results, however all the computations are available upon an email request to the authors. Time and financial demands are quantitative variable, so pairwise comparisons were made on that base. Predictive accuracy is not a quantitative variable that could be assessed on the basis of cost or time and it could be loaded with subjective view. In order to prevent this, it was used the group decision making. Each decision-maker had the same weight and results for the calculation of the final weights were taken as the average.

Now follows the selection of the optimal alternative, it means, and selection of the best forecasting method. A comparison of the individual methods has been done with respect to each of the three determined criteria. The requirement of matrix consistency was fulfilled in all cases. In Tab. 5, we can see the results of the pairwise comparison of the alternatives. In perspective of financial demands (first row), we can see, that scenario method, extrapolation models and econometrics and mathematical methods are the less financial demanded. In term of time demand (second row) we can say that extrapolation models, analogy and scenario method is less time demanded. From the view of predictive accuracy we can see that scenario method, analogy and econometrics and mathematical methods were evaluated as the best.

Selection of optimal alternative is done using (7). Results are in Tab. 6. In the first to the third row, there are partial results due to the each of the criterion but in the result it is taken into consideration the weight of each criterion (rows from Tab. 5 are multiplied by parent criterion). The last row is the sum of partial results.

Tab. 5: Pairwise comparison of alternatives

Delphi	Analogy	Scenario method	Conjoint analysis	Extrapol. models	Morphol. method	Econom. and math. methods	Total
0.041	0.096	0.242	0.041	0.242	0.096	0.242	1.000
0.044	0.215	0.189	0.041	0.238	0.090	0.183	1.000
0.110	0.189	0.350	0.031	0.063	0.095	0.161	1.000

Source: own elaboration

Tab. 6: Selection of optimal alternative

Delphi	Analogy	Scenario method	Conjoint analysis	Extrapol. Models	Morphol. method	Econom. and math. methods	Total
0,008	0,019	0,047	0,008	0,047	0,019	0,047	
0,014	0,067	0,059	0,013	0,074	0,028	0,057	
0,054	0,093	0,173	0,016	0,031	0,047	0,080	
0.076	0.179	0.279	0.036	0.153	0.094	0.184	1.000

Source: own elaboration

6 Discussion

As it is obvious from Tab. 6, the best forecasting methods that could be used for SME are based on the scenario method, which reached the score 27.88%. In the same analysis, the econometric and mathematical methods reached a score of 18.39% and the method of analogy reached a score of 17.88%. All these methods are useful in predicting the medium horizon, which for small and medium-sized enterprise is also satisfactory. The disadvantage may be that the methods of scenarios and analogies often need the attendance of experts. Econometric and also mathematical models require these experts, who can work with data; however, as to the methods of small or medium financial and time constraints, they may be acceptable for a small or medium company.

Conclusion

Forecasting helps managers assess the factors affecting the future evolution of the environment, and thus the organization. This activity can help improve the strategic planning of the company. The AHP method is a method of multi-criteria decision making, which facilitates decision-making by organizing perceptions, feelings, judgments and memories of the decision maker in a framework that shows a preference that affects the decision. It is therefore possible to use it for the selection of appropriate methods of forecasting. Criteria that most influence the choice of a particular method are predictive accuracy, time demands and financial demands. These criteria and various methods of forecasting, as possible alternatives, were assessed by utilizing the AHP method. This can serve as a guide for managers in selecting the best method. Whatever method is chosen as appropriate for the organization, the result will be subject to a certain error. Forecasting accuracy decreases depending on the length of a period and is influenced by variability of the environment. Although the method accuracy is essential for the selection criterion, it is the most difficult to determine.

Acknowledgements

The paper was written with the support of Student Grant Competition of the Faculty of Economics, VŠB-Technical University of Ostrava (project registration number: SP2015/93) and Operational Programme Education for Competitiveness – project no. CZ.1.07/2.3.00/20.0296. All the support is greatly acknowledged and appreciated.

References

[1] ARMSTRONG, J. S. *Principles of forecasting: A Handbook for Researchers and Practitioners*. New York: Kluwer, 2002. ISBN 0-7923-7930-6.

[2] BAUROVÁ, V., M. JANEČKO a M. PAPALOVÁ, 2013. The Influence of Corporate External Environment on Strategy. In: *PEFNet 2013: European scientific conference of Ph.D. students: 17th Year, November 21, 2013.* Brno: Mendelova Universita. s. 25-32, ISBN 978-80-7375-906-3.

[3] BUŘITA, L., Prognostické metody a jejich využití v resortu MO. [online]. 2011 [cit. 3. 2. 2014]. Dostupný z WWW: <http://defenceandstrategy.eu/filemanager/files/file.php?file=6373>

[4] GRANT, R. M. *Contemporary strategy analysis*. Malden: Blackwell, 2008. ISBN 978-1-4051-6308-8.

[5] GREEN, P. E., SRINIVASAN, V. *Conjoint analysis I marketing: New developments with implications for research and practice*. Journal of Marketing, 1990, roč. 54, č. 4, s. 3–19. DOI: 10.2307/1251756.

[6] JOHNSON, G., SCHOLES K. and WHITTINGHTON, R. *Exploring corporate strategy: text&cases*. Harlow: Prentice Hall, 2008. ISBN 978-0-273-71192-6.

[7] HYNDMAN, J. R. Business forecasting methods. In: *International Encyclopedia of Statistical Science.* Springer, 2011. pp. 185-187. ISBN 978-3-642-04897-5.

[8] POSTMAA, T. and LIEBL, F. *How to improve scenario analysis as a strategic management tool?* Technological Forecasting & Social Change 72. 161–173. 2005. doi:10.1016/j.techfore.2003.11.005.

[9] PRINCE, G. M. P*ractice of creativity: a manual for dynamic group problem-solving*. Williamsville: Echo Point. 2012. ISBN 09-638-7848-4.

[10] RAMÍK, J. *Vícekriteriální rozhodování – analytický hierarchický process (AHP)*. Karviná: Slezská univerzita v Opavě, 1999. ISBN 80-7248-047-2.

[11] RITCHEY, T. *Futures Studies using Morphological Analysis*. UN University Millennium Project Futures Research Methodology series. [online]. 2005 [cit. 3. 2. 2013]. Dostupný z WWW: <http://www.swemorph.com/downloads.html.>

[12] ROWE, G., WRIGHT, G. *The impact of task characteristics reliability: a qualitative Delphi study in primary health care in on the performance of structured group forecasting techniques.* The Netherlands. Technological Forecasting and Social Change International Journal of Forecasting 12, 73–89. 1996.

[13] SAATY, T. L. and KEARNS, K. P. *Analytics Planning: The Organization of Systems.* New York: Pergamon Press, 1985. ISBN 00-803-2599-8.

[14] SLAUGHTER, R. *Futures beyond dystopia: creating social foresight*. New York: RoutledgeFalmer, 2004. ISBN 04-153-0270-6.

[15] ŠINDELÁŘ, J. *Přesnost a spolehlivost prognózy v řízení*. Dizertační práce. Česká zemědělská univerzita, Praha, 2010.

Contact Address

Ing. Terezie Bartusková
VŠB – TU Ostrava, Faculty of Economics, Department of Management
Sokolská tř. 33, 701 21 Ostrava, Czech Republic
Email: terezie.bartuskova@vsb.cz
Phone number: +420 596 992 275

Ing. Marcela Papalová, Ph.D.
VŠB – TU Ostrava, Faculty of Economics, Department of Management
Sokolská tř. 33, 701 21 Ostrava, Czech Republic
Email: marcela.papalova@vsb.cz
Phone number: +420 596 992 390

Ing. Aleš Kresta, Ph.D.
VŠB – TU Ostrava, Faculty of Economics, Department of Finance
Sokolská tř. 33, 701 21 Ostrava, Czech Republic
Email: ales.kresta@vsb.cz
Phone number: +420 596 992 015

Received: 23. 02. 2015
Reviewed: 31. 05. 2015, 30. 6. 2015
Approved for publication: 02. 09. 2015

EVALUATING THE IMPACT OF OPEN DATA USING PARTIAL LEAST SQUARES STRUCTURAL EQUATION MODELING

Renáta Bílková, Renáta Máchová, Martin Lněnička

Abstract: *Governments around the world are opening up their data to the public. This paper develops the issue of open data and their impact. More precisely, it evaluates how can be open data as a resource transformed to generate the impact and added value for the public sector. The main aim is to propose a new model, which uses attributes of open data in the context of the e-government development. The model consists of five enabling factors and five generating mechanisms (collaboration, efficiency, participation, transparency and innovation). To show the causal relationships between these constructs, the method of partial least squares structural equation modeling was chosen. By understanding the relationships, governments can improve their actions and investments in the context of e-government and related open data initiatives. The results suggest that the focus should be on the support of collaboration, participation and innovation processes in the public sector.*

Keywords: *Open data, Public sector, E-government, Initiatives, Partial least squares, Structural equation modeling.*

JEL Classification: *C39, C52, H83, L86, O38.*

Introduction

Open government is a recent phenomenon in which public sector data are made available and can be used by everybody for what it seems an unlimited amount of purposes [3]. Opening data may allow citizens and businesses to analyze various datasets and understand what governments are spending public resources on. Hence, many governments have started creating interoperability and open data frameworks spanning boundaries between public sector institutions, citizens and businesses to manage their data in a transparent and efficient way [9], [14]. The emergence of open data use is another phase of the Information and Communication Technologies (ICT) revolution and the public sector is at the center of the current shift to openness [10].

Although, the debate about open data is often reduced to open government data (OGD), there are also other type of open data such as open business data (OBD), open citizen data (OCD) and open science data (OSD). OGD are the most interesting subset of open data because such subsets have already been collected for specific use, have been paid for by taxpayers, are relevant and offer value beyond what is captured from the originally intended use. When opened up, government data become a common, shared resource (i.e., public good) that is provided by the government [7]. In 2012 and again in 2014, the United Nations issued OGD for their E-Government Survey reports, which summarized how governments utilized these data to better serve and protect their people [14]. However, OGD have limited impact if these data are not evaluated in the context of enabling factors and focus on developing sustainable ecosystems of users, which involve their collaboration, participation, innovation, etc.

1 Literature review

1.1 Open data and open government initiatives

The literature on reuse of open data often circles around their potentials [3] and the economic value of government data, while the literature on open government is in a higher grade directed towards government policy and centered on how use of open data can contribute to the generation of social value in collaborative settings [7]. As mentioned above, interest in the concept of open data has been around for many years [6]. Various studies have confirmed that releasing public data in open formats creates considerable benefits for citizens, businesses, researchers, and other stakeholders to understand public or private problems in new ways through advanced data analytics [2], [3], [6], [10], [13].

Open data are a piece of content or data if anyone is free to use, reuse, and also redistribute it – subject only, at most, to the requirement to attribute and share-alike. Most of open data are actually in raw form. However, republishing does imply citing the original source not only to give credit but to ensure that the data has not been modified or results misrepresented [6], [10]. Kucera and Chlapek [10] presented a set of benefits that can be achieved by publishing OGD and a set of risks that should be assessed when a dataset is considered for opening up. Cowan, Alencar and Mcgarry [2] used practical examples in an attempt to illustrate many of the related issues and allied opportunities of open data.

Open government acts as an umbrella term for many different ideas and concepts. The definition of open government mostly consists of transparency, participation and collaboration of the state towards third actors like the economy or the citizenship. Most often, open government is equated with e-government and the usage of ICT [3], [13]. The number of open data initiatives has grown from two to over three hundred in the period 2009–2013 [7], and the membership in the Open Government Partnership (OGP) has gone from eight in 2011 to the sixty-five participating countries in 2015. Governments are initiating open data initiatives as a new approach where external stakeholders can play an increased role in the innovation of government services. This is unlike previous approaches of e-government service innovation where services are solely initiated and developed by the agencies themselves [2], [8], [14], [17]. By promoting openness of government data, governments hope to enhance transparency, public efficiency, participation, collaboration and innovation of government services through the reorganizing, re-packaging, and synthesizing information from various sources [3], [17]. These open government principles are then best viewed as initiatives that government takes to accomplish defined objectives that provide the opportunity to achieve greater or additional value through incorporating these democratic practices [8], [10]. Social media can also play an important role in inspiring or enabling OGD usage, and in involving communities of practice, formed by people who engage in a process of collective learning related to OGD to sustain relevant initiatives and help create a network of actors [13].

Kalampokis, Tambouris and Tarabanis [8] claim that the real value of OGD will unveil from performing data analytics on top of combined statistical datasets that were previously closed in disparate sources and can now be linked to provide unexpected and unexplored insights. To support this claim, authors described the OGD analytics concept along with its technical requirements, which can be later extended with Apache Hadoop. Contributing to this trend is the increasing government recognition of the economic potential of open data [17]. Kalampokis, Tambouris and Tarabanis [9] also revised existing e-government stage models and proposed an OGD stage model, which provides a roadmap for OGD reuse

and enables evaluation of relevant initiatives' sophistication. Vickery [15] suggests that the economic value from the exploitation of OGD surpasses government investments in collecting, interpreting and disseminating the data. Jetzek, Avital and Bjørn-Andersen [7] developed a conceptual model portraying how open data as a resource can be transformed to value. Geiger and von Lucke [3] then analyzed the added value of freely-accessible government data and discussed challenges of OGD for public sector at the different administration levels. A cost-benefit analysis often shows the impact and value of taking the time to facilitate access [13]. Solar, Concha and Meijueiro [12] proposed an open data maturity model to assess the commitment and capabilities of public agencies in pursuing the principles and practices of open data, which has a hierarchical structure consists of domains, sub-domains and critical variables.

1.2 Structural equation modeling and partial least squares regression

Structural equation modeling (SEM) is the first generation path modeling widely used by researchers and practitioners to analyze the interrelationship among variables in a model. Some of the researchers classify SEM as the covariance-based SEM (CB-SEM). However, this method has been argued since its application should achieve the criterion before conducting the measurement and structural model. Thus, partial least squares SEM (PLS-SEM) was established to solve this problem [1], [5]. Afthanorhan [1] then compared CB-SEM and PLS-SEM, examined which one of these structural equation modeling methods is appropriate to use for confirmatory factor analysis and concluded that PLS-SEM is more reliable and valid.

Its application is aimed to maximize the explained variance of the endogenous latent variables (dependent) by estimating partial model relationships in an iterative sequence of ordinary least squares (OLS) regressions, and minimize the unexplained variances [1], [5]. Latent variables are underlying variables that cannot be observed directly, they are also known as constructs or factors [16]. The most frequently cited reasons to use PLS-SEM are related to small sample sizes, non-normal data, the use of formatively measured latent variables, and also the unrestricted use of single attribute constructs. Other substantive reasons for choosing PLS-SEM can be found in [4] or [11], where authors provided comprehensive guidelines to aid researchers in avoiding common pitfalls in the PLS-SEM use. PLS-SEM is not appropriate for all kinds of statistical analysis. There are also some weaknesses such as [16]: since arrows are always single headed, it cannot model undirected correlation; high-valued structural path coefficients are needed if the sample size is small; it may create large mean square errors in the estimation of path coefficient loading, etc.

There are two sub-models in a structural equation model, the inner model specifies the relationships between the independent and dependent latent variables, whereas the outer model specifies the relationships between the latent variables and their observed indicators, which can be measured directly, they act as indicators for an underlying latent variable [5], [16]. In the SEM, a variable is either exogenous or endogenous. An exogenous variable has path arrows pointing outwards and none leading to it. Meanwhile, an endogenous variable has at least one path leading to it and represents the effects of other variables [16].

Outer model assessment involves examining individual indicator (attribute) reliabilities, the reliabilities for each construct's composite of measures (i.e., internal consistency reliability), and also the measures' convergent and discriminant validities. When evaluating how well constructs are measured by their indicators, individually or jointly, researchers need to distinguish between reflective and formative measurement perspectives [4]. While

criteria such as Cronbach's alpha and composite reliability are commonly applied to evaluate reflective measures, an internal consistency perspective is inappropriate for assessing formative ones. Also formative measures' convergent and discriminant validities cannot be assessed by empirical means [4], [5], [11].

2 Problem formulation and research methodology

OGD change the role of the public sector to the information publisher, which in turn may result in a change of power distribution between the public and private sectors as well as between the government and the public, where are chances that the work of the government will improve due to increased collaboration, participation, innovation, efficiency, transparency, which will subsequently strengthen democracy.

The aim of this paper is to evaluate how can be open data as a resource transformed to generate the impact and added value for the public sector. The proposed model uses five enabling factors and five generating mechanisms to evaluate the impact. To show the causal relationships between these constructs, the PLS-SEM is chosen. Authors' model is then based on the conceptual model of OGD value generation, which was developed by Jetzek, Avital and Bjørn-Andersen [7]. However, their model used data from 2011-2012 including some attributes, which do not exist anymore in 2015. Also frameworks of some the indices used were reworked, especially the Web Index by World Wide Web Foundation (W3F). Furthermore, new trends such social media or open data portals arise and have to be incorporated into the new model. Finally, they evaluated only 61 countries. The new model evaluates 86 countries, which offers a bigger sample size. It also solves the problem of the validation of constructs by using only the attributes supported by the literature review.

The PLS-SEM method was chosen, as this study is exploratory due to the emergent state of the phenomenon, use of formative constructs, the small sample size and the complexity of the structural model [4], [5]. Since PLS is based on a series of OLS regressions, it has minimum demands regarding sample size, and generally achieves high levels of statistical power [5]. The main tool used is SmartPLS 3, because it is freely available to the research community. Furthermore, this software has maintained an active online discussion forum, providing a good platform for knowledge exchange among its users. Data pre-processing and basic operations on them are conducted in Microsoft Excel 2010.

3 Research study

3.1 Model description and data sources

The main changes in the new model, which is shown in the Table 1, are as follows: In the first construct, three attributes had to be removed, because they don't exist anymore in 2015. Extent of open government initiative was moved to the data governance construct. These new attributes were thus added to the data openness and freedom construct: personal data protection laws/regulations, legal requirements for Net neutrality, safeguards to protect privacy of electronic communications, right to information/freedom of information law and freedom of the press. Three attributes had to be also removed from the data governance construct, three others were added: government success in ICT promotion, effective legal protection from cybercrime and use of web-powered ICTs to catalyze action. Also two attributes of the capabilities and readiness construct don't exist in 2015. They were replaced by the Human Capital Index, quality of the educational system and use of web-powered ICTs to improve education outcomes. Infrastructure and connectivity construct still consist

of firm level technology absorption and Telecommunication Infrastructure Index, however, the structure of this index changed (three new attributes were added into this index). International Internet bandwidth (bit/s) per Internet user, Secure Internet servers per one million people and availability of latest technologies were added. Accessibility of digital content was then moved to the new construct – relevant content and use, together with Online Service Index, which was moved from the data governance construct. This new construct also consist of blocking/filtering of web content.

Attributes of the efficiency construct remained the same. The only two attributes of the innovation construct don't exist anymore. Therefore, four new attributes were added: Global Innovation Index, capacity for innovation, government procurement of advanced technology products and The Patent Cooperation Treaty patent applications. One attribute from the transparency construct had to be removed and was replaced by the Corruption Perceptions Index. The e-participation index is still the main part of the participation construct, although, the structure of the index used was changed in 2014 [14]. The second attribute of this construct is voice and accountability, which reflects perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media. The new collaboration construct then consists of use of virtual social networks and cooperation in labor-employer relations.

The focus of the last construct was changed from "value" to "impact", when three attributes remained, one was replaced by the social performance and the data source of the environmental impact was changed from the Natural Resource Management Index to the Environmental Performance Index because of outdated data (only data from 2011 are available).

Tab. 1: Description of the exogenous type of constructs, attributes and data source 1/2

Construct	Attribute	Type (measure)	Data source
Capabilities and Readiness (CR)	1.1 Human Capital Index	Exogenous (reflective)	UN
	1.2 Quality of the educational system		WEF
	1.3 Extent of staff training		WEF
	1.4 Use of web-powered ICTs to improve education outcomes		W3F
Data Governance (DG)	2.1 Importance of ICTs to government vision of the future	Exogenous (formative)	WEF
	2.2 Government success in ICT promotion		WEF
	2.3 Extent of open government initiative		W3F
	2.4 Effective legal protection from cybercrime		W3F
	2.5 Use of web-powered ICTs to catalyze action		W3F
Data Openness and Freedom (DOF)	3.1 Personal data protection laws/regulations	Exogenous (formative)	W3F
	3.2 Legal requirements for Net neutrality		W3F
	3.3 Safeguards to protect privacy of electronic communications		W3F
	3.4 Right to information/freedom of information		W3F
	3.5 Freedom of the press		Freedom House

Source: Authors

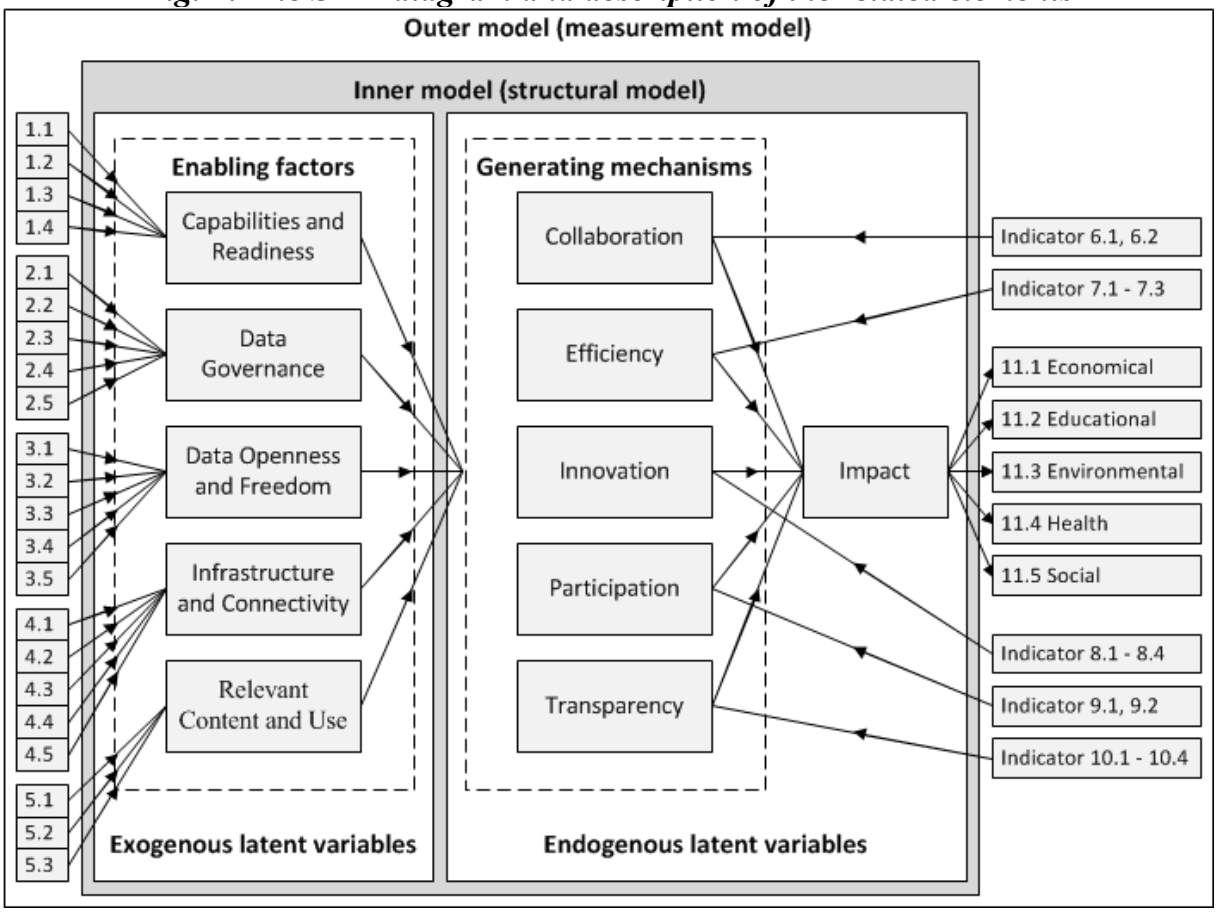
Tab. 1: Description of the endogenous type of constructs, attributes and data source 2/2

Infrastructure and Connectivity (IC)	4.1 Telecommunication Infrastructure Index	Exogenous (reflective)	UN
	4.2 International Internet bandwidth (bit/s) per Internet user		ITU
	4.3 Availability of latest technologies		WEF
	4.4 Secure Internet servers per one million people		World Bank
	4.5 Firm level technology absorption		WEF
Relevant Content and Use (RCU)	5.1 Online Service Index	Exogenous (formative)	UN
	5.2 Accessibility of digital content		WEF
	5.3 Blocking/filtering of web content		W3F
Collaboration (COL)	6.1 Use of virtual social networks	Endogenous (reflective)	WEF
	6.2 Cooperation in labor-employer relations		WEF
Efficiency (EFF)	7.1 ICT use and government efficiency	Endogenous (reflective)	WEF
	7.2 Government effectiveness		World Bank
	7.3 Ease of doing business index		World Bank
Innovation (INN)	8.1 Global Innovation Index	Endogenous (reflective)	INSEAD
	8.2 Capacity for innovation		WEF
	8.3 Government procurement of advanced technology products		WEF
	8.4 The Patent Cooperation Treaty patent applications (all types)		WEF
Participation (PAR)	9.1 e-Participation Index	Endogenous (reflective)	UN
	9.2 Voice and accountability		World Bank
Transparency (TRA)	10.1 Corruption Perceptions Index	Endogenous (reflective)	Transparency International
	10.2 Transparency of government policymaking		WEF
	10.3 Judicial independence		WEF
	10.4 Irregular payments and bribes		WEF
Impact (IMP)	11.1 Economical: GDP/capita	Endogenous (reflective)	World Bank
	11.2 Educational: Education index		UN
	11.3 Environmental: Environmental Performance Index		Yale and Columbia University
	11.4 Health: Health index		UN
	11.5 Social: Human Development Index		UN

Source: Authors

In this research study, constructs are made from a maximum of five indicators, and the impact has the largest structural equation with five direct paths pointing towards it. Inner and outer model in a SEM diagram can be seen from the Fig. 1.

Fig. 1: The SEM diagram and description of the related elements



Source: Authors

3.2 Data analysis

Given that highly skewed data inflate bootstrap standard errors [4], thus statistical Given that highly skewed data inflate bootstrap standard errors [4], thus statistical parameters of kurtosis and skewness were calculated using the Data Analysis tool in Microsoft Excel. There were no missing data and all columns showed a reasonable degree of normality (kurtosis < |1.5|, skewness <|1|) except for International Internet bandwidth (bit/s) per Internet user, Secure Internet servers per one million people, The Patent Cooperation Treaty patent applications and GDP per capita where it was 2.7, 2.1, 2.5 and 1.6 respectively, which was solved by converting these attributes to a logarithmic scale, because there were no negative numbers. Then, the dataset was converted into .csv file format and uploaded into SmartPLS. Here, the inner model of latent variables was built. Then, the outer model was built by linking the indicators to the related latent variable. When formative indicators exist in the model, the direction of the arrows has to be reversed. That is, the arrow should be then pointing from the formative indicators to the latent variable in SmartPLS.

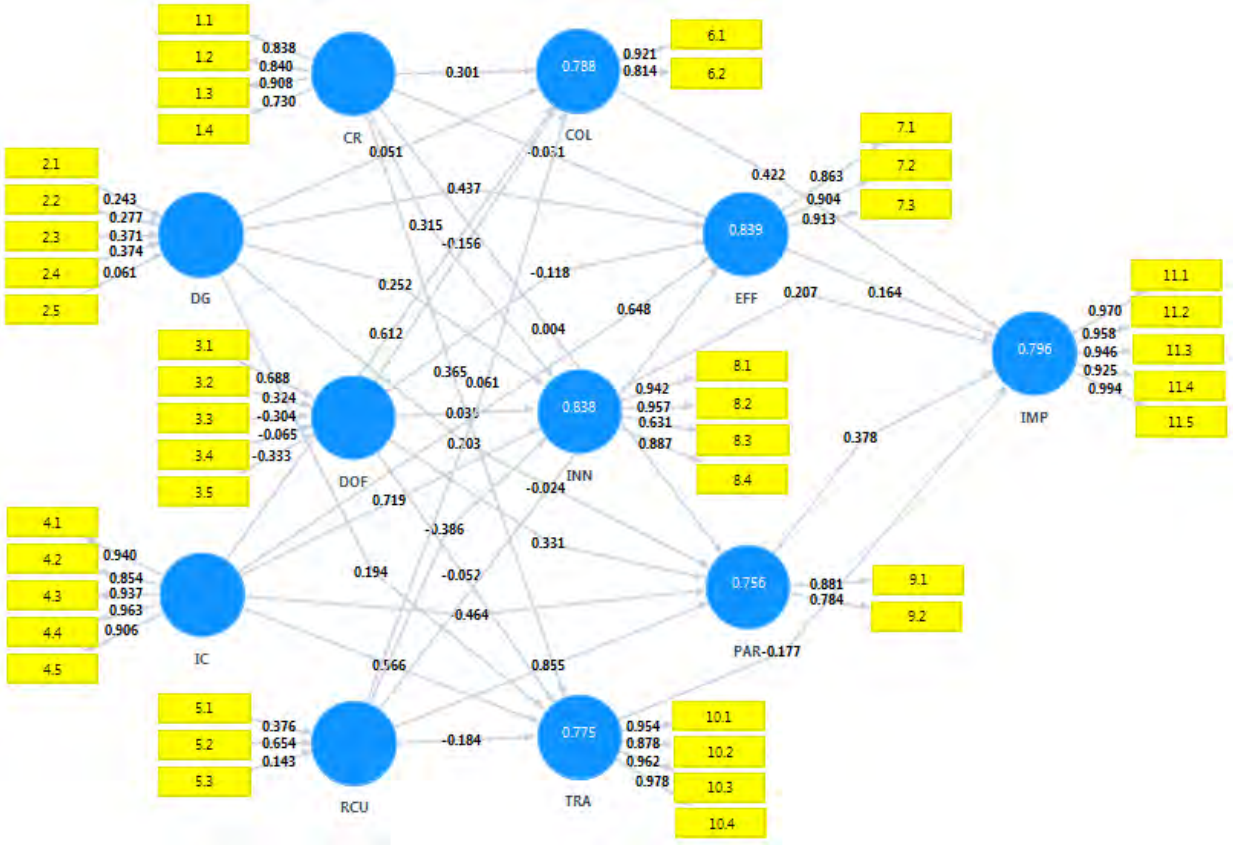
Reporting the precise settings is important, because a poor choice of options can lead to significantly biased standard error estimates [11]. Therefore, settings of the PLS algorithm were configured with these parameters – weighting scheme: path weighting scheme; maximum iterations: 500; stop criterion: 10^-7 and initial weights: 1.0. All measures were also standardized before running the algorithm. SmartPLS can generate T-statistics for significance testing of both the inner and outer model, using a procedure called bootstrapping. In this procedure, a large number of subsamples (e.g., 5000) are taken from the original sample with replacement to give bootstrap standard errors, which in turn gives approximate T-values for significance testing of the structural path. The Bootstrap

result approximates the normality of data [16]. Then, settings were configured with these parameters – subsamples: 5000; test type: two tailed; significance level: 0.05 and sign changes: no sign changes.

4 Results and discussion

In the PLS-SEM diagram, which can be seen from the Fig. 2, there are two types of numbers – numbers in the circle: these show how much the variance of the latent variable is being explained by the other latent variables; and numbers on the arrow, which are called the path coefficients and explain how strong the effect of one variable is on another variable. The weight of different path coefficients enables to rank their relative statistical importance [16].

Fig. 2: The PLS-SEM diagram with the results



Source: Authors

By looking at the diagram, the following preliminary observations can be made. The coefficient of determination (R^2) is 0.796 for the target IMP endogenous latent variable. For R^2 of 0.75 it is substantial, 0.50 is moderate, and 0.25 is weak [5], [16]. This means that the five endogenous latent variables (COL, EFF, INN, PAR and TRA) substantially explain 79.6% of the variance in IMP, which is also 5% more than in the study [7]. The exogenous latent variables then substantially explain 78.8 % of the variance in COL, 83.9 % in EFF, 83.8 % in INN, 75.6% in PAR and 77.5 % in TRA. The inner model suggests that COL has the strongest effect on IMP (0.422), followed by PAR (0.378) and INN (0.207). Therefore, it can be concluded that COL and PAR are both moderately strong predictors of IMP.

One of the concerns with formatively measured constructs is multicollinearity across the attributes of each construct. High first eigenvalues can be an indicator of multicollinearity, however, all formative construct´s first eigenvalues are lower than 3. All Variance Inflation Factors (VIFs) were also below the recommended 5.00 value [5]. Table 2 then presents the

reliability and validity of the latent variables (reflective outer model) to complete the examination of the inner structural model.

Tab. 2: Results summary for reflective outer model

Latent variable	Indicators	Loadings	Indicator reliability	Composite reliability	Cronbach's alpha	AVE
CR	1.1	0.838	0.702	0.899	0.849	0.691
	1.2	0.840	0.706			
	1.3	0.908	0.824			
	1.4	0.730	0.533			
IC	4.1	0.940	0.884	0.965	0.955	0.848
	4.2	0.854	0.729			
	4.3	0.937	0.878			
	4.4	0.963	0.927			
	4.5	0.906	0.821			
COL	6.1	0.921	0.848	0.860	0.687	0.755
	6.2	0.814	0.663			
EFF	7.1	0.863	0.745	0.922	0.874	0.799
	7.2	0.904	0.817			
	7.3	0.913	0.834			
INN	8.1	0.942	0.887	0.920	0.881	0.747
	8.2	0.957	0.916			
	8.3	0.731	0.534			
	8.4	0.887	0.787			
PAR	9.1	0.881	0.776	0.820	0.668	0.695
	9.2	0.784	0.615			
TRA	10.1	0.954	0.910	0.970	0.959	0.891
	10.2	0.878	0.771			
	10.3	0.962	0.925			
	10.4	0.978	0.956			
IMP	11.1	0.970	0.941	0.983	0.978	0.919
	11.2	0.958	0.918			
	11.3	0.946	0.895			
	11.4	0.925	0.856			
	11.5	0.994	0.988			

Source: Authors

Indicator reliability (i.e. loadings^2), measured as outer loadings numbers, 0.70 or higher is preferred. If it is an exploratory research, 0.40 or higher is acceptable [4], [5]. Internal consistency reliability, measured as composite reliability and also Cronbach's alpha, should be 0.70 or higher. If it is an exploratory research, 0.60 or higher is acceptable. Convergent validity, measured as average variance extracted (AVE), can be accepted when the value is greater than 0.50 [4], [11]. Otherwise, these indicators should be removed from the measurement model, since they indicate that the selected indicators have less contribution towards the related constructs [1], [5]. This procedure is known as unidimensionality procedure [1]. This model assessment should be applied in order to improve model's reliability and validity. However, in this model, all the requirements are achieved. Then, the discriminant validity was conducted.

Discriminant validity (as Fornell-Larcker criterion) values were obtained from the square root of AVE value and are shown in the Table 3. The diagonal values (in bold) are the square root of AVE, while the other values are the correlations between the related constructs. In this case, the discriminant validity is achieved when a diagonal value is higher than the value in its row and column [1]. The result then indicates that discriminant validity is well established.

Tab. 3: Fornell-Larcker criterion analysis for checking discriminant validity

Latent variable	CR	IC	COL	EFF	INN	PAR	TRA	IMP
CR	**0.831**							
IC	0.818	**0.921**						
COL	0.823	0.861	**0.869**					
EFF	0.817	0.891	0.792	**0.894**				
INN	0.808	0.890	0.758	0.861	**0.864**			
PAR	0.755	0.788	0.611	0.768	0.700	**0.834**		
TRA	0.806	0.857	0.825	0.886	0.845	0.681	**0.944**	
IMP	0.804	0.920	0.794	0.811	0.784	0.787	0.749	**0.959**

Source: Authors

Using a two-tailed t-test with a significance level of 5%, the path coefficient will be significant if the T-statistics is larger than 1.96 [5], [16]. This has to be done for the path coefficients of the inner model, which are shown in the Table 4, as well as for the outer model, where all of the T-statistics are larger than 1.96, so it can be said that the outer model loadings are highly significant. In the case of the inner model, it can be claimed that only the COL – IMP, INN – IMP and the PAR – IMP linkage are significant in the context of this study. This also confirms the earlier findings. Also the IC exogenous latent variable has the significant impact on all the endogenous latent variables.

Tab. 4: T-statistics of path coefficients (inner model)

Relationship	**T-statistics**	**Result**	**Relationship**	**T-statistics**	**Result**
CR → COL	2.045	Significant	IC → COL	3.043	Significant
CR → EFF	0.228	Not significant	IC → EFF	3.746	Significant
CR → INN	2.214	Significant	IC → INN	3.504	Significant
CR → PAR	0.027	Not significant	IC → PAR	2.060	Significant
CR → TRA	2.822	Significant	IC → TRA	2.503	Significant
DG → COL	0.423	Not significant	RCU → COL	0.344	Not significant
DG → EFF	4.208	Significant	RCU → EFF	0.180	Not significant
DG → INN	2.399	Significant	RCU → INN	2.664	Significant
DG → PAR	1.779	Not significant	RCU → PAR	4.073	Significant
DG → TRA	1.465	Not significant	RCU → TRA	0.879	Not significant
DOF → COL	2.196	Significant	COL → IMP	4.191	Significant
DOF → EFF	1.560	Not significant	EFF → IMP	1.213	Not significant
DOF → INN	0.403	Not significant	INN → IMP	1.982	Significant
DOF → PAR	3.293	Significant	PAR → IMP	4.073	Significant
DOF → TRA	0.607	Not significant	TRA → IMP	1.505	Not significant

Source: Authors

Conclusion

The purpose of the proposed model was to demonstrate the impact of open data and how governments can improve their actions by understanding the relationships among the related enabling factors and generating mechanisms. It provides a more systematic approach to measure the role of open data in improving collaboration, participation, innovation, transparency and efficiency of governments. The results suggest that the focus should be on the support of collaboration, participation and innovation generating mechanisms. They also show that the five endogenous latent variables (COL, EFF, INN, PAR and TRA) used in this model substantially explain 79.6% of the variance of the open data impact (IMP). The most significant indicators in the impact construct are social and economical impact, i.e. open data have the biggest impact on these two areas. These findings would result in more confident predictions and evaluations of open data impacts using constructs introduced in the newly proposed model.

This model represents the most important scientific contribution of this paper, because it is consisted of the most recent attributes defining actions and trends in the e-government development focusing on open data. This model can be also easily extended in the future.

References

[1] AFTHANORHAN, W. M. A. B. W. A Comparison Of Partial Least Square Structural Equation Modeling (PLS-SEM) and Covariance Based Structural Equation Modeling (CB-SEM) for Confirmatory Factor Analysis. *International Journal of Engineering Science and Innovative Technology*, 2013, Vol. 2, Iss. 5, pp. 198-205.

[2] COWAN, D., ALENCAR, P., MCGARRY, F. Perspectives on Open Data: Issues and Opportunties. In: *Proceedings of the 2014 IEEE International Conference on Software Science, Technology and Engineering*. IEEE, 2014. pp. 24-33.

[3] GEIGER, C. P., VON LUCKE, J. Open Government and (Linked) (Open) (Government) (Data). *eJournal of eDemocracy & Open Government*, 2012, Vol. 4, No. 2, pp. 265-278.

[4] HAIR, J. F., SARSTEDT, M., RINGLE, C. M., MENA, J. A. An assessment of the use of partial least squares structural equation modeling in marketing research. *Journal of the Academy of Marketing Science*, 2012, Vol. 40, Iss. 3, pp. 414-433.

[5] HAIR, J. F., RINGLE, C. M., SARSTEDT, M. PLS-SEM: Indeed a silver bullet. *The Journal of Marketing Theory and Practice*, 2011, Vol. 19, Iss. 2, pp. 139-152.

[6] JANSSEN, M., CHARALABIDIS, Y., ZUIDERWIJK, A. Benefits, Adoption Barriers and Myths of Open Data and Open Government. *Information Systems Management*, 2012, Vol. 29, No. 4, pp. 258-268.

[7] JETZEK, T., AVITAL, M., BJØRN-ANDERSEN, N. Generating Value from Open Government Data. In: *Proceedings of 34th International Conference on Information Systems: ICIS 2013*. Berkeley: Bepress, 2013, pp. 1-20.

[8] KALAMPOKIS, E., TAMBOURIS, E., TARABANIS, K. Linked Open Government Data Analytics. In: *Proceedings of the 12th IFIP WG 8.5 International Conference: EGOV 2013*. Springer, Berlin Heidelberg, 2013, pp. 99-110.

[9] KALAMPOKIS, E., TAMBOURIS, E., TARABANIS, K. Open Government Data: A stage model. In: *Proceedings of the 10th IFIP WG 8.5 International Conference: EGOV 2011*. Springer, Berlin Heidelberg, 2011, pp. 235-246.

[10] KUCERA, J., CHLAPEK, D. Benefits and Risks of Open Government Data. *Journal of Systems Integration*, 2014, Vol. 5, No. 1, pp. 30-41.

[11] RINGLE, C. M., SARSTEDT, M., STRAUB, D. W. A Critical Look at the Use of PLS-SEM in MIS Quarterly. *MIS Quarterly*, 2012, Vol. 36, No. 1, pp. 3-14.

[12] SOLAR, M., CONCHA, G., MEIJUEIRO, L. A Model to Assess Open Government Data in Public Agencies. In: *Proceedings of the 11th IFIP WG 8.5 International Conference: EGOV 2012*, Springer, Heidelberg, 2012, pp. 210-221.

[13] UBALDI, B. Open Government Data: Towards Empirical Analysis of Open Government Data Initiatives, *OECD Working Papers on Public Governance*, No. 22, OECD Publishing, 2013, 60 p.

[14] UNITED NATIONS. *United Nations e-Government Survey 2014: E-Government for the Future We Want*. New York: UN Publishing Section, 2014. 263 p. ISBN 978-92-1-123198-4.

[15] VICKERY, G. *Review of Recent Studies on PSI Reuse and Related Market Developments* [online]. 2011 [cit. 2015-02-02]. Available at WWW: <http://www.nsgic.org/public_resources/Vickery.pdf>

[16] WONG, K. K.-K. Partial Least Squares Structural Equation Modeling (PLS-SEM) Techniques Using SmartPLS. *Marketing Bulletin*, 2013, Vol. 24, Iss. 1, pp. 1-32.

[17] YANG, Z., KANKANHALLI, A. Innovation in Government Services: The Case of Open Data. In: *Grand Successes and Failures in IT: Public and Private Sectors*. Springer, Berlin, 2013, pp. 644-651.

Contact Address

Ing. Renáta Bílková, Ph.D.
University of Pardubice, Faculty of Economics and Administration
Studentská 84, 53210 Pardubice, Czech Republic
Email: renata.bilkova@upce.cz
Phone number: +420 46603 6245

Ing. Renáta Máchová, Ph.D.
University of Pardubice, Faculty of Economics and Administration
Studentská 84, 53210 Pardubice, Czech Republic
Email: renata.machova@upce.cz
Phone number: +420 46603 6074

Ing. et Ing. Martin Lněnička
University of Pardubice, Faculty of Economics and Administration
Studentská 84, 53210 Pardubice, Czech Republic
Email: martin.lnenicka@gmail.com
Phone number: +420 46603 6075

Received: 06. 02. 2015
Reviewed: 08. 06. 2015, 26. 06. 2015
Approved for publication: 02. 09. 2015

HISTORICAL ASPECT OF THE INDIVIDUAL-FOCUSED TRAINING OF THE PROFESSIONAL TUTORSHIP IN XXI CENTURY

Marina Dyuzheva

Abstract: *The basic social significance of business - is to provide jobs for working-age population and to unite professional workers in the enterprise. Historical forms of training, such as coaching, tutorship, patronage etc. can be successfully used to solve these problems. Russian experience allows us to generalize and systematize the best tutorship movement in the state. Analysis of the history of tutorship helped to formulate the modern forms and learning tools, such as: training, specific situations solution, business games, etc. The author of this article offers the modern interpretation of the tutorship movement for business based on the historical analysis of tutorship movement in Russia and foreign experience. Tutorship in business in Russia is just starting to gain its force. Entrepreneurs begin to realize the benefits of this form of education. The economic component of business has always been and will always be a priority, so the financial investments in tutorship are small and the return of these investments for enterprise is enormous.*

Keywords: *Tutorship, Tutor, Supervisor, Professional schools, Manpower reserves.*

JEL Classification: *I25, M53.*

Introduction

The dynamics of the economy affects the activity of the company and its employees. A modern unstable economic condition confronts managers ever new challenges to solve the problem of skilled trade workers. Employees should be experts in many situations because they often have to cope with changing conditions in enterprises. This must be designed and methods of education of qualified professionals, such as tutoring, mentoring and especially tutorship laying in the paper.

1 Problem formulation

Up-to-date social processes are complex, dynamical and unstable. That is the reason of various behavioural situations in the professional activity of the Russian business personnel. The problem of effective labor productivity of the personnel in certain business unit is quite actual because of the world financial and economic instability.

The tutorship is to solve the problem named.

The essence of term «tutorship» is revealed in the scientific works of S. Vershlovsky [11], S. Batysheva [2], L. Lisokhina [4], A. Hodakov [11], S. Ikonnikova [4], L. Magalnik [7], G. Lewis [6], and others. The need of the young specialist for support from the skilled teacher - the tutor, able to assist urgently on a workplace, able to raise theoretical and professional competence of a young specialist are presented in the researches of B. Frank [3], L. Tolmati [3], O. Lapina [5] and others.

Different authors interpret the term «tutorship» in different ways. Anyway it represents inherently a process of knowledge, abilities, skills and experience transfer.

Tutorship appeared together with mankind, as all the mankind history always represents the transfer of experience. Since the most ancient times teachers, senior companions played the irreplaceable role in the education of a person. All of them can be called in one word - tutors.

In the Ancient Greece education had military character and first of all prepared soldiers in whom the state needed. Children from noble families had tutors who trained them in many useful for the further service arts. We remember legendary Achilles who had two tutors: Hiron and the Phoenix.

The centaur Hiron trained Achilles in sports and many military skills: spare throwing, hunting, riding, and also playing lyre and medicine. Phoenix brought up Achilles since the childhood and trained him in two basic arts: military and rhetorical which were arts of the first necessity [9].

The history of pedagogics knows various ways of the organization of education in educational institutions. For example, in 1813 the Ministry of national education of Russia (MNE) established the division of functions of training and education with a special circular.

There was a post of «the room supervisor at board». Within days the supervisor had to be with children (he presented at the lessons, helped to do homework, organized leisure, and watched children's behavior). Only speaking French highly moral persons were appointed to this post.

In 1835 there was established the post of class supervisors, whose duties included supervision over students' behavior at school, in public places, in domestic conditions. As supervisors could have just elementary education, so far as they had no authority among students. Moreover, the constant supervision bordering on police investigation, caused hatred towards the supervisors.

Since 1961 (after serfdom cancellation) the term «supervisor» in MNE documents has been replaced by the term «tutor». More attention was paid to the selection of tutors.

According to the Charter of grammar schools and programmar schools of 1864 the main duty of class tutors there was an out-of-class supervision of students. Educational process was put under strict control of the state.

Since 1871 there was established the institute of class tutors. They were chosen among the teachers, who worked in the certain class. The tutor supervised students of the class and was responsible for their behavior (in female grammar schools class tutors were called «class ladies»). The appearance of class tutors promoted the rapprochement of training and education processes, their merge in a one stream of pedagogical influence on students.

In the end of a XIX-th century class tutors appeared in initial and lowest professional educational institutions. The feature of their activity was to bring up students physically tolerant, respecting heavy physical work, «… accustoming to simple and unpretentious food», supervising students in public places.

At the same time the rules for the craft schools students confirmed in 1901, contained instructions to class tutors to use cultural leisure and physical training with a view of education.

After October, 1917 the institute of class tutors was abolished, as heads of the Soviet education considered that both training and education should enter into duties of each teacher.

Indeed it decreased the level of educational work. In 1931 there was established the post of the group leader (since 1934 - the class teacher) - besides teaching he was carrying out the general work on the organization and education of students' collective of a certain class.

In 90th years XIX - the beginning of XX century a further strengthening supervising functions of class tutors and their assistants took place. It happened not only in general educational institutions, but also in professional educational institutions. The control became stricter and it proceeded from class tutors, their assistants and supervisors. They controlled students wearing uniform out of school, during summer vacations.

The value of the advanced class tutors' experience in 1910s was in their pedagogical influence on student's clubs, subject sections, that gave educational orientation to its activity [1].

As to the tutorship in professional training – the first professional schools in Russia appeared in 1701.

In 1919 Soviet Government with a special resolution created the general center to organize and manage the qualified labor training.

Professional educational institutions appeared the time and the place that economic development demanded. That is why children received the first craft knowledge at comprehensive schools, they were trained metalwork, joiner's, forge, weapon and to shoemaking.

In October, 1940 the Presidium of the USSR Supreme body accepted the Decree «About the State manpower reserves of the USSR». It established the one centralized system of the qualified labor preparation in craft and railway schools, schools of factory training, and also distribution of the prepared specialists. It was established two-year training in craft and railway schools and six-month training at special schools preparing workers of mass professions.

A difficult international situation proceeded the creation of this Decree. «Manpower reserves» was very mobile system, quickly adapting to time requirements. Every factory, every enterprise, village had the order to train certain number of people certain trades. Basically it concerned the defensive industry. For 13 mobilization appeals in 1940-1942 2,5 million people were prepared and basically there were children who replaced the parents in back.

Highly skilled workers-tutors actively participated in education and professional training of young workers, in 70th and till the period of «reorganization» tutorship became a mass tendency [10].

2 Methods, metodological approaches

During «the reorganization» period tutorial professional movement has been destroyed. For a long time businessmen, heads of the «new format» enterprises considered it to be just a formality in human resource management sphere.

In last 10-20 years the tutorship has been recognized as an important mechanism of transfer of knowledge.

Modern conditions of economy demand effective and productive business management, so and human resource management. Tutorship gets new sense in the modern crisis situation. The technique, technologies, mechanism of qualitative achievement of professional motion are developed by specialists in the field of tutorship.

However the existing literature on the tutorship problems is first of all devoted to the problem of mutual relations of the tutor and the student, and also to recommendations about the tutor's behavior and the description of his functions.

The tutorship profit is expressed in the adherence to work increase and in the staff turnover decrease, but according to 68 sources studied nobody was engaged in researching dependence of the tutorship and the volume of knowledge in the organization increase.

However a number of researches affirm that people supported by tutors worked better and did their career faster. Probably because they acquired their tutors' knowledge.

It is obvious that both officially appointed and informal tutors are as informal teachers when impart their knowledge. Last years the tutorship concept includes mutual help and «reverse tutorship», in other words the process of getting knowledge by the teacher (tutor) from the student [10].

Despite available researches in the field of tutorship, the considerable work made by the authors above-stated, the modern literature pays not enough attention to the institute of tutorship as a complete system.

Available researches do not define accurately: tutorship's forms and methods, the monitoring and analysis means, that allow to estimate its efficiency in system; dynamics of professional formation of the worker in the course of tutorial activity isn't characterized, perspective forms of the system of tutorship development aren't specified, there is no generalization and ordering of tutorial experience, its development and distribution. The restrictions of the article given don't allow to reveal all these directions.

Due attention should be paid to foreign experience associated with mentoring, based on storytelling, so the authors Walter, Dorothy Leonard, Mimi Shils, Lisa Abrams in their book «How to turn knowledge into value: solutions from IBM Institute for Business Value» the results of research conducted since 2000 in Silicon Valley, Boston, Washington, India, Singapore, Hong Kong. They conducted a survey of teachers newly established companies and teams, the purpose of which is the ability to track the flow of knowledge between experienced entrepreneurs, act as a "successful capitalist mentors" venture capitalists "incubators" and budding entrepreneurs that they helped in the development. The collection of survey participants was more than 100 interviews, half of which is the study of issues with mentors. The study findings were formulated that information on the direct positive relationship between mentoring and efficiency of the organization gathered enough, nobody is engaged in research communication coaching and increase knowledge in the organization. The authors note that all existing literature in the field of mentoring is dedicated to the structuring of the relationship teacher and student, describing the main functions of a mentor, recommendations aimed at the behavior of a mentor that does not fully meet the needs of the business, the entrepreneur who starts to develop a new business, you should stick to the old known rule - "Attention, attention, and once again the attention", thus it is necessary to know that only an experienced mentor will feel when you need to expand the range of activities. Mentoring plays a key role in building the competence of the organization, of which the main ones are the socialization and internalization. [12]

The competition in business predetermine workers′ necessity looking-for effective decisions of professional problems, a possibility of overcoming the obstacles, getting practical experience, the efficiency of the labor potential application, it's also why tutorship becomes actual, attractive, timely among businessmen, manufacturers, chiefs. The individual-focused training of professional tutorship of the personnel would encourage the formation of really professional and personnel's professional competence upgrading.

Let's dwell upon the structure of the individual-focused training of professional tutorship of the personnel in business.

3 The individual-focused training of professional tutorship of the personnel….

It is accepted to understand as training «the method of active training that creates conditions for participants' self-disclosing and for their independent search of ways of the problems' solving and also directed on development of knowledge, abilities, skills and acquisition of social experience» (edition of the author of article).

The value of the individual-focused training of professional tutorship is predetermined by its conduction form and active role of the participants.

Making the approximate individual-focused training program it is necessary to consider the concept of pedagogical activity structure, proceeding from the tutor's personality. This concept was developed by V. Slastenin [8].The tutor's (teacher's) personality is considered as the complete formation which logic center is the motivational sphere that defines a social, professional-pedagogical and informative orientation [8, 9].

It is necessary to consider the necessity of realization of inducing functions of problem-developing training, inclusion of emotions into training process that involves participant's deepening of motivation of activity, change of installations and semantic formations of participants, promotes the development of belief, skills, in some situations and abilities, and not just to mastering of knowledge [8, 9].

It is necessary for the tutor to remember while preparing and carrying out training that he is understanding and benevolent colleague, who just corrects and (or) coordinates the activity of participants of training, and the participants of the training group carry out independently all basic work under the solving problems and self-development.

The number of standard group is recommended to be 12-16 persons; the author of the present article takes into consideration her personal experience and recommends it to be less than 14 persons.

The room for work should be prepared the way that all the participants could easily change their location for work in the big and small groups.

Procedure and regulations questions should be discussed at the very beginning of the class and to try not to break them.

Participants of training take seats on chairs (on a floor) in a circle, faced to the center, the tutor observes their actions. Often people take seats proceeding from psychological compatibility, psychologically not the compatible people try to take a sit far from each other.

Each training begins with representation (acquaintance), it is better, if cards with the names of participants are prepared in advance. The cards are fixed on a breast or established on a floor so that any could read a name.

Explanation of the purpose and training process.

Revealing the ones who don't wish to participate in training as voluntary and open participation is one of conditions of successful training. Not every participant is ready to it.

The next aspect the tutor should pay attention to, is formulation of principles and rules of behavior of the participants of training. It is necessary to remember that training should be positive, promote favorable moral and psychological interaction. Therefore rules and principles should be simple and clear:

1. To call each other respectfully and by name.
2. To be here and now.
3. To listen and to hear.
4. To speak shortly and to the point.
5. To keep a format of the academic discussion, not to interrupt each other.
6. To express only it is personified, i.e. from itself personally.
7. To perceive the statement of any participant of training as its personal opinion, the viewpoint, without denying and without discussing it.
8. Confidentiality of work training groups.
9. To give positive mood to itself and to others.

The rules presentation is also important, it is good, if they are printed in large print and hang up in visual availability after their acceptance by group.

The next stage for participants of training is a formation of positive mood and a favorable microclimate in training group. The tutor gives installation on training, formulates the task, specifies, whether the installation on training is clear to participants.

The most widespread positive training is «Association of the neighbor on the right with a plant». The essence of it is following — even if at first sight it would be «fantasy» (invented) plant or even «cactus» will be chosen, the tutor accompanies each association in a finishing part of description and formulates the positive information.

For example «cactus. (What? Let the participant describe it aloud in details), it is necessary to notice that some cactuses are edible, so in Mexico people prepare salads, stalks of one of kinds of cactuses of prickly pears promote decrease the level of sugar in blood of people with a diabetes. Flowers of a cactus of rare beauty.

On the basis of it, it is possible to resume that our participant has only external signs of «prickliness» and warns us «it is necessary to be accurate with me if you arrive badly, I «will prick» you». Actually this person is ready to come to the rescue and give everyone serious support.

After that the tutor makes a resume about the whole group, and the next stage of work starts. In process training can transfer from one form to another, trainings can be classified to following signs:

- By quantity of participants:

1. Group.
2. Pair.

3. Quartet.
4. Command.
5. Etc.

- On rigidity of carrying out:

1. Rigid.
2. Soft.
3. Combined.

- On a field of activity:

1. Administrative.
2. Commercial.
3. Psychological.
4. Social, etc.

- On a process orientation:

1. Training.
2. Developing.
3. Fastening of knowledge, abilities, skills.

- Etc.

Participants of training are offered to generate microgroup or commands (on 2-6 persons) and to choose the coordinator of group (responsible, the head).

The tutor suggests to solve a concrete real situation (the task, a problem). He defines regulations of time for it. In the course of work the tutor watches the participants.

If there are prepared special forms on each participant with instructions of high lights of activity in the course of training the tutor makes notes. If they aren't prepared in advance and videorecording (participants are warned in advance about it) isn't conducted, the tutor should do serious work analyzing the course of training when it is over. When the time for decision in microgroups is up, the tutor offers each microgroup to sound its variant of decision.

Then together with participants of training he promotes production of various variants of decisions depending on possible factors of influence, more often: a pessimistic, optimistic, realistic variant.

The main requirement for the tutor at that stage is to remember time regulations as any training should be completed, the training purpose should be reached.

After the basic variants of decisions are formulated, the tutor once again pays participants attention to them, pronouncing and specifying at participants of training, the reasons which influenced the acceptance of these decisions.

Summing up training, the tutor thanks all participants and asks to fill questionnaires which will allow him to reveal weak and strengths of training and improve process in further work.

Joint activity of the tutor and workers in the course of knowledge, development or fastening this or that material means that everyone brings the special individual contribution in it, that there is an exchange of knowledge, ideas, ways of activity in this process. It happens in goodwill and mutual support atmosphere that allows not only to receive new knowledge, but also develops informative activity, trannsfers it on higher forms of cooperation and cooperation.

Tutorship gets another new sense, it is the most effective with introduction of nonconventional forms and methods of transfer of professional experience.

It is necessary to notice that the individual-focused training of professional tutorship will promote formation of the worker, if:

- it is carried out purposeful preparation of workers for tutorial activity;
- tutorial activity is built stage by stage, according to logic of designing of dynamics of professional formation of the worker in self-education sphere;
- a free choice and the tutor, and the trainee should be provided and also steady interest to tutorial movement should be formed;
- constructive professional interaction of the instructor and the worker (trainee) should be provided;
- tutorial activity promotes creative self-realization of the tutor and the worker (trainee);
- a level of the workers and his tutor's personal-significant ascension to the top of professionalism, continuous self-development and self-realization acts as criteria of professional formation of the worker;
- various collective, group and individual forms of educational activity, such as: training on a workplace, business games, trainings, the decision of concrete situations, etc. are used in the course of tutorial activity.

To develop the tutorship in modern enterprise structures and to fix it in business structures the joint decision of some question is needed:

- The tutorship phenomenon is a necessary socially-pedagogical component of social development and preservation of self-value traditional sociocultural bases, it demands not only state support, but also a support from proprietors of business, heads of the enterprises;
- tutorial movement is the keeper of traditions of the enterprises and is that link which transfers these traditions to the following generations, and also promotes formation and development of high-quality professional personnel resources of the organizations, therefore it is necessary to think over the system of motivation of tutorship, that would be capable to revive the prestigiousness of this movement;
- it is necrssary to create a structurally functional model of system of the tutorship providing professional formation of the worker, and its realization within the limits of enterprise activity;

- necessary and sufficient organizational-pedagogical requirements in the course of professional formation of the worker by means of tutorship system are the following: development of steady motivation to the trade chosen and involving of the worker in processes of self-knowledge, self-judgement, a self-appraisal, self-checking and continuous self-development and self-realization; a concrete definition and stage-by-stage formation of professional abilities on use of the received knowledge in practical activities; creation within the limits of courses of improvement of qualification of programs for tutors and the young specialists promoting their creative realization; the organization of scientifically-practical conferences, round tables, seminars for young specialists and tutors for the purpose of an experience exchange and business cooperation.

Conclusion

The information presented in this article in the development of tutorship movement in Russia, its forms and tools for business is advisory in nature and is the point of view of the author. The further development of the tutorship problem research will be presented in other articles. I am going to research and to present the articles in in the field of the domestic tutorship, professional tutorship in the high school, modular technologies by the tutors′ education. In addition to these research areas related to mentoring, continues the author of many years of work associated with the formation of a professional coach based on the competence approach. The author developed competence model of a professional mentor (base) and a professional mentor (Specialized). This theme of the research was, is and will be controversial and actual.

References

[1] BABAYAN A. V. Problem of class preceptorship in the theory and practice of comprehensive school of Russia, second half XIX - beginning XX century//the dissertation on competition of a scientific degree of the candidate of pedagogical sciences. - Pyatigorsk: Pyatigorsk pedagogical university 1999.

[2] BATYSHEVA S. Pedagogical fundamentals of the tutorship. The stuff s of the theoretical conference, part 1. - M.: B.i.,1977, 324p.

[3] FRANK B., TOLMATI L. Strategy in support of pedagogical potential of the higher education teacher using the modern teaching methods and progressive technologies in the medical education (pre diploma, after diploma, continuous education). Project «Transfer of the technologies and realization of the institutionalreform in the Kazakhstans′ public health sector». Astana, 2010. Available at WWW: <http://lib.znate.ru/docs/index-265342.html>

[4] IKONNIKOVA S., LISOKHINA L. Workmen's tutor about psychology and pedagogy. – M.: Profizdat, 1977, 206p.

[5] LAPINA O. Pedagogy: common basis of the learning theory:_manual. Irkutsk: publishing house IRGTU, 2003, 160 p.

[6] LEWIS G. Manager-tutor. Strategy in support of the finding talent and the knowledgdiffusion. - M.: Amalfeya, 1998, 97 p.

[7] MAGALNIK L. Tutorship: variant of the management of the directors′ career of the educational institution// School technologies. 2001, №6.- P. 39-60.

[8] SLASTENIN V., ISAEV I., MITSCHENKO A., SCHIYANOV E. Pedagogy: school-book for the students.- M.: School - Press, 1997, 512 p. http://yandex.ru/clck

[9] SLASTENIN V., PODYMOVA L. Pedagogy: innovative activity. - M.: ITschP «Magistr», 1977, 308 p.

[10] Tutorship and storytelling as a way of the knowledgdiffusion in the worker′ environment. Available at WWW: <http://www.e-xecutive.ru/reading/newfolder2921/article_3939>

[11] VERSHLOVSKY S., HODAKOV A. Pedagogy occurs the workshop. To the problem of the young workers training. L.: Lenizdat, 1977, 143 p.

[12] SWAP W., LEONARD D., SHILS M., ABRAMS L., in the book "How to turn knowledge into value: solutions from IBM Institute for Business Value». - M.: Harvard Business Review, 2006, 250 p.

Contact Address

Marina Dyuzheva, PhD
Omsk State Transport University
20 Kemerovskaja St., Apt. 51, 644043 Omsk, Russia
Email: Dyzgeva@mail.ru

Received: 01. 05. 2015
Reviewed: 03. 06. 2015, 16. 06. 2015
Approved for publication: 02. 09. 2015

PRODUCTION-CONSUMPTION PATTERNS OF BEHAVIOUR OF EUROPEAN REGIONS

Ivana Kraftová, Zdeněk Matěja

Abstract: *Cohesion policy belongs among the most important fields of EU interests. Its objectives are achieved by many ways with respect to diversity among the European regions at the level of NUTS 2. The aim of this paper is to analyse relevant indicators, and via the evaluation of EU regional policy effectiveness to rewiev difference in the production-consumption patterns of behaviour of European regions; focussing on convergence and variabiliness of these regions. With defined goal in mind, the regions have been classified. To classify the regions, the relational indicator has been created. The relational indicator has been developed as the relationship between the index of relative performance and index of relative consumption sources. The changes of relational indicator, as well as the GDP per capita criterion, have been evaluated in two periods.*

Keywords: *Cohesion policy, Production-consumption patterns, Convergence, Variability, Classes of EU regions.*

JEL Classification: *R12, R58.*

Introduction

A major area of EU policy is the area of cohesion policy, which can undoubtedly be testified by the funds it has been allocated in the last two multiannual financial frameworks to support the objective "cohesion for growth and employment": in the planning period 2007-2013 the amount of approximately 335 billion EUR, i.e. 33.70 % of the total commitment, and in the planning period 2014-2020 the amount of 325 billion EUR (i.e. 33.85 %). [4] The importance given to policies aimed at the cohesion of regions across the EU territory will remain preserved in the future; the objective remains to achieve the necessary degree of cohesion within the European integration grouping. The last three expansions meant the accession of states with a prevalence of less developed regions at various different levels, and so the emphasis on the convergence objectives of cohesion policy was further enhanced by a focus on promoting growth. It can be spoken about of the objective of "growth orientated convergence of EU regions".

Any meaningful policy should have a defined purpose, and therefore the concept of cohesion policy can be viewed from a teleological point of view. [3] It is subject to the principle of finality perceived from the present to the future. When identifying policy objectives and their fulfilment it is necessary to address - in addition to the above relationship of hierarchical succession - the question of relations between different objectives (purposes), and means.

With connection to the EU policy and its member states, the terms of performance and competitiveness have been many times mentioned. But it should not be forgotten that such terms do not create the original purpose of policy, since satisfying the needs of inhabitants via consumption do. It is possible to assume that by filling the original purpose not only single production-consumption pattern for all regions exists. On the contrary, as a consequence of regional diversity we can suggest that more behaviour

patterns which reflect different initial conditions and chosen ways to reach the objectives exist.

A comparative study presents different views on the development of EU Member States in terms of the objectives of cohesion policy and shows the consequences of EU enlargement. [1, 12, 13] For example A. Krueger [10] concludes that while Member States converge in terms of gross domestic product per capita in PPS (measured variation range in 2000-2008), internal disparities between the regions within the states increase. It is not unusual to also point out that the causality between the high consumption of income in a given state and the tendency for low investment (and vice versa) is weakening as a result of the significant effects of global capital markets and international trade. [2]

The continuity of consumption with the production function is quite obvious. Only to a limited extent can man consume what has not been produced. If consumption is understood as the fulfilment of a desired standard of living, it is not possible to disagree with the idea of the winner of the 2008 Nobel Prize in Economics, P. Krugman, who said that: *"The ability of the state* (or region) *to improve the standard of living depends almost entirely on the ability to increase output per worker"*. [11]

With regard to aforementioned minds, it looks to be useful to analyse relevant indicators in this field, and focussing on evaluation of EU cohesion policy effectiveness to catch possible differences in production-consumption patterns of behaviour of European regions. Furthermore, we would like to provide some kind of classification of these regions.

The objective of the research is to evaluate European regions according to the relation between the growth of performance and growth in sources of individual consumption and to classify them.

Two partial hypotheses are set:

A. European regions reflect the expression of beta convergence in the sense that the less developed regions have a higher growth performance index than the index of growth of creation of sources of individual consumption;

B. European regions confirm the high variability of the regions of individual states, i.e. NUTS 2 of the respective states in terms of the surveyed relationship does not fall into the same class.

1 Data and methodology

Eurostat data was used for the analysis. From the total number of 272 NUTS 2 of all of the 28 states, 85 NUTS 2 had to be excluded because of an absence of the relevant data. Therefore, the sample includes 187 NUTS 2 (69 %) of eighteen EU Member States (regardless of whether the country was an EU Member State in the year of the survey or not).

A ten-year period from 2000 to 2009 is assessed, which includes the impact of the global economic crisis that hit Europe in 2008. In order to eliminate the impact of the recession selected moments evaluated in this period were compared with the results for the shortened period from 2000 to 2007.

The analysis works with regional disposable income of private households as an indicator of sources of individual consumption and regional gross domestic product as an indicator of performance. A relational indicator was created for analyses of the

relation between the performance and consumption in EU regions showing the relationship between the index of growth of relative performance I_P and the index of growth of relative production of sources of individual consumption I_H in order to point whether in the relevant NUTS 2 region the growth of performance exceeded the growth of individual, or vice versa.

$$r(P,H) = \frac{I_P}{I_H} = \frac{{}^{P_{2009}}/_{P_{2000}}}{{}^{H_{2009}}/_{H_{2000}}} \quad , \quad \text{resp. } r(P,H) = \frac{I_P}{I_H} = \frac{{}^{P_{2007}}/_{P_{2000}}}{{}^{H_{2007}}/_{H_{2000}}} \tag{1}$$

The relative performance P_t is given by the gross domestic product per economically active person (2). [9]

$$P_t = {}^{GDP_t}/_{EAP_t} \tag{2}$$

Where: GDP = gross domestic product at current market prices in PPS;
EAP = economically active person from 15 to 64 years;
t = time, year.

Furthermore, the indicator of relative creation of sources of individual consumption H_t was calculated as a share of regional disposable income of private households in PPCS and the mid-year population of the relevant region (3). [9]

$$H_t = {}^{DIH_t}/_{MYP_t} \tag{3}$$

Where: DIH = disposable income of private households in PPCS;
MYP = mid-year population;
t = time, year.

In order to avoid the anticipated effects of the global crisis, therefore the relational indicator r(P, H) is calculated for the two periods, as indicated by formula (1), both for the period 2000-2009 and for comparison with the pre-crisis situation for the period 2000-2007, including an assessment of the changes that determined the outcome. According to classification two criteria - degree of development of the region according to the median of gross domestic product per capita, and the ratio of the dynamics of the growth of consumption and performance using r(P,H), the sample of surveyed regions was divided into four classes, namely:

Class I. r(P,H)<1 in the less developed regions;

Class II. r(P,H)<1 in more developed regions;

Class III. r(P,H)>1 in more developed regions;

Class IV. r(P,H)>1 in less developed regions.

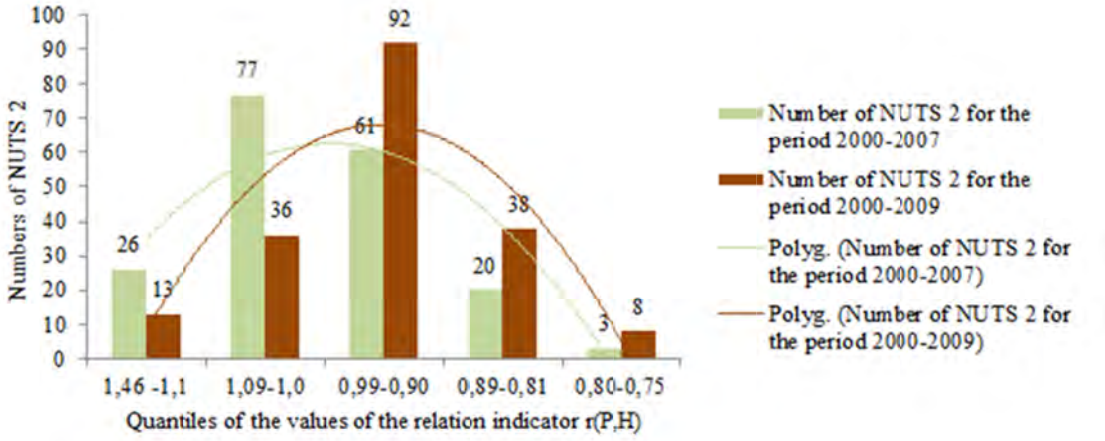
The regions were classified according to the ratio of the growth index P_t and the growth index H_t in the period 2000-2009 and at the same time by GDP per capita in PPS in the period 2000-2009. To assess the impact of the global crisis the ratio of the growth index P_t and growth index H_t was also incorporated into the analysis of the processed data.

2 Problem solving and discussion

Due to the devastating impact of the global economic crisis that hit Europe in 2008, a comparison was made of the NUTS 2 in five percentiles according to the relation between the growth of performance and the growth of indicators of final consumption r(P,H) both

for the period 2000/2007 (i.e. before the crisis) as well as for the entire study period 2000-2009 - see Fig. 1.

Fig. 1: Comparison of the distribution of NUTS 2 in percentiles based on the relation between growth of performance and growth of sources of consumption



Source: own work based on Eurostat data [5, 6, 7, 8]

Note: intervals of extreme quartiles incorporate the boundary values achieved.

The almost normal distribution of NUTS 2 in the period including the crisis is represented by a loss of skewness of the histogram in the pre-crisis period, which showed the predominance of the growth of performance over the growth of consumption in many of the regions. Fig. 1 illustrates that the condition $I_P>I_H$ (growth of performance exceeds growth of consumption), which was recorded in the first two quintiles, is shown by 103 regions of the sample in the period 2000-2007, i.e. approximately 55 %, whereas in 2000-2009 this was only 49 regions, i.e. approximately 26 % of the sample.

When examining the causes of the results of the relation between the growth of performance and growth of individual consumption (i.e. one of the classification criteria) six theoretically possible cases were created; however, the results only include three versions of the practical expressions that determine the results:

A. the result of the calculation $r(P,H)<1$ according to the formula (3) is given by the conditions: $I_P>1$ et $I_H>1$ et $I_P<I_H$;

B. the result of the calculation $r(P,H)<1$ according to the formula (3) is given by the conditions: $I_P<1$ et $I_H>1$;

C. the result of the calculation $r(P,H)>1$ according to the formula (3) is given by the conditions: $I_P>1$ et $I_H>1$ et $I_P>I_H$.

The remaining possible cases do not occur in the examined economic reality:

$r(P,H)<1$ where $I_P<I_H$ et $I_H<1$ et $I_P<1$;

$r(P,H)>1$ where $I_P>I_H$ et $I_H<1$ et $I_P<1$;

$r(P,H)>1$ where $I_P>1$ $I_H<1$.

Regions in the sample group for the period 2000-2009 show a clear predominance of version A (135 regions, i.e. 72 %), whereas version B has a marginal representation (3 regions, i.e. 2 %), and version C had a significant representation (49 regions, i.e. 26 %). Group B, which showed a growth of individual consumption and decrease in performance,

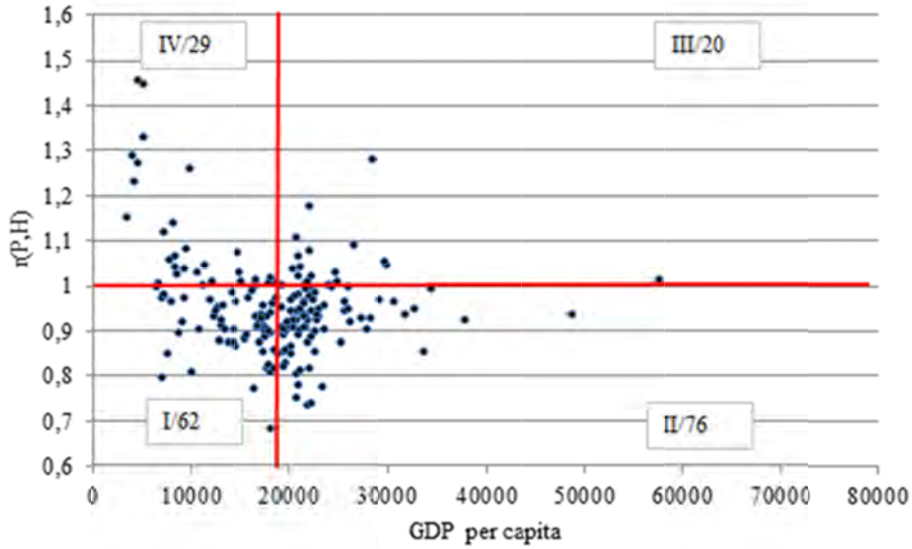
includes two French regions (Champagne-Ardenne and Basse-Normandie) and the Swedish region of Sydsverige. Group C, which is characterized by the growth of individual consumption and growth of performance, while consumption is growing more slowly than performance, includes regions of Belgium (3), the Czech Republic (5), Germany (8 - both the former East and West Germany, Great Britain (7), the Netherlands (6), Poland (10), Portugal (1), Romania (7), Slovenia (1), and Slovakia (1). It is also interesting that these Group C regions for the individual countries include the region that represents or includes the capital city of that country. All of the other regions show a growth in individual consumption and performance, while consumption is growing faster than performance (group A).

In order to classify the regions into defined classes the criterion of the degree of development of the regions was analysed using gross domestic product per capita. A general evaluation of the sample regions for the years 2000, 2007 and 2009 shows that between 2000 and 2007 there was an increase in the median and average of the evaluated indicators for all of the regions included in the sample. However, in 2000 the median exceeded the average, while in 2007, on the contrary, the average exceeded the median. Between 2007 and 2009 there was a reduction in the value of the median and average gross domestic product per capita and the median is smaller than average, which is similar to in 2007 but even more significant.

The changed in variability of the extent of development of the regions in terms of gross domestic product per capita is reflected by the relation of this indicator of the individual countries to the minimum determined value in 2000 and 2009. To illustrate: in 2000 the maximum gross domestic product per capita (British Inner London) is nearly 17 times the minimum (Romanian Nord-Est), the other 5 regions represented ten times the minimum indicator; whereas in 2009 it was “only” about 11 times (again, Inner London is the maximum and the minimum is Nord -Est). No other region had less than 10 times the minimum. The second highest (7.56 times) against the minimum of the Nord-Est region in 2009 is Rég. Bruxelles / Brussels Gewest. In this sense, the imaginary gap between the least and most developed regions is closing.

By using both parameters – r(P, H) and gross domestic product per capita – we can create, as described above, classes of regions whose changes in terms of affiliation in 2000, 2007 and 2009 are depicted in Figures 2, 3 and 4.

Fig. 2: Distribution of regions into classes according to the relation of growth of performance and individual consumption r(P,H) for the period 2000-2009 and the gross domestic product per capita in 2000

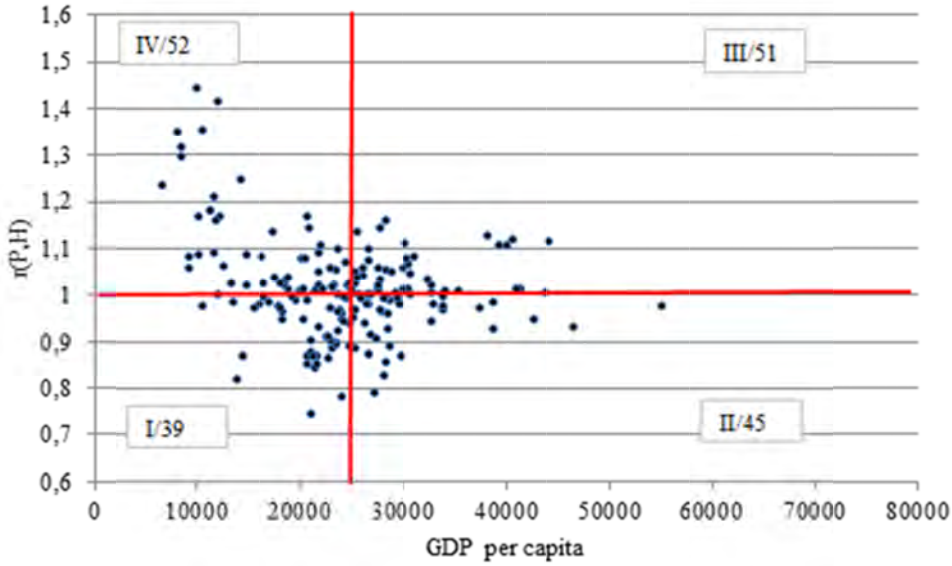


Source: own work based on Eurostat data [5, 6, 7, 8]

Note: The median gross domestic product per capita in 2000 was 19 085 PPS.
The regions of the following countries are located in the individual quadrants:

IV. quadrant BE(1), CZ(4), DE(4), PL(10), RO(7), SI(1), UK(2)	III. quadrant BE(2), CZ(1), DE(4), NL(6), PT(1), SK(1), UK(5)
I. quadrant BE(3), CZ(3), DE(2), EE(1), I.E.(1), ES(10), FR(10), CY(1), LV(1), LT(1), NL(1), PL(6), PT(6), RO(1), SI(1), SK(3), UK(11)	II. quadrant BE(5), DE(24), I.E.(1), ES(7), FR(12), NL(5), SE(8), UK(14)

Fig. 3: Distribution of regions into classes according to the relation of growth of performance and individual consumption r(P,H) for the period 2000-2007 and the gross domestic product per capita in 2007

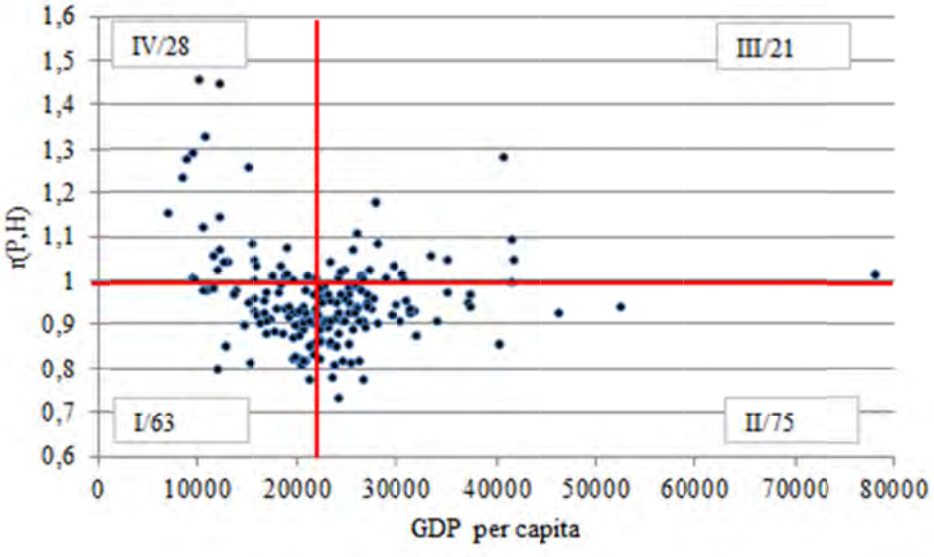


Source: own work based on Eurostat data [5, 6, 7, 8]

Note: The median gross domestic product per capita in 2000 was 24 091 PPS.
The regions of the following countries are located in the individual quadrants:

IV. quadrant BE(3), CZ(4), DE(3), EE(1), ES(5), LT(1), PL(14), PT(1), RO(7), SK(2), UK(11)	III. quadrant BE(4), CZ(1), DE(15), I.E.(1), ES(2), FR(1), NL(6), PT(2), SI(1), SK(1), UK(17)
I. quadrant BE(1), CZ(3), DE(3), ES(2), FR(17), CY(1), LV(1), PL (2), PT(4), RO(1), SI(1), SK(1), UK(2)	II. quadrant BE(3), DE(13), I.E.(1), ES(8), FR(4), NL(6), SE(8), UK(2)

Fig. 4: Distribution of regions into classes according to the relation of growth of performance and individual consumption r(P,H) for the period 2000-2009 and the gross domestic product per capita in 2009



Source: own work based on Eurostat data [5, 6, 7, 8]

Note: The median gross domestic product per capita in 2009 was 22 258 PPS.
The regions of the following countries are located in the individual quadrants:

IV. quadrant BE(1), CZ(4), DE(3), PL(10), RO(7), UK(3)	III. quadrant BE(2), CZ(1), DE(5), NL(6), PT(1), SI(1), SK(1), UK(4)
I. quadrant BE(3), CZ(3), DE(1), EE(1), I.E.(1), ES(7), FR(15), LV(1), LT(1), NL(1), PL(5), PT(5), SI(1), SK(3), UK(15)	II. quadrant BE(5), DE(25), I.E.(1), ES(10), FR(7), CY(1), NL(5), PL(1), PT(1), RO(1), SE(8), UK(10)

Fig. 2 and 4 use the relation r(P,H) for years 2000-2009 and GDP per capita for the years 2000 and 2009. Fig. 3 includes the relation r(P,H) for the period 2000-2007 and GDP per capita for the year 2007. In all three years (i.e. 2000, 2007 and 2009) developed regions (i.e., projecting above the median GDP per capita) were represented by 96 regions. The remaining 91 regions (nearly half) are below the median. The figures clearly show an increase in the variation between regions in terms of this indicator, in other words: "the quadrants are increasing in breadth".

Analysis of the change in the vertical axis r(P,H) shows a significant difference between the period 2000 to 2007 (before the crisis) and the period 2000 to 2009. Whereas in 2007 there were 103 regions for which growth in consumption was greater than growth in performance (with an almost equal representation of developed and less developed regions), in 2009 there were only 49 regions and the less developed regions (28) prevailed over the developed ones (21). Conversely, a higher growth in the sources of individual consumption than growth of performance was recorded in 138 regions in 2009. It is clear that the crisis significantly affected the European regions in this respect.

The main differentiating moment of the regions in terms of classification is therefore the relation r(P,H) not the median gross domestic product per capita.

The two largest countries based on the number of NUTS 2 regions - Germany and the United Kingdom – have regions in all four categories (I. - IV.), In addition, Belgium is third in terms of the number of regions. If we remove the exceptions (one of the regions of the country), then the regions of five countries fall into two classes classification (I., II.), Namely: all of the Spanish and French regions have lower performance, whether they are more or less developed, Dutch regions are all in the developed category, although some are characterized by higher growth performance (III.), or the second highest growth if consumption (II.), the Portuguese regions represent both the class of less developed performance regions (I.) as well as the class of advanced performance regions (II.), and finally the Polish regions are in terms of the relationship between the growth of performance and growth of consumption analogous to the Dutch regions , but unlike them they fall into the category of less developed regions (I., IV.). The regions of Sweden have an exceptional position as they remain in the class of developed regions with higher growth of individual consumption than growth of performance (II). In contrast, the Romanian regions (with one exception) are in the less developed regions with higher growth of performance than consumption (IV.). Regions of the Czech Republic and Slovakia representing or comprising of the capital city are specific as the belong to the developed regions with higher performance than consumption (III.), other regions have less performance but fall into both categories according to the indicators r(P, H) (I., IV.). It should be emphasized that the individual regions do not remain in the same class, and that their position changes over time. (In terms of the country's regions belonging to individual classes, countries representing a single NUTS 2 are not represented, i.e. Estonia, Cyprus, Latvia, Lithuania, and Slovenia, as well as Ireland with its two NUTS 2).

Conclusion

The validity of beta convergence in the sense that the less developed regions have a higher index than the growth performance index of growth of individual consumption of resources was not proven. From the sample of regions, 91 are less developed, of which 62 regions have a lower growth of performance than growth of consumption in 2000; however in 2007 there were only 39 but in 2009 their number increased to 63. The hypothesis A has not been verified.

Classification analysis confirms that regions of a single country (if it is not a country which is also a single NUTS 2) do not fall into a single class. The hypothesis B has been verified. Moreover, the classification of the individual regions into classes changes over time. The positive development of the economy in 2000-2007 contributed to a more even distribution of the Regions in the classification of classes. On the contrary, the economic

crisis pushed many regions back into becoming regions with lower growth of performance, i.e. Classes I. and II.

The development of the relation between performance growth (P_t) and consumption growth (H_t) was significantly affected by the economic crisis. Up until 2007, there was a predominance of regions with performance growth higher than consumption growth, whereas between 2007 and 2009 there was a general decline in performance and in most regional economies the dynamics of performance were below the growth values of sources of consumption, the development of which manifested a certain inertia.

When classifying the regions into classes according to the selected criteria we determined that the differences in the indicator of gross domestic product per capita reduced during the studied period, despite the extremely high value of this indicator in the region of Inner London in 2009. The classification analysis revealed a highly significant finding i.e. the main classification criterion of the regions is the relationship between performance and consumption expressed by the relation indicator r(P,H). Although the average and extreme values of the indicators performance and consumption tended to confirm the validity of the beta convergence, in the case of its assessment based on the relation performance and consumption this was no longer valid. Less developed regions were included not only in Class IV. where $r(P,H)>1$, where they should be in the case of the validity of the beta convergence, but also to Class I., where $r(P,H)<1$, and where regions with growth of performance and growth of sources of consumption dominated, although growth of performance (P_t) is lower than growth of consumption (H_t).

It is clear that growth of sources of consumption without growth of performance is not sustainable in the long term; on the other hand, supporting growth of performance cannot be an end in itself. In terms of the application of instruments of EU economic policy, particularly in the area of cohesion policy, it is not beneficial to focus only on gross domestic product per capita, it is necessary to use other additional indicators so that the applied instruments and allocated resources can ensure fulfilment of the main purpose, i.e. “long and quality of life of the inhabitants of the individual regions of Europe and the EU as a whole”.

Acknowledgement

The paper was supported by Internal Grant Agency of the University of Pardubice, Project SGSFES_2015001 „Economic and social development in private and public sector“.

References

[1] APPLOVÁ, P. Vliv rozšiřování Evropské unie na stupeň dosahované konvergence. In Klímová, V., Žítek, V. (eds.) *XVII. Mezinárodní kolokvium o regionálních vědách. Conference Proceedings.* Brno: Masarykova univerzita, 2014, pp. 62-68. ISBN 978–80–210–6840–7.

[2] DUBSKÁ, D. *Investice a ekonomický růst v České republice: kam se ztrácí vysoká míra investic?* Praha: ČSÚ, 2006. [cit. 2015-01-20]. Available at WWW: <czso.cz/csu/2006edicniplan.nsf/p/1135-06>.

[3] ENGLIŠ, K. *Teleologie jako forma vědeckého poznání.* Praha: Nakladatelství F. Topič, 1930.

[4] EU. *Multiannual Financial Framework 2014-2020.* [cit. 2015-01-16]. Available at WWW: <http://ec.europ.eu/budget/mff/index_en.cfm>.

[5] EUROSTAT. *Regional gross domestic product (million PPS) by NUTS 2 regions.* [cit. 2014-10-27]. Available at WWW: <http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tgs00004&plugin=1>.

[6] EUROSTAT. *Disposable income of private households by NUTS 2 regions - PPS (based on final consumption) per inhabitant.* [cit. 2014-10-27]. Available at WWW: <http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tgs00026&plugin=1>.

[7] EUROSTAT. *Economically active population by sex, age and NUTS 2 regions (From 15 to 64 years)*. [cit. 2014-10-27]. Available at WWW: <http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tgs00001>.

[8] EUROSTAT. *Total population resident in a region. Average of population at the beginning of the year and population at the end of the year.* [cit. 2014-10-27]. Available at WWW: <http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tgs00001>.

[9] KRAFTOVÁ, I., MATĚJA, Z. Relation of Economic Performance and Creation of Sources of Consumption in Regions of the European Union. In *5th Central European Conference in Regional Science, International Conference Proceedings.* Košice: Technical University of Košice, 2015, pp. 461-470. ISBN 978-80-553-2015-1.

[10] KRUEGER, A. Convergence and disparities in regional Gross Domestic Product. Eurostat. In *Statistic in focus*. Vol. 11, Iss. 46/2011, pp. 2-6. ISSN 1977-0316.

[11] KRUGMAN, P. *Competitiveness: an international economics reader.* New York, Council on Foreign Relations, 1994. ISBN 978-087-6091-777.

[12] TVRDOŇ, M. Makroekonomická konvergence: případ zemí visegradské čtyřky. In *Scientific Papers of the University of Pardubice, Series D, Faculty of Economics and Administration.* Vol. 16, Iss. 1/2010 pp. 316-328. ISSN 1211-555X.

[13] ZDRAŽIL, P. Using the EU funds between 2007 and 2013 from a development of disadvantaged regions perspective: the case of Polish regions. In *5th Central European Conference in Regional Science, International Conference Proceedings.* Košice: Technical University of Košice, 2015, pp. 1170-1179. ISBN 978-80-553-2015-1.

Contact Address

doc. Ing. Ivana Kraftová, CSc.
University of Pardubice
Faculty of Economics and Administration
Institute of Regional and Security Sciences
Studentská 95, 532 10 Pardubice, Czech Republic
Email: Ivana.Kraftova@upce.cz
Phone number: +420 466 036 711

Ing. Zdeněk Matěja
University of Pardubice
Faculty of Economics and Administration
Institute of Regional and Security Sciences
Studentská 95, 532 10 Pardubice, Czech Republic
Email: Zdenek.Mateja@upce.cz
Phone number: +420 466 036 665

Received: 22. 04. 2015
Reviewed: 28. 05. 2015, 17. 06. 2015
Approved for publication: 02. 09. 2015

EFFECT OF CONTROLLING ON THE ECONOMIC PERFORMANCE OF SMES IN THE CZECH REPUBLIC

Lukáš Kruml, Pavel Duspiva

Abstract: *This paper deals with the use of controlling in the management of small and medium-sized enterprises in the Czech Republic and its influence on their economic performance. Data from primary research are presented, which determined the extent of implementation of controlling activities in the examined enterprises. The aim of the secondary research was to evaluate the economic performance of enterprises with and without controlling and to determine whether it is possible to confirm the hypothesis of better economic (financial) results of the enterprises that apply controlling in their management process. The two groups of enterprises are compared by using calculated arithmetic means and medians of selected economic indicators. The source of data is the corporate database MagnusWeb. The compared data are also subjected to statistical analysis. Nonparametric tests í. e. the Mann-Whitney U test and the Kolmogorov-Smirnov test to determine statistically significant differences between the financial results of the enterprises that use and do not apply controlling.*

Keywords: *Management, Controlling, Economic performance, Financial analysis, Small and medium-sized enterprises (SME).*

JEL Classification*: M21.*

Introduction

The current market environment places high demands on the competitiveness of enterprises. Pressure on the economic efficiency of enterprises has increased in recent years due to the influence of the previous economic crisis. Therefore, in order for enterprises to succeed on the market they use various management tools and practices, leading to an increase in their efficiency. One of the most widely used management tools is controlling. This tool allows enterprises to effectively analyze and manage their business economy in order to achieve long-term objectives. Controlling is actively used mainly in large and multinational companies who have the necessary organizational conditions and skilled employees. In practice, they benefit from considerable years of experience with the use of this management tool. SMEs also use or want to use controlling. The use of controlling by these enterprises is important because they have a relevant position in each country's economy in terms of their share of gross domestic product, employment, and innovation. However, due to their size they are somewhat limited in the number of skilled workers needed for each individual area of management. The question therefore arises as to whether small and medium-sized enterprises in the Czech Republic use controlling and what economic results they achieve.

The aim of the research is to determine the extent to which controlling is used in small and medium-sized enterprises, to analyze real economic data and to evaluate whether they achieve better economic results than enterprises that do not use this management tool. The article presents the results of primary and secondary research in this area.

1 Formulation of the issue

1.1 The philosophy of controlling

It is rather difficult to clearly define the concept of controlling because there are innumerable explanations of the term in the literature from various foreign as well as Czech authors. One reason for this is the difficulty in translating the English word controlling, which can be assigned up to 50 semantic equivalents in everyday speech.

The basis of the term controlling is the word "control", which is usually understood in the sense of to control or to manage. Controlling is understood by some authors to mean control in the sense of the final function of a management system. Others look considerably longer at the issue. Freiberg, for example, states that controlling is a specific concept of corporate governance based on comprehensive information and the organizational links between planning and control processes. [5] This means that controlling is not only control but also a certain approach to the management system, a method of economic management of the company which is oriented towards the future. Some even talk of a type of managerial philosophy based on management by deviation. Eschenbach sees the basic difference between control and controlling as added value consisting of the evaluation and design of corrective changes, corrective and preventive measures for eliminating deviation, and the achievement or adjustment of planned objectives in the future. [4] Hence, control can be described as a kind of subsystem of controlling.

The general objective of controlling is to contribute to ensuring the viability of the enterprise in the present and especially in the future. Some of its most important tasks include planning, budgeting, costing, standard and special analyses, identification and evaluation of deviation, processing of information reports, administration, etc. The essence is to create a planning system which allows an enterprise to evaluate and influence the development of actually achieved results compared to planned ones. Controlling in an enterprise has primarily the function of coordination, innovation, information and consultancy. [9]

In terms of content, Král divides controlling into financial, cost and natural, which are usually applied in non-financial areas such as controlling production, sales, inventory, personnel etc. [8] Based on a temporal viewpoint, controlling can be divided into strategic and operational. Strategic controlling focuses on a longer period of time (several years) and the long-term strategic objectives of the organization. Its task is to manage and control measures required for the implementation and realization of the strategies of the organization. [14] In contrast, operative controlling focuses on a shorter time period, usually one year. Its main task is to optimize business operations and processes, leading to the more effective management of the generation of profit. Here, we constantly compare reality (the actually achieved results) and plans (target, planned results), identify deviation and propose measures to ensure the achievement of operational objectives, which contributes to the fulfilment of organizational strategies. [1] Relevant information obtained in real time is vital for reducing the risk of managers making incorrect decisions. Access to, and acquisition, transfer and evaluation of information are purposeful - their aim is to find and use hidden reserves to increase business potential. [12]

Controlling inherently leads to the continuous formation of innovation (improvement) in spheres of interest, and variables in the form of corrective or preventive measures against deviation. This has a certain connection with the so-called Deming PDCA cycle of continuous improvement or adaptation to the external and internal conditions

of an enterprise. [2] In the framework of which, planning (Plan) takes place, whereby the target values of the variables and paths (procedures, actions) to reach them are determined. In the next stage the plans are implemented and monitored and the actually achieved values of the attributes are measured (Do). Subsequently, the control is performed (Check), which identifies deviations from the plan. In the last phase (Act), these deviations, their causes and consequences are analyzed, and then corrective and preventive actions are proposed and implemented. [3]

1.2 Small and medium-sized enterprises

Small and medium-sized enterprises (SMEs) are a very important part of the market economy of each country. They have a crucial influence not only on the economic performance of the national economy but they are also significant in the context of social benefits. Up to 99% of all business entities in the European Union are classed as small and medium-sized enterprises. Annually, they account for approximately three-quarters of all jobs and 60% of the total produced gross domestic product. For this reason they are often referred to as the main engine of the economy, or its spine. [6] SMEs in the Czech Republic are one of the most important segments of the business environment. Small and medium-sized enterprises make up 99.8% of all subjects and provide more than 60% of the total employment in the Czech business sector, producing about 35% of the total gross domestic product of the Czech Republic. [13]

To be clear what an SME is and what it is not, an exact quantitative definition has been created. According to the methodology of the European Union a small and medium-sized enterprise is considered to be a business entity that: [10]

- employs a maximum of 249 employees,
- while its annual turnover does not exceed 50 million EUR (approximately 1.4 billion CZK),
- or its balance sheet total (assets and liabilities) does not exceed 43 million EUR (approximately 1.2 billion CZK).

One of the major advantages of SMEs is their flexibility. Smaller businesses can usually respond much faster and more effectively to various changes in their surroundings and try to adapt to them. This also relates to their more effective innovation activities. SMEs are able to innovate faster and more effectively due to their flexibility and less complex structure. They are also continuously forced to innovate in order to survive on a highly competitive market in comparison to larger corporations. In contrast, disadvantages of SMEs include their difficulty in accessing financial resources and thus their smaller overall financial strength. This is often associated with a lack of qualified human resources, limited support opportunities and lower bargaining power with stronger trading partners. Nevertheless, SMEs are the main source of economic prosperity and their existence is strongly encouraged by both the European Union and by the individual Member States. [11]

2 Methods

In order to analyze and determine the possible impact of controlling on the economic results and performance of SMEs in the Czech Republic, we conducted secondary research using data from the MagnusWeb database implemented at the Faculty of Economics and Administration of the University of Pardubice. This database contains information on most enterprises operating in the Czech Republic, including financial data. A research

segment comprising 218 companies was selected from the database according to the following criteria:

- Number of employees 100-249,
- working in the manufacturing industry,
- geographically located in the region NUTS 2 (North-east Cohesion Region) – the regions of Hradec Králové, Pardubice and Liberec,
- active enterprises with data available from 3-5 years in the analysis period 2009-2013.

The evaluation of economic performance was preceded by primary research, during which 218 enterprises were contacted by email with the following question: "We would like to ask you whether controlling is performed in any way at your company. Either in the form of a controlling department, a specialized employee, or only a partial incorporation of controlling principles into management".

The representativeness of the selected sample for the research can be statistically determined by the formula: [7]

$$n \geq \frac{t_{\alpha}^{2} * p * (1-p)}{d^{2}} \tag{1}$$

where: n is the required minimum sample size,

α is the reliability,

tα is the reliability coefficient of α,

p is an estimate of the relative frequency of the studied feature in the base set,

d specifies the permissible error in the survey.

If, in our case, the required reliability is 90% with a permissible error of 11% and an estimated relative frequency of 0.6, then the following is true:

$$n \geq \frac{1.645^{2} * 0.6 * 0.4}{0.11^{2}} = 53.67 \cong 54 \tag{2}$$

This means that the minimum number of enterprises in the sample in order to ensure its representativeness should be at least 54.

The sample is defined by non-random selection based on the answers to the question on the use of corporate controlling. From the 218 surveyed enterprises selected according to the above criteria answers were received from 57 respondents included in the research. This figure, therefore, satisfies the condition for the minimum number of enterprises and thus the sample can be considered representative. The response rate to the question was 26.1%.

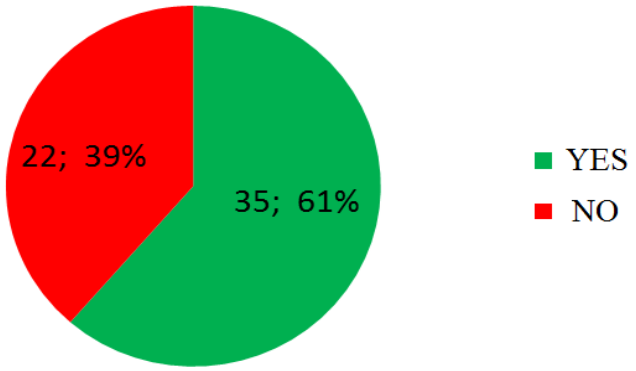
A total of 10 economic indicators are included in the analysis of economic performance, of which 4 absolutely indicate the characteristics of the selected enterprises and the remaining 6 proportional indicators are used for a comparison. The arithmetic averages

of the individual values are calculated and evaluated for each enterprise, and subsequently the means and medians are calculated for both groups of enterprises.

3 Results of the research

During the primary research it was found that out of the 218 surveyed enterprises 35 companies actively use controlling. The majority mentioned the existence of an independent controlling department or at least one employee specializing in controlling procedures. The remaining 22 respondents gave a negative response to implementing even the basic principles of controlling. The structure of the responses is shown in Figure 1.

Fig. 1: Use of controlling



Source: own work

For the purposes of the secondary research using economic and financial data we applied the following hypothesis **H1: The use of controlling in the management of small and medium-sized enterprises achieves better economic results**. It is supposed that SMEs using controlling activities have better values of indicators, especially in profitability, liquidity and indebtedness.

Table 1 includes the mean and median values of basic economic data characterizing the surveyed enterprises.

Tab. 1: Characteristics of the surveyed enterprises

Indicator (CZK)	YES		NO	
	Mean	Median	Mean	Median
A – Total assets	223 837 046	192 704 000	171 084 845	139 137 000
E – Equity	104 047 235	76 524 000	91 796 867	85 018 000
L – Liabilities	119 789 087	88 459 976	79 287 888	54 205 544
PTP – Pre-tax profit	11 116 549	6 251 000	9 782 359	5 467 000

Source: own work

It is evident that on average enterprises using controlling (YES) have greater assets (balance sheet total) and both components of liabilities than companies without controlling management (NO). On average, enterprises with controlling conduct business with a higher proportion of liabilities, while companies without controlling exhibit a greater proportion of equity. Enterprises with controlling have both higher mean and median pre-tax profit.

Table 2 summarizes the mean and median values of the selected proportional indicators of economic performance of enterprises in the monitored period. It also shows their mutual index and percentage of above-average values separately for both of the groups.

Tab. 2: Comparison of economic proportional indicators

Indicator	YES		NO		Index YES/NO		% above average values	
	Mean	Median	Mean	Median	Mean	Median	YES	NO
L1 – Immediate liquidity	0.39	0.09	1.31	0.10	0.30	0.90	22.86	22.73
ROE – Return on equity (%)	1.56	8.30	5.26	5.72	0.30	1.45	80.00	54.55
ROA – Return on assets (%)	4.57	3.69	2.69	3.59	1.70	1.03	48.57	59.09
LP – Labour productivity (CZK)	542 248	527 062	506 816	430 478	1.07	1.22	37.14	40.91
Percentage change in pre-tax profit (%)	63.94	4.72	60.33	44.33	1.06	0.11	42.86	54.55
Debt Ratio (%)	54.20	52.08	60.01	42.37	0.90	1.23	42.86	18.18

Source: own work

It is then possible in Table 3 to compare the percentage of above average values of the individual enterprises over the overall mean and median (both groups of enterprises) for each indicator.

Tab. 3: Percentage of above average values

Indicator (%)	% of above average values over the overall mean		% of above average values over the overall median	
	YES	NO	YES	NO
L1 – Immediate liquidity	14.29	27.27	57.14	54.55
ROE – Return on equity	74.29	54.55	62.86	54.55
ROA – Return on assets	54.29	50.00	54.29	50.00
LP – Labour productivity	42.86	36.36	51.43	40.91
Percentage change in pre-tax profit	45.71	54.55	71.43	77.27
Debt Ratio	40.00	22.73	54.29	45.45

Source: own work

Immediate liquidity expresses an enterprise's ability to immediately pay its short-term liabilities from freely available funds. Enterprises without controlling reported significantly better mean values; however, the median values are around the same level. This is due to several extreme values which increase the mean. Compared to the recommended range for this indicator (0.2-0.5) the mean for enterprises with controlling is in the specified interval, whereas the value for enterprises not using controlling is greatly above-average. Therefore, Table 3 shows better values for enterprises without controlling for the percentage

of above average values over the total mean but when comparing above average values with the overall median the opposite conclusion can be inferred.

One of the most followed indicators ROE expresses the ratio of profit over the amount of capital invested. When comparing the means enterprises without using controlling win again. However, the median values indicate better profitability of the enterprises with controlling. This is backed up by 80% of above average values within this group. Likewise, a comparison of the above average values over the overall mean and median for ROE shows enterprises using controlling principles dominating.

Another important indicator is return on assets (ROA) which is the ratio of profit over the total amount of managed assets. The mean and median values are greater in the group using controlling. In addition, a higher percentage of above average values over the overall mean and median ROA demonstrates better results for enterprises using controlling in their management practices.

Labour productivity specifies the volume of revenue generated on average by one employee of a business entity. Again, the mean and median for enterprises using a controlling philosophy are higher and reach more than half a million CZK. The improved performance of this group of enterprises for the indicator of labour productivity is also confirmed by the higher percentage of above average values over both the overall mean and median.

The indicator of percentage change of pre-tax profits reflects the annual percentage change in the amount of profit generated. An enterprise using controlling fares better on average but the median values, which are significantly lower, suggest otherwise. This shows a kind of higher variability of percentage changes in enterprises with controlling and extreme positive but also negative values of this indicator. Above average values over the overall mean and median are relatively higher for enterprises not using controlling.

The last indicator to be compared is total debt. This indicates the ratio of external resources over total utilized resources (value of liabilities or assets). On average, enterprises without controlling activities have more debt; however the median total debt is larger for enterprises with controlling. All of the values are in the range of 40-60%, which corresponds to the recommended values of the indicator based on to the individual specifics of each organization. The percentage of above average values in Table 3 indicates in both cases higher debt of enterprises that implement controlling processes.

The economic data were further statistically evaluated using the Statistica software. The average values of all 57 companies are analyzed in the monitored period for individual indicators separated into the groups YES or NO – based on the use of controlling of functions. Due to the fact that the data do not meet the condition of the Gaussian normal distribution, it was necessary to perform the analysis using so-called nonparametric tests. Two independent tests were used to increase the credibility of the results.

The first was the Mann-Whitney U test corrected for continuity, which is used to verify the null hypothesis that the two varieties come from the same distribution, therefore, that there is no statistically significant difference between the two groups of enterprises. The second is the Kolmogorov-Smirnov test, whose null hypothesis also states that the two varieties correspond to the same probability distribution. This test is based on cumulative frequencies. The tests are performed at a significance level of 0.05.

Tab. 4: Mann-Whitney U test

Variable	The indicated tests are significant at the level p <0.05000						
	U	Z	p-value	Z	p-value	Y valid	N valid
ROE	310.0000	1.221202	0.222010	1.221202	**0.222010**	35	22
ROA	330.0000	0.893363	0.371664	0.893363	**0.371664**	35	22
LP	318.0000	1.090066	0.275685	1.090066	**0.275685**	35	22
L1	358.5000	-0.426191	0.669969	-0.426226	**0.669944**	35	22
% change	344.0000	-0.663875	0.506771	-0.663875	**0.506771**	35	22
Debt Ratio	308.0000	1.253986	0.209848	1.253986	**0.209848**	35	22

Source: own work

Tab. 5: Kolmogorov-Smirnov test

Variable	The indicated tests are significant at the level p <0.05000						
	Max negative	Max positive	p-value	Mean	Mean	Y valid	N valid
ROE	-0.080519	0.241558	**p > .10**	2.9	4.3	35	22
ROA	-0.051948	0.206494	**p > .10**	4.8	2.6	35	22
LP	-0.107792	0.277922	**p > .10**	532428.2	502505.2	35	22
L1	-0.141558	0.089610	**p > .10**	0.4	1.2	35	22
% change	-0.174026	0.050649	**p > .10**	47.7	59.3	35	22
Debt Ratio	-0.090909	0.209091	**p > .10**	53.8	63.7	35	22

Source: own work

Table 4 shows the result of the Mann-Whitney U test for the examined indicators. Looking at the individual p-values it is clear that the null hypothesis is not rejected for any of the indicators because the p-values are greater than the level of significance. In this case it can be said that there is no statistically significant difference in the various indicators between enterprises with and without controlling. Absolutely the same conclusion can be reached for the results of the Kolmogorov-Smirnov test shown in Table 5. Here, the p-values for the individual indicators are greater than 0.1 and are therefore also greater than the significance level of the test and again the null hypothesis is not rejected for any of the indicators.

For a higher degree of accuracy the tests were further carried out with all the individual indicators in the monitored period. This helps avoid any distortion of values, as in the previous analysis of their averages.

Tab. 6: Mann-Whitney U test for all values

Variable	The indicated tests are significant at the level p <0.05000						
	U	Z	p-value	Z	p-value	Y valid	N valid
ROE	6596.000	1.61301	0.106744	1.61301	**0.106744**	150	100
ROA	7478.000	0.69025	0.490040	0.69025	**0.490039**	153	103
LP	5238.000	2.44404	0.014524	2.44404	**0.014524**	136	95
L1	6527.500	-2.09147	0.036487	-2.09456	**0.036211**	153	101
% change	5986.000	0.06691	0.946657	0.06691	**0.946657**	118	102
Debt Ratio	6081.000	3.09492	0.001969	3.09492	**0.001969**	153	103

Source: own work

Different results can be deducted from Table 6 than in the case of testing the average values after conducting the Mann-Whitney U test. For the indicators labour productivity indicators, immediate liquidity and total debt the p-value is less than the tested significance level and therefore the null hypothesis of equality of probability distributions for these indicators is rejected. It is therefore possible to state that for these three indicators there is a statistically relevant difference between the two groups of enterprise.

Tab. 7: Kolmogorov-Smirnov test for all values

Variable	The indicated tests are significant at the level p <0.05000						
	Max negative	Max positive	p-value	Mean	Mean	Y valid	N valid
ROE	-0.060000	0.206667	**p < .025**	1.6	5.3	150	100
ROA	-0.064471	0.093407	**p > .10**	4.6	2.7	153	103
LP	-0.034752	0.209830	**p < .025**	542247.7	506816.3	136	95
L1	-0.142755	0.000000	**p > .10**	0.4	1.3	153	101
% change	-0.070954	0.076105	**p > .10**	63.9	45.3	118	102
Debt Ratio	-0.071134	0.186052	**p < .05**	54.2	60.0	153	103

Source: own work

The results of the Kolmogorov-Smirnov test shown in Table 7 confirm the rejection of the null hypothesis of a statistically significant difference between enterprises with and without controlling in the case of labour productivity and total debt. It also confirms that the null hypothesis is not rejected in the context of ROA and the percentage change in pre-tax profit. Conversely, the difference can be seen for immediate liquidity, where the null hypothesis is not rejected. For ROE the null hypothesis is rejected compared to the previous test and there is a statistically relevant difference between enterprises implementing and not implementing controlling activities.

From the analysis of the economic results of the surveyed enterprises and the statistical evaluation it follows that the hypothesis H1: "The use of controlling in the management of small and medium-sized enterprises achieves better economic results" was not clearly confirmed in the synopsis of all of the monitored indicators.

4 Discussion

The results obtained through the primary and secondary research are determined by the selection of the sample of enterprises. Enterprises were only selected from the manufacturing industry and enterprises employing less than 100 workers were excluded as SMEs. This restriction is based on the consideration that the smaller the company, the more difficult it is to provide controlling in terms of organization and personnel and hence the assumption that it is used more in manufacturing companies. The other selection criteria i.e. territorial restrictions to NUTS 2 regions and the availability of data for at least three years did not significantly affect the objectivity of the research.

Thirty-five enterprises declaring the use of controlling shows that controlling is implemented in nearly two-thirds of the 57 surveyed enterprises. From this it follows that there is still considerable space in small and medium-sized enterprises for the expansion of an important management tool such as controlling.

There were no collectively and unambiguously better economic results of enterprises with controlling. However, the analysis did show differences in individual indicators, mostly in favour of enterprises with controlling. These related in particular to the comparison of median values which have better predictive ability than arithmetic means. Here, enterprises with controlling achieved better results in the indicators of immediate liquidity, ROE, total debt ratio and labour productivity. On the contrary, the results were worse in the dynamics (changes) of pre-tax profit and ROA. This suggests that enterprises with controlling place a greater emphasis on the efficiency of management and use more financial leverage for higher debt, which may be related to the practical use of controlling in corporate governance and management decision-making. The statistical evaluation carried out using several tests showed that the use of all of the values of the indicators in the monitored period provides a more accurate evaluation of the results than the use of means and medians. This demonstrated statistically relevant differences between the two groups of evaluated enterprises.

The research of the use of controlling in the Czech enterprises will continue. During further work the research should be extended to include a larger number of enterprises without territorial or sectoral restrictions. Primary research should focus on the qualitative aspects of the use of controlling. Therefore, the questionnaire survey will involve two sets of questions i.e. how controlling is provided in terms of organization personnel and qualifications and how its use is combined with other management tools. This concept of research focused on the qualitative aspects of the use of controlling will provide a more objective view of the application of controlling in small and medium-sized enterprises in the Czech Republic.

Conclusion

Today’s dynamically changing times and increasing market competition require enterprises to use effective management tools to ensure economic prosperity. There are a number of tools and management methods available for this purpose that focus on individual activities of enterprises. One of the most important tools for evaluating and influencing the economy of an enterprise is controlling. Foreign enterprises have long-term experience in the use of controlling. Czech enterprises gradually began to introduce modern methods and tools with the deepening transformation of the economy. Large enterprises with foreign owners had an advantage in this. Small and medium-sized

enterprises without foreign ownership structures were in a more difficult situation as they could not rely on previous experience. Therefore, it is useful to determine the extent to which SMEs are currently putting controlling into practice and how this is reflected in their economic results.

Primary research of selected small and medium-sized enterprises in the manufacturing industry in the Czech Republic showed that less than two-thirds of enterprises use controlling in any form. This means that there is ample space for the expansion of this efficient management tool in small and medium-sized enterprises. A summary of the secondary research which focused on the analysis, evaluation and comparison of financial results of enterprises with and without controlling failed to clearly show that enterprises using controlling achieve better results. Enterprises with controlling had better results in the case of the median values of certain indicators. In addition, the evaluation of all of the values of the indicators for the whole time period of three to five years showed that enterprises with controlling had more positive results. Nevertheless, it can be concluded that should controlling be effectively used in corporate governance the results of these enterprises should be significantly better. Research of the use of controlling in enterprises in the Czech Republic will continue and will focus primarily on the qualitative aspects of controlling processes in terms of organization, personnel and qualifications. It will also examine the connection between controlling and other management tools, which should lead to a synergistic effect. The ongoing research will further characterize in detail the position and use of controlling in enterprises in the Czech Republic.

References

[1] BECKER, W., et al. (2011). Controlling as a science in Germany. *Singidunum Revija*, Vol. 8 (2), p. 40-54. ISSN 1820-8819.

[2] BHULYAN, N., BAGHEL, A. (2005). An overview of continuous improvement: from the past to the present. *Management Decision*, 43 (5), p. 761 – 771.

[3] ČAPEK, Z. (2014). Controlling v managementu a řízení projektů MSP. *Controlling in SMEs – Beyond Numbers,* Praha: Proceedings of The International Conference. p. 103-119. ISBN 978-80-7408-086-9**.**

[4] ESCHENBACH, R. et al. (2004). *Controlling.* 2nd edition, Praha: ASPI Publishing, 816 s. ISBN 80-7357-035-1.

[5] FREIBERG, F. (1996). *Finanční controlling*. 1st edition, Praha: Management Press, p. 200. ISBN 80-85943-03-4.

[6] GABRIŽOVÁ, Z., et al. (2009). SMEs in V4 countries. *SMEs and innovative businesses*, Visegrad.info [online]. Available at WWW: <http://www.visegrad.info/smes-and-innovative-businesses/factsheet/smes-in-v4-countries.html.>

[7] KOZEL, R. (2006). *Moderní marketingový výzkum.* Praha: Grada Publishing, p. 277. ISBN 802470966X.

[8] KRÁL, B., et al. (2010). *Manažerské účetnictví*. 3rd supplementation and updated edition, Praha: Management Press, p. 660. ISBN 978-80-7261-217-8.

[9] MIKOVCOVÁ, H. (2007). *Controlling v praxi*. 1st edition, Plzeň: Vydavatelství a nakladatelství Aleš Čeněk, p. 183. ISBN 978-80-7380-049-9.

[10] MPO. (2015). Malé a střední podnikání, mpo.cz [online]. Available at WWW: <http://www.mpo.cz/cz/podpora-podnikani/msp/>

[11] MORSE, W. J., et al. (2003). Management Accounting: A Strategic Approach. Mason, Ohio, *Thompson South Western College*.

[12] MYSKOVA, R. Economic Information Systems for Small and Medium Businesses and Evaluation of Return. In WSEAS TRANSACTIONS on INFORMATION SCIENCE and APPLICATIONS, Issue 3, Volume 8, March 2011, p. 119-128, ISSN: 1790-0832

[13] PLAČKOVÁ, A., KOUDELKOVÁ, P. (2011). Srovnání vývoje MSP v České republice a na Slovensku. *International Scientific Ph.D. and Post Docs Conference*, VUT Brno.

[14] VOLLMUTH, H. J. (2004). *Nástroje controllingu od A do Z*. 2nd edition, Praha: Profess Consulting, p. 359. ISBN 80-7259-029-4.

Contact addresses

Ing. Lukáš Kruml
University of Pardubice
Faculty of Economics and Administration
Institute of Business Economics and Management
Studentská 84, 532 10 Pardubice, Czech Republic
Email: lukas.kruml@seznam.cz
Phone number: 466 036 664

doc. Ing. Pavel Duspiva, CSc.
University of Pardubice
Faculty of Economics and Administration
Institute of Business Economics and Management
Studentská 84, 532 10 Pardubice, Czech Republic
Email: pavel.duspiva@upce.cz
Phone number: 466 036 480

Received: 28. 04. 2015
Reviewed: 02. 06. 2015, 30. 07. 2015
Approved for publication: 02. 09. 2015

E-GOVERNMENT DEVELOPMENT INDEX AND ITS COMPARISON IN THE EU MEMBER STATES

Martin Lněnička

Abstract: *This paper deals with a comparison of the e-Government development index, which is presented by the United Nations since 2003, usually every two years. It compares and describes the progress of this index between the years 2008 and 2014 in the European Union Member States in the context of the economic decline and the global recession. It also considers factors contributing to successful e-Government implementation, such as unemployment or inflation rate. The purpose of the submitted research study is to identify the influence of the selected macroeconomic indicators on the e-Government development index. The methodology of this research study comprised bibliographic studies, analysis of specialised reports, statistical analyses and evaluations. The main methods used were descriptive, correlation and the cluster analysis, which was in this case represented by the connectivity model (hierarchical clustering) as well as the centroid model (K-means clustering). The findings confirmed that the global recession and the Eurozone crisis have influenced the progress of the e-Government in the evaluated years. This research study provides insights that may be useful in improving the implementation of e-Government services.*

Keywords: *E-Government, Public sector, Cluster analysis, European Union.*

JEL Classification: *C38, H11, H83, L86.*

Introduction

With the trend of cost savings in the public sector, the electronic government or just e-Government is one of the possible options to operate more efficiently, effectively and transparently, to provide better, cheaper and faster services and open data to the public and to facilitate the participation of citizens and businesses in the governance. In March 2010 the European Commission launched the Europe 2020 Strategy [4] in view to exit the financial crisis and prepare the European Union (EU) economy for the challenges of the next decade. The Digital Agenda for Europe is one of the seven flagship initiatives of the Europe 2020 Strategy, defining the key enabling role that the use of Information and Communication Technologies (ICT) will have to play if Europe wants to succeed in its ambitions for 2020 [3], [4].

More broadly, e-Government can be referred to as the use and application of ICT in the public administration to streamline and integrate workflows and processes, to effectively manage data and information, enhance public service delivery, as well as expand communication channels for engagement and empowerment of people. The opportunities offered by the digital development of recent years, whether through online services, big open data, social media, mobile applications or cloud computing, are expanding the way for the development of e-Government [23].

World e-Government rankings are increasingly important as they guide countries' focus of their efforts. The e-Government rankings are in a process of maturation in that direction, moving from purely measuring web sites to assessing use and government qualities. There

are a number of indexes. Each model measures how ready a society or economy is to benefit from ICT. However, the range of tools uses widely varying definitions and different methods for measurement [14]. Some of them have become frequently cited and used as benchmarks, guiding the debate as well as governments' investments in e-Government [7]. In the EU, there is a series of the EU e-Government Benchmarking reports. This annual exercise started in 2001 and the 2014 report [3] is the eleventh measurement. These reports are mostly focused on the best performing countries that have implemented the most mature e-Government services. However, these countries cannot be compared in time, because the ranking system has changed over time. The last report is based on the e-Government Benchmark Framework 2012–2015 [3]. In a global perspective, frequently cited indexes include the United Nations (UN) e-Government rankings, the Economist's e-Government readiness index and Brown university's regular global e-Government studies [7], [14]. The e-Government Development Index (EGDI) by UN is broader than the EU's one by adding a social component. The Economist's index also measures government quality aspects. The Brown index is again more limited focusing on features of web systems, such as the existence of a privacy policy, security policy, advertisements and the opportunity to comment [7]. The last two indexes were not used in this research study, because there is a big time gap between the individual reports or they only cover selected countries.

1 Problem formulation and tools used

The main aim of this paper is to compare the progress of the information society and also macroeconomic indicators, which are represented by the EGDI and the e-Participation index (EPI), in the EU Member States between 2007 and 2013. This period is covered by the UN e-Government Surveys 2008, 2010, 2012 and 2014. The EGDI presents the state of e-Government development of the UN Member States. Mathematically, the EDGI is a weighted average of three normalized scores on the most important dimensions of e-Government, namely: provision of online services – Online Service Index (OSI), telecommunication connectivity – Telecommunication Infrastructure Index (TII) and human capacity – Human Capital Index (HCI). More about the weight calculation can be found in [20], [21], [22] or [23]. It is not designed to capture e-Government development in an absolute sense; rather, it aims to give a performance rating of national governments relative to one another [23]. The EPI is then derived as a supplementary index to the UN e-Government Survey. It is focused on the use of online services to facilitate provision of information by governments to citizens (e-information sharing), interaction with stakeholders (e-consultation), and engagement in decision-making processes (e-decision making). The maximum possible value of the EGDI as well as the EPI is one and the minimum is zero. The conceptual framework of the EGDI and the EPI remains unchanged since its inception in 2001 [23].

This paper also evaluates the influence of the financial crisis, which started at the end of 2007 and led to the global recession [6], [15], and the Eurozone crisis, that has been affecting the members of the Eurozone since early 2009 – more in [17], [18], on the progress of the EGDI and selected macroeconomic indicators. These were chosen based on the literature review – the real Gross Domestic Product (GDP) per capita, unemployment rate, inflation rate and total population of the EU Member States, which are closely related to the implementation of the e-Government services. States with deep impact of the financial crisis has increased governmental spending and enacted laws supporting the demand for key products industry [8]. Thus, this research study tries to find the answers to the following questions: What are the differences between the EU Member States through

the years? Are there still groups of the “old” and the “new” Member States? Which Member States are more similar to each other than to those in other groups? What is the most successful Member State? What are the most significant changes between the years 2008, 2010, 2012 and 2014?

The first part of this paper is based on literature review of foreign and domestic resources which led to make recommendations on the selection of macroeconomic indicators and other related attributes connected to the development of e-Government. The research study consists of correlation and cluster analysis over the set of obtained data. The last part contains results and recommendations for the further research. The main tools used are the statistical software Statistica 10 and Microsoft Excel 10.

2 Literature review and background

In recent years, most of the researchers have focused on the current state of the art of e-Government, the measurement of the e-Government services or relationship between e-Government and selected macroeconomic indicators, those characterize the state and efficiency of a national economy. Wilkinson and Cappel [24] utilized content and correlation analysis to determine whether the variables of economic prosperity and population had any significant effect on predicting the extent of country e-Government involvement. Their results showed a significant correlation between the variables. Therefore, the level of resources and size of a country appeared to be associated with the extent to which it delivered services via the web, meaning the larger a country was in terms of income and population, the greater was its e-Government involvement. Along similar lines, Mazengera in [13] used the correlation analysis to identify factors contributing to successful e-Government implementation. The study has revealed that there was the correlation between the internet use and the number of cell phones, but a very low correlation with the literacy level. However, it did not consider other softer aspects that may impact the uptake and use of e-Government services such as social background, income levels, etc.

Krishnan et al. in [9] showed that ICT infrastructure, e-Participation and human capital had a direct relationship with e-Government maturity. Their results also indicated that governance in a country, e.g. political stability, regulatory quality or control of corruption, did not significantly contribute to its e-Government maturity, and their relationship was not mediated by e-Participation. Špaček [19] stated that governments across Europe work with a mix of instruments aimed at enhancing the centralization of their e-government development through new centrally promoted infrastructures and services that allow for more integrated service delivery, virtual or physical, and through changes in organizational structures. Matei and Savulescu [12] analysed the current state of e-Government in the eleven Balkan countries based on data provided by UN e-Government Surveys. However, they only used the data from UN Surveys and highlighted the most important strategies and programmes without the connection to any macroeconomic indicator. Also Dumpe and Arhipova [2] analysed the EGDI changes in the period 2008–2012, as well as discussed the main factors influenced this index. Máchová and Lněnička [11] offered a comprehensive look at the state of e-Government services in the EU Member States in 2010. They used the data available before the beginning of the financial crisis, thus this research study may revise their findings and help to clearly compare the EGDI progress.

The quality of the EPI by validating it against other indexes of government-citizen relations qualities, democracy, internet filtering, and transparency was analysed by Grönlund [7]. The author found out that the relation between the EPI and indexes of democracy and participation was non-existent, even very undemocratic countries could score high on the EPI and countries whose severely obstructed citizen internet use by filtering could score high on the EPI by introducing technical tools on their web [7]. Mohammed and Ibrahim [14] revisited the existing e-Government indexes to show the main common indicators and proposed a preliminary framework to refine indexes' indicators according to the characteristics of the cloud computing. As a result, some indicators will get low weight in the index and others will get high weight or even new indicators or variables can by introduced. ICT infrastructure is considered as one of the main indicators to preparedness of a country to implement e-Government systems and it relatively has high weight in the current indexes. Thus, as infrastructure is hosted on cloud, government does not have to spend on hardware, software, skills resources and maintenance. Therefore, ICT infrastructure as a component of the index will get less weight [14]. Also the EU emphasizes the cloud computing technologies and big open data to provide flexibility and enable greater consistency in the public services [3].

Koťátková-Stránská and Lelek [8] analysed the similarity of the EU Member States on the evolution of selected variables (e.g. real GDP growth rate in %, employment rate in %, inflation rate in %, etc.) which can show the integration process success. They used cluster analysis and compared the data before and after the financial crisis (period 2004 –2008 and period 2009–2010). Their results showed that GDP growth rates significantly dropped during the crisis. Especially those, which had have the highest growth rate in the previous period (Latvia and Estonia). Public debt rose most in Ireland and Italy and most Member States do not meet the Maastricht criteria with long-term values of 60%. There are, however, still relatively few studies that have addressed the influence of the financial crisis in the context of e-Government.

3 Hypotheses statement

According to the above defined aim and the literature review author has formulated the following four hypotheses. Their validity will be examined by using multivariate statistical methods.

H1: There is a correlational relationship between the GDP per capita and the EGDI, but no correlational relationship between the GDP per capita and the EPI.

H2: After a decline captured in the UN report 2010, there will be an increase in the upcoming years 2012 and 2014.

H3: The decline of the EGDI in the "old" Member States in 2010 will be lower than in the "new" Member States in the following years.

H4: There is a similarity in the development of the Eurozone Member States and they will be clustered together in 2014.

4 Research study

Data analysis includes descriptive, correlation and cluster analysis was conducted. Statistical software Statistica 10 and Microsoft Excel 2010 were used.

4.1 Data preparation and descriptive analysis

Selected analyses were performed with Statistica 10, data pre-processing and the basic operations on them were conducted in Microsoft Excel 2010. The data used to test hypotheses outlined above came from the UN database [1]. The main documents used were the UN e-Government Surveys from 2008, 2010, 2012 and 2014. The other data came from Eurostat [5], which provides more actual data than UN. These data were from 2007, 2009, 2011 and 2013, because the reports always evaluated the state of e-Government from the previous year. The following attributes were chosen:

1. Total population,
2. Real GDP per capita (in €),
3. Unemployment rate (annual in %),
4. Inflation rate (annual in %),
5. Points for emerging information services (stage 1 in %) – part of the OSI,
6. Points for enhanced information services (stage 2 in %) – part of the OSI,
7. Points for transaction services (stage 3 in %) – part of the OSI,
8. Points for connected approach (stage 4 in %) – part of the OSI,
9. Estimated internet users per 100 inhabitants – part of the TII,
10. Main fixed telephone lines per 100 inhabitants – part of the TII,
11. Mobile subscribers per 100 inhabitants – part of the TII,
12. Personal computers per 100 inhabitants – part of the TII,
13. Total fixed broadband per 100 inhabitants – part of the TII,
14. Adult literacy rate (in %) – part of the HCI,
15. Gross enrolment ratio (in %) – part of the HCI,
16. EPI.

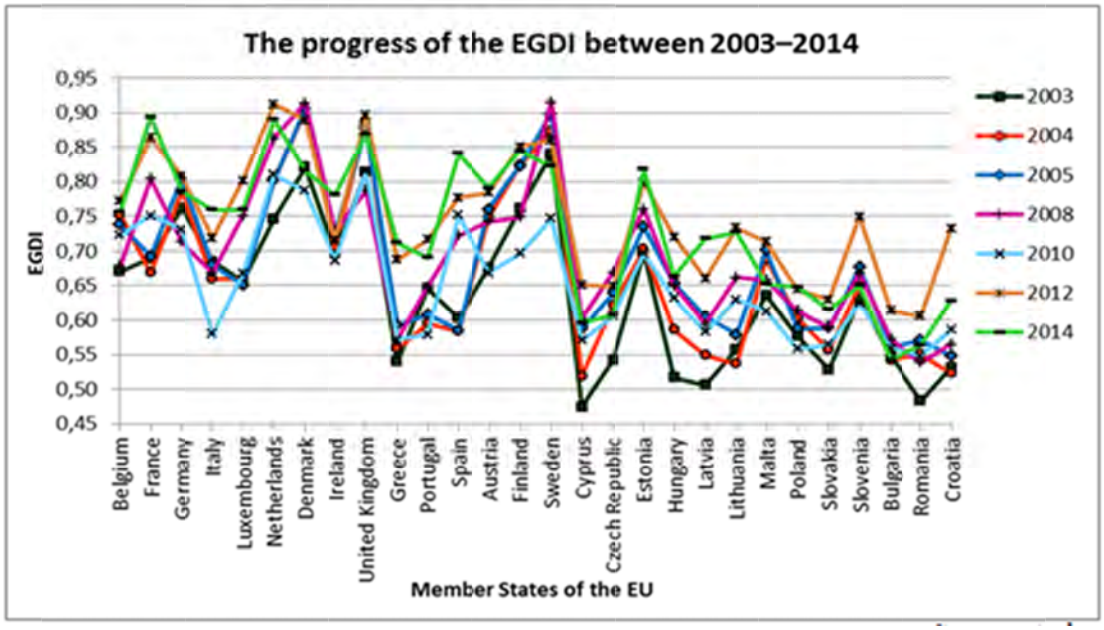
Firstly, only the data valid for the EU Member States in the evaluated years were selected. Then the attributes were copied into Microsoft Excel 2010 sheets for further processing and saved as a file named “data.xlsx”. The same data were also saved in Statistica 10 as four files named “data2008.sta”, “data2010.sta”, “data2012.sta” and “data2014sta”. In total, each data matrix consisted of 28 cases (EU Member States) and 16 attributes (variables). Finally, the data were formatted, i.e. unified the number of decimal places, a comma was chosen as a decimal mark, checking for missing and unreliable entries, etc. Descriptive analysis is needed to help visualize the data and get a sense of their values, i.e. plot histograms and compute summary statistics to observe the trends and the distribution of the data [10]. It was performed using the Data Analysis tool in Microsoft Excel 2010. Next step was the comparison of the relevant statistics between 2008, 2010, 2012 and 2014. It helped to form the basis of the initial description of the data as part of a more extensive statistical analysis, which will be followed later in this paper.

4.2 The progress of the EGDI between 2003–2014

Microsoft Excel 2010 was, among others, used to show the progress of the EGDI in 2003, 2004, 2005, 2008, 2010, 2012 and 2014. For the missing years, the interpolation

can be used [10]. The EU Member States are sorted by the year they joined the EU. In the same year of the accession, they are in the alphabetical order as it is shown in the Fig. 1. No other analysis was performed using data from the years 2003, 2004 or 2005.

Fig. 1: The progress of the EGDI between 2003–2014 in the EU Member States



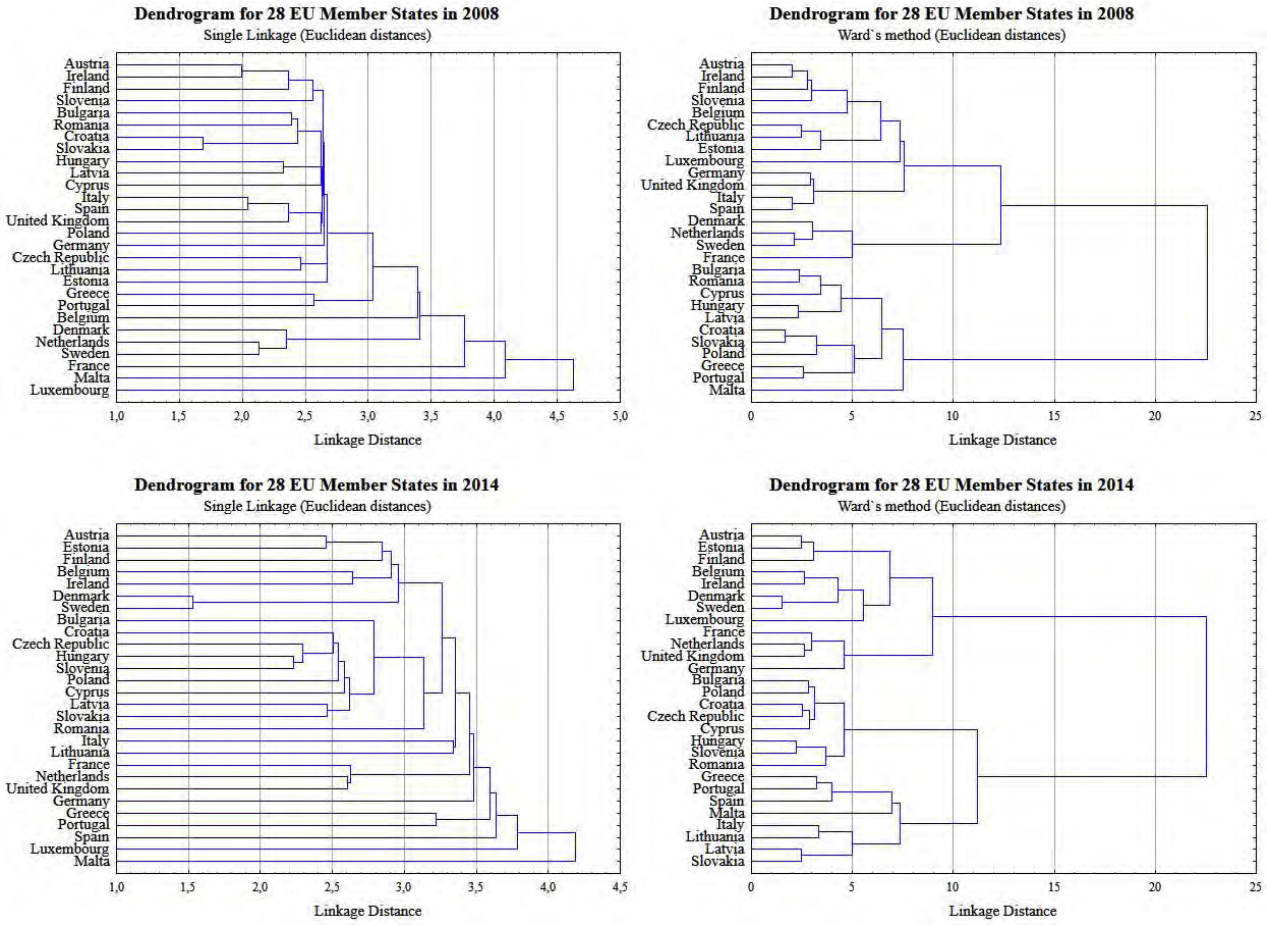
Source: Author

4.3 Correlation and cluster analysis

Correlation analysis was used to test the statistical significance of the relationship that may exist between the two variables. The results indicate an association between the predictor and criterion variables [10], [16]. The first data matrix was uploaded into Statistica 10, which made its standardization and subsequently performed cluster analysis based on the selected variables and parameters set for the clustering. But first, the variables had to be as independent from one another as possible. Therefore, the correlation matrix was tested to check if any of the variables are strongly correlated to eliminate any of the correlated ones. Correlations greater than 0,5 are statistically significant [10]. It happened in the case of the variables of the OSI and the TII for all the years, when the highest values were found in 2008. For this reason, the variables 6 and 7 were removed from matrices as well as the variable 10 (see section 4.1).

A non-hierarchical clustering K-means method and hierarchical algorithms have been applied. These methods belong to the group of unsupervised learning methods, and also clustering. In the case of K-means algorithm initial cluster centres are set first and then the samples, which are located within a given distance from the centre of the cluster, are assigned to the cluster [10], [16]. Thus, the next step here was the initial setup of the centres of the clusters, which was carried out using a hierarchical single linkage algorithm and Ward's minimum variance method, which enables the efficient functioning of the K-means algorithm and reduces the possibility of the error (utility) function being stuck at the local minimum [10], [16]. The Euclidean metric (distance) was chosen as a measure of dissimilarity. Fig. 2 then shows the dendrogram of the hierarchical single linkage algorithm and for the comparison also the dendrogram of the Ward's method, both for 2008 and 2014 data sets. Compared to the hierarchical single linkage algorithm the Ward's method provides a key contribution to the variance rather than the distance of the samples. This is reflected in the different shape of the dendrogram [16].

Fig. 2: Dendrograms for Single Linkage and Ward's method in 2008 and 2014



Source: Author

The non-hierarchical clustering was done by means of algorithm K-means for 3, 4, 5 and 6 clusters. From the given number the highest quality clustering proved to be clustering for 5 clusters (e.g. distances, no cluster with a single member, etc.). This value was selected for the further processing. The results for every year are shown in the Tab. 1. A member of each cluster with the longest distance from the centre is bold.

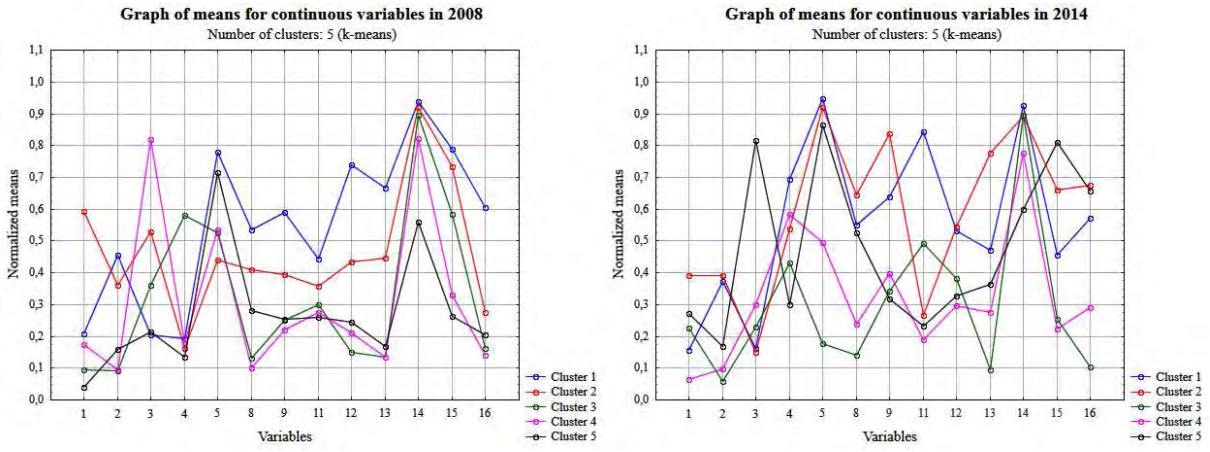
Tab. 1: Clustering in 2008, 2010, 2012 and 2014 using K-means algorithm

2008	2008	2010	2010
Cluster 1	**Cluster 3**	**Cluster 1**	**Cluster 3**
Austria	Bulgaria	Austria	Bulgaria
Denmark	Greece	Estonia	Czech Republic
Estonia	Hungary	Finland	Greece
Finland	Latvia	Ireland	Poland
France	**Lithuania**	Italy	**Portugal**
Ireland	Romania	**Luxembourg**	Romania
Luxembourg	Slovenia	**Cluster 2**	**Cluster 4**
Netherlands	**Cluster 4**	Belgium	Croatia
Sweden	Croatia	Denmark	Hungary
United Kingdom	Poland	France	Latvia
Cluster 2	**Portugal**	Germany	Lithuania
Belgium	Slovakia	Netherlands	**Slovakia**
Germany	**Cluster 5**	Slovenia	**Cluster 5**
Italy	Cyprus	**Spain**	Cyprus
Spain	Czech Republic	Sweden	Malta
	Malta	United Kingdom	
2012	**2012**	**2014**	**2014**
Cluster 1	**Cluster 3**	**Cluster 1**	**Cluster 3**
Austria	Bulgaria	Austria	**Bulgaria**
Estonia	Romania	Estonia	Czech Republic
Finland	**Cluster 4**	Finland	Poland
Germany	Croatia	Italy	**Cluster 4**
Italy	**Greece**	Lithuania	Croatia
Lithuania	Portugal	**Luxembourg**	Cyprus
Luxembourg	**Cluster 5**	**Cluster 2**	Hungary
United Kingdom	Cyprus	Belgium	Latvia
Cluster 2	Czech Republic	Denmark	**Malta**
Belgium	Hungary	France	Romania
Denmark	Latvia	**Germany**	Slovakia
France	**Malta**	Ireland	Slovenia
Ireland	Poland	Netherlands	**Cluster 5**
Netherlands		Sweden	Greece
Slovenia		United Kingdom	Portugal
Spain			**Spain**
Sweden			

Source: Author

Another output of K-means is the graph of means for variables. The selected graphs are shown in the Fig. 3. Numbers of variables on the x-axis can be seen from the list of the attributes in the section 4.1.

Fig. 3: Graphs of means for variables in 2008 and 2014



Source: Author

5 Results and discussion

Based on the results of the descriptive analysis, the mean value of the GDP per capita has increased about 3% between 2008 and 2014 as well as the range between the largest and smallest values (more than 5%). The biggest difference between these two years is in the unemployment rate. The mean value has increased about 70% and the range about 200%. There is also a decline between 2008 and 2010, only the mean value of the mobile subscribers per 100 inhabitants has increased. The mean value of the EGDI has increased about 15% (the EPI even about 75%) from 2008 to 2014 and the range has decreased about 5% (the EPI more than 16%), which means that the differences in the e-government development between the EU Member States are minor through the years.

When testing whether there is a relationship between the GDP per capita and the EGDI, the results show that the GDP per capita has a correlational relationship with the EGDI at the significance level $p < 0,05$ where p-value is a measure of statistical significance [10]. However, it has been slightly decreased from 0,65 in 2008 to 0,59 in 2014. Also the UN stated that the income level of a country is a general indicator of economic capacity and progress, which influences its e-Government development. Access to ICT infrastructure and the provision of education, including ICT literacy, are related to the income level of a nation [23]. There is no significant correlational relationship between the real GDP per capita and the EPI. Correlation coefficient is only between 0,2–0,3 through the evaluated years. As a result, H1 is supported.

As can be seen from the Tab. 2, after a decline captured in the UN report 2010 [21], there was an increase in 2012, but in 2014 there was a decrease again. As a result, H2 is rejected. Also H3 is rejected, because the decline of the EGDI in the "old" Member States (EU15) in 2010 was higher than in the "new" Member States (EU13).

Tab. 2: A percentage change of the EGDI in the evaluated years

Group of the EU Member States / year	Percentage change of the EGDI versus the previous period			
	2008 [%]	2010 [%]	2012 [%]	2014 [%]
EU28	1,17	-5,52	14,29	-2,43
EU15	1,02	-6,17	14,09	-0,32
EU13	1,37	-4,57	14,56	-5,31

Source: Author

The results of the Ward's method in 2008 suggest that the EU Member States can be divided into two large clusters and a cluster with Denmark, Netherlands, Sweden and France. This cluster of four had a very low unemployment and inflation rate, but very high points for emerging information services and the EPI. These four Member States joined in 2010 the first large cluster, which is mostly consists of the "old" Member States together with Estonia and Slovenia. These two "new" Member States have achieved very good results in e-Government in the past years, they also belong to the Eurozone. However, in 2014 Slovenia has dropped in most of the evaluated variables. The second large cluster in 2010 is formed by the "new" Member States together with Greece and Portugal. These states together with Spain were affected by the financial crisis and the Eurozone crisis very deep. Therefore, they were clustered to one group in 2014, which was also confirmed by the use of the K-means algorithm. This group is defined by a very high unemployment rate, relatively low number of estimated internet users and total fixed broadband per 100 inhabitants. Based on the graph of means for variables, also the total population size has positive influence on the clustering (e.g. due to economies of scale or cloud computing).

The results of the Ward's method in 2012 suggest that the EU Member States can be divided into at least four smaller clusters. The biggest differences between the EU Member States were found in this year. Also two very small clusters were formed using K-means algorithm in 2012 and the distances from the centre within the clusters were larger than in 2010 or 2014. Consequently, this period between 2010 and 2011 covered by the UN report 2012 [22] was characterized by the increase of the unemployment and inflation rate, decrease of the GDP per capita and the OSI, which is closely connected to the government's investments. The results also show similarity in the Eurozone. In 2014, all the members were in the clusters 1, 2 and 5, except Lithuania, which is only in the European Exchange Rate Mechanism (ERM II), and Denmark, Sweden and United Kingdom, which obtained special opt-outs in the original Maastricht Treaty. As a result, H4 is supported.

Conclusion and future research directions

The main aim and partial steps were completed successfully. The results obtained using the statistical methods indicated that there was a decline in 2010 and again in 2014, where the decrease was more significant in the "new" Member States. Based on the results it can be concluded that the continuing stagnation has affected mainly the EU Member States in southern Europe. Although Croatia did join the EU on 1st July 2013, the strong similarity to the other Member States was found in 2008, 2010 as well as in 2012. Considering the development of e-Government in the Czech Republic through the evaluated years, it is characterized by the low inflation and unemployment rates, only average availability of online services and relatively high numbers of internet users and mobile subscribers per 100 inhabitants. The other Member States with the quite similar values are Bulgaria, Malta and Poland. The most successful EU Member States were in 2008 in cluster 1, in 2010 in cluster 1 and also cluster 2 as well as in 2012, and in 2014 in cluster 2 headed by Denmark.

Otherwise, the uptake of e-Government services, especially parts of the TII, which implies past public investment in delivering such services, may increases the relative probability of the lower unemployment and inflation rate. The clustered groups of the EU Member States with the measured similarities may be used in the context of the financial instruments of the EU's Regional policy or the Digital Agenda to set new and more stringent targets and requirements for this funding period in terms of quality, openness

and completeness. Also the other European states could be clustered together with the EU Member States. There are clear opportunities for the future improvement of e-Government, including technology trends towards, e.g. social media and mobile devices and technology which are inherently interactive, as well as cloud computing.

For the future research methodology it was confirmed that Ward's method provides an appropriate mechanism for the connection of variables into the appropriate clusters as the most common grouping of the EU Member States based on the level of the EGDI and the related macroeconomic indicators. Also, further research could focus on the determinants not only of the total amount of money devoted to e-Government services but also of the strategic choices that EU Member States have done.

Acknowledgement

This contribution was supported by SGSFES_2014003 fund.

References

[1] A DATA CENTER. *United Nations: UNPACS* [online]. 2014 [cit. 2014-07-01]. Available at WWW: <http://unpan3.un.org/egovkb/en-us/Data-Center>

[2] DUMPE, D.; ARHIPOVA, I. The e-Government Readiness in Latvia: Past and Present. *Information Technology and Management*, 2012, Vol. 15, pp. 93–98.

[3] EUROPEAN COMMISSION. *Delivering the European Advantage?: The 11th eGovernment Benchmark report*. Luxembourg: Publications Office of the European Union, 2014. 120 p. ISBN 978-92-79-38052-5.

[4] EUROPEAN COMMISSION. *The European Union explained Europe 2020: Europe's growth strategy*. Luxembourg: Publications Office of the European Union, 2012. 12 p. ISBN 978-92-79-23972-4.

[5] EUROSTAT [online]. c2014, 06. 07. 2014 [cit. 2014-07-01]. *Statistics – Browse / Search Database*. Available at WWW: <http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database>

[6] FRATZSCHER, M. Capital Flows, Push versus Pull Factors and the Global Financial Crisis. *Journal of International Economics*, 2012, Vol. 88, No. 2, pp. 341–356.

[7] GRÖNLUND, Å. Connecting eGovernment to Real Government – The Failure of the UN eParticipation Index. In: *Electronic government.* Berlin Heidelberg: Springer, 2011, pp. 26–37.

[8] KOŤÁTKOVÁ-STRÁNSKÁ, P.; LELEK, T. Analysis of European Union Cohesion. *Scientific Papers of the University of Pardubice, Series D, Faculty of Economics and Administration*, 2012, Vol. 18, No. 24, pp. 102–113.

[9] KRISHNAN, S.; TEO, T.; LIM, J. E-Participation and E-Government Maturity: A Global Perspective. In: *Grand Successes and Failures in IT: Public and Private Sectors*. Berlin Heidelberg: Springer, 2013, pp. 420–435.

[10] KUBANOVÁ, J. *Statistické metody pro ekonomickou a technickou praxi*. Bratislava: Statis, 2008. 245 p. ISBN 978-80-85659-47-4.

[11] MÁCHOVÁ, R.; LNĚNIČKA, M. Electronic Services of eGovernment in the European Union Countries. *Scientific Papers of the University of Pardubice,*

Series D, Faculty of Economics and Administration, 2010, Vol. 15, No. 17, pp. 138–150.

[12] MATEI, A.; SAVULESCU, C. E-government in the Balkans. Comparative study. In: *National and European Values of Public Administration in the Balkans*. Bucharest: Editura Economică, 2011, pp. 25-40.

[13] MAZENGERA, B. Factors Contributing To Successful E-Government Implementation in Southern African Development Community (SADC) Countries. In: *Proceedings of the 16th IBIMA Conference on Innovation and Knowledge Management: A Global Competitive Advantage*. Kuala Lumpur, Malaysia, 2011, pp. 1050–1057.

[14] MOHAMMED, F.; IBRAHIM, O. Refining E-government Readiness Index by Cloud Computing. *Jurnal Teknologi*, 2013, Vol. 65, No. 1, pp. 23–34.

[15] POORAN, P. N. Global Financial Crisis. *World Economics*, 2010, Vol. 11, No. 3, pp. 127–132.

[16] ŘEZANKOVÁ, H.; HÚSEK, D.; SNÁŠEL, V. *Shluková analýza dat*. Praha: Professional Publishing, 2007. 196 p. ISBN 978-80-86946-26-9.

[17] REBSTOCK, R. J. Eurozone Debt Crisis. In: *K-State Research Exchange* [online]. 2013 [cit. 2014-07-07]. Available at WWW: <http://krex.k-state.edu/dspace/bitstream/handle/2097/16900/RemingtonRebstock2013.pdf>

[18] ROY, J. *The State of the Union(s): The Eurozone Crisis, Comparative Regional Integration and the EU Model*. United States, Miami: Thomson-Shore, 2012. 196 p. ISBN 978-146-7524-018.

[19] ŠPAČEK, D. Coordination of and through E-Government: The Case of the Czech Republic. *The NISPAcee Journal of Public Administration and Policy*, 2014, Vol. 7, No. 1, pp. 83–106.

[20] UNITED NATIONS. *United Nations e-Government Survey 2008: From e-Government to Connected Governance*. New York: UN Publishing Section, 2008. 225 p. ISBN 978-92-1-123174-8.

[21] UNITED NATIONS. *United Nations e-Government Survey 2010: Leveraging e-government at a time of financial and economic crisis*. New York: UN Publishing Section, 2010. 125 p. ISBN 978-92-1-123183-0.

[22] UNITED NATIONS. *United Nations e-Government Survey 2012: E-Government for the People*. New York: UN Publishing Section, 2012. 143 p. ISBN 978-92-1 -123190-8.

[23] UNITED NATIONS. *United Nations e-Government Survey 2014: E-Government for the Future We Want*. New York: UN Publishing Section, 2014. 263 p. ISBN 978-92-1-123198-4.

[24] WILKINSON, V. O.; CAPPEL, J. J. Impact of economic prosperity and population on e-Government involvement. *Issues in Information Systems*, 2005, Vol. 6, No. 2, pp. 204–209.

Contact Address

Ing. et Ing. Martin Lněnička
University of Pardubice, Faculty of Economics and Administration
Studentská 84, 53210 Pardubice, Czech Republic
Email: martin.lnenicka@gmail.com
Phone number: +420 46603 6075

Received: 13. 08. 2014
Reviewed: 11. 09. 2014, 24. 09. 2014
Approved for publication: 02. 09. 2015

AN ANALYTICAL HIERARCHY PROCESS MODEL FOR THE EVALUATION OF THE E-GOVERNMENT DEVELOPMENT

Renáta Máchová

Abstract: *With the increasing number, variety and effects of modern technologies, e-government needs to define a new evaluation model that fits their requirements and operations. Therefore, this paper presents an example on solving the e-government development evaluation problem using the Analytical Hierarchy Process method. The proposed model consists of criteria identified through the comparison of the selected e-government indices, including the new approaches such as cloud computing, open data, social media, etc. A case study is presented to demonstrate the usefulness of this model to solve multiple criteria decision making problems.*

Keywords: *AHP, Decision making, E-government evaluation, E-government indices.*

JEL Classification: *C43, C44, H11, H83, L86.*

Introduction

Since the development of e-government is a continuous process of improvement, it requires continuous evaluation and updating its framework using modern computing technologies and platforms. However, e-government also faces several challenges and constraints, primarily budget shrinking, increasing public demand for information and services and continuous advances in technology, resources and standards. In order to overcome these challenges, governments should be willing to adopt innovative ideas for e-government such as cloud computing, big data analytics, open data portals, etc. In such a situation, the traditional e-government model has become difficult to operate.

A large amount of research has been investigated into monitoring, evaluating and benchmarking e-government system. Thus, with the rapid e-government development, it becomes critical to investigate, redefine, restructure and also reweight the related e-government development frameworks and indices.

E-government is closely related to e-readiness, which is defined as the degree to which a community (citizens, businesses and governments) is prepared to participate in using modern information and communications technologies (ICT) [11], [17]. But these terms are nowadays mostly used as synonyms.

1 Problem formulation and research methodology

In [14], there has been introduced a model using an Analytic Hierarchy Process (AHP), but only focused on the regional level in the developing countries. Since this paper is intended to focus on the European level, only a few of the proposed criteria may be used. Yuming and Hongyan [20] used AHP to analyze the relative weight of the influential factors to the success of the e-government development. However, they only focused on the single index in the selected developing countries.

The main aim of this paper is to propose an AHP model for the comparison of the selected European countries based on the new innovative ideas for the e-government evaluation. To meet this aim, some objectives are defined. The first objective of this paper is

to determine the variables or criteria in the e-government evaluation using the global e-government development indices and related reports. For this reason, a list of criteria has been elaborated in detail based on the literature review, experiences and the needs of governments to analyze capability of each selected index. The second objective is to propose a case study, which uses the AHP model and help to select the most suitable European country based on the defined criteria.

The first part of this paper is based on literature review of foreign and domestic resources which led to make recommendations on the selection of the most suitable e-government development indices and the related criteria to propose the AHP model. The case study then consists of the AHP method over the set of obtained data. Data were collected mostly from annual e-government reports [3], [17] or [19], international journals, reference books, websites, and related organizations/authorities, etc. The main tools used are the Expert Choice software and Microsoft Excel 2010.

2 Literature review

2.1 E-government development and related indices

Through the last 15 years, several frameworks have been introduced to compare and assess the opportunities and challenges facing various e-government strategies and initiatives. Some of them are based on measurable characteristics of the entities, others then use one or more subjective measures, a few employ a combination of both [11]. The output is then mostly a rank or weighted index. There are a number of indexes. However, the range of tools uses widely varying definitions and different methods for measurement. Some of them have become frequently used as benchmarks, guiding the debate as well as governments' investments in e-government [2], [10]. In the European Union (EU), there is a series of the EU e-Government Benchmarking reports. This annual exercise started in 2001 and the 2014 report [1] is the eleventh measurement. These reports are focused on the best performing countries that have implemented the most mature e-government services. The results are mostly shown in the graph and there is no single ranking, but more rankings based on the measured services. Also the weights or even indicators in the same model may change over the time for different reasons, the most important, emerging new technology or paradigm. The last report is based on the E-government Benchmark Framework 2012–2015 [1].

In a global perspective, frequently cited indices include the United Nations (UN) E-government rankings, the Economist's E-government readiness and digital economy rankings, Brown university's global e-government report, Waseda E-government ranking, World Economic Forum's (WEF) index and International Telecommunication Union's (ITU) index. The early 2010s has added new indices to the e-government development evaluation research, e.g. the Asia Cloud Computing Association's (ACCA) Cloud Readiness Index (CRI), Business Software Alliance (BSA) Global Cloud Computing Scorecard, the Web Index produced by the World Wide Web Foundation (W3F) or Open Knowledge Foundation's (OKF) index.

In recent years, most of the researchers have focused on the current state of the art of e-government, the evaluation of the e-government services or relationship between businesses, citizens and governments. Špaček [16] outlined emerging coordination practices that can be observed in European countries and stated that governments across Europe work with a mix of instruments aimed at enhancing the centralization of their e-government

development through various centrally promoted infrastructures and services that allow for more integrated service delivery, virtual or physical, and through changes in organizational structures. Rorissa et al. [11] then assessed the strengths and limitations of six selected frameworks for computing e-government indices and concluded that benchmarking evaluations should be extended to include other means of access and delivery of e-government services, such as digital television or mobile technologies. Mazengera in [9] then used the correlation analysis to identify factors contributing to successful e-government implementation. This study has revealed that there was the correlation between the Internet use and the number of mobile phones, but a very low correlation with the literacy level. Krishnan et al. in [4] showed that ICT infrastructure, e-participation and human capital had a direct relationship with e-government maturity.

Mohammed and Ibrahim [10] revisited the existing e-government indices to show the main common indicators and proposed a preliminary framework to refine indices' indicators according to the characteristics of the cloud computing. This framework is based on the claim that the benefits of cloud computing for e-government will reduce the need for some requirements, while the challenges impose more attention to others. As a result, some indicators will get low weight in the index and others will get high weight or even new indicators or variables can by introduced. Also Kurdi et al. [5] designed a framework for assessing the readiness of e-government systems, which was focused on the migration to cloud computing. The framework covered four dimensions – technological block (network and security infrastructures and quality of systems and services), organizational block (structure, culture, size and strategy of organization together with strategic planning), people and stakeholders block (citizens, businesses and governments) and the last one is environment and society block (demographic characteristics and social, cultural, political and economic issues of a country).

Among others, also the EU, the UN or the WEF emphasize the importance of cloud computing technologies, social media, open and big data to provide flexibility and enable greater consistency in the public services. These elements are the driving forces behind making use of e-government in increasingly sophisticated ways [1], [17], [19].

2.2 Multiple criteria decision making and AHP in the e-government development

Real-world decision making problems are usually complex and no structures are to be considered through the examination of a single criterion, or point of view that will lead to the optimum decision. Multiple criteria decision making (MCDM) offers a lot of methods that can help in problem structuring and tackling the problem complexity because of the multi-dimensionality of the sustainability goal and the complexity of socio-economic, environment and government systems [21].

AHP is a MCDM tool that has been used in almost all the applications related with decision making [18]. AHP, developed by Saaty [12], [13], is a powerful, flexible and widely used method for complex problems, which consider the numeric scale for the measurement of quantitative and qualitative performances. This is an Eigen value approach to the pairwise comparisons. It is one of the very few MCDM approaches capable of handling many criteria [12], [18]. The most important characteristic of AHP is combining knowledge, experience, individual opinions and foresights in a logical way. Moreover, it can be also user friendly as AHP is well supported by commercially developed software (e.g. Expert Choice), which also provides sensitivity analysis of results [18].

The main aim of calculation technique is to make a reciprocal matrix comparison expressing the relative values of a set of attributes. The comparisons are used to structure a matrix of pairwise comparisons called the judgment matrix or square matrix *M*. To calculate relative weights of elements in each pairwise comparison matrix, the Eigen value method can be employed. The Eigen value (λ_{max}) can be then obtained by summing of products between each element of Eigen vector multiplied by the total of columns of the reciprocal matrix. Inconsistency may occur when λ_{max} moved away from *n* this is because of the inconsistency responses in pairwise comparisons. Saaty [12], [13] proved that the biggest Eigen value is equal to the number of comparisons (λ_{max} = n). Therefore, the matrix *M* should be examined for consistency by using consistency index (CI) as illustrated in the equation (1):

$$CI = \frac{\lambda max - \mathrm{n}}{n-1} \tag{1}$$

While CI depends on *n*, then should calculate consistency ratio (CR) as shown in the equation (2):

$$CR = \frac{CI}{RI} \tag{2}$$

where RI is the Random consistency index. The CR of less than 0.1 or (CR ≤ 0.1) indicates a satisfactory degree of consistency, otherwise, subjective judgments have to be revised [12], [13].

Shareef et al. [14] applied the SWOT analysis method to identify the priority factors (strengths and opportunities) and to concentrate on the most important factors of e-government. Then, the AHP method was used to provide a quantitative measure of significance of each factor on the decision making process to implement selected e-government development strategies. E-government project is a core of each national strategy for its benefits now and in the future. The problem of e-government projects failure is complicated due to its compound multi-attribute nature. Therefore, Sultan el al. [15] proposed a multiple criteria decision model to implement the most important and efficient actions for successful e-government projects. They concluded that human skills have the highest importance for the success of the e-government transformation.

Liangkui et al. [6] used AHP to establish the evaluation model of the e-government services outsourcing, which can determine the influence degree of different factors on e-government services outsourcing. Liu and Wang [7] proposed a hierarchical model and calculation method of e-government objectives according to the principles of AHP. Their aim was to ensure that e-government policy makers can select a higher score to consider the object as a key according to the specific scores of various options and give priority to decision making through preferences. Yuming and Hongyan [20] then used AHP to optimize the E-Government Development Index (EGDI) by the UN. Their results showed that online services are less important than telecommunication infrastructure or human capital.

3 An AHP model proposal and description

3.1 Criteria definition and selection

Firstly, the most suitable e-government indices have to be chosen. Although there are a lot of indices, most of them cannot be used. Mostly because there is a big time gap between the individual reports (the progress in time cannot be clearly compared) or they only cover selected countries. Consequently, the EGDI by the UN [17], the ITU's ICT

Development Index (IDI) [3] and the Networked Readiness Index (NRI) by the WEF [19] were chosen and compared. A brief description of them is presented in the Tab. 1, including the weight of each component (if available). The next step is the criteria selection.

Tab. 1: Comparison of the selected e-government development indices

Index	Period covered	Countries covered	Number of reports	Structure and components of the index
EGDI	2003–2014	193	7	1/3 Online Service Index (4 components), 1/3 Telecommunication Infrastructure Index (5 components with the same weight), 1/3 Human Capital Index (4 components with 1/3, 2/9, 2/9 and 2/9 weight).
IDI	2008–2014	166	6	2/5 Access sub-index (5 components with the same weight), 2/5 Use sub-index (3 components, same weight), 1/5 Skills sub-index (3 components with the same weight).
NRI	2002–2014	148	13	1/4 Environment sub-index (consists of the political and regulatory environment, business and innovation environment = 2 pillars), 1/4 Readiness sub-index (infrastructure and digital content, affordability, and skills = 3 pillars), 1/4 Usage sub-index (individual, business, and government usage = 3 pillars), 1/4 Impact sub-index (economic impacts and social impacts = 2 pillars).

Source: Author

Therefore, these three indices were decomposed and improved to encompass the new trends with a focus on the increasing emphasis on service usage, open data, cloud computing, social media and multichannel service delivery, the expansion of mobile government and e-participation. The hierarchy of criteria can be seen from the Tab. 2 As an indicator of the state of open data, the Open Data Index by the OKF and own criterion evaluating the existence of the open data portal, were added to the model together with the e-Participation Index by the UN, the International Property Rights Index by the Property Rights Alliance (PRA) and the existence of the cloud computing national framework or strategy as an own criterion.

Tab. 2: The hierarchy of the selected criteria and their data sources

Hierarchy of criteria		Data source	Range of the values
1. political environment and intellectual property rights			
	1.1 ICT use and government efficiency	WEF	1–7 (best)
	1.2 Accessibility of digital content	WEF	1–7 (best)
	1.3 Availability of latest technologies	WEF	1–7 (best)
	1.4 Cloud computing framework or strategy	own	Y/N
	1.5 International Property Rights Index	PRA	1–10 (best)
2. ICT readiness, businesses and citizens environment			
	2.1 Quality of educational system	WEF	1–7 (best)
	2.2 Global competitiveness index	WEF	1–7 (best)
	2.3 Mobile cellular telephone subscriptions per 100 inhabitants	ITU	0–304 (in 2014)
	2.4 Percentage of individuals using the Internet	ITU	0–100
	2.5 Use of virtual social networks	WEF	1–7 (best)
	2.6 e-Participation Index	UN	0–1
3. open data and e-service delivery			
	3.1 Open Data Index – percentage of openness	OKF	0–100
	3.2 National open data portal	own	Y/N
	3.3 E-service delivery – transactional presence	UN	0–100
	3.4 E-service delivery – networked (connected) presence	UN	0–100

Source: Author

3.2 Selection of alternatives and a decision table

These European countries were chosen as an example of alternatives for the case study: Czech Republic, Hungary, Poland and Slovakia. The following Tab. 3 shows the values of selected indices between 2008 and 2014. The IDI and the NRI values have to be normalized to fit the data within unity (1), so all data values will take on a value of 0 to 1. The highest value in each line is then bold. The main purpose is to demonstrate the development of e-government in these countries. This information may also influence the decision making process and the distribution of preferences. As an example, only Poland has all the best values in 2014, i.e. there can be identified a continuous improvement.

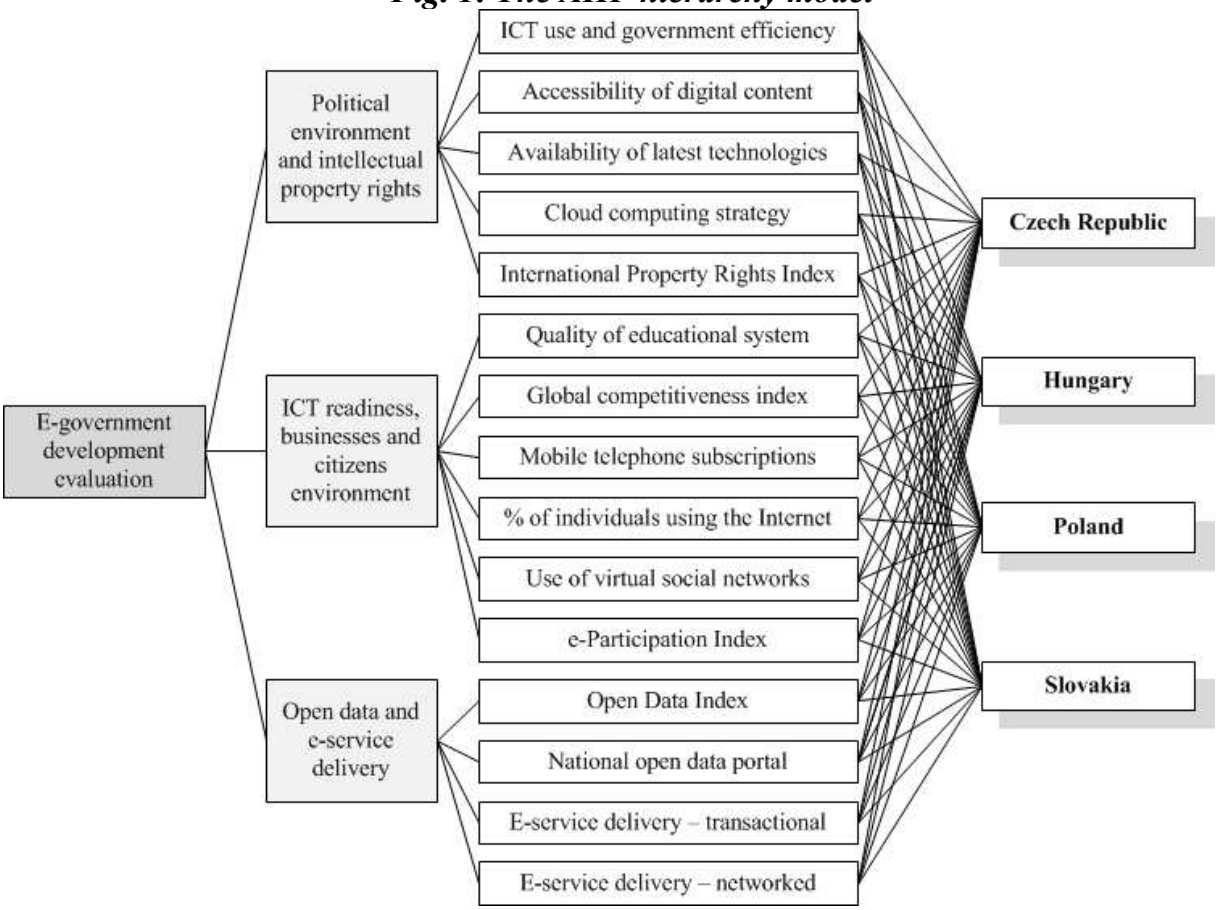
Tab. 3: The development of the selected indices between 2008 and 2014

Country	Index	Year				Average value
		2008	2010	2012	2014	
Czech Republic	EGDI	**0.670**	0.606	0.649	0.607	*0.633*
	IDI	0.492	0.597	0.630	**0.672**	*0.598*
	NRI	0.555	0.558	0.555	**0.583**	*0.563*
Hungary	EGDI	0.649	0.632	**0.720**	0.664	*0.666*
	IDI	0.518	0.604	0.591	**0.652**	*0.591*
	NRI	0.547	0.497	**0.550**	**0.550**	*0.536*
Poland	EGDI	0.613	0.558	0.644	**0.648**	*0.616*
	IDI	0.495	0.595	0.622	**0.660**	*0.593*
	NRI	0.468	0.457	0.527	**0.533**	*0.496*
Slovakia	EGDI	0.589	0.564	**0.629**	0.615	*0.599*
	IDI	0.486	0.594	0.585	**0.658**	*0.581*
	NRI	**0.528**	0.477	0.490	0.517	*0.503*

Source: Author

The first step in the AHP method is to decompose the complex decision problem into the hierarchical structure with the goal at the top of the structure. The hierarchy then descended from the more general criteria in the second level to sub-criteria. The four considered decision alternatives are located at the bottom level of the hierarchy as depicted in the Fig. 1.

Fig. 1: The AHP hierarchy model



Source: Author

It has to be noted, that the usage of the AHP method is not a new discovery in the measurement of the e-government development. However, the main contribution of this paper lies in providing a new measurement framework, which reflects the actual trends in the e-government development. These trends are then based on the in-depth analysis of global e-government reports by the ITU [3], the UN [17], the WEF [19] and also the EU [1].

A decision table with the values for the selected alternatives can be seen from the Tab. 4. The data used are from 2014.

Tab. 4: A decision table for the evaluation of selected countries using AHP

Criteria	Alternatives			
	Czech Republic	Hungary	Poland	Slovakia
1.1	3.6	3.9	3.4	3.4
1.2	6.1	6.1	5.1	5.8
1.3	5.2	5.2	4.4	5
1.4	Y	N	N	N
1.5	6.5	6.3	6.2	6.3
2.1	3.7	3.4	3.4	2.7
2.2	4.43	4.25	4.46	4.1
2.3	131.3	116.4	150.0	113.9
2.4	74.1	72.6	62.8	77.9
2.5	6	5.6	5.1	5.9
2.6	0.2549	0.451	0.4902	0.6275
3.1	66	48	42	35
3.2	Y	N	N	Y
3.3	23	37	42	16
3.4	21	9	26	38

Source: Author

4 Results and discussion

After the AHP model had been completed, a pairwise comparison of all the criteria belonging to a certain level was performed. Pairwise comparisons were performed systematically to include all the combinations of criteria and sub-criteria relationships. A matrix was formed in each group on the hierarchy. According to the data collected in the decision table, the criteria and sub-criteria were compared according to their relative importance with respect to the parent element in the adjacent upper level by using a nine-point scale. This scale ranges from 1/9 (least valued than), to 1 (equal), and to 9 (absolutely more important than).

Next, alternatives were compared by assigning corresponding numerical values based on the relative importance of alternatives under each of the sub-criterion in the decision hierarchy. In each level of the hierarchical structure, after comparing data in couples, the weight of each element was computed. The last step is to use the Eigen value approach to estimate the relative weight of decision elements and aggregate the relative weights of decision elements to arrive at a set of rating for the alternatives. For the accuracy of this application, an additional test reflecting AHP consistency (CR) was performed. Finally, a series of sensitivity analyses were conducted to investigate the impact of changing the priority of the criteria on the alternatives' ranking.

To show the importance of preferences, two use cases were designed. The first one is focused on the "old" concept of e-government, which emphasized the role of the political environment and users' readiness such as percentage of individuals using the Internet and global competitiveness index. The second use case is then focused on the "new"

concept of e-government using new trends and technologies such as open data, cloud computing or social network. In the Tab. 5, each sub-criterion weights in the "local column" is relative to the criterion of superior and in the "global column" is combining weights related to the goal.

Tab. 5: Criteria and their weights for the defined use cases

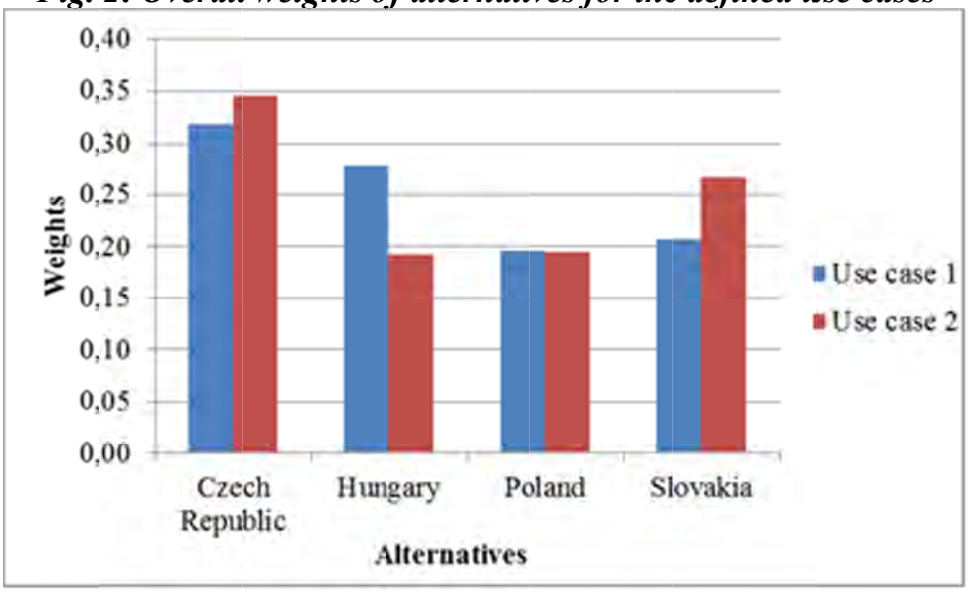
Hierarchy of criteria		Weights			
		Use case 1		Use case 2	
		Local	Global	Local	Global
1. criterion		**0.540**	-	**0.196**	-
	1.1 sub-criterion	0.384	0.207	0.068	0.013
	1.2 sub-criterion	0.209	0.113	0.169	0.033
	1.3 sub-criterion	0.212	0.114	0.187	0.037
	1.4 sub-criterion	0.080	0.043	0.464	0.091
	1.5 sub-criterion	0.115	0.062	0.112	0.022
2. criterion		**0.297**	-	**0.311**	-
	2.1 sub-criterion	0.217	0.064	0.095	0.030
	2.2 sub-criterion	0.159	0.047	0.071	0.022
	2.3 sub-criterion	0.244	0.072	0.157	0.049
	2.4 sub-criterion	0.210	0.062	0.127	0.039
	2.5 sub-criterion	0.094	0.028	0.328	0.102
	2.6 sub-criterion	0.076	0.023	0.222	0.069
3. criterion		**0.163**	-	**0.493**	-
	3.1 sub-criterion	0.195	0.032	0.391	0.193
	3.2 sub-criterion	0.138	0.022	0.276	0.136
	3.3 sub-criterion	0.276	0.045	0.138	0.068
	3.4 sub-criterion	0.391	0.064	0.195	0.096

Source: Author

Fig. 2 shows the final weights for the selected alternatives for each use case. Based on these results, the main findings are discussed as follows. In terms of the selected alternatives, the Czech Republic is regarded as the highest priority by decision maker compare to Hungary, Poland and Slovakia for both use case. It is found that Hungary is more focused on the "old" concept of e-government and Slovakia is more focused on the "new" concept of e-government.

The results have important implications for governments, especially in Hungary, that they should place more emphasis on the criteria of cloud computing, social media, open and big data, because the importance of these technologies is still increasing in the society. Also the other European countries may be compared using the proposed AHP model. For future studies, more alternatives which encompass both domestic and international aspects may be added to the current research.

Fig. 2: Overall weights of alternatives for the defined use cases



Source: Author

Conclusion and future research directions

The aim and partial objectives were completed successfully. E-government aims at increasing the convenience and accessibility of government services and information to citizens, businesses and also governments. Therefore, the purpose of this paper was to develop a decision support model by using AHP. The proposed model addresses the most relevant issues in selecting the country with the best e-government system based on the defined hierarchy of the criteria. This paper also analyzed the structure of the selected e-government development frameworks and indices to introduce the issue of redefining and reweighting of these indices and their attributes.

The future research will be directed to the extension of this model to cover the other EU Member States or countries in the world, while the selected attributes may be omitted or reweighted to measure the impact of new technologies on the e-government development, e.g. using the framework presented in [8]. The proposed model can be also used to calculate a new index using the hierarchy of criteria defined in the Table 2, where all these attributes will get weight according to their importance for the e-government development, e.g. as it was proposed in [10].

References

[1] EUROPEAN COMMISSION. *Delivering the European Advantage?: The 11th eGovernment Benchmark report*. Luxembourg: Publications Office of the European Union, 2014. 120 p. ISBN 978-92-79-38052-5.

[2] GRÖNLUND, Å. Connecting eGovernment to Real Government – The Failure of the UN eParticipation Index. In: *Electronic government.* Berlin Heidelberg: Springer, 2011, pp. 26–37.

[3] INTERNATIONAL TELECOMMUNICATION UNION. *Measuring the Information Society Report 2014*. Geneva: Telecommunication Development Bureau, 2014. 250 p. ISBN 978-92-61-15291-8.

[4] KRISHNAN, S.; TEO, T.; LIM, J. E-Participation and E-Government Maturity: A Global Perspective. In: *Grand Successes and Failures in IT: Public and Private Sectors*. Berlin Heidelberg: Springer, 2013, pp. 420–435.

[5] KURDI, R.; TALEB-BENDIAB, A.; RANDLES, M.; TAYLOR, M. E-Government Information Systems and Cloud Computing (Readiness and Analysis), In: *Developments in E-systems Engineering (DeSE)*. IEEE, 2011, pp. 404–409.

[6] LIANGKUI, Y.; DONGSHAN, M.; QING, J. Analysis Based on AHP about the Factors of E-Government Services Outsourcing. In: *Proceedings of the International Conference on Management and Service Science (MASS'09)*. IEEE, 2009, pp. 1–4.

[7] LIU, J.; WANG, S. A Study on Multi-objective Optimization of E-Government Based on AHP. In: *Proceedings of the 2010 International Conference on Electrical and Control Engineering*. IEEE, 2010, p. 2643–2646.

[8] LNĚNIČKA, M.; MÁCHOVÁ, R.; KOMÁRKOVÁ, J. Cloud E-Government Index as a New Benchmarking Framework for the Public Sector. In: *Proceedings of the 19th International Conference Current Trends in Public Sector Research.* Brno: Masaryk University, 2015, pp. 29–37.

[9] MAZENGERA, B. Factors Contributing To Successful E-Government Implementation in Southern African Development Community (SADC) Countries. In: *Proceedings of the 16th IBIMA Conference on Innovation and Knowledge Management: A Global Competitive Advantage*. IBIMA, 2011, pp. 1050–1057.

[10] MOHAMMED, F.; IBRAHIM, O. Refining E-government Readiness Index by Cloud Computing. *Jurnal Teknologi*, 2013, Vol. 65, No. 1, pp. 23–34.

[11] RORISSA, A.; DEMISSIE, D.; PARDO, T. Benchmarking e-Government: A comparison of frameworks for computing e-Government index and ranking, *Government Information Quarterly*, 2011, Vol. 28, No. 3, pp. 354–362.

[12] SAATY, T. L. Decision making with the analytic hierarchy process. *International journal of Services Sciences*, 2008, Vol. 1, No. 1, pp. 83–98.

[13] SAATY, T. L. How to make a decision: The Analytic Hierarchy Process. *European Journal of Operational Research*, 1990, Vol. 48, No. 1, pp. 9–26.

[14] SHAREEF, M. S.; JAHANKHANI, H.; PIMENIDIS, E. Analysis of the e-Government stage model evaluation using SWOT-AHP method, *University of East London: ROAR,* 2011, pp. 1–30. Available at WWW: <http://roar.uel.ac.uk/1314/1/E-government%20model%20evaluation.pdf>

[15] SULTAN, A.; ALARFAJ, K. A.; ALKUTBI, G. A. Analytic Hierarchy Process for the Success of E-government. *Business Strategy Series*, 2012, Vol. 13, Iss. 6, pp. 295–306.

[16] ŠPAČEK, D. Coordination of and through E-Government: The Case of the Czech Republic. *The NISPAcee Journal of Public Administration and Policy*, 2014, Vol. 7, No. 1, pp. 83–106.

[17] UNITED NATIONS. *United Nations e-Government Survey 2014: E-Government for the Future We Want*. New York: UN Publishing Section, 2014. 263 p. ISBN 978-92-1-123198-4.

[18] VAIDYA, O. S.; KUMAR, S. Analytic hierarchy process: An overview of applications. *European Journal of Operational Research*, 2006, Vol. 169, No. 1, pp. 1–29.

[19] WORLD ECONOMIC FORUM. *The Global Information Technology Report 2014: Rewards and Risks of Big Data*. Geneva: SRO-Kundig, 2014. 343 p. ISBN 978-92-95044-63-0.

[20] YUMING, W.; HONGYAN, L. Optimization for Weight Design of the E-Government Development. In: *Proceedings of the 7th International Conference on Wireless Communications, Networking and Mobile Computing (WiCOM)*. IEEE, 2011, p. 1–4.

[21] ZAVADSKAS, E. K.; TURSKIS, Z. Multiple criteria decision making (MCDM) methods in economics: an overview. *Technological and Economic Development of Economy*, 2011, Vol. 17, Iss. 2, pp. 397–427.

Contact Address

Ing. Renáta Máchová, Ph.D.
University of Pardubice, Faculty of Economics and Administration
Studentská 84, 53210 Pardubice, Czech Republic
Email: renata.machova@upce.cz
Phone number: +420 46603 6074

Received: 11. 12. 2014
Reviewed: 27. 01. 2015, 05. 02. 2015
Approved for publication: 02. 09. 2015

MACROECONOMIC AND CAPITAL MARKET DETERMINANTS OF INITIAL PUBLIC OFFERINGS: A TIME-SERIES ANALYSIS IN THE POLISH CAPITAL MARKET

Tomáš Meluzín, Marek Zinecker, Jana Meluzínová

Abstract: *The main objective of this study is to indicate the influence of local macroeconomic and capital market factors on the values of IPOs in Poland over the period of 2003 to 2012. Our sample includes 330 local enterprises that conducted an IPO on the Main Market of the Warsaw Stock Exchange after Polish EU accession. The models for which estimation results are presented in this paper reveal that the individual country regression analysis working with untransformed IPO values (Model 1) did not generate significant parameter estimates. On the other hand, a logarithmic transformation of IPO values leads to persistently significant estimates for our regressions. Based on the Model (2) the empirical evidence supported the hypothesis that Polish ten-year government bond yields (indicating the price of competing financing funds) have explanatory power for IPO values. However, our assumption that also other macroeconomic- and capital market indicators have explanatory power for IPO values in the Polish capital market could not be supported by empirical evidence.*

Keywords: *Going Public, Initial Public Offering, IPO, Capital Market, Macroeconomics, Determinants, Poland.*

JEL Classification: *E44, G23, G32.*

Introduction

Substantial academic literature devotes a significant amount of research to emphasising the importance of the financial system to economic growth. Kominek [14] summarises recent empirical research and concludes that "well developed financial systems stimulate economic growth". Although the continental financial system is traditionally focused on banking, there is increasing interest in the stock markets and initial public offering (IPO) implementation [e.g. 22, 27].

Most of the studies examining initial public offerings examine the following issues: IPO determinants, i.e. motivations for going public, timing of the IPO, underwriter selection, under-pricing, signalling, IPO process issues, the decision to stay private and IPO pricing process [3]. Academic research dealing with initial public offerings´ determinants focuses on the analysis of two categories: the external factors such as macroeconomic and capital market environment [1, 13] and the internal factors such as the tendency of a company to reduce leverage or to obtain capital for new projects [4, 20].

Relations between the number of IPOs and macroeconomic factors have been investigated for example by Loughran et al. [19]. His paper reviews the IPO timing in fifteen countries in relation to inflation-adjusted stock price indexes and GDP growth rates. The results suggest a positive relationship between the number of IPOs and stock price levels, however no positive correlation with the cycle movements. Rydqvist and Högholm [29] compare the data for a sample of family-owned enterprises in Sweden (1970–1991) and eleven European countries (1980-1989). They find that "most going public

activity took place after an exceptionally sharp stock price increase, and that going public activity is not related to the business cycle". Ljungqvist [18] suggests that high number of IPOs is positively correlated with both high stock index levels and good business conditions and tends to follow phases of extensive IPO underpricing. Breinlinger and Glogova [4] investigate the explanatory power of selected macroeconomic factors influencing IPOs by analysing a data set of annual IPO volumes for six developed continental European countries over a time period of 18 years. The authors followed the question if there are stable indications that IPOs depend on stock index returns for what they termed consolidated periods. The results show that a "logarithmic transformation of IPO volumes (representing authors´ supposition of a nonlinear relationship between IPO volumes and stock index returns) leads to persistently significant estimates for both pooled and individual country regressions". The hypothesis that percentage changes in savings, GDP growth and interest rates have explanatory power for IPO volumes could not be supported by empirical evidence. A paper by Ameer [1] shows a significant negative relationship between the interest rate and the number of IPOs and a significant positive relationship between the industrial production and the number of IPOs in the emerging market of Malaysia. Bilson et al. [2] find a moderate evidence to support the connection between local macroeconomic factors and stock returns in emerging markets.

Capital market determinants affecting going public activities have been empirically investigated by Peterle [23] and Roženský [28]. They address the issue of the attractiveness of primary capital markets in the CEE region and for this used quantitative a qualitative indicators.

The quantitative factors such as the capital market size, the capital market liquidity and stock market indices returns have been the subject of investigations. Peterle [23], who studied IPOs in the CEE region between 2000 and 2009, conclude that capital market factors such as "market size, liquidity and market capitalization to GDP do not have a decisive impact on IPO activities in the CEE region". On the other hand, "the attractiveness of capital market as measured by annual stock index returns and by annual market and liquidity growth" could have been an incentive for decision makers about IPOs in the observed period.

Institutional and historical (i.e. qualitative) factors have been assessed by "soft" indicators such as perception of the capital market by enterprises, their confidence in the capital market and quality of the national regulations and structures. Roženský [28] also explored conditions created by local stock exchanges using the following indicators: cost of going public, administrative requirements towards issuers, market segmentation of the particular stock exchange and finally its marketing and public relations. Groh, Lichtenstein and Lieser [10] calculated composite indices to compare the attractiveness of 27 European countries for institutional investments into the Venture Capital and Private Equity. They conclude that "the investor protection and corporate governance rules and the size and liquidity of its capital market are likewise a proxy for the professionalism of the financial community, for deal flow and exit opportunities".

1 Statement of the Problem

Academic studies conducted on CEE markets cover mainly descriptive statistical analyses of individual markets [23, 25, 28] and analyses of determinants and consequences of going public [15, 23, 28].

This study intends to study the explanatory power of selected macroeconomic and capital market factors on IPO values in Poland over the period 2003-2012 and thus to complement our prior research aimed at an analysis of the following question: What is the influence of local macroeconomic factors on the number of IPOs in Poland over the period of 2004 to 2012? "Unlike IPO numbers, IPO values (being monetary data) can appropriately reflect the extent to which the primary market was actually tapped – information that cannot be simply deduced from the number of IPOs" [4]. In this study we extend the IPO literature by analysing a unique set of data to test the existing theories examining the IPO determinants by using a quantitative model on the Polish capital market which is the most developed capital market in the region of Central and Eastern Europe (CEE).

Concerning the composition of the data set no previous paper has, to our knowledge, used either Polish IPO values data or the same time-series.

This paper is structured as follows. Section 2 describes the research design, i.e. data and methodology. Section 3 presents the empirical research results. The last section summarizes and provides concluding remarks.

2 Methods

2.1 Data Set

The nature of this study is based on the theory and previous empirical research. All macroeconomic and capital market indicators analysed in this paper have sufficient support in the finance academic studies [1, 4, 5, 17, 25, 28].

For purposes of this paper the following hypotheses have been outlined:

Hypothesis 1: There is a positive relationship between GDP growth rates and IPO volumes.

La Porta et al. assess the influence of economic conditions (namely the legal system) on the number of IPOs using a sample of 49 countries. La Portas et al. [17] research results show that "the quality of law enforcement, which is highly correlated with the level of GDP per capita, has a strong positive effect on the number of IPOs". The authors identify a statistically significant relationship between long-term GDP growth rates, i.e. average annual percentage growth of per capita GDP for the period 1970 to 1993, on the number IPOs. Peterle [23] confirmed that macroeconomic factors, specifically "a quicker reform development in terms of governance and enterprise restructuring, competition, policy, improved business regulations and sizeable pension funds, could have had a positive impact on IPO activities in Poland in the 2000s". On the other hand, the studies conducted by Rydqvist and Högholm [29] and Loughran et al. [19] show that the GNP short-term growth rates are no significant explanatory power for IPO activity across the sample of European countries. In a similar way, Breinlinger and Glogova´s analysis [4] of annual IPO volumes for six continental European countries over a time period of 18 years could not support the hypothesis that GDP growth rates have explanatory power for IPO volumes. Complementary to these empirical findings we want to test the explanatory power of GDP growth rates for IPO volumes for our sample.

Hypothesis 2: There is a negative relationship between the reference interest rate and IPO volumes.

Rees [26], concentrating on UK data, found no significant link between the number of IPOs and interest rates. Research results by Breinlinger and Glogova [4] also indicate that

there is no perceivably influence of interest rates (ten-year government bond yields/GBY) on demand for raising equity through IPOs. On the contrary, the study published by Ameer [1] reports the opposite. Ameer´s results [1] imply that "monetary policy has a direct impact on capital markets and that central bank intervention propagates IPO cycles in Malaysia". Based on a paper by Jovanovic and Rousseau [13] Ameer [1] supposed a negative relationship between interest rate and the number of IPOs. We also included this assumption in our investigation.

Hypothesis 3: There is a positive relationship between industrial production growth rates and IPO volumes.

The industrial production index as a measurement of the output of an economy also helps to map structural economy development. The industrial production index rate is the indication of business lifecycle and business life cycle affects by its fluctuations the stock market prices. Besides, authors say that enterprises enter capital markets when other enterprises enter them too, meaning potentially higher overall industrial production [7, 20]. Therefore, industrial production growth analysis is a next part of our investigation.

Hypothesis 4: There is a positive relationship between the stock market index returns and IPO volumes.

The pessimism and optimism which affects stock markets is in alignment with investor sentiment theory and the market timing theory. As the stock market index mirrors the investor´s willingness to invest or not, the number of IPOs vary accordingly. Enterprises are more likely to implement IPOs when the stock market promises higher returns and therefore profit for enterprises and also for potential investors. Studies by Loughran et al. [19], Rees [26] and Rydqvist and Högholm [29] detect a significantly positive influence of stock index levels and stock index returns on the number of IPOs. Brzeszczynski [5] analysed the number of new IPOs and the main stock market index (WIG) returns for the Polish stock market over a period from 1997 to 2008. He detects the correlation coefficient between those two variables 0.0244 when IPOs and stock market index return are analysed simultaneously. However, the value of this index is 0.5683 when the WIG returns are lagged by one year. Brzeszczynski [5] concluded that "the number of IPOs in emerging markets and the profitability of the public offers are related to macroeconomic conditions, business cycles and stock market activity. In most emerging market countries there is a time lag between movements of the stock market index and decisions to launch new IPOs".

Hypothesis 5: There is a positive relationship between private equity investments volume and IPO volumes.

Private equity investors view emerging markets as a suitable opportunity to diversify their investment portfolios and to catch excess risk premiums. In the financial literature the going public strategy has been considered for an important channel how venture capitalists can leave investee companies [8].

This paper is based on evidence from the Polish capital market over the period of 2003 to 2012. Our sample includes only local enterprises that conducted an IPO on the Main Market of the Warsaw Stock Exchange (WSE). The IPO data were obtained from the WSE Fact Books [30] and Federation of European Securities Exchanges (FESE) [9]. Macroeconomic data such as gross domestic product growth rates (GDPGR), reference interest rates (GBY), industrial production growth rates (IPGR), Warsaw stock exchange index (WIG) and private equity investments (PEI) were obtained from the Polish National

Bank (PNB) [24], OECD Stat Extracts [21] and European Venture Capital Association (EVCA) [11].

Tab. 1 shows an overview of the variables outlined above, their data sources and calculations and expected sign expressing the relation of these variables to the dependent variable.

Tab. 1: Source Data and Data Description

Note: IPOs on the Main Market of the Warsaw Stock Exchange, only Locals

	Data Sources	**Calculation**	**Expected Sign**
Explanatory Variables			
% Real GDP Growth Rates in Period *t-1* ($GDPG_{t-1}$)	OECD Stat Extracts, PNB	annual growth rates in % (using yearly closing dates)	+
% Industrial Production Growth Rate in Period *t-1* (IPG_{t-1})			+
% Ten-Year Government Bond Yields in period *t-1* (GBY_{t-1})		in % (using yearly closing dates)	-
% Change in Stock Market Index Returns in period *t-1* (WIG_{t-1})		in % (using yearly closing dates)	+
Private Equity Investment as % of GDP in period *t-1* (PE_{t-1})	EVCA Yearbooks	in % (using yearly closing dates)	+
Gross Domestic Product in period *t* (GDP_t) / *t-1* (GDP_{t-1})	OECD Stat Extracts	in EUR m (using yearly closing dates)	
Dependent Variable			
IPOs value in period *t* (IPO_t) / *t-1* (IPO_{t-1})	WSE Fact Books, FESE	in EUR m (using yearly closing dates)	

Source: Authors

Tab. 2 reflects market statistics of the annual going public numbers and values at the Warsaw Stock Exchange, Main Market.

Tab. 2: Summary Statistics for the Sample of IPOs in Poland (2003-2012)

Panel A: Distribution of IPOs´ Numbers and Values by Year

Year	Value of IPO Shares (in EUR m)	Proportion (%)	Number of IPO Shares	Proportion (%)
2003	288	1.30	6	1.82
2004	3,124	14.14	36	10.91
2005	1,809	8.19	35	10.61
2006	1,085	4.91	38	11.52
2007	5,097	23.07	81	24.55
2008	2,235	10.12	33	10.00
2009	1,701	7.70	13	3.94
2010	4,006	18.13	34	10.30
2011	1,931	8.74	38	11.52
2012	819	3.70	16	4.85
Total	22,095	100.00	330	100.00

Panel B: Descriptive Statistics of IPOs´ Characteristics

Variable	Mean	Median	Minimum	Maximum	St. Dev.
Value of Offerings (EUR	44.09	7.83	0.032	2 992.77	228.65
Number of Offerings	33.00	34.50	6.00	81.00	19.46
% of Primary Shares	52.35	49.05	8.07	99.03	33.08

Panel C: Descriptive Statistics of Explanatory Variables

Variable	Mean	Median	Minimum	Maximum	St. Dev.
% GDP Growth	4.29	4.20	1.60	6.80	1.58
% IPG	6.55	7.85	-3.90	12.90	5.14
% GBY	5.91	5.87	5.00	7.30	0.70
% WIG	17.85	27.09	-51.07	46.85	29.77
% PE	0.13	0.12	0.05	0.22	0.06

Source: [34, 50], Authors

2.2 Model Specifications

Based on above-hypotheses (Tab. 1) the following models are specified:

$$IPO_t = \alpha + \beta_1 IPO_{t-1} + \beta_2 GDPG_{t-1} + \beta_3 IPG_{t-1} + \beta_4 GBY_{t-1} + \beta_5 WIG_{t-1} + \beta_6 PE_{t-1} + u_t \quad (1)$$

Where the variables are defined as stated below:

$$IPO_t = \left(\sum_{j=1}^{p} FLP_j \times NB_j \right) (million) \times DC/EUR$$

j = index of IPOs in period t

p = number of IPOs in period t

FLP_j = first listed price of IPO_j

NB_j = number of stocks of IPO_j

DC/EUR = exchange rate of the PLN against the EUR for period t

We also test this model formulation by taking first differences, "as the IPO series is not unambiguously stationary whereas first differences of IPOs are".

$$ln\left(\frac{IPO_t}{GDP_t}\% \times 100\right) = \\ = \alpha + \beta_1 ln\left(\frac{IPO_{t-1}}{GDP_{t-1}}\% \times 100\right) + \beta_2 GDPG_t + \beta_3 IPG_{t-1} + \beta_4 GBY_{t-1} + \beta_5 WIG_{t-1} \\ + \beta_6 PE_{t-1} + u_t \tag{2}$$

2.3 Methodology

As follows from the research done [1, 4, 5], the situation in the year preceding the company's initial public offering is crucial. Therefore, our models use one-year delay for all the explanatory variables in relation to the dependent variable. The idea behind the model specification (2) is to put IPO values into proportion with GPD. This ratio is connected with the assumption that "a nonlinear (specifically a logarithmic) relationship could possibly better model any dependence of IPO values on included independent variables than a linear one" [4]. Model (2) is tested with and without one year delay of the dependent variable as an explaining variable.

To estimate the model coefficients we used a panel data approach. The normality of the data was checked by the Kolmogorov–Smirnov test. The data was evaluated at the significance level of α=5 %. The model estimation was performed with the regression model and with the use of the Statistica.CZ software, version 12.

3 Problem Solving

Tab. 3 presents the results of the estimation of the model described with the formula (1). An important feature of the model is the one-year shift of new IPOs relative to the macroeconomic and capital market indicators. The unmodified IPO series are denominated in EUR. The model is statistically correct. Based on the F test (F-statistics) it can be stated that no significant dependences of IPO values on explanatory variables could be identified. The general performance of the model is satisfactory (R2 = 0.6543).

Tab. 3: Results of the Estimation Model Describing the IPO Values in Poland in the Years 2003-2012 with Macroeconomic- and Capital Market- Determinants (Model 1)

Dependent variable: IPO_t					
Explanatory variables	**Coefficient**	**Standard Error**	***t-statistics***	***p-value***	**Significance[a)]**
Intercept	4972.68	7211.49	0.690	0.5127	
IPO_{t-1}	-0.33	0.36	-0.910	0.3929	
$GDPG_{t-1}$	865.82	1301.91	0.665	0.5273	
IPG_{t-1}	-185.50	439.56	-0.422	0.6857	
GBY_{t-1}	-460.85	391.70	-1.177	0.2778	
WIG_{t-1}	106.20	60.28	1.762	0.1215	
PEI_{t-1}	39861.65	39140.59	1.018	0.3424	
Observations			10		
Standard error of residuals			4682.522		
R			0.8089		
R^2			0.6543		
F (6, 7) = 2.208			*p-value* 0.1618		

Source: Authors

Estimation results for model (2) are presented in Tab. 4. We put IPO values into proportion with GDP to investigate the assumption that a "nonlinear (a logarithmic) relationship could possibly better model any dependence of IPO values on included explanatory variables than a linear one" [6].

Interest rates expressing the price of a competing form of financing are the only macroeconomic factor with a statistically significant impact on the IPO values executed in Poland. The model uses one-year delay for the explanatory variable in relation to the examined phenomenon (GBYt-1 variable). The general performance of the model is satisfactory and statistically significant (R2 = 0.8913, p=0.004). The parameter α amounted to -0.49 (p=0.003) and indicates a very strong influence of this variable on the IPO values. We can conclude that on average GBY decrease of 1% results in a more than proportional (by nearly 0.50%) decrease in the value of IPOs. Therefore, the hypothesis H2 was verified positively.

The hypotheses that GDP growth (H1), industrial production growth (H3), stock market index returns (H4) and private equity investments (H5) have explanatory power for IPO values in the Polish capital market could not be supported by the model (2). Therefore, the hypotheses H1, H3, H4 and H5 failed to be verified positively.

Tab. 4: Results of the Estimation Model Describing the IPO Values in Poland in the Years 2003-2012 with Macroeconomic- and Capital Market- Determinants (Model 2)

Dependent variable: $Ratio\ 1 = ln\left(\frac{IPO_t}{GDP_t}\% \times 100\right)$					
Explanatory Variables	**Coefficient**	**Standard Error**	***t-statistics***	***p-value***	**Significance[a)]**
Intercept	1.21	2.16	0.561	0.5926	
$Ratio\ 2 = ln\left(\frac{IPO_{t-1}}{GDP_{t-1}}\% \times 100\right)$	-0.19	0.26	-0.713	0.4989	
$GDPG_{t-1}$	0.37	0.44	0.844	0.4264	
IPG_{t-1}	-0.06	0.12	-0.491	0.6387	
GBY_{t-1}	-0.49	0.11	-4.423	0.0031	**
WIG_{t-1}	0.02	0.02	1.218	0.2628	
PEI_{t-1}	-2.84	9.22	-0.308	0.7667	
Observations			10		
Standard error of residuals			1.2018		
R			0.9441		
R^2			0.8913		
F (6, 7) = 9.573			*p-value* 0.0044**		

Source: Authors

4 Discussion and Conclusions

In this paper we investigated the explanatory power selected macroeconomic and capital market factors have for IPO values in Poland by analysing a data set of annual IPO values for Poland over a time period of 2003 to 2012. Companies' specific aspects were excluded. Previous researches of this issue [e.g. 1, 4, 5, 20] conducted under conditions in terms of both developed and emerging countries show no consistent results regarding the explanatory power of macroeconomic and capital market indicators and values of capital raised by IPOs.

Our sample includes only local enterprises that conducted an IPO on the Main Market of the Warsaw Stock Exchange. The main conclusions of this work are: Firstly, individual country regression analysis working with untransformed IPO values (Model 1) did not generate significant parameter estimates. This result implies that the business cycle indicated by GDP and industrial production growth rates as well by the level of private equity investments has not a direct impact on the IPO values in the Polish capital market. In this respect, our research results are similar to those of the study by Breinlinger and Glogova [4]. They concluded that "percentage changes in GDP growth have no significant influence on IPO values". Contrary to the conclusions by Peterle [23], who indicates an importance of the capital market characteristics supporting its "attractiveness for investors, as measured by annual index returns and annual market and turnover growth", our results does not support the assumption that the attractiveness of a capital market

for investors measured by annual stock index returns to be an important factor for amounts of capital raised by IPOs. The last conclusion of this study is that a logarithmic transformation of IPO values leads to persistently significant estimates for our regressions. Based on the Model specification (2) the empirical evidence supported the hypothesis that Polish ten-year government bond yields (indicating the price of competing financing funds) have explanatory power for IPO values. However, our assumption that also other macroeconomic- and capital market indicators have explanatory power for IPO values in the Polish capital market could not be supported even by the Model (2).

Acknowledgement

This contribution was supported by the Internal Grant Agency of the Brno University of Technology. Title of the Project: Economic Determinants of Competitiveness of Enterprises in Central and Eastern Europe. Project Registration No. FP-S-15-2825.

References

[1] AMEER, R. Macroeconomic Factors and Initial Public Offerings in Malaysia. *In Asian Academy of Management Journal of Accounting and Finance*, 2012, Vol. 8, Iss. 1, pp. 41-67. ISSN: 1823-4992.

[2] BILSON, C. M., BAILSFORD, T. J., HOOPER, V. J. Selecting macroeconomic variables as explanatory factors of emerging stock market returns. *In Pacific-Basin Finance Journal*, 2002, Vol. 9, Iss. 4, pp. 401–426. ISSN: 0927-538X.

[3] BRAU, J. C., FAWCETT, S. E. Initial Public Offerings: An Analysis of Theory and Practise. *In Journal of Finance*, 2006, Vol. 61, Iss. 1, pp. 399−436. ISSN: 0022-1082.

[4] BREINLINGER, L., GLOGOVA, E. *Determinants of Initial Public Offerings: A European Time-Series Cross-Section Analysis*. Wien: Oesterreichische Nationalbank, Working Paper, Financial Stability Report 3, 2002. 108 p.

[5] BRZESZCZYNSKI, J. *IPOs in Emerging Markets*. QFinance. [cit. 2012-03-07]. Available from WWW: <http://www.qfinance.com/financing-best-practice/ipos-in-emerging-markets?full>.

[6] *CEE Stock Exchange Group and its Capital Markets*. [cit. 2014-05-05]. Available from WWW: <http://www.ceeseg.com>.

[7] CHOE, H., MASULIS, R. W., NANDA, V. Common stock offerings across the business cycle: Theory and evidence. In Journal of Empirical Finance, 1993, Vol. 1, Iss. 1, pp. 3-31. ISSN 0927-5398.

[8] CUMMING, J. D., JOHAN, S. *The IPO as an Exit Strategy for Venture Capitalists: Regional Lessons from Canada with International Comparisons*. Handbook of Research on IPOs, 2012.

[9] *Federation of European Securities Exchanges, Statistics & Market Research*. [cit. 2014-10-09]. Available from WWW: <http://www.fese.eu>.

[10] GROH, A., P., VON LIECHTENSTEIN, H., LIESER, K. The European Venture Capital and Private Equity Country Attractiveness Indices. Journal of Corporate Finance, 2010, Vol. 16, Iss. 2, pp. 205–224. ISSN 0929-1199.

[11] *European Venture Capital Association (EVCA), EVCA Yearbooks*. [cit. 2014-05-16]. Available from WWW: <http://www.evca.eu/knowledgecenter/statisticsdetail.aspx?id=6392>.

[12] HÁJEK, P., OLEJ, V., MYŠKOVÁ, R. Forecasting Corporate Financial Performance Using Sentiment in Annual Reports for Stakeholders' decision-making. *In Technological and Economic Development of Economy*, 2014, Vol. 20, Iss. 4, pp.721-738, ISSN 2029-4913.

[13] JOVANOVIC, B., ROUSSEAU, P. L. *Interest rates and Initial Public Offerings*. National Bureau of Economic Research, Working Paper, 2004.

[14] KOMINEK, Z. *Stock markets and industry growth: an Eastern European perspective*. Working Paper No. 81. London: EBRD, 2003. 9 p.

[15] MELUZÍN, T., ZINECKER, M., ŁAPIŃSKA, J. Determinants of Initial Public Offerings: The Case of Poland. *In Revista de metodos cuantitativos para la economia y la empresa*, Vol. 18, Iss. Diciembre, pp. 5–17, ISSN 1886-516X.

[16] MYŠKOVÁ, R. *Satisfaction of Financial Managers with Accounting Information System*. Houston, USA: WSEAS Press, Proccedings of the 3rd International Conference on Management, Marketing and Finances. In Advances in Marketing, Management and Finances, 2009, pp. 76 -81. ISBN 978-960-474-073-4.

[17] LA PORTA, R., LOPEZ DE SILANES, F., SHLEIFER, A., VISHNY, R. Legal determinants of external finance. *In Journal of Finance*, 1997, Vol. 52, pp. 1131-1150. ISSN 0022-1082.

[18] LJUNGQVIST, A. P. *When do firms go public? Poisson evidence from Germany*. Working Paper, University of Oxford, 1995.

[19] LOUGHRAN, T., RITTER, J. R., RYDQVIST, K. Initial public offerings: International insights. *In Pacific-Basin Finance Journal*, 1994, Vol. 2, Iss. 2, pp. 165-200. ISSN 0927-538X.

[20] LOWRY, M., SCHWERT, G., W. IPO Market Cycles: Bubbles or Sequential Learning? In Journal of Finance, 2002, Vol. 67, Iss. 3, pp. 1171−1200. ISSN 0022-1082.

[21] *OECD Stat Extracts*. [cit.2014-04-12]. Available from WWW: <http://stats.oecd.org>.

[22] PAGANO, M., PANETTA, F., ZINGALES, L. Why do companies go public? An empirical analysis. *In Journal of Finance*, 1998, Vol. 53, pp. 27−64. ISSN 0022-1082.

[23] PETERLE, P. *Internal characteristics and external factors of IPO activities in Central and Eastern Europe: Empirical analysis and comparison*. Ljubljana: Faculty of Economics of the University of Ljubljana, Working Paper, 2013. 30 p.

[24] *Polish National Bank, Interest Rate Statistics*. [cit. 2014-04-14]. Available from WWW: <http://www.nbp.pl/homen.aspx?f=/en/statystyka/oproc/oproc.html>.

[25] PWC, PriceWaterhouseCoopers UK. *IPO Watch Europe (2003-2013)*. [cit. 2014-03-20]. Available from WWW: <http://www.pwc.co.uk/audit-assurance/publications/ipo-watch-europe-previous-editions.jhtml>.

[26] REES, W. P. The Arrival Rate of Initial Public Offers in the UK. In European Financial Management, 1997, Vol. 3, Iss. 1, pp. 45-62. ISSN 1354-7798.

[27] RITTER, J. R., WELCH, I. A Review of IPO Activity, Pricing, and Allocations. *In Journal of Finance*, 2002, Vol. 57, Iss. 4, pp. 1795−1828. ISSN 0022-1082.

[28] ROŽENSKÝ, V. *IPO na středoevropských akciových trzích (Initial Public Offerings on Central European stock markets)*. Thesis, Univerzita Karlova v Praze, Fakulta sociálních věd, 2008. 103 p.

[29] RYDQVIST, K., HÖGHOLM, K. Going public in the 1980s: Evidence from Sweden. *In European Financial Management*, 1995, Vol. 1, pp. 287-315. ISSN 1354-7798.

[30] *Warsaw Stock Exchange, Fact Books 1992 – 2013*. [cit. 2014-01-20]. Available from WWW: <http://www.gpw.pl/fact_books>.

Contact Address

doc. Ing. Tomáš Meluzín, Ph.D.
doc. Ing. Marek Zinecker, Ph.D.
Ing. Jana Meluzínová
Brno University of Technology, Faculty of Business and Management
Department of Economics
Kolejní 2906/4, 61200 Brno, Czech Republic
Email: meluzint@fbm.vutbr.cz; zinecker@fbm.vutbr.cz
Phone number: +420 541 143 705

Received: 01. 05. 2015
Reviewed: 10. 06. 2015, 15. 06. 2015
Approved for publication: 02. 09. 2015

ASSESSING THE DEGREE OF BALANCE BETWEEN STAFF DISPOSITIONS AND THEIR JOB POSITIONS USING FUZZY LOGIC

Renáta Myšková

Abstract: *Management of many Czech enterprises, especially SMEs, is able to respond flexibly to the current changes in their surroundings while using mainly the quality of its employees to gain a competitive advantage. Ever increasing is thus the importance of personal dispositions, skills and knowledge of employees that affect their work performance. It is undisputed that staff of the enterprise strongly influences all business operations, however, the measurement of these impacts is problematic, as they are mostly the so called soft factors. In terms of supporting the overall economic results of the company as well as in terms of ensuring employee satisfaction, it is, inter alia, very important to ensure the balance between the dispositions of a worker and his/her job function. This need not occur only in employee recruitment but also in job redeployment or in determining the cause of unsatisfactory work performance. This paper describes and makes use of an indicator, which in mathematical terms allows companies to evaluate the level of balance between staff dispositions and their job functions, not only by assessing an individual, but also by assessing individuals in relation to a group of workers and a group of jobs. The aim is to achieve an optimal balance between the skills of employees and their job functions. The indicator Degree of balance between the staff dispositions and job positions was constructed using fuzzy logic. Its use is shown in a real example that draws on the practice of a small enterprise engaged in assembling and servicing of hardware devices.*

Keywords: *Balance between staff dispositions and their jobs, Skills of staff, Job performance, Fuzzy sets, Management of human resources, Personnel economics.*

JEL Classification*: M51, M12, C630.*

Introduction

Evaluation of employees, their work behaviour and job performance is covered by many authors, both economists and psychologists (see e.g. [4], [3]; [2], [6], [5], [10]), because these are important aspects affecting the success of businesses. Job performance is affected by subjective dispositions of people (e.g. physical and mental qualities and abilities of a person in relation to the job, qualifications of the person, volitional qualities of the person) as well as objective prerequisites of job performance, thus external circumstances in which it takes place [13].

Evaluation of employees and their performance is closely tied to the specification of job tasks, formulation of evaluation criteria and their differentiation in relation to the type of activity. According to Palán [16], the performance of an individual, group or organization can be measured extensively (volume of production and services over a certain period), but it is preferable to use the intensive measurement method (the indicator of labour productivity, the appreciation rate of inputs, etc.).

Job performance thus includes not only the quantity and quality of work but also the willingness, attitude to work, work behaviour, employee turnover, absenteeism, attendance and other characteristics. Regarded as important are dispositions of an employee for work performed because the optimal utilization of employee personal dispositions gives rise to manufacturing flexibility (MF), and promotion of effective utilization of corporate resources. [14]

In connection with the evaluation of workers and their dispositions, a need emerges to define skills utilisation [17], because the evidence base on skills utilisation is relatively sparse [8].

In examining personality, various forms of structured interviews are used (see e.g. [22]). Slaughter et al. [21], Lievens and Sackett [12], Schmitt and Chan [20] recommended, in evaluating employees, to use situational judgment tests (SJTs) as a means to assess a number of job-related knowledge, skills, abilities and other characteristics (KSAOs), however, at the same time they mention certain limitations thereof in identifying interpersonal skills. Also, Dayan et al. [7], Goffin et al. [9] emphasize that when evaluating employee we may experience problems due to poorly set parameters or improper assessment thereof. Vetráková, Potkány and Hitka [23] recommended in the evaluation of employees also using the services of specialized organizations outsourcing.

The error rate of evaluation can be mitigated by the application of psychology [6] as well as by the use of meta-analyses [11]. In connection with the requirements for employees, Arthur and Villado [1] use predictors while defining a predictor as "*a specific behavioural domain, information about which is sampled via a specific method"*. The behavioural domain of predictors (i.e. what is measured) can be defined through theories of psychological constructs (e.g. knowledge, skills and abilities), theories of work situations/requirements, or even some combinations thereof. This statement corresponds with the indicator Degree of balance between the staff dispositions and their job positions, which was constructed using fuzzy logic and is described and applied in the context of this article.

1 Defining the bases for monitoring balance between the staff dispositions and their job functions

1.1 Determinants of employees' conduct and job performance dispositions

Rules for the interaction of people can be defined by three fundamental concepts: cooperation, effort, performance [18]. Cooperation is necessary to enable the group to act as a single entity, effort affects the worker's abilities and skills and the performance of the whole team depends on how the allocation of work roles to individuals respects their employment status.

The conduct and behaviour of employees can be considered from several aspects, for example:

- how people accept objective influences in their surroundings (rational point of view),
- how psychological personality traits are manifested (emotional point of view),
- how people's behaviour is influenced by social factors.

In evaluating an employee's dispositions and his/her abilities to perform certain activities, it is necessary to distinguish the impact of external factors from personal dispositions.

To identify the impact of external factors on employee conduct are applied, for example, in terms of consensus (Do other workers behave in the same situation in the same way?), consistency (Does the worker behave in this situation in the same way as on other occasions?), and diversity (Does the worker behave in other situations in a different way?).

1.2 Determinants of job performance

A person's job performance is dependent on his/her dispositions, motivation and working conditions. A person can realize performance on condition that he/she has adequate professional training and willingness.

The level of job performance is then the result of psychological reactions of the employee.

There are many job performance evaluation criteria and they can be direct indicators (the amount of work over time, quality of work for a certain period of time, timeliness of performance, etc.) as well as indirect indicators (e.g. the stability of performance over time, how long a person keeps a performance standard, changes in human mental processes during the performance, the occurrence and frequency of wrongful conduct). Employee performance evaluation must focus not only on the results of the work, but also on working and social behaviour, abilities, and other characteristics of the individual.

Work performance can therefore be assessed also with respect to the employees' dispositions and their willingness to devote themselves fully to their job. It also follows that job performance is affected by factors stemming from individual employee's goals and his/her value system, but also from interpersonal relationships.

To achieve optimum performance, the employer has to create suitable working conditions and also clearly define the requirements associated with a concrete job position.

An unsatisfactory work performance may be caused by a wrong choice of employee for a specific position when taking up the job or when being transferred to another type of work performed. It is therefore necessary both to improve the decision making process in recruitment or redeployment of the existing staff, and to specify the characteristics of job positions and seek the optimum combination [19].

1.3 Job description, specification and quantification of work

Before starting the process of filling vacant positions it is necessary to define requirements as precisely as possible that will be imposed on the candidates. This implies the need to create a description of jobs (in the literature also referred to as positions) describing its purpose, tasks, powers and responsibilities, including prerequisites of eligible candidates. The job description should also include objectives and criteria (staffing requirements) associated with this position. At the same time, it is necessary to update the description at specified intervals, based on an analysis of the job. The analysis of jobs must also provide information about their mutual relations. It is necessary not only to specify the required work, but also to quantify it.

1.4 Defining requirements for employees in connection to jobs

To ensure a high-quality selection process, it is necessary to define, along with a description of the job (the position), requirements to be met by the candidates (workers).

These requirements are divided into several basic categories, which include: vocational, language and other special skills and abilities (including required education), motivational requirements, personal flexibility, responsibility and loyalty, management skills and experience, personal qualities and social skills, work experience, health.

With these characteristics, it is necessary to determine which are necessary and which are desired (and may be obtained, for example, during job training or may be replaced with other requirements). Usually, it is not a problem to define professional, technical and language requirements, but the problem is setting requirements in the area of personal and social characteristics of the candidates. Usually, the following are regarded as the most important:

- Loyalty,
- responsibility,
- positive work attitudes,
- employment stability,
- ability and willingness of work drive,
- intrinsic employee motivation (related to the accordance of their personal goals with their work).

2 Using the indicator Degree of balance between the staff dispositions and job functions (DB_{SDJF})

The emergence of this indicator is a result of a causal analysis of a deductive character. If we define the worker's unsatisfactory performance as a known consequence, this analysis aimed to determine the causal chain that begins as the consequence under consideration and ends with identification of the primary cause of the problem. In this case, the deductive causal analysis was focused on finding the causes of the unsatisfactory performance in the field of personnel management.

The causal chain was expressed as follows:

Unsatisfactory job performance → inadequate skills and qualifications for the job → error in assigning the job → incorrect evaluation of the employee when being assigned with the job.

The DB_{SDJF} indicator was designed to allow or rather facilitate finding the best possible match between the employee (and the work he/she performs) and his/her job position [15]. The basic prerequisite for using this indicator is that each position under consideration has the most accurate description. If this condition is met, we can:

a. define partial demands and their importance in relation to a specified job position,
b. evaluate each candidate (or the existing staff) with regard to the requirements defined.

3 Applying fuzzy logic in the evaluation of staff dispositions with regard to the job position

3.1 Evaluation of the degree of balance between the staff dispositions and job positions using the A o B composition

The basic prerequisite for the construction and use of the proposed indicator is that the job description, requirements and ensuing assessment of the worker in each required field (qualification, skills, abilities) shall be expressed in numerical terms in the interval < 0;1 >, where:

- 0 corresponds to "totally unacceptable", 1 to "totally satisfactory" in evaluating employee dispositions with regard to the requirements imposed,
- 0 corresponds to "not required", 1 to "is necessary" in determining if the disposition is required as a criterion in the respective job position.

The more accurately (more detailed definition) and responsibly the evaluation is carried out, the higher the information value is of the proposed indicator.

If these conditions are met, it is possible to find an optimum staffing level with workers who are available, using indicators of the balance between staff dispositions and job position DB_{SDJF} as follows.

Each worker is assigned an identification variable x_i for i ϵ <1, 2, ..m>, wherein m corresponds to the number of employees.

Specified desired characteristics (required knowledge and skills of workers) are expressed with a variable y_i for i ϵ <1, 2, ..n>, wherein n is the total number of defined requirements (partial characteristics).

Job positions are described by variables z_i for i ϵ <1, 2, ..m>, wherein m is the total number of job positions.

The importance of meeting the requirements specified y_i with regard to the job position is numerically evaluated in the interval <0;1>. Based on the evaluation of candidates in the recruitment process, it is possible to quantify (again, in the interval < 0;1 >) the extent to which the applicant meets the requirements arising from the job position.

The fuzzy relation A in (X,Y) expresses the evaluation of partial dispositions of individual employees with respect to the requirements imposed, the fuzzy relation B in (Y, Z) expresses the bare minimum of the fulfilment of requirements for the respective job position.

The indicator of the Degree of balance between the staff dispositions and job positions (DB_{SDJF}) is expressed as a composition B o A, thus:

$$DB_{SDJF} = \mathbf{f_{B\,o\,A}(X, Z) = max\,(min\,f_A(x,y)\,,\,f_B(y,z))\ \ for\ y\ \epsilon\ Y.}$$

$\mathbf{x_i}$ – identification variables of employees,

i ϵ <1, 2, .. m>, m = the number of employees,

$\mathbf{y_i}$ – required performance characteristics (knowledge and skills),

i ϵ <1, 2, .. n>, n = the number of characteristics,

$\mathbf{z_i}$ – job position,

i ϵ <1, 2, .. m>, m = the number of job positions.

The procedure used for calculation of B o A:

1. Compare a couple of components (x_1, y_i) and (y_i, z_i) and others. Consequential selection of lower component = min f_A (x, y), f_B (y, z).
2. Select a maximum value for construction of B o A.

3.2 Evaluation of the degree of balance between the staff dispositions and job positions – application in business practice (analysis of the problem)

The application of the DB_{SDJF} indicator is presented on an actual example of practice of a small business whose management solved a problem of the need to find a manager and a technician-dealer among six persons of the existing staff employed in the service centre. According to the owner, there was no considerable difference among their dispositions, and therefore an opportunity presented itself to assess their skills and abilities against the requirements of the respective jobs using the DB_{SDJF} indicator. At the same time, an opportunity presented itself to clarify the requirements as well as the job positions of service engineers and find out how existing employees comply with the requirements for this position.

Each employee was assigned an identification variable x_i for i ϵ <1, 2,...6>, and also the required knowledge and skills of employees were specified and expressed through a variable y_i for i ϵ <1, 2, ..7>.

Given that these are long-time and responsible workers who have high loyalty to their employer, it is not necessary to include all basic categories of requirements in the evaluation (see above). Partial characteristics were therefore chosen after consultation with the owner of the company as follows:

y_1 – technical expertise,

y_2 – economic knowledge,

y_3 – communication skills,

y_4 – the ability to give reasons and evaluate,

y_5 – willingness to learn

y_6 – independence and ability to lead and make decisions,

y_7 – willingness to work flexible hours (e.g. due to family circumstances).

The job positions are described with variables z_i for i ϵ <1, 2,... 6>. The job positions z_1 through z_4 were defined for service engineers, therefore, these were existing positions, while the position z_5 was newly created for the head of the service department, and so was the position z_6 for the technician-dealer.

The fuzzy relation A in (X, Y) contains the evaluation performed by the managing director and assesses the level of fulfilment of each partial dispositions of the employees against the defined requirements (Table 1). The fuzzy relation B in (Y, Z) gives the bare minimum for meeting the requirements specified for the particular job position (Table 2).

Tab. 1: Comparison of partial dispositions of the employees against the requirements defined for each job positions

A	y_1	y_2	y_3	y_4	y_5	y_6	y_7
x_1	0.9	0.2	0.5	0.6	0.7	0.85	0.6
x_2	0.85	0.1	0.75	0.75	0.8	0.75	0.8
x_3	0.7	0.35	0.65	0.65	0.75	0.7	0.9
x_4	0.75	0.65	0.7	0.7	0.7	0.55	0.7
x5	0.65	0.55	0.8	0.6	0.65	0.65	0.75
x_6	0.7	0.7	0.7	0.75	0.8	0.7	0.8

Source: [author]

Tab. 2: Bare minimum for meeting the requirements specified for the particular job position

B	z_1	z_2	z_3	z_4	z_5	z_6
y_1	0.9	0.9	0.9	0.9	0.9	0.7
y_2	0.3	0.3	0.3	0.3	0.6	0.8
y_3	0.5	0.5	0.5	0.5	0.9	0.8
y_4	0.3	0.3	0.3	0.3	0.6	0.9
y_5	0.6	0.6	0.6	0.6	0.9	0.9
y_6	0.3	0.3	0.3	0.3	0.7	1
y_7	0.5	0.5	0.5	0.5	1	0.8

Source: [author]

The other tables (Table 3 and Table 4) present methods for calculating the composition B o A.

Tab. 3: The calculation of B o A

x_1, z_i	0.90	0.20	0.50	0.30	0.60	0.30	0.50
	0.90	0.20	0.50	0.30	0.60	0.30	0.50
	0.90	0.20	0.50	0.30	0.60	0.30	0.50
	0.90	0.20	0.50	0.30	0.60	0.30	0.50
	0.90	0.20	0.50	0.60	0.70	0.70	0.60
	0.70	0.20	0.50	0.60	0.70	0.85	0.60
x_2, z_i	0.85	0.10	0.50	0.30	0.60	0.30	0.50
	0.85	0.10	0.50	0.30	0.60	0.30	0.50
	0.85	0.10	0.50	0.30	0.60	0.30	0.50
	0.85	0.10	0.50	0.30	0.60	0.30	0.50

	0.85	0.10	0.75	0.60	0.80	0.70	0.80
	0.70	0.10	0.75	0.75	0.80	0.75	0.80
x_3,z_i	0.70	0.30	0.50	0.30	0.60	0.30	0.50
	0.70	0.30	0.50	0.30	0.60	0.30	0.50
	0.70	0.30	0.50	0.30	0.60	0.30	0.50
	0.70	0.30	0.50	0.30	0.60	0.30	0.50
	0.70	0.35	0.65	0.60	0.75	0.70	0.90
	0.70	0.35	0.65	0.65	0.75	0.70	0.80
x_4,z_i	0.75	0.30	0.50	0.30	0.60	0.30	0.50
	0.75	0.30	0.50	0.30	0.60	0.30	0.50
	0.75	0.30	0.50	0.30	0.60	0.30	0.50
	0.75	0.30	0.50	0.30	0.60	0.30	0.50
	0.75	0.60	0.70	0.60	0.70	0.55	0.70
	0.70	0.65	0.70	0.70	0.70	0.55	0.70
x_5,z_i	0.65	0.30	0.50	0.30	0.60	0.30	0.50
	0.65	0.30	0.50	0.30	0.60	0.30	0.50
	0.65	0.30	0.50	0.30	0.60	0.30	0.50
	0.65	0.30	0.50	0.30	0.60	0.30	0.50
	0.65	0.55	0.80	0.60	0.65	0.65	0.75
	0.65	0.55	0.80	0.60	0.65	0.65	0.75
x_6,z_i	0.70	0.30	0.50	0.30	0.60	0.30	0.50
	0.70	0.30	0.50	0.30	0.60	0.30	0.50
	0.70	0.30	0.50	0.30	0.60	0.30	0.50
	0.70	0.30	0.50	0.30	0.60	0.30	0.50
	0.70	0.60	0.70	0.60	0.80	0.70	0.80
	0.70	0.70	0.70	0.75	0.80	0.70	0.80

Source: [author]

The final values of the indicator are stated in Table 4.

Tab. 4: $DB_{SDJF} = f_{B\,o\,A}(X, Z)$

	z_1	z_2	z_3	z_4	z_5	z_6
x_1	0.9	0.9	0.9	0.9	0.9	**0.85**
x_2	**0.85**	0.85	0.85	0.85	0.85	0.8
x_3	0.7	0.7	0.7	0.7	**0.9**	0.8
x_4	0.75	**0.75**	0.75	0.75	0.75	0.7
x_5	0.65	0.65	0.65	**0.65**	0.75	0.8
x_6	0.7	0.7	**0.7**	0.7	0.8	0.8

Source: [author]

4 Discussion

Based on the calculation of values of the DB_{SDJF} indicator, best suited for the position of the head of the service centre is the employee X_1, who, however, it is also an eligible candidate for the position of the technician-dealer. In terms of the criteria under consideration, this is the best employee in the observed group. Similar results in relation to the newly created job positions were also achieved by the employee x_3, however, his assessment for the position of the head is slightly worse. It can therefore be recommended that the job position of the head of the service centre be filled by the employee x_1 and the job position of the technician-dealer by the employee x_3.

The results show that the indicator made it possible to find suitable workers for the newly created positions in connection with the final evaluation of all employees of the service centre. At the same time, however, we can also evaluate the fulfilment of the requirements in the remaining positions of service workers by the other employees (the rankings of the employees in relation to the degree of fulfilment of the specified requirements: x_2, x_4, x_6, x_5). The results were forwarded to the managing director of the company where the evaluation of dispositions of employees took place.

Conclusion

Proper evaluation of staff dispositions for a job position is one of the prerequisites not only for achieving his/her expected work performance, but also for ensuring his/her satisfaction with the work performed. The better you define criteria resulting from the analysis of the job position, the more precisely you can define requirements for applicants for this job, and then determine to what extent they meet these requirements. In this sense, it is also the creators of criteria and evaluators, their experience and objectivity that play an important role.

Based on the defined characteristics of the job position, the DB_{SDJF} indicator allows assessing the suitability of a worker for the position, in relation to other workers or candidates. The advantage of the DB_{SDJF} indicator is that it does not evaluate just one worker in relation to a job position, but it allows comparing a set of workers (and their quality) and a set of jobs (and requirements based thereon). This allows us to find an optimal staffing procedure to appoint the most suitable staff to the positions, since the DB_{SDJF} indicator finds the best match of abilities of the workers and the requirements that resulted from the analysis of these positions.

As has been shown, this indicator can also be used in comparing the degree of staff dispositions in the same positions (in the example given, these were positions of service engineers). Given the possibility to supplement and change the requirements for the staff on the basis of new experience and knowledge (or at regular intervals), the evaluation of staff dispositions using the DB_{SDJF} indicator can be further elaborated.

Acknowledgement

The paper was supported by GA ČR No. GA13-10331S "The role of text information in corporate financial distress prediction models - country-specific and industry-specific approaches" and by SGSFES 2015001" Economic and social development in private and public sector".

Reference

[1] ARTHUR W, JR., VILLADO A. J. The importance of distinguishing between constructs and methods when comparing predictors in personnel selection research and practice. *In Journal of Applied Psychology*, 2008, Volume 93, Issue 2, pp. 435–442. ISSN: 0021-9010, eISSN: 1939-1854.

[2] ARTHUR, W., JR., DOVERSPIKE, D. Achieving diversity and reducing discrimination in the workplace through human resource management practices: Implications of research and theory for staffing, training, and rewarding performance. In R. L. Dipboye & A. Colella (Eds.), *Discrimination at work: The psychological and organizational bases* (pp. 305–327). San Francisco: Jossey-Bass. 2005, 508 p.

[3] ARTHUR, W., JR., DAY, E. A., MCNELLY, T. L., et al. Meta-analysis of the criterion-related validity of assessment center dimensions. In *Personnel Psychology,* 2003, Volume 56, Issue 1, pp. 125–154. ISSN: 1744-6570

[4] ARTHUR, W., JR., EDWARDS, B. D., BARRETT, G. V. Multiple-choice and constructed response tests of ability: Race-based subgroup performance differences on alternative paper-and-pencil test formats. In *Personnel Psychology,* 2002, Volume 55, Issue 4, pp. 985–1008. ISSN: 1744-6570

[5] BUCHANAN, J., SCOTT, L., et al. Skills demand and utilisation: an international review of approaches to measurement and policy development. Working paper, *OECD Local Economic and Employment Development (LEED)*, OECD, Sydney. 2010. ISSN 2079-4797. DOI 10.1787/20794797

[6] CASCIO, W. F., AGUINIS, H. *Applied psychology in human resource management.*7th ed. Upper Saddle River, NJ: Prentice Hall. 2011, 552 p. ISBN-13: 978-0136090953 ISBN-10: 0136090958

[7] DAYAN, K., KASTEN, R., FOX, S. Entry-level police candidate assessment center: An efficient tool or a hammer to kill a fly? *In Personnel Psychology,* 2002, Volume 55, Issue 4, pp. 827–849. ISSN: 1744-6570

[8] Findlay, P., Warhurst, C. Skills utilisation in Scotland. In *Skills in Focus Series, Scottish Funding Council/Skills Development Scotland*, 2012, pp. 3-13. ISSN 1466-1535

[9] GOFFIN, R. D., ROTHSTEIN, M. G., JOHNSTON, N. G. Personality testing and the assessment center: Incremental validity for managerial selection. *Journal of Applied*

Psychology, 1996, Volume 81, Issue 6, pp. 746–756. ISSN: 0021-9010, eISSN: 1939-1854

[10] HARRISON, D. A., KLEIN, K. J. What's the difference? Diversity constructs as separation, variety, or disparity in organizations. *Academy of Management Review*, 2007, Vol. 32, No. 4, 1199-1228

[11] HAUSKNECHT, J. P., DAY, D. V., THOMAS, S. C. Applicant reactions to selection procedures: An updated model and meta-analysis. *In Personnel Psychology,* 2004, Volume 57, Issue 3, pp. 639–683. ISSN: 1744-6570

[12] LIEVENS, F., SACKETT, P. R. Video-based versus written situational judgment tests: A comparison in terms of predictive validity. *Journal of Applied Psychology,* 2006. Volume 91, Issue 5, pp. 1181–1188. ISSN: 0021-9010, eISSN: 1939-1854.

[13] MAYEROVÁ, M. *Stres, motivace a výkonnost* 1. vyd. Praha: Grada Publishing, 1997. 136 str. ISBN 80-7169-425-8

[14] MENDES, L., MACHADO, J. Employees' skills, manufacturing flexibility and performance: a structural equation modelling applied to the automotive industry. *In International Journal of Production Research*. 2015. Volume 53, Issue13, pp. 4087-4101. DOI: 10.1080/00207543.2014.993772

[15] MYŠKOVÁ, R. *Vliv pracovní výkonnosti na efektivnost podniku*. Brno: Vědecké spisy VUT, Edice PhD Thesis, sv. 179, 30 str., 2003, ISBN 80-214-2355-2

[16] PALÁN, Z. *Lidské zdroje - výkladový slovník*. 1. vyd. Praha: Academia, 2002. 282 str. ISBN 80-200-0950-7

[17] PAYNE, J. Skill utilisation: towards a measurement and evaluation Framework. Research Paper No. 93, SKOPE, 2010. Cardiff and Oxford Universities, Cardiff. [on-line]. [2015-03-25]. Available from WWW: <http://www.cardiff.ac.uk/socsi/research/researchcentres/skope/publications/researchpapers/RP93.pdf>

[18] PITRA, Z. *Zvyšování podnikatelské výkonnosti firmy*. 1. vyd. Praha: EKOPRESS, 2001. 305 str. ISBN 80-86119-64-5

[19] RAŠTICOVÁ, M., KONEČNÝ, Š. Work- Life Balance in Male and Female Managers of Selected Companies in the Czech Republic. In *Crafting Global Competitive Economies: 2020 Vision Strategic Planning & Smart Implementation*. Milan, Italy: International Business Information Management Association (IBIMA), 2014. s. 2128-2142. ISBN: 978-0-9860419-3- 8

[20] SCHMITT, N., CHAN, D. Situational judgment tests: Methods or constructs? *In J. Weekley & R. E. Ployhart (Eds.). Situational judgmenttests: Theory, measurement, and application* (pp. 135–155). 2006. Mahwah, NJ: Erlbaum. ISBN-13: 978-1138004108 ISBN-10: 1138004103

[21] SLAUGHTER, J. E., CHRISTIAN, M. S., PODSAKOFF, et al. On the Limitations of Using Situational Judgment Tests to Measure Interpersonal Skills: The Moderating Influence of Employee Anger. *In Personel Psychology,* 2014, Volume 67, Issue 4, pp. 847-885. DOI: 10.1111/peps.12056. ISSN: 0031-5826, eISSN: 1744-6570.

[22] VAN IDDEKINGE, C. H., RAYMARK, P. H., ROTH, P. L. Assessing personality with a structured employment interview: Construct-related validity and susceptibility

to response inflation. *In Journal of Applied psychology*, 2005,Volume 90, Issue 3, pp. 536–552. ISSN: 0021-9010, eISSN: 1939-1854.

[23] VETRÁKOVÁ, M., POTKÁNY, M., HITKA, M. Outsoucing of Facility management. In *Economy & Management E+M*. 2013, Volume 16. Issue 1, pp. 80-92. ISSN 1212-3609.

Contact Address

doc. Ing. et Ing. Renáta Myšková, Ph.D.
University of Pardubice, Faculty of Economics and Administration
The Institute of Business Economics and Management
Studentská 95, 532 10 Pardubice, Česká republika
Email: renata.myskova@upce.cz
Phone number: +420 466 036 510

Received: 30. 04. 2015
Reviewed: 23. 06. 2015, 22. 07. 2015
Approved for publication: 02. 09. 2015

LEAN: 4W & 1H OF LEAN IN MEDICAL FACILITIES

Veronika Vavrušová

Abstract: *The academic literature offers many examples of firms which have achieved significant improvement via lean management implementation. These firms usually apply well-defined lean tools. The impact of its implementation is well established in the literature, which means they can use it as a guidebook. The essence of lean management is the creation of a culture that encourages learning and thus continuous process improvement through simplifying and standardizing the way work is performed and systematically attacking problems as they occur. This paper is divided into two parts. The first part summarizes available relevant materials about lean healthcare and its methods, applications, results (academic or practitioner literature, case studies, etc.) and creates a complex study of this very current topic. The second part introduces the results of a survey focused on medical staffs´ knowledge of lean methods which was carried out in 2013 in various Czech medical facilities. Both parts point out the ergonomic principles in lean healthcare and its benefits.*

Keywords: *Lean management, Lean healthcare, Lean methods, Ergonomics principles, Medical errors.*

JEL Classification: *I15, P46, J32, O14.*

Introduction

Without any doubts, lean philosophy leads to reduce disruptions, process variability and wasting. On the other hand it can increase productivity and efficiency. Before implementing of this philosophy, it is necessary to ensure that all involved staff is aware of lean principles, history and purposes. Employees who go along with lean philosophy are the key for its successful implementation.

For the reasons stated above, the first part of this paper introduces from five perspectives; the WHEN and WHERE, WHAT, HOW and WHY. The perspectives "WHEN and WHERE" briefly describe the beginnings of lean in manufacturing and also in healthcare and its origin. The part "WHAT" defines the essence of lean as a pure process simplifying and waste reduction; describes the most important and usable lean tools and methods. The pure knowledge of lean methods, techniques and approaches is not sufficient. It is necessary to know how the lean practices work and which its results are. The last part called "WHY" offers main reasons for implementing lean philosophy to both industry and healthcare. In terms of manufacturing, lean generally leads to reducing waste and increasing productivity. Whereas in healthcare lean can remove unnecessary procedures, but first of all, it can eliminate disruptions which may cause fatal consequences.

1 4W & 1 H of LEAN

1.1 The WHEN and WHERE of Lean

In 1990 James Womak published a comparative study of American, Europe and Japanese automotive production systems in which he used the phrase "lean manufacturing" but not its meaning. Lean manufacturing or industry engineering is strongly

connected with TPS (Toyota Production System), but it is deeper rooted. TPS was developed from Henry Ford´s production system, and Henry Ford developed F. W. Taylor´s scientific management of manufacturing – thus "lean" has its beginnings at the turn of the twentieth century [2, 14].

Lean had its beginnings on the production floor at Toyota Production System, then migrated to other enterprises and these days is more and more producing benefits in services, including healthcare [8].

The precise date of the first application of lean in healthcare is uncertain. In 1995 Heinbuch offered a lean solution in a particular case of just in time method. His work was dealing with physical inventory reduction in hospitals. A similar application regarding implementing lean approaches in healthcare was made by Jacobs and Pelfrey in 1995. Speculations about the potential use of lean in healthcare were put forth by the NHS Modernisation Agency in 2001. Bushell and Shelest described a pilot implementation of lean in a mid-sized hospital in the U.S.A. – this work was focused on patient flow improvement. Other similar publications of positive results of lean implementation in the area of medical facilities increased the interest about the topic Evidence presented in the literature indicates that lean has been embraced across the public services, including healthcare since 2005 [1, 10].

1.2 The WHAT of LEAN

Literature on lean is generally divided into two categories, which are nevertheless strongly linked: the definition of tools and practices and the lean implementation – research and case studies. These research and case studies address the specific lean methods, tools and approaches that result in the highest performance [9].

The lean tools are mostly grouped according to their impact on functional areas of the company (e.g., Just-in-Time, Total Quality Management, Total Productive Maintenance, SMED, Pull System, Kaizen, Ergonomics, etc.). Pure process simplifying and waste reduction is considered the essence of lean. Actually, Womack and Jones encourage lean companies to identify all wasting activities and eliminate them, because wasteful activities are those that do not add value from a customer perspective. However lean is not only concerned with waste elimination and cost reduction. Hines point out that in fact there are two ways to increase customer value, by reducing waste and thus the cost of products or services; or by increasing the value-adding activities without increasing the cost of goods or services [10].

As a customer (patient, in the case of lean healthcare) "buys" only value added activities, it is extremely important to define lean value stream, which provides increased value to a customer in a more efficient and cost-effective manner. Value adding time in hospital means diagnostic time (collecting and analyzing clinical information), active care time (clinical interventions), passive care time (under observations, no interventions) and positive wasting time (patient's condition is likely to improve without interventions). Non-value adding time is superfluous time (not needed diagnostics, observations or interventions), administrative time, passive wasting time (no change in patient´s condition is expected) and negative wasting time (patient´s condition is likely to deteriorate). Many authors argue that lean is not rocket science; it is basically only waste reduction in all processes [6].

1.2.1 Wastes in Healthcare

The eight wastes targeted by lean manufacturing, all of which can apply to healthcare:

1. **Overproduction** – making more of something than the next process needs. This waste shows up most commonly in batching work. In medical facilities it can include tests, paperwork or claims [8, 11]. Thaiichi Ohno, who is considered the father of the Toyota Production System (TPS), said that "in a period of low economic growth, overproduction is a crime." [2]
2. **Inventory –** as the major cost to healthcare is for carrying inventory or supplies, it is the most important kind of wasting from the hospital perspective. In this case it is necessary to find inspiration in lean manufacturing when the overall cost of delivery is considered to define ideal shipment and its frequency.
3. **Motion** – the easiest way to consider what this type of wasting means is walking or any other body movements. A lot of walking waste originates from poor layout design or a lack of optimal working conditions. In the field of hospitals or any other medical facilities it should be, more than elsewhere, body movements linked with patient manipulation which can cause a musculoskeletal disorder.
4. **Transportation -** in manufacturing this appears as moving parts around. In healthcare this kind of waste shows up when moving patients, tests, materials and information around.
5. **Over processing –** it means doing more than customers require. From the point of view of a patient, it could be multiple claim forms.
6. **Defects –** the second most important type of wasting in lean healthcare. Defects, corrections, adjustments or inaccurate information may cause many problems. For example, an incorrect label on a blood tube can cause irreversible errors in a process.
7. **Waiting –** in any form, waiting is a waste. It can be, e.g., waiting in an emergency room for an available bed, waiting for equipment to arrive from another department, waiting for a doctor, nurse or operating room, test results or information.
8. **Under-utilizing staff** - inadequate using of knowledge, skills, education and creativity which employees possess is a serious waste. It is important to highlight that the people closest to the work know it best; they are experts and they just have to be trained in problem solving and lean techniques but they also have to share their knowledge and experiences [8, 11, 13].

1.3 The HOW of LEAN

A pressing issue for researchers but also for practitioners is explaining "how" implementing lean practices leads to improvement. Many authors argue that the pure knowledge of lean methods, techniques and approaches is not sufficient. It is necessary to combine doing work with learning to do work better –it is really important to continuously monitor the work results, make it immediately apparent when results contrary to expectations are occurring – mainly in the case of lean healthcare [9].

It is not easy to implement lean; nevertheless the most difficult issue is to control it and to continuously improve it. According to the Dennis, lean production is not only a set of techniques; it should become a path that must be approached with spirit of humility and lifelong learning. Irving Layton´s motto says: "They dance best who dance with desire." The author believes that intensity is the soul of lean production and team members are its heart [2].

1.4 The WHY of LEAN

The main reason for implementing lean methods is the fact that lean leads to less disruptions and therefore to higher stability. According to Dennis, "STABILITY" is the main object of the lean. Archimedes motto: "Give me a place to stand, and I can move the earth", explains the importance of stability either in the production factors (man, machine, material, method) in the case of production or in other areas. Dennis argues that the stability starts with visual management, 5S workplace organization and TPM (Total Productive Maintenance). All of them support standardization and provide point-of-use information that eases decision making [2].

Implementation of lean in healthcare, particularly in hospitals, should remove duplicate processes and unnecessary procedures and also eliminate disruptions which may cause fatal consequences [10].

One of the most common examples of medical disruption is adverse drug reaction, which can be caused, e.g., by incorrect drugs application. Lazarou et al. analyzed records for prescribed medications for 33 million U.S. hospital admissions in 1994. It discovered 2.2 million serious injuries due to prescribed drugs; 2.1% of in-patients experienced a serious adverse drug reaction, 4.7% of all hospital admissions were due to a serious adverse drug reaction, and fatal adverse drug reactions occurred in 0.19% of in-patients and 0.13% of admissions. The authors estimated that 106,000 deaths occur annually due to adverse drug reactions [3, 7].

A five-country survey published in the Journal of Health Affairs found that 18 – 28 % of people who were recently ill had suffered from a medical drug error in the previous two years. The breakdown by country showed the percentages of those suffering a medical or drug error were 18 % on Britain, 23 % in Australia and in New Zealand, 25 % in Canada, and 28 % in the USA. In the USA more people died in each year from medical errors in hospitals than those dying from road traffic accidents, breast cancer or even AIDS [12].

Although lean is increasingly prevalent in healthcare, there is only little evidence of a full implementation of lean to the level achieved by Toyota. The literature suggests that healthcare organizations are implementing lean by using simple tools on small projects. In the UK, Radnor analyzed the annual reports 2007/2008 of 152 acute hospitals for evidence of lean led improvement activities. In the sample, 80 hospitals cite the applications of lean principles (e.g., process mapping, 5S, etc.), only 5 hospitals attested to the adoption of lean principles as part of the culture of the organization [10].

It is necessary to wise up that the center of all activities in medical facilities are patients – their safety, comfort and time, the aim of medical staff (doctors, nurses, etc.) is doing maximum to gain this objectives, for example by using ergonomic principles. Ergonomics is other very useful tool of lean. The ergonomic principles are commonly used in all types of industries, rarely in services, including medical facilities. Many authors argue that the implementation of its principles helps to prevent disruptions in medical processes by reduction of staff exhaustion and increase of patients comfort. Ergonomics is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance. Ergonomists contribute to the design and evaluation of tasks, jobs, products, environments and systems in order to make them compatible with the needs, abilities and limitations of people [5].

The most recent US Department of Labor (DOL) summary statistics indicate that nursing aides, orderlies and attendants, along with two other occupations (truck drivers and non - construction laborers), account for one out of five musculoskeletal disorders (MSDs) reported nationally in 2001. The American Hospital Association has stated that work-related MSDs account for the largest proportion of Workers Compensation costs in hospitals and long-term nursing home facilities nationwide. In addition, the American Nurses Association reports that ergonomic injuries occur in nurses at a rate that is twice that found in the general working population [4].

The negative consequences of poor working environment in hospitals with respect to ergonomic principles are globally very serious problem. The survey presented in the second part of this paper analyses application of ergonomic principles in chosen Czech medical facilities and its impact on medical staff.

2 Survey: Application of Ergonomic principles, MSD´s Symptoms

The aim of the second part of this paper is the analysis of the current situation of medical staff´s knowledge of lean method in representative Czech hospitals, focusing on ergonomics.

In order to find out what is Czech medical staff´s knowledge of lean healthcare philosophy and tools was created a questionnare survey to evaluate the knowledge, working attitude, behaviors of participants and working environment in several Czech hospitals.

The survey was divided in two parts: overall interest of the hospitals staff in lean methods and ergonomic principles using in healthcare environment and their inpact on medical staff.

Main object of this part is find out the work environment of medical staff, which could directly affect the staff´s performance and patients comfort and rehabilitation conditions. The basic question were:

- Is MSD´s experience influenced by job position /doctors/nurses/paramedical staff/?
- Is MSD´s experience influenced by length of practice of participants?
- Is there any influence of length of practice on frequency of MSD´s symptoms occurency?
- Is there any difference in type of MSD´s symptoms and medical care sought for MSD´s?

The quantitative portion of this study comes from a survey of employees (doctors, nurses and paramedical staff) in various not-for-profit hospitals across the Czech Republic. The survey started in October 2013 and was executed online via survio.com.

Until now we collected a total of 279 completed surveys. Surveys were distributed to doctors, nurses and paramedical staff in selected state hospitals across the Czech republic (total of 12 hospitals). The collected data was statistically proved using different statistic methods, mostly by ANOVA.

The basic characteristics are displayed below.

Tab. 1: The basic characteristic of a sample

		Frequency (n)	Percent (%)
Gender	Female	42	15,05%
	Male	237	84,95%
Age	18 - 29 years	87	31,18%
	30 - 49 years	129	46,24%
	50 and more	63	22,58%
Practice	Less than 5 years	60	21,51%
	5 - 10 years	66	23,66%
	10 and more	153	54,84%
Position	Doctor	42	15,05%
	Nurse	174	62,37%
	Paramedical staff	63	22,58%
MSD´s experienced in the past	Experienced	215	77,89 %
	Not experienced	64	22,11 %
MSD´s frequency	Constantly	47	16,84 %
	Weekly	87	31,18 %
	Monthly	134	48,02 %
	Infrequently	11	3,96 %
Medical care sought for MSD´s	Yes	84	30,11 %
	No	195	69,89%
MSD´s symptoms	pain	175	62,72%
	edema	8	2,86%
	tingling	20	7,16 %
	cramps	76	27,26 %

Source: [15]

2.1 Results

According to the results, almost three – quarters of respondents are affected by the musculoskeletal disorders (MSD´s). The main reason of this result should be e.g. poor-designed workplaces or hard and time-consuming manipulation with patients without any ergonomic devices. Based on the results, 93 % of medical staff affected by MSD´s got a sick note.

In US, MSDs account for $1 of every $3 spent on workers compensation and affect 1,8 million workers each year. Many experts believe this numbers to be under-reported. Compared to other private industry sectors, the medical, economic, and social costs of work-related musculoskeletal disorders or ergonomic injuries in the healthcare environment are particularly serious and warrant special consideration. [4].

In the table below is displayed the influence of job position on MSD´s experience.

Tab. 2: ANOVA Job position vs. MSD´s experience

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	49,54839	1	49,54839	113,6253	0,000000000000000000057537	3,89249
Within Groups	80,23656	184	0,436068			
Total	129,7849	185				

Source: [15]

According to the results, job position does not have an influence on MSD´s experience. There is not difference between job position and inclination to MSD´s.

Tab. 3: ANOVA Length of practise vs. MSD´s experience

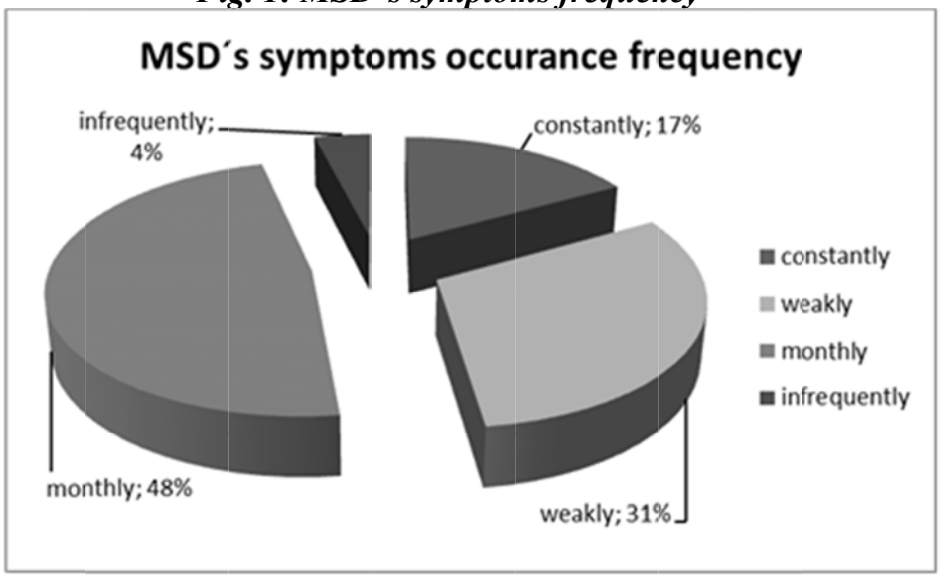
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,263441	1	0,263441	0,313796	0,576041188	3,892494
Within Groups	154,4731	184	0,839528			
Total	154,7366	185				

Source: [15]

Regarding the MSD´s symptoms occurrence, we decided to analyze an influence of length of participants´ practice on MSD´s experience. As can be seen in the table above, length of practice has an impact on it. P-value is moving to 1, it means very strong correlation between proved factors.

Graph below shows us that the 17 % of respondents has the symptoms of MSDs constantly, almost 50 % weakly and 30 % monthly. Apparently, these physical problems are caused by high staff´s exertion. It is evident that each mistake made in healthcare services can cause fatal consequences. Therefore it is inevitable to take up appropriate actions – in our case to start up with applying the lean healthcare principals, especially ergonomics. In order to find out the influenc of length of practice on frequency of MSD´s symptoms occurance we carried out other ANOVA testing.

Fig. 1: MSD´s symptoms frequency



Source: [15]

Tab. 4: ANOVA Length of practise vs. frequency of MSD´s experience

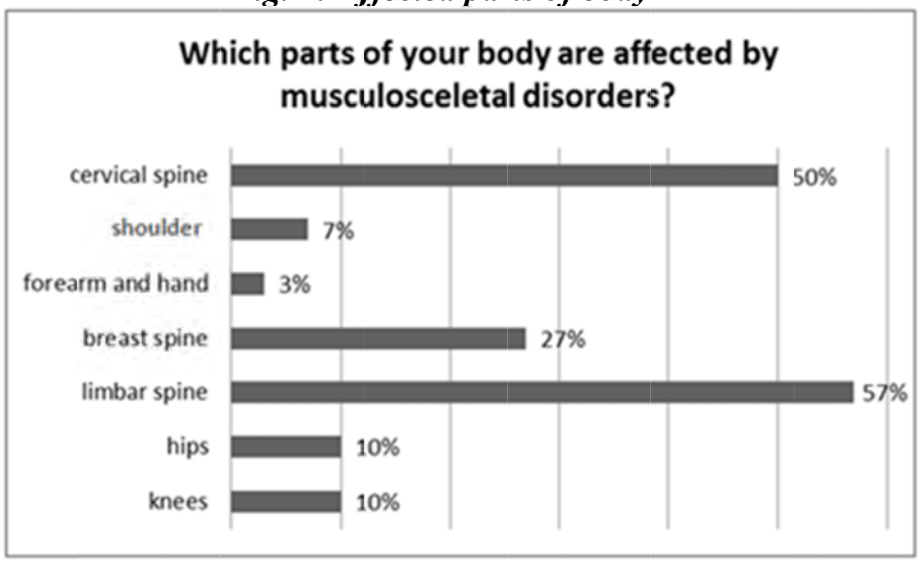
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	9,94086	1	9,94086	19,22993	0,000019	3,892494
Within Groups	95,11828	184	0,516947			
Total	105,0591	185				

Source: [15]

According to the results, length of participants´ practice does not have an influence on frequency of MSD´s experience. It could mean that there are other important factors which is necessary to prove. It could be wide spectrum of factors, eg. workplaces conditions, demography, social background, lifestyle, etc.

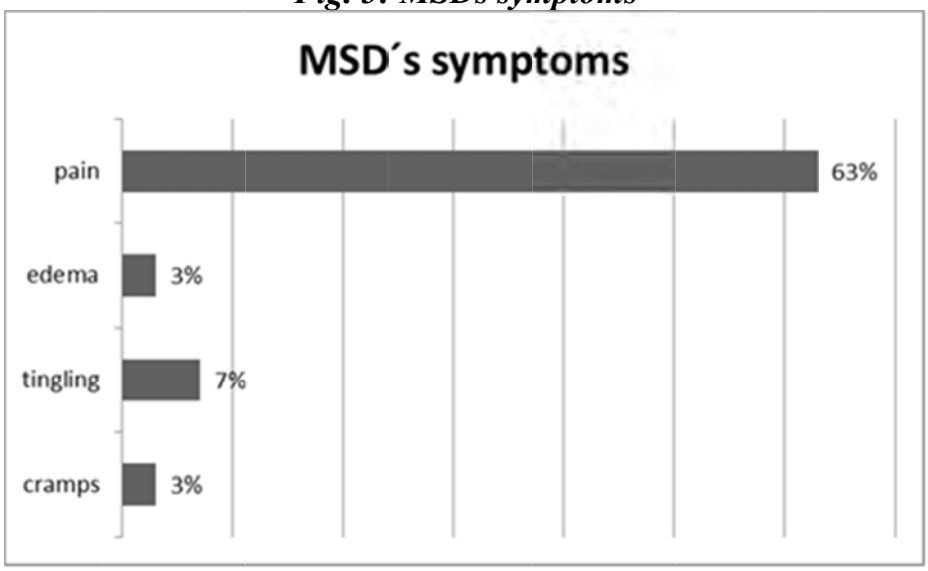
The respondents also indicated parts of their body which are affected by MSD´s. Apparently, as can be seen in the graph below, the most affected is the backbone; concretely lumbar, cervical and breast spine. Based on the results, the majority of MSD´s symptoms, exactly 63%, are accompanied by pain.

Fig. 2: Affected parts of body



Source: [15]

Fig. 3: MSDs symptoms



Source: [15]

In the table below is seen the relation between type of MSD´s symptoms and medical care sought for MSD´s. P-value is 0,8027. It means very strong influence between these factors. It is evident that there are some symptoms which occurenccy needs the medical care and others that do not need it. The most common symptoms and its occurency is displayed in the graph below. As a serious one we could consider eg. edema or tingling of affected parts of body.

Tab. 5: ANOVA Type MSD´s symptoms experienced vs. medical care sought

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,048387	1	0,048387	0,062566	0,802764	3,892494
Within Groups	142,3011	184	0,773375			
Total	142,3495	185				

Source: [15]

3 Discussion

Healthcare sector is very specific area, but also methods of industrial engineering, including ergonomics, can be applied both in production and in the non-manufacturing sector. This is evidenced by numerous international studies dealing with these problems.

Czech health care facilities are almost untouched as regards the lean healthcare. The crucial point is consciousness that the benefits of the implementation of some chosen methods of lean healthcare can have a very positive effect on economic indicators, which could be a good argument at a time when some Czech facility is on the verge of bankruptcy. The results of my work could be a basis for an appeal to the management of healthcare facilities that took a step toward lean healthcare decided to implement lean tools, especially applying of ergonomic principles (ergonomic tools, training, audits). Through the application of ergonomic principles the occurrence of occupational diseases would be eliminate. The occupational diseases carries double cost - the cost of refund of wages for inability to work and cost of often very prolonged treatment.

Last but not least the uncomfortable working conditions lead to medical disruption, both due to exhaustion of the medical staff, and because of the negative impact on the patient himself.

Conclusion

This paper introduced the WHEN, WHAT, HOW and WHY of lean in both industry and healthcare. In order to emphasize the importance of lean methods, tools and approaches were reviewed some international statistics related to medical disruptions, as the goal of lean methods is to eliminate errors and to increase procedural stability. This paper presented results of our own survey, focused on ergonomics in Czech hospitals. The results alerted to the poor work environment in medical facilities which can be a reason for musculoskeletal disorders, claimed by 73 % of participants. Undoubtedly, it should indirectly influent patient´s comfort and safety.

Acknowledgement

"The author is thankful to the Internal Grant Agency of FaME TBU No. IGA/FaME/2013/023 (Optimization of management and processes of medical facilities and social services through IE methods) for financial support to carry out this research."

References

[1] BRANDAO DE SOUZA, L. *Trend and approaches in lean healthcare.* Leadership in Health Services. [online]. 2009, vol. 22 no. 2, pg. 121-139. ISSN: 1751-1879. Available from WWW: <http://www.emeraldinsight.com/case_studies.htm/case _studies.htm?articleid=1789347&show=html>

[2] DENNIS, Pascal. *Lean production simplified: a plain language guide to the world's most powerful production system.* New York: Productivity Press, 2002, 170 pg. ISBN 1563272628.

[3] *Drug giant accused of false claims*. MSNBC News. July 11, 2003 Accessed December 17,2003. [cit. 2013-12-19]. Available from WWW: <http://msnbc.com/news/937302.asp?0sl=-42&cp1=1>

[4] Ergonomics in Healthcare: *Ergonomic Injury Prevention in Healthcare Services.* MEINHARDT, Patricia L. Ergonomics in Healthcare [online]. [cit. 2013-12-19]. Available at WWW: <http://ergonomicsinhealthcare.org/>

[5] International Ergonomics Association: *Definition and Domains of ergonomics*. IEA [online]. 2014. [cit. 2014-01-10]. Available from WWW: <http://www.iea.cc/whats/index.html>

[6] JOOSTEN, Tom, BONGERS, Inge and JANSSEN Richard, *Application of lean thinking to health care: issues and observations*. International Journal for Quality in Health Care [online]. 2009, vol. 21, no. 5, pg. 341 – 347. ISSN 1464-3677. Available from WWW: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2742394/pdf/mzp036.pdf>

[7] LAZAROU J, POMERANZ BH, COREY PN. *Incidence of adverse drug reactions in hospitalized patients: a meta-analysis of prospective studies.* JAMA. [online].1998 Apr 15;279(15):1200-5. [cit. 2013-12-19] Available from WWW: <http://www.ncbi.nlm.nih.gov/pubmed/9555760>

[8] MANOS, Anthony, SATTLER, Mark and ALUKAL, George. *Make Healthcare Lean.* Quality Progress [online]. 2006, vol. 39, no. 7, p. 24. ISSN: 0033524X. [cit. 2013-10-29]. Available from WWW: <http://search.proquest.com/docview/214764700?accountid=15518>

[9] MARLEY, Kathryn A., WARD, Peter T. *Lean management as a countermeasure for „Normal" disruptions.* Operation Management Research [online] .2012, vol. 6, no. 1-2, pg. 44 - 52. ISSN: 1936-974. [cit. 2013-12-12]. Available from WWW: <http://link.springer.com/article/10.1007%2Fs12063-013-0077-2>

[10] ROBINSON, Stewart. SimLean: *Utilising simulation in the implementation of lean in healthcare.* European Journal of Operational Research [online]. 2012, vol. 219, no. 1, pg. 188-197 [cit. 2013-10-29]. Available from WWW: <http://www.sciencedirect.com/science/article/pii/S0377221711011234#>

[11] TEICH, Sorin T. and Fady F. FADDOUL. *Lean Management-the Journey from Toyota to Healthcare.* Rambam Maimonides Medical Journal [online]. 2013, vol. 4, no. 2e0007 [cit. 2013-10-29]. DOI: ISSN:2076-9172. Available from WWW: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3678835/>

[12] WEINGART, SN, McL Wilson R, GIBBERFD, RW, HARRISON, B. *Epidemiology of medical error*. West J Med . 2000 Jun;172(6):390-3.

[13] WOMACK, J.P. JONES, D. T. Lean Thinking: *Banish the Waste and Create Wealth in your Corporation.* Simon & Schuster, 1996, London.

[14] WOMACK, J.P. JONES, D.T and ROODS, D. *The Machine that Changed the World*. New York: Rawson Associates Scribner, 1990.

[15] Own elaboration.

Contact Address

Ing. Veronika Vavrušová
Tomas Bata University in Zlin, Faculty of Management and Economics
Department of Industrial Engineering and Information Systems
Mostní 5149, 76001 Zlin, Czech Republic
Email: vavru.ve@gmail.com

Received: 03. 02. 2015
Reviewed: 22. 05. 2015, 01. 06. 2015
Approved for publication: 02. 09. 2015

IS CZECH HEALTH CARE GOING TO BE LEAN?

Edita Vitásková

Abstract: *There is a growing interest in applying lean in healthcare. Healthcare services around the world have adopted industrial engineering methods and process improvement methodologies from the manufacturing sector, known as lean production. The aim of this paper is to provide a review of the existing literature on lean healthcare and to publish basic results of survey focused on Czech medical staff´s knowledge of lean healthcare philosophy. Focus of this article is not to detail lean principles and concepts. The article explores challenges and opportunities faced by organizations that intend incorporating lean management principles and presents the specific context of the healthcare industry. Though there seems to exist an agreement about the potential of lean healthcare, it remains a challenge for academics and practisioners to evaluate lean healthcare under a more critical perspective. This paper aims to describe how the lean healthcare philosophy has being applied and to asses how trends and methods of approach in lean healthcare have evolved over the years.*

Keywords: *Lean management, Healthcare, Quality, Continuous improvement, Customer value.*

JEL Classification: *I19.*

Introduction

The idea of lean healthcare or lean services is not new. A concept which works well in industry has become a great example of using "best practises" to increase work efficiency. Therefore various attempts have been made since 70s´to improve service performance in healthcare sector. Many of new studies talk about costs and non-value added activities reduction, increasing quality, reducing errors and increasing employee motivation and customer satisfaction. Public services all over the world are pressured to increase their efficiency and save money. This trend gives an opportunity to researchers to study this topic in detail and to assess which of the time-proven methods could be used in healthcare to make the health care efficient.

1 Introducing Lean

Lean is a multi-faceted concept that requires organizations to exert effort in several areas simultaneously. The evolution of production systems is tightly linked to the story of Toyota Motor Company (TMC), which initiated the lean manufacturing process. In1950, the entire Japanese auto industry was producing an annual output equivalent to three days of U.S. car production. Therefore, Eiji Toyoda was sent to the U.S. to study manufacturing methods. Based on his findings and through much iteration, the Toyota Production System (TPS) evolved and provided a tool that made use of innovation and common knowledge. [26]

The evolution of production systems is tightly linked to the story of Toyota Motor Company (TMC) which initiated the lean manufacturing process. By 1950, the entire Japanese auto industry was producing the annual output equivalent to three days of the US car production. Therefore Eiji Toyoda was sent to the US to study manufacturing methods. Based on his findings and through much iteration, the Toyota Production System (TPS)

evolved and provided a tool that used innovation and common knowledge. [26] Although lean concepts were initially developed to improve car production, a study showed that the lean principles could be applied to virtually any manufacturing system. [29]

The precise date of the first application of lean in healthcare is uncertain. Joseph Juran, who linked manufacturing and the healthcare industry, wrote: "…as the health industry undertakes … change, it is well advised to take into account the experience of other industries in order to understand what worked and what has not." … [4]

In minds of many, the health industry is different. This cannot be disclaimed. History, technology and culture of the healthcare industry is completely different. However, the decisive factors in what works and what does not are the managerial processes, which are alike for all industries. [18]

This is the reasoning that allows the lean production principles to be applied in the healthcare industry, despite the principles were originally developed for application in other industries.

2 Why to implement Lean in hospitals?

Lean is a management model that was born in manufacturing and is now taking hold in health care. Focused on patient needs, it uses a bottom-up approach to identify and fix broken systems anywhere in an organization. Lean engages all staff as well as leaders in redesigning processes for greater efficiency and quality. [20]

Healthcare systems are very costly and the inpatient treatment in hospitals is a major part of these costs. The question is, how can greater efficiency be effected without influencing the core business of a hospital - the cure of patients. Through improving the process flow of facility management (FM) processes, savings within these processes and less disturbance of primary processes should be accomplishable. [17]

The main reason for implementing lean methods is the fact that lean leads to less disruptions and therefore to higher stability. According to Dennis, "STABILITY" is the main object of the lean. Archimedes motto: "Give me a place to stand, and I can move the earth", explains the importance of stability either in the production factors (man, machine, material, method) in the case of production or in other areas. Dennis argues that the stability starts with visual management, 5S workplace organization and TPM (Total Productive Maintenance). All of them support standardization and provide point-of-use information that eases decision making. [12]

Implementation of lean in healthcare, particularly in hospitals, should remove duplicate processes and unnecessary procedures and also eliminate disruptions which may cause fatal consequences [21].

2.1 History of implementing Lean in healthcare

Although lean is increasingly prevalent in healthcare, there is only little evidence of a full implementation of lean to the level achieved by Toyota. The literature suggests that healthcare organisations are implementing lean by using simple tools on small projects. Experience from abroad shows that the interpretation of lean concept and industrial engineering methods outside of the industry is a challenge, and its success rests on undestanding first that lean is a system, not a toolbox [2].

The reviewed literature shows that speculation about the potential use of “lean” in healthcare first appears in a work published by the NHS Modernisation Agency (2001). In 2002, Bushell and Shelest described a pilot implementation of lean in a mid-sized hospital in the USA. Specifically, the implementation was focused on the improvement of patient flow. This work increased interest about the subject, by claiming that good results were achieved.

The other example of successful implementation of comprehensive lean projects in healthcare institutions is Virginia Mason Medical Center in US. The hospital reported increased profit margins, decrease in deaths and decrease in the number of medication errors. Other reported benefits are an 85% reduction in how long patients wait for lab results, increased productivity by 93 % and lowering inventory costs by $ 1 million [5].

Afterwards, there have been published several books suggesting implementation guidelines for lean in healthcare (see [3], [10], [32] or [32] for reference). However, it seems that healthcare delivery is still far from achieving the level of excellence of lean applications in manufacturing, such as the Toyota´s “way”. [7]

Hospital facilities are tied very ossified system of laws and health insurance companies are very conservative and do not have enough economically oriented emploees who would be interested in reducing costs and improving the efficiency of individual processes. Often hospitals focus more on external conditions such as the right legislation or situation payers – insurance companies. They can not accept the idea of reducing internal costs and support their own equipment and their own staff.

2.2 Wasting

Lean thinking is a philosophy that requires the continuous elimination of waste or non-value-added elements from processes so that customers (or patients in healthcare industry) are given even greater value. These wastes are common in all industries and are not unique to healthcare.

Undestanding waste is the most important in Lean thinking. People should realize which processes are wasteful and which add value to the customer – to the patient. "Rather than focusing on cutting personnel and assets, "lean healthcare" looks to improve patient satisfaction through improved actions and processes". [28] Only 5% of activities are Value Adding and 95% of activities are wasteful. [31] Peter Drucker says: "There is nothing so useless as doing efficiently that which should not be done at all." [31]

The pre-defined wasteful activities are described below [8], [1]:

- Overproduction. Producing something in excess, earlier, or faster than the next process needs it. In healthcare it can be e.g. printing clinical reports when they are not needed or reprinting labels “just in case” they are.
- Inventory. The cost of managing a large supply inventory may not be obvious at first glance, however, beside consumption follow-up and space required to store, there is a need to follow expiration dates and to constantly ensure that the items in the inventory are not technologically obsolete. Moreover, it was already shown that the overall cost of smaller and more frequent shipment is lower than a large-volume discount purchases. Example in healthcare system: retaining unnecessary forms or obsolete items or keeping unused supply closets.

- Movement. Moving or seeking patients, equipment, medication or charts unnecessarily far away or walking too far to find other staff members are the main examples of this type of waste. A lot of walking waste can arise from poor layout (or design of the working area).
- Transportation. In healthcare the wasting transportation can be evident when moving patients, lab tests, information, etc.
- Over-processing. There are times when material provided to the customers (patients) mandated by regulations can be confusing. Staff may be taking down unnecessary information from patients on admission, making multiple recordings and logs of data, writing by hand rather than by using a computer etc. Moreover, multiple insurance claim forms (mainly in the US), including ones that are not bills, can confuse the unexperienced "novice".
- Defects (errors). There are many examples for these defects that can be related to poor labeling of tests, incomplete information in patients´charts, misfiling or making mistakes in documents that must be corrected later, making mistakes that lead to complaints about service quality, or in instructions provided to referrals.
- Waiting. There is probably not much need to explain why waiting a few hours in line is a wasteful activity, as well as waiting for people to phone back, waiting for equipment to arrive from supplier departments etc.
- Under-utilizing staff. Under-use is not only time-dependent but also involves deeper levels such as not sharing knowledge or not taking advantage of someone´s skill and creativity. Under-use typically shows in hierarchical structures and not using teams.

Standard healthcare systems are not designed to make the process of care flow smoothly. Most are organized around functional departments such as pathology, radiology, radiotherapy etc., in which patients travel from one site to queue up at another. In such systems, a patient can typically spend a day in hospital for only 18 minutes of value-added-time: three minutes for a blood test and five for a radiograph (for example) and then ten minutes spent with a doctor. The focus of lean thinking in healthcare is on improving flow among activities of "core value" to organizations, and on individual patients and their journeys. [1]

Compared to other industries, health care has been slow to identify who the customer really is. Because of the complexity of the health care system, internal customers — physicians, hospitals, insurers, government, payers — have often driven processes. It is critically important that valuebe defined by the primary customer: the patient.

A perfect process creates precisely the right value for the customer. In a perfect process, every step is valuable (creates value for the customer), capable (produces a good result every time), available (produces the desired output, not just the desired quality, every time), adequate (does not cause delay), flexible, and linked by continuous flow. Failure in any of these dimensions produces some type of waste. [14]

The challenge is to revolutionize our expectations of healthcare: to design a continuous flow of work for clinicians and a seamless experience of care for patients. [1]

2.3 Factors of successful implementation

Authors of case studies focused on applying lean tools to healthcare often points out that the tools or methods would not have led to success on their own. Additional factors are frequently cited as central to the successful implementation. These factors are [23]:

- Wide-spread involvement. Any process change within an organization will have multiple stakeholders. Stakeholder involvement in the change effort is cited as a crucial factor to success. In healthcare systems, the typical stakeholders are frontline staff, local management, upper management and medical staff. The involvement of those who are stakeholders extends beyond the local departments to all those who are directly or indirectly influenced by the change. The goal is to provide a clear and consistent vision to guide the program and to help members of the organization to view Lean methods and quality as an integral part of their everyday work.
- Communication. This is reported by many authors as critical when implementing a Lean initiative. It is necessary to create an environment in which people feel free and safe to report issues and errors. Forms of communication include for example face-to-face meetings, regular meetings of staff and employees, emails, banners and various forms of visual communication. Several authors also highlight that publicizing the success of Lean projects makes change visible, inspires others within the hospitals and therefore encourages a culture of continuous improvement. [13]
- Organization Commitment and Support. This support means providing sufficient resources such as: funding for staff or IT systems, investment in training, development in project management and facilitation of change to support improvement activities. It is important for managers to spend time working with staff to resolve problems and encourage staff to try new ideas. [16]
- Training. A few authors specifically stated the importance of senior managers attending special training in the use of Lean tools, so that they are able to teach others how to use them. Authors emphasis that leaders also need to prepare staff for a change. The goal is to help staff understand and accept the reasons for implementing Lean, its benefits and challenges and what exactly Lean means for them personally. Ways of preparation include meetings to explain current situation, initial education of Lean, or Lean awareness workshop. According to several authors, staff preparation time varies from one week to several months. [6],[16]
- Problem-solving. Numerous authors highlight the importance of accurately identifying the problem and its root cause. Root cause analyses attempt to identify the source of a problem at a deep enough level that solution will prevent recurrence in the future. Subsequently comes experimenting on possible solutions to verify that the problem was diagnosed correctly. [24]

2.4 Inhibitors to Successful Lean Implementation

An important reason for failure in lean implementation to healthcare is that most organizations revert to old habits without successfully making the transformation to lean thinking and behaviors. [19]

One of the most salient inhibitors for the improvement community is believed to be the adaptation of Lean tools and concepts to a healthcare setting. Most of the existing examples are specific to manufacturing and there is an absence of translation of the manufacturing language for Lean into healthcare. [24]

Authors report that the difficulty is due to the lack of leaders with expertise, and trainees having limited knowledge of basic tools and skills commonly used in manufacturing. Several authors believe that there are still knowledge gaps in how management should facilitate effective lean learning processes and behaviors in hospitals. [19]

Therefore administrators and managers may be unprepared to provide their employees with the learning and experience necessary to develop a lean culture and mindset. Using unfamiliar terminology and examples foreign to the average healthcare worker hampers the acceptance of the methodology. [13],[16]

3 Current situation in selected Czech hospitals

In order to find out what is Czech medical staff´s knowledge of lean healthcare philosophy and tools, we created a survey and worked with several not-for-profit Czech hospitals. In evaluating the knowledge, working attitude and behaviors of participants, it is important to use both quantitative and qualitative methods. Quantitative data provides numerical and statistical information, and qualitative data provides the deep narrative on the context. The design of the survey was done using standard instrument design methods. [11]

Main object of our interest was the overall interest of the hospitals staff in lean methods and their attitude to any improvement activities. The basic questions were:

- Is there any difference in perception of lean initiatives of doctors/nurses/ paramedical staff? (Does education have any influence?)
- Is interest in improvement activities influenced by length of practise? If so, does practice influence the interest in improvement activities in positive or in negative way?

The quantitative portion for this research comes from a survey of employees (doctors, nurses and paramedical staff) in various not-for-profit hospitals across the Czech Republic. The survey was administrated since October and November 2013. Until now we collected a total of 279 completed surveys. Surveys were distributed to doctors, nurses and paramedical staff in selected state hospitals across the Czech republic (total of 12 hospitals). The basic characteristics are displayed below.

Tab. 1: Basic characteristic of a sample.

		Frequency	Percent (%)
Gender	Male	42	15,05%
	Female	237	84,95%
Age	18 - 29 years	87	31,18%
	30 - 49 years	129	46,24%
	50 and more	63	22,58%
Practice	Less than 5 years	60	21,51%
	5 - 10 years	66	23,66%
	10 and more	153	54,84%
Position	Doctor	42	15,05%
	Nurse	174	62,37%
	Paramedical staff	63	22,58%
Interest in improvement activities (kaizen)	Absolutely interested	30	10,75%
	Maybe interested	135	48,39%
	Not interested	60	21,51%
	Nothing to improve	54	19,35%
Percieved influence on quality	Absolutely influencing	153	54,84%
	Rather influencing	90	32,26%
	Rather not influencing	30	10,75%
	Definitely not influencing	6	2,15%
Percieved rate of wasting	0 - 4 (0 = rarely, 4 = permanently)		
Overproduction	0	15	5,38%
	1	78	27,96%
	2	99	35,48%
	3	54	19,35%
	4	33	11,83%
Wasteful movements	0	25	8,96%
	1	74	26,52%
	2	90	32,26%
	3	57	20,43%
	4	33	11,83%
Defects	0	48	17,20%
	1	93	33,33%
	2	78	27,96%
	3	30	10,75%
	4	30	10,75%

Source: Author

3.1 Results

Below the perceived influence on quality depending on job position in hospital is displayed.

Tab. 2: ANOVA: Perceived influence on quality vs. job position.

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	10,4086022	1	10,40860215	21,57887085	0,00000645	3,89249438
Within Groups	88,7526882	184	0,482351566			
Total	**99,1612903**	**185**				

Source: Author

According to the results, job position does not have an influence on how hospital employees do perceive their influence on quality of health care. A good message is, that regardless the job position, almost 88% of the participants believe that they can influence the quality of health care directly. If they do realize that, we can suppose that they should be more willing to work on increasing the quality.

It may seem astounding, but based on the results, 91 % of the intervention group participants have never heard about the Lean Healthcare concept. Only 9 % of the participants do know the Lean Healthcare concept, mainly from medical journals or from internet.

We have also asked on what do the participants think the Lean Healthcare is consists in. 62 % participants have no idea about meaning of the Lean healthcare concept. 14 % of the intervention group thinks that Lean Healthcare is focused mainly in cost-saving and waste-reducing activities; 17 % believe that Lean Healthcare consists in increasing work efficiency. Remaining 7 % participant thinks that Lean Healthcare provides only a basic care to patients.

Another good result was given by participants according to their willingness to get involved in improvement activities, which is also not conditional on a job position they have.

Tab. 3: ANOVA: Involvement in improvement activities vs. job position.

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1,94086	1	1,94086	5,181279	0,023983346	3,892494
Within Groups	68,92473	184	0,374591			
Total	**70,86559**	**185**				

Source: Author

Regarding the improvement activities, we decided to analyze an influence of length of participants´ practice on their attitude to improvement activities. As can be seen in the table below, length of practice has an impact on interest in improvement activities.

Tab. 4: ANOVA: Involvement in improvement activities vs. length of practise.

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1,209677	1	1,209677	1,590839	0,20880303	3,892494
Within Groups	139,914	184	0,760402			
Total	**141,1237**	**185**				

Source: Author

In order to prove the results above we have tested a correlation between the two factors. Measurement units of the correlation values are set up as follows: [17]

0,00 - 0,14 ⇒very weak correlation;

0,15 - 0,24 ⇒ weak correlation

0,25 - 0,39 ⇒ middle strong correlation

0,40 - 0,50 ⇒ strong correlation

0,51 and above ⇒ very strong correlation

Correlation value between length of practice and interest in improvement activities is 0,5105. It means very strong correlation between these factors. Therefore we can say that willingness to improve is strongly influenced by length of practice. The longer practise participants have, the less interested they are in any improvement activities. This is not really a positive outcome.

The most positive feedback from the survey was given by 91 % of the intervention group when answering question about possible interest in learning methods which can increase an efficiency of their everyday work, such as waste reduction, new layouts, applying ergonomic principles etc. These results give a huge opportunity and suggest a role for practicing professionals to implement (or assist in implementation) Lean concept to healthcare. It also suggests a role for academics to study, characterize and disseminate best practices.

4 Conclusions and Future Directions

As the cost of health care continues to rise, hospitals are put under increasing pressure to reduce costs while improving patient safety and care, and reducing errors. New discoveries in medicines are being made and new treatments are being developed, but these will be no more important to healthcare services in the future than the results of lean thinking. Medical devices and equipment are very costly and therefore it is necessary for hospitals to seek all possible ways of reducing them. One of those ways can consist of optimizing processes and a use of industrial engineering methods to make the processes more effective.

Applying lean thinking to the healthcare sector can provide significant cost and process efficiencies. However, in order to realize and sustain these benefits fully, there is an urgent need to educate and empower healthcare staff in the Lean principles and methodologies.

Education and training in lean thinking should be an inseparable part of organisations´ competency frameworks to ensure consistency across all functions. Therefore there appears to be a significant need for the development of training materials and curricula that replace manufacturing jargon with healthcare terminology, contain healthcare-related examples. Much work remains to understand how to implement the lean model into healthcare.

Acknowledgement

This contribution was supported by the Internal Grant Agency of FaME TBU No. IGA/FaME/2013/023 "Optimization of management and processes of medical facilities and social services through Industrial Engineering methods".

References

[1] AHERNE, J. Think lean. *Nursing management*. Vol. 10 No. 10, 2007. Pp 13-15.

[2] BALLÈ, M., RÈGNIER, A., (2007), "Lean as a learning systém in a hospital ward", *Leadership in Health Services*, Vol. 20 No. 1, pp. 33-41.

[3] BERWICK, D., KABCENELL, A., NOLAN T. No Toyota yet, but a start. *Modern Healthcare*, 2005. Vol. 35 No. 5, pp. 18-20

[4] BEST M., NEUHAUSER D. Joseph Juran: overcoming resistence to organisational change. *Qual Saf Health Care*, 2006. 15:380-2.

[5] BLACK, C. To build a better hospital. Virginia Mason takes lessons from Toyota Plants. *Seattle Post-Intelligencer*, 2008.

[6] BOADEN, R. Quality Improvement: Theory and Practise. *British Journal of Healthcare Management*, 2009. 15(1), pp 12-16

[7] BRANDAO DE SOUZA, L. Trend and approaches in lean healthcare. *Leadership in Health Services*. Vol. 22 No. 2, 2009. Pp 121-139

[8] BUSH, RW. Reducing waste in US health care systems. *JAMA*, 2007;297:871-4.

[9] BUSHELL, S., SHELEST B. Discovering lean thinking at progressive healthcare. *The Journal for Quality and Participation*, 2002. Vol. 25 No. 2, pp.20-5

[10] CHALICE, R. Stop Rising Healthcare Costs using Toyota lean Production Methods: 38 Steps for Improvement. *Quality Press*, 2005. Milwaukee, WI

[11] CROCKER, L., ALGINA J. Introduction to Classical and Modern Test Theory. *Wadsworth Publishing*, 2006.

[12] DENNIS, P. Lean production simplified: a plain language guide to the world's most powerful production system. *New York: Productivity Press*, 2002, 170 pg. ISBN 1563272628.

[13] DICKSON, E., ANGUELOV, Z., VETTERICK, D., ELLER, A., SINGH S. Use of Lean in the Emergency Department: A Case Series of 4 Hospitals. *Annals of Emergency Medicine*, 2009. 54(4), pp 504-510.

[14] *Going Lean in Health Care*. IHI Innovation Series white paper. Cambridge, MA: Institute for Healthcare Improvement; 2005. (Available on www.IHI.org)

[15] KAPLAN, G., PATTERSON S. Seeking PERFECTION in Healthcare: A Case Study in Adopting Toyota Production System Methods. *Healthcare Executive*, 2008. 23(3), pp 16-21.

[16] KUNIBERT, L., JOCHEN, A., UWE, P., VISHAL, S. Step-by-step process analysis for hospital facility management: An insight into the OPIK research project, *Facilities*, 2005. Vol. 23 Iss: 3/4, pp.164 - 175

[17] MANOS A, SATTLER M., ALUKAL G. *Make healthcare lean*. Qual Prog, 2006. 39:24.

[18] MAZUR, L., McCREERY, J., ROTHENBERG L. Facilitating Lean Learning and Behaviors in Hospitals During the Early Stages of Lean Implementation. *Engineering Management Journal*, Vol. 24 No. 1, 2012. Pp 11-22

[19] MITCHELL, R. *Getting Lean: A Journey Toward Better Health Care*. California Healthcare Foundation; 2013. Available at WWW: <http://www.chcf.org/publications/2013/12/getting-lean>

[20] ROBINSON, S. *SimLean: Utilising simulation in the implementation of lean in healthcare*. European Journal of Operational Research. 2012, vol. 219, no. 1, pg. 188-197 [cit. 2014-10-29]. Available at WWW: <http://www.sciencedirect.com/science/article/pii/S0377221711011234#>

[21] SMITH, A. C., BARRY, R., BRUBAKER C. E. Going Lean: Busting Barriers to Patient Flow. *Health Administration Press*, 2008. Chigago, IL.

[22] SOBEK, D. K., LANG, M. Lean Healthcare: Current State and Future Directions. *Proceedings of the 2010 Industrial Engineering Research Conference*. Montana State University, Bozeman, MT 59717-3800

[23] SOBEK, D., JIMMERSON C. A3 Reports: Tool for Process Improvement. *Proceedings of the Industrial Engineering Research Conference*, 2004. Houston, TX.

[24] SOBEK, D., JIMMERSON C. Applying the Toyota Production System to a Hospital Pharmacy. *Proceedings of the Industrial Engineering Research Conference*, Portland, OR, 2003.

[25] TEICH S. T., FADDOUL F. F. Lean Management — *The Journey from Toyota to Healthcare*. RMMJ, 2013. 4(2):e0007. doi:10. 5041/RMMJ. 10107.

[26] VITÁSKOVÁ, E. The author´s own intellectual creation.

[27] WEINSTOCK, D., (2008), "Lean Healthcare", *The Journal of medical Practice Management* : MPM, Vol. 23 No. 6, pp. 339-341.

[28] WOMACK, J. P., JONES D. T. Lean Thinking: Banish the Waste and Create Wealth in your Corporation. *Simon & Schuster*, 1996, London.

[29] WOOD, N., (2004), "Lean Thinking", *Management Services*, Vol. 48 No.2, pp. 8-10.

[30] ZIDEL, T. A lean Guide to Transforming Healthcare: How to Implement lean Principles in Hospitals, Medical Offices, Clinics, and other Healthcare Organizations. *Quality Press*, 2006. Milwaukee, WI.

[31] ZIEBERTZ, H.-G., KAY K. W. Youth in Europe. New Brunswick, N.J.: Distributed in North America by Transaction Publishers, 2005-2009, 3 v. ISBN 97838258157903.

Contact Address

Ing. Edita Vitásková
Tomas Bata University in Zlin, Faculty of Management and Economics
Department of Industrial Engineering and Information Systems
Mostní 5149, 76001 Zlin, Czech Republic
Email: vitaskova.edita@gmail.com

Received: 03. 02. 2015
Reviewed: 26. 05. 2015, 08. 06. 2015
Approved for publication: 02. 09. 2015

GUIDELINES FOR PAPER WRITING

Scientific Papers of the University of Pardubice. Series D, Faculty of Economics and Administration

GENERAL INFORMATION

By sending an article, the author agrees that the article is original and unpublished. The author agrees with the on-line publication of the contribution as well. All the papers must follow the format guidelines. Decision about acceptance of article for publication is based on anonymous peer review reports.

FORMAL REQUIREMENTS

Language

Papers can be written in Czech, Slovak or English language according to the calls of contribution submission. In the case of contribution submission written in English, the statement about the quality of English language is required.

Paper Structure

Title. Author. Abstract (150 – 200 words). Keywords (5 – 7 keywords). Codes of JEL Classification (http://www.aeaweb.org/jel/jel_class_system.php). Introduction. 1 Statement of a problem. 2 Methods. 3 Problem solving. 4 Discussion. Conclusion. Acknowledgement. References. Contact Address. For writing your article please use predefined template styles and formats. The structure of the article is required.

Main Text Format

The article should not be longer than min. 8 and max. 12 pages format A4. The paper should be written in MS Word, font Times New Roman 13, line spacing 1, spacing after heading and paragraphs is 6 mm, justified alignment. All margins are set to 2.5 on the left and right, top and down edge 2. Header 1.25 and footer to 1.6. If necessary, use bold, do not use underline and italics. Paragraph indentation is 6 mm. Do not use the numbering of pages.

Headings

1 Chapter (Times New Roman, 14, bold)

1.1 Sub-chapter (Times New Roman, 13, bold)

1.1.1 Sub-sub-chapter (Times New Roman, 13, bold italics)

Tables and Figures

Tables and pictures are placed directly in the text. Figure is any graphical object other than table. Figures – we recommend choosing two-dimensional graphs, only in cases of inevitable spatial graphs. Lines, axes and a description of the image are written in font size 9. We recommend not using the raster grid and outer surround. Journal is printed in black and white. The source is placed right below the figure or table, Times New Roman, italics, 11.

Marking tables: **Tab. 1: Title in italics, bold, 13**, placed above the table, an explanation of abbreviations used in the note below the table. Tab. 1, Tab. 2 in the text. Example:

Tab. 1: Title of the table

Number	Year 2001	Year 2002	Year 2003
1	23	25	23
2	24	25	24

Source of data: [1]

Marking figures: ***Fig. 1: Title in italics, bold, 13,*** *located above the figure*. Fig. 1, Fig. 2 in the text of article. Example:

Fig. 1: Title of the figure

Source of data: [1]

Formulas

Formulas are to be numbered. The number should be written in font size 13 Times New Roman in parentheses, aligned to the right margin and next to the formula.

Citation in the Text

Literature reference should be presented in the text in its respective place with an indication number in square parentheses: [1]. If necessary, use [1, p. 24].

Footnotes

Footnotes should be used sparingly. Do not use footnotes for citing references

Acknowledgement

In the case, the paper presents the result of the grant project, an acknowledgement should be there (e.g. The paper was supported by GA ČR No. 111/111/111 “Title of the project”).

References

References to literature should be presented according to ISO 690 (01 0197). Sources are sorted alphabetically. Numbers are in square brackets, font Times New Roman, size 13 pt, indent 1 cm, space 6 points. List of multiple publications from one author must be listed in order of date of issue. If one title has more authors, initiate maximally three. If one or more names are missed attach to the last mentioned name abbreviation "et al." or its Czech equivalent of “a kol.”. Example:

References (Times New Roman, 13 points, bold, alignment left, a gap of 6 points)

[1] BELODEAU, B., RIGBY, D. *Management Tools and Trends 2009*. Bain&Company. [cit. 2010-02-25]. Available at WWW: Available from WWW: <http://www.bain.com/bainweb/PDFs/cms/Public/Management_Tools_2009.pdf>.

[2] BERGEVOET, R. H. M., ONDERSTEIJN, C. J. M., SAATKAMP, H. W., VAN WOERKUM, C. M. J., HUIRNE, R. B. M. Entrepreneurial behavior of Dutch dairy farmers under a milk quota system: goals, objectives and attitudes. *In Agricultural Systems,* 2004, Vol. 80, Iss. 1, pp. 1-21. ISSN: 0308-521X.

[3] GREENACRE, M. *Correspondence Analysis in Practice*. Boca Raton: Chapman & Hall/CRC, 2007. 280 p. ISBN 978-1-58488-616-7.

Contact Address (Times New Roman, 13 points, bold, alignment left, a gap of 6 points)

prof. Ing. Jan Novák, CSc.
University of Pardubice, Faculty of Economics and Administration
Studentská 84, 532 10 Pardubice, Czech Republic
Email: Jan.Novak@upce.cz
Phone number: +420 466 036 000

Paper submission
Please send your paper in electronic form MS Word via e-mail
to Martina.Kynclova@upce.cz

REVIEW PROCEDURE
At first, each submission is assessed by executive editor and by The Editorial Board, who check whether the submission satisfies the journal requirements. If it does, they send the papers to the 2 referees. Referees elaborate evaluation reports in the form of a standard blank form (sent to referees by the executive editor). Referees evaluate the papers from content and formal point of view, a summary of comments for the author(s) is included. The referee recommendation to the editor should be one of the following: Accept for publication, accept with minor revisions, accept with major revisions, reject. The Editorial Board reserves the right to return to the authors any manuscript that in their opinion is not suitable for publication in the journal, without expressly stipulating the reasons for doing so. Accepted articles for publication do not undergo linguistic proofreading. Executive editor informs the author about the result of the review procedure.

EDITORIAL BOARD

Senior editor
doc. Ing. et Ing. Renáta Myšková, Ph.D.

Executive editor
Ing. Martina Kynclová

Members
prof. Dr. John R. Anchor, University of Huddersfield, England
doc. Ing. Josef Brčák, CSc., Czech University of Life Sciences Prague, Czech Republic
prof. Ing. Jan Čapek, CSc., University of Pardubice, Czech Republic
prof. Ing. Jiří Dvořák, DrSc., University of Technology Brno, Czech Republic
doc. Ing. Peter Fabian, CSc., The University of Žilina, Slovak Republic
doc. Ing. Mojmír Helísek, CSc., The University of Finance and Administration Prague, Czech Republic
prof. Dr. Roberto Henriques, Universidade Nova de Lisboa, Portugal
prof. Lazaros S. Iliadis, Democritus University of Thrace, Greece
prof. Ing. Ivan Jáč, CSc., Technical university of Liberec, Czech Republic
prof. Ing. Christiana Kliková, CSc., Technical University of Ostrava, Czech Republic

prof. Sergey V. Kostarev, PhD., Omsk Institute of Plekhanov Russian University of Economics, Russia

prof. JUDr. Jozef Králik, CSc., Police Academy Bratislava, Slovak Republic

prof. PhDr. Miroslav Krč, CSc., University of Defence Brno, Czech Republic

prof. PhDr. Karel Lacina, DrSc., The University of Finance and Administration Prague, Czech Republic

doc. Ing. Ivana Linkeová, Ph.D., Czech Technical University in Prague, Czech Republic

doc. JUDr. Eleonóra Marišová, PhD., Slovak University of Agricultural in Nitra, Slovak Republic

doc. Ing. Ilona Obršálová, CSc., University of Pardubice, Czech Republic

prof. Ing. Vladimír Olej, CSc., University of Pardubice, Czech Republic

prof. dr. Ing. Miroslav Pokorný, Technical University of Ostrava, Czech Republic

prof. Ing. Jiří Polách, CSc., Business School Ostrava, Czech Republic

prof. univ. dr. Angela Repanovici, Universitatea Transylvania Brasov, Romania

prof. RNDr. Bohuslav Sekerka, CSc., University of Pardubice, Czech Republic

prof. dr. Ligita Šimanskienė, Klaipėda University, Lithuania

Ing. Karel Šatera, PhD. MBA, University of Pardubice, Czech Republic

doc. Ing. Elena Šúbertová, Ph.D., University of Economics Bratislava, Slovak Republic

prof. dr.Teodoras Tamošiūnas, Šiauilai University, Lithuania

doc. Ing. Miloš Vítek, CSc., Emeritus academic staff University of Hradec Králové, Czech Republic

CONTACT US

University of Pardubice
Faculty of Economics and Administration
Studentská 95, 532 10 Pardubice, Czech Republic
Email: martina.kynclova@upce.cz
www.uni-pardubice.cz

Journal web page:
http://www.upce.cz/en/fes/veda-vyzkum/fakultni-casopisy/scipap.html

Title	Scientific Papers of the University of Pardubice, Series D
Publisher	University of Pardubice Faculty of Economics and Administration Studentská 95, 532 10 Pardubice, Czech Republic
Registration number	IČ 00216275
Edited by	Ing. Martina Kynclová
Periodicity	3 per year
Volume number	22
Issue number	34 (2/2015)
Place	Pardubice
Publication Date	16. 09. 2015
Number of Pages	152
Number of Copies	80
Edition	First
Printed by	Printing Centre of the University of Pardubice

MK ČR E 19548
ISSN 1211-555X (Print)
ISSN 1804-8048 (Online)

ISSN 1211 555X
MK ČR E 19548