Nikša Alfirević, Ph.D.
Faculty of Economics, University of Split, Split, Croatia
niksa.alfirevic@efst.hr

Darko Rendulić, Ph.D.
Karlovac University of Applied Sciences, Karlovac, Croatia
darkorendulic1@gmail.com

Tanja Urem, mag. oec.
graduated student, Faculty of Economics, University of Split, Split, Croatia
tanja.urem@gmail.com

KEY PERFORMANCE INDICATORS FOR E-GOVERNMENT: METHODOLOGICAL APPROACH TO INDICATOR DEVELOPMENT

Recived: October 15, 2018
Accepted: December 20, 2018

Review

Abstract

It is often assumed that modern information technology (IT) is a source of performance improvement. Empirical research has not univocally confirmed this assumption, since complex, extensive and resource demanding IT tools require extensive organizational restructuring, in order to be properly and successfully implemented. This generates the need to create and use business intelligence and key performance indicators (KPI) to obtain a high quality basis for making decisions in real time. In this paper, authors analyze the existence of a potential relationship between the methodological approach to defining business intelligence (BI)-related KPIs and achieving business process performance, as well as the overall organizational performance. The methodological determinants of the process, in which the KPIs are defined, are empirically analyzed and associated with the two discussed aspects of performance.

The empirical analysis is conducted for the case of e-government development, with the special emphasis on countries from Central, East and South-East Europe. The E-Government development is measured by two KPIs, which have been defined, by strictly following the recommended BI methodology. The two KPIs are related to a business process, performed by the public administration, which can

be greatly facilitated by the introduction of E-Government. This is the process of opening a new enterprise, which can be also viewed as one of key measures of the national economic and entrepreneurial development. The public administration performance in serving the needs of new entrepreneurs for company registration is, therefore, considered in terms of E-Government performance. Two KPIs used measure the procedural complexity and costs for opening a new enterprise in a sample, consisting of 28 European Union member-states.

The statistical analysis uses secondary data, available from the official Eurostat Web pages. The empirical results confirm the existence of the hypothesized relationship between the methodological procedures for developing KPIs and the process performance, which affirms the need to develop both E-Government, as well as other processes in public administration, by using solid planning and methodological approaches.

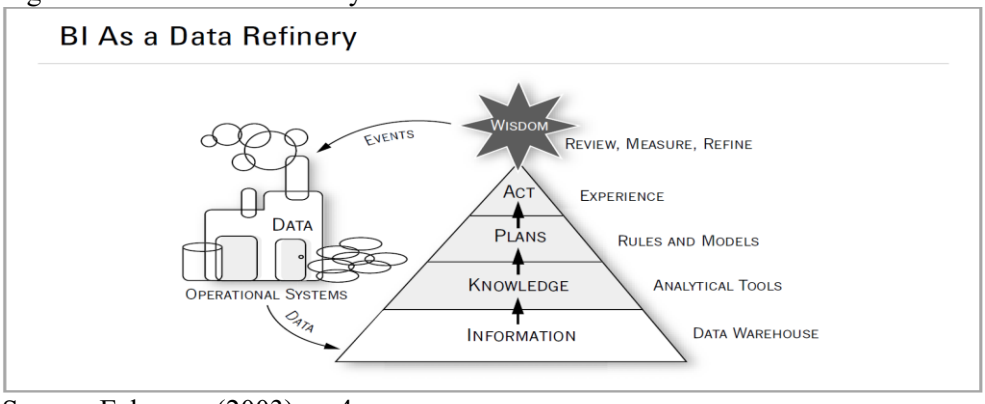
Keywords: *key performance indicators, business intelligence, business processes, information technology, public government*

JEL: D73, H11, L86

1. BUSINESS INTELLIGENCE AND KEY PERFORMANCE INDICATORS

„Business Intelligence" (BI) is frequently emphasized as an important factor of business success, which is often mediated by the performance of business processes. It is used for discovering knowledge, hidden in business records, using appropriate methods, supported by contemporary information technologies (IT). Processing these resources transforms data into information, which can be used by companies' analytics to provide answers to key problems in real time and gain complex knowledge about impact to their businesses for its overall improvement.

Figure 1. BI as a 'data refinery'

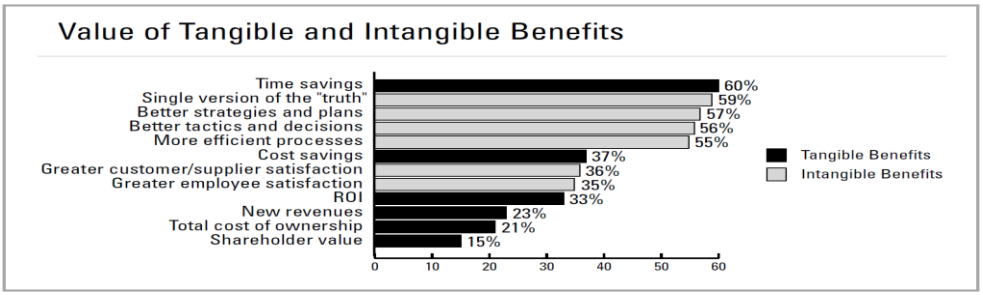


Source: Eckerson (2003), p. 4

It consequently leads to more efficient management. Practicing this has been recognized as competitive advantage, too. The most critical moment at implementing and exploiting BI advantages is defining Key Performance Indicators (KPI), showing the critical aspects of performance in the monitored period of time. They have to be appreciable and reflect the goals one wishes to achieve. KPIs are formulated by management, in cooperation with internal, or external BI specialists. BI cannot replace managers' insights, but it can develop indicators, based on stored and available data or information, which support quick decision-making, by providing quick and precise facts.

The issue of creating indicators, fitting the needs of the company, goes beyond the simple SMART (Specific, Measurable, Action-oriented, Realistic, Time-related) criteria, since those need to provide real business value. As it is often the case with complex methods, requiring a high level of IT investment, empirical research usually demonstrates more intangible, than tangible benefits. For instance, in the case of Knowledge Management implementation in Croatian companies, indirect/intangible benefits, perceived by respondents, proved to be associated with the implementation of KM, while the association of KM with financial performance proved to be elusive (Hajdić, 2015). A similar situation can be observed with BI, as demonstrated by the Figure 2.

Figure 2. A BI solution typically delivers more intangible than tangible benefits



Note: Based on 510 respondents who rated the value of the benefits as "very high" or "high."

Source: Eckerson (2003), p. 11.

2. EMPIRICAL RESEARCH

2.1. Research topic and methodology

This topic of this study is the definition of key performance indicators (KPI), i.e. their correct modeling, according to the business needs, including the definition of the role of BI experts in the process. Data used for generating KPIs were

downloaded from the Eurostat database, related to public administration performance. EU Commission, aware of the importance of digital transformation for EU, has developed the *„eGovernment Action Plan 2016-2020“* (European Commission, 2016), with the goal to modernize the public administration, by improving interaction with companies and citizens. Improved accessibility of public services provides faster, cheaper and users oriented e-government. Thus, we have focused to the one point of action plan, for which three KPIs will be developed, by using the BI process. This is the opening of new companies, which can be considered as one of the key outcomes of the efficient public administration, fostering the entrepreneurial development and business climate in a national economy.

We hypothesize that the quality of the BI process, used to define the relevant KPIs, will contibute to the performance of E-Government business processes.

Hypothesis. *There is a causal relationship between the correctly defined BI KPIs, developed by using a high-quality BI process, and performance of selected e-government processes.*

The survey of KPIs was conducted on the population of 28 EU countries. As a measure of the correct definition of business intelligence indicators, the data on the percentage of ICT (Information and Communication Technology) employees in total employment is used, as those have the ability and knowledge to develop, manage and maintain the ICT systems. The relationship between the quality of the KPI selection process for e-government development and the percentage of ICT employees in total employment is reflected in the fact that effective public sector management requires the use of ICT to achieve a higher level of government efficiency and improved public service for individuals and organizations. Developed economies are relatively advanced in using ICT to improve the functioning of the public sector and provide services, and have a higher percentage of ICT experts in total employment.

Due to the lack of relevant sources on the public administration processes, to be used for comparison of BI processes in public sector(s) of EU counries, used to KPIs, it was measured by the share of ICT specialists among the total number of employees (United Nations, 2012, p. 18).

In order to monitor and compare the status of e-government, as well as form public policies and strategies, it is necessary to define a set of relevant and internationally comparable indicators. Data collection for e-government is complicated and assciated with a range of measurement challenges, such as statistical feasibility, relevance, cost of data collection, burden on respondents, etc. Thus, if the *"share of ICT in governmental organizations"* is to be measured, this ratio will be

comparable only for countries with similar government organization. There are also structural differences in the functions of government in different countries. For example, railway traffic in one country can be a function of general government, and in another country it can be responsibility of business (public or private) sector. Most governments have more levels of authority (central, provincial, regional, local), so the observed ratio of *"ICT officials in governmental organizations*" can lead to skewed data (United Nations, 2014, pp. 3-4).

2.2. Definition and overview of e-government KPIs in the EU

For the purpose of this study, the following KPIs were formulated, with the following characteristics: name and definition of indicator, method of data collection and what data is required for the analysis, data requirements, disaggregations, definitions of units and terms, notes, including scope of extensions to other levels of authority, statistical issues and the otline of a statistical standards statement for the purposes of international reporting (United Nations, 2012, p. 18).

KPI 1: **Share of ICT specialists among the total number of employees** (2016; top 3 EU-28 countries, Croatia and Slovenia).

Title: % ICT specialists among the total number of employees

Indicator definition: Share of ICT specialists among the total number of employees in EU countries. The three most advanced EU member countries, concerning the ICT specialists' share are observed. Share or percentage is calculated as a ratio of ICT specialists employed, divided by number of the total number of employees, multiplied by 100.

Data collection methods: interviewing public institutions or statistics records from the Eurostat database.

Necessary data: number of ICT employees, total number of employees in a country.

Data sorting: Indicators sorted by years and countries; 2016 was observed; presented either in percentage or thousands of employees; annually.

Model questions: How many employed people were in the observed year? How many ICT specialists were employed in the observed year? What is the share – percentage of ICT employees as a share of the overall number of employees?

Definitions of units and terms: ICT specialists are professionals with abilities and knowledge for developing, managing and maintaining ICT systems in the business and public sector.

Notes: Start and end of data collection have to be determined, especially when reporting internationally. Further division, by using the gender, the level of education and similar criteria is also possible.

KPI 2: **Percentage of companies (by country), considering the number of administrative procedures as not being an obstacle to starting a new business** (2016; top 3 EU-28 countries, Croatia and Slovenia).

Title: % companies (in the country) satisfied with the number of procedures to starting a new business (2016)

Definition of indicators: Percentage of the companies (by country) which consider that the number of administrative procedures is not an obstacle for starting a new business. Percentage is obtained by dividing the number of satisfied companies by total number of the companies and multiplied by 100. Top three EU countries, Croatia and Slovenia are analyzed.

Data collection methods: interviewing public institutions or statistics records from the Eurostat database.

Necessary data: number of satisfied companies; total number of companies

Data sorting: Indicators sorted by years and countries; 2016 was observed; presented either in percentage or thousands of companies; annually.

Model questions: How many companies were satisfied/not satisfied? How many companies had a neutral answer?

Definitions of units and terms: Small and mid-size companies, established since the last change of the number of administrative procedures. Number of procedures is number of administrative actions needed for establishing company.

Notes: Start and end of data collection have to be determined, especially when reporting internationally.

KPI 3: **Percentage of companies (by country), considering the costs of establishing a company as not being an obstacle to starting a new business** (2016; top 3 EU-28 countries, Croatia and Slovenia).

Title: % companies satisfied with the start-up costs (2016)

Definition of indicators: Percentage of the companies (by country) which consider that start-up costs are not an obstacle to starting a new business. Percentage is calculated by a ratio of satisfied companies and the total number of companies, multiplied by 100. Top three EU countries, Croatia and Slovenia are analyzed.

Data collection methods: interviewing public institutions or statistics records from the Eurostat database.
Required data: number of companies, which do not consider start-up costs as an obstacle to starting a new business; total number of companies

Data sorting: Indicators sorted by years and countries; 2016 was observed; presented either in percentage or thousands of companies; annually.

Model questions: How many companies do/do not consider the start-up costs as an obstacle to starting a new business? How many companies had a neutral answer?

Definitions of units and terms: Small and mid-size companies, established since the last change of the number of administrative procedures. The cost of procedures is the administrative cost, mandatory in establishing a new company.

Notes: Start and end of data collection have to be determined, especially when reporting internationally.

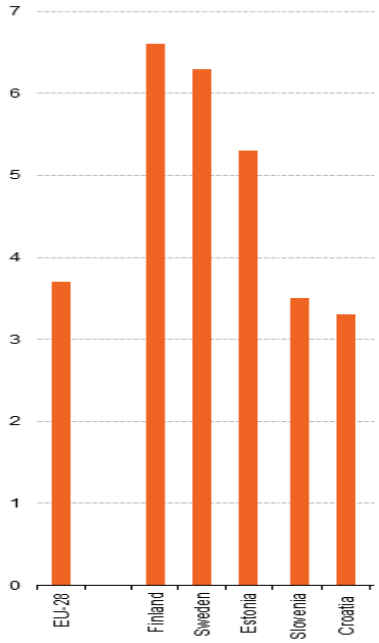
Data, analysis and graphics for KPI1 were directly downloaded from the Eurostat[1], while data for KPI 2 and 3 were downloaded from Eurostat as an Excel table[2], which has been further analyzed. Dashboards were created by using the BI functionalities of a corporate SAP software suite, which was kindly provided for this study by the Swiss BI consultancy DatArt SA[3].

KPI1 - Share of ICT specialists amonh the total number of employees (2016)

The highest values for KPI1 can be found in Finland (6.6%), Sweden (6.3%) and Estonia (5.3%) – far above the EU average of 3.7% (see Figure 3).

[1] Eurostat, http://ec.europa.eu/eurostat/statistics-explained/index.php?title=ICT_specialists_in_employment
[2] Eurostat, https://data.europa.eu/euodp/data/dataset/S2089_417_ENG
[3] http://www.datart.ch

Figure 3. KPI1 values for the top 3 EU members, Croatia and Slovenia

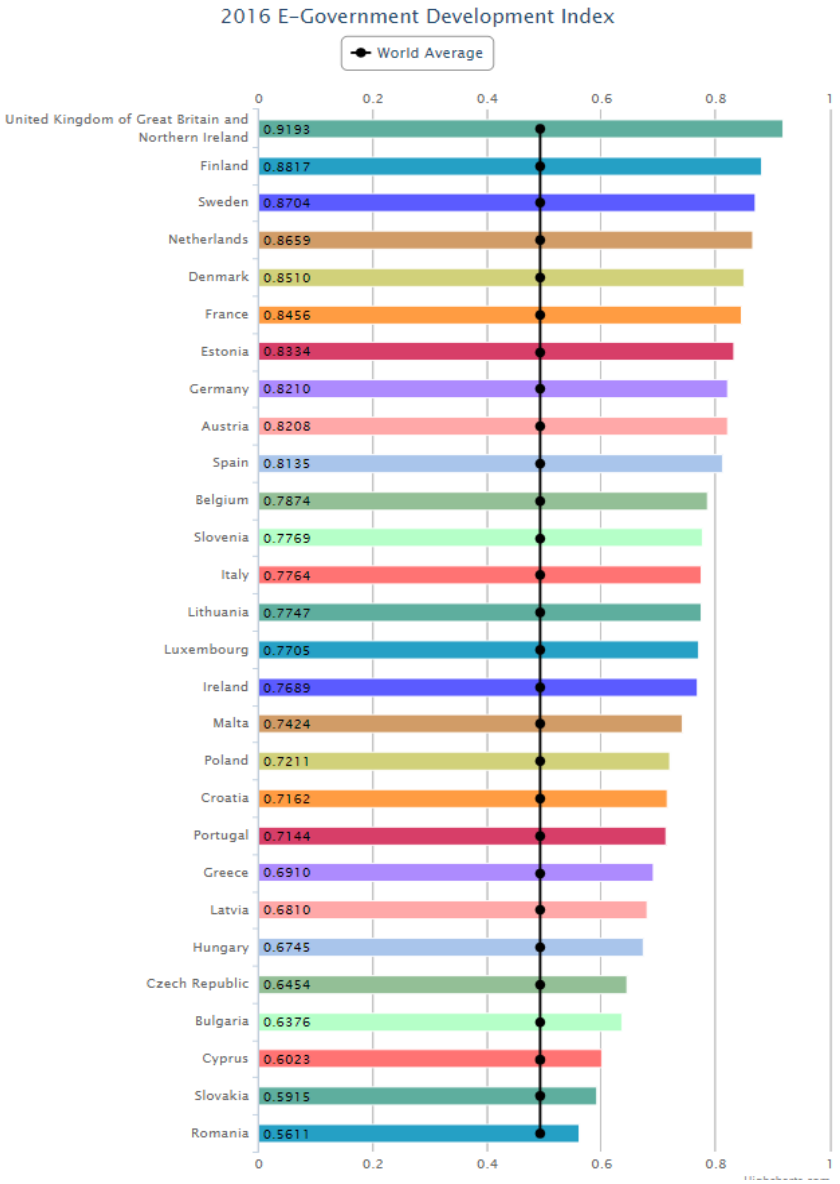


Source: Eurostat,
http://ec.europa.eu/eurostat/statistics-explained/index.php?title=ICT_specialists_in_employment

The countries with the largest share of ICT employees also have the highest value of the E-Government Development Index (see Figure 4)[4].

[4] UN E-Government Knowledge DataBase, 2016 E-Government Development Index, available at: https://publicadministration.un.org/egovkb/en-us/Data/Compare-Countries

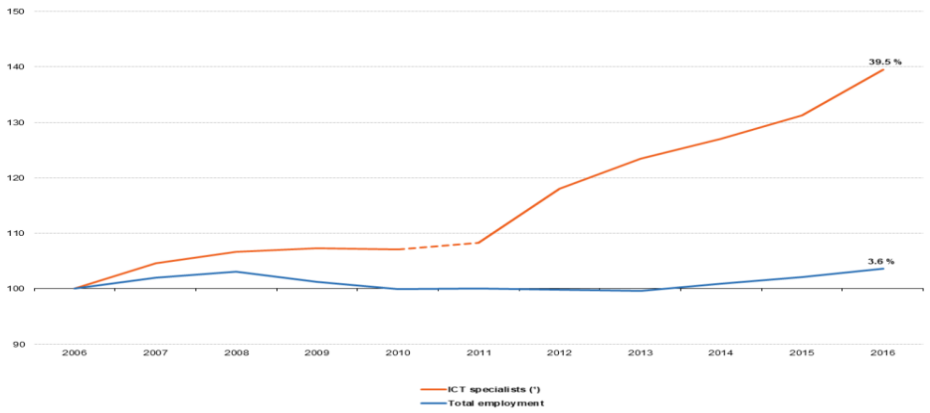
Figure 4. Index of E-Government development in 28 EU members



Source: UN E-Government Knowledge DataBase, 2016 E-Government Development Index, https://publicadministration.un.org/egovkb/en-us/Data/Compare-Countries

The growth of the total number of employees in EU-28 member states has been only 3.6% annually, for the 2006-2016 period, while the annual growth of ICT specialists was 39.5% (see Figure 5).

Figure 5. Annual growth of the total number of employees and ICT specialists in EU-28

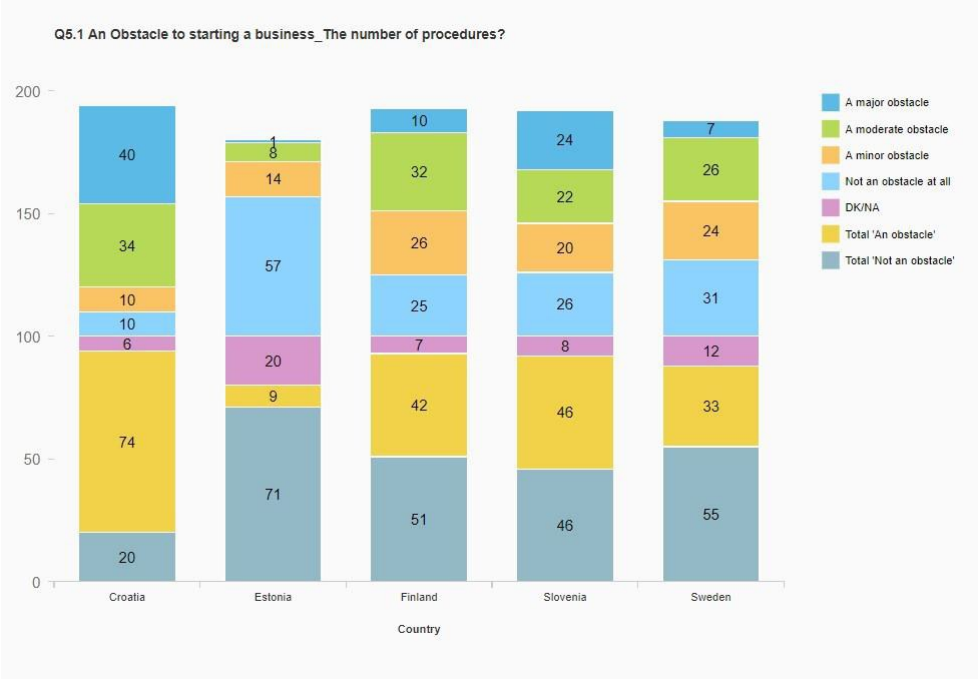


Source: Eurostat, http://ec.europa.eu/eurostat/statistics-explained/index.php?title=ICT_specialists_in_employment

KPI2 - Percentage of companies (by country), considering the number of administrative procedures as not being an obstacle to starting a new business (2016)

The largest amount of the companies, which do not consider the number of procedures for starting business as an obstacle are located in Estonia (71%), Sweden (55%) and Finland (51%). In Slovenia, the KPI 2 value amounts to 46%, while in Croatia, its value is only 20% (see Figure 6).

Figure 6. KPI 1 values for the top 3 EU members, Croatia and Slovenia



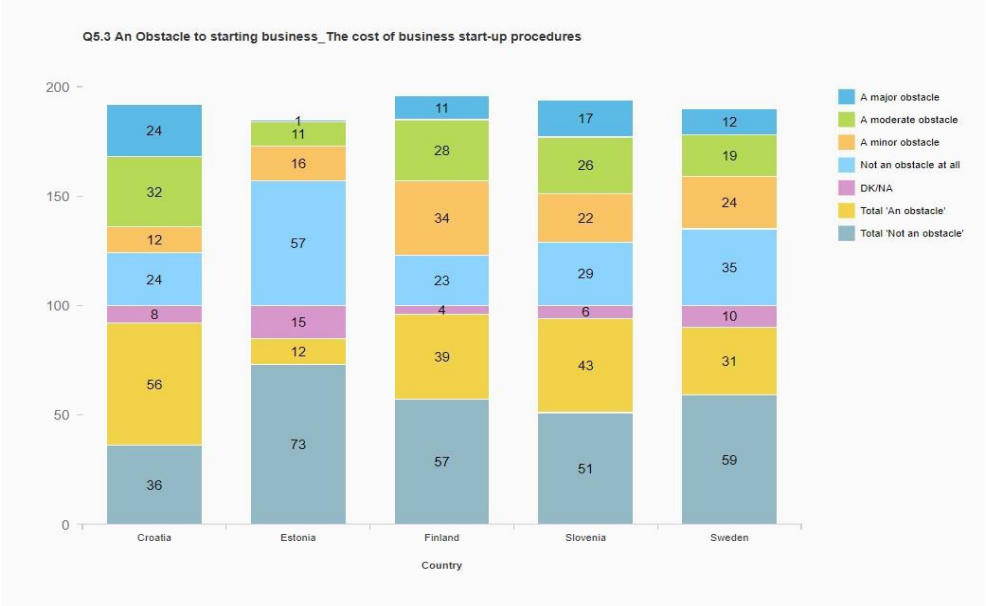
Source: Authors' analysis performed in SAP BI module[5]

KPI 3 – Percentage of companies (by country), considering the costs of establishing a company as not being an obstacle to starting a new business (2016)

The top three EU-28 countries, regarding the KPI 3 value, are: Estonia (73%), followed by Sweden (59%) and Finland (57%). Its value in Slovenia it is 51% and Croatia only 36%.

[5] Data sources used for KPIs are coming from the European Commission data: http://ec.europa.eu/COMMFrontOffice/publicopinion/index.cfm/Survey/getSurveyDetail/instruments/FLASH/surveyKy/2089: http://ec.europa.eu/commfrontoffice/publicopinion/index.cfm/ResultDoc/download/DocumentKy/72225

Figure 7. KPI3 values for the top 3 EU members, Croatia and Slovenia



Source: Authors' analysis performed in SAP BI module[6]

The countries, with the highest amount of ICT employees seem to be leaders in terms of entrepreneurship development, with lowest perceived complexity and costs, regarding creation of start-ups, which is theorized to represent a lever of economic development (Kwang, 2005). However, this needs to be formally recognized by means of statistical analysis, conducted in the IBM SPSS statistical analysis tool.

The quality of BI process, as related to KPI creation, is approximated by the national share of ICT employees (cf. Olszak, 2015). The performance of E-Government processes is measured by the amount of companies, not considering administrative complexity, or costs, to represent a burden to creation of start-ups in the country.

2.3. Research results

Significant and relatively high values of correlation coefficients are found (see Table 1), which required the linear regression analysis to be performed, as to establish the causal relationship between the variables involved.

[6] Ibid.

Table 1. Correlations between BI quality and E-Government indicators

		%ICT inEmpl
Administrative complexity not an obstacle to start-ups	Pearson Correlation	,639**
	Sig. (2-tailed)	,000
	N	28
Costs not an obstacle to start-ups	Pearson Correlation	,581**
	Sig. (2-tailed)	,001
	N	28

** Statistically significant at 1% level.
Source: Authors' analysis performed in SPSS

When using the administrative complexity as a measure of the E-Government processes, the entire model is significant at the statistical level of 1% (F = 17,944; p=0.000), with the linear coefficient being significant, as well (see Table 2). Strength of the model is illustrated by a relatively high value of R^2=0.408.

Table 2. BI quality – administrative complexity linear regression model

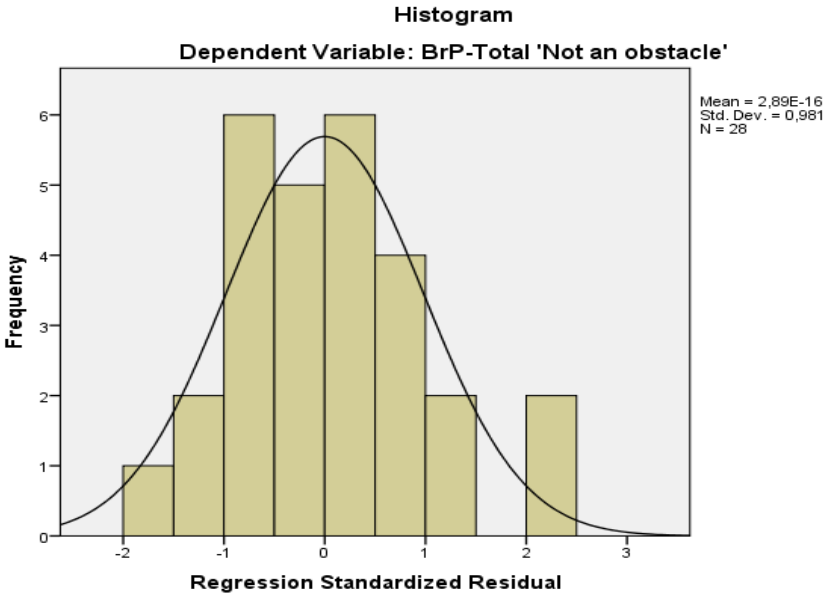
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3,473	7,074		,491	,628
	%ICT inEmpl	7,875	1,859	,639	4,236	,000

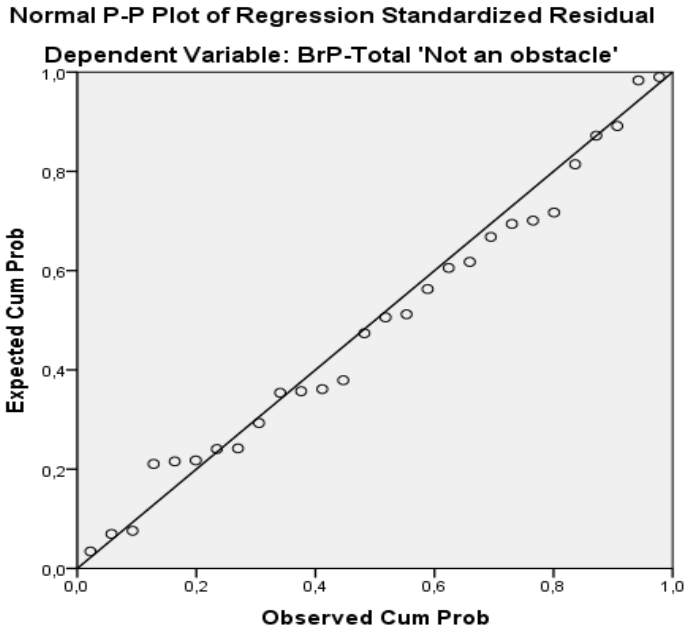
a. Dependent Variable: Br.Proc-Not an obstacle

Source: Authors' analysis performed in SPSS

The statistical assumption that no collinearity is present is confirmed by the values of Tolerance (1, being higher than 0.2) and the factor of the variance inflation (VIF), with the value of 1.0 (being lower than 5). The Durbin-Watson (DW) value of 1,334 confirms that autocorrelation does not exist, while the normal distribution of standardized residuals has been checked visually and confirmed by the P-P plot of collected and expected values (both presented by Figure 8).

Figure 8. Histogram of standardized residuals and P-P plot





Source: Authors' analysis performed in SPSS

The assumption of the non-existing heteroscedasticity of the residuals' variance is confirmed by the non-signficant nonparametric correlation among the values of absolute residuals and the predictor variable (see Table 3).

Table 3. Result of the heteroscedasticity analysis for the regression model

Correlations

			BrP-Total 'Not an obstacle'	absres
Spearman's rho	%ICT inEmpl	Correlation Coefficient	,521**	-,190
		Sig. (2-tailed)	,004	,332
		N	28	28
	BrP-Total 'Not an obstacle'	Correlation Coefficient	1,000	-,112
		Sig. (2-tailed)	.	,572
		N	28	28

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

Source: Authors' analysis performed in SPSS

When using the start-up costs as a measure of the E-Government processes, the entire model is significant at the statistical level of 1% (F = 13,426; p=0.001), with the linear coefficient being significant, as well (see Table 4). Strength of the model is also quite high, although somewhat lower than for the case of administrative procedures, with the value of the R^2=0.338.

Table 4. BI quality – administrative complexity linear regression model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	12,037	7,686		1,566	,129
	%ICT inEmpl	7,351	2,020	,581	3,640	,001

a. Dependent Variable: Tr.Proc.-Not an obstacle

Source: Authors' analysis performed in SPSS

The statistical assumption that no collinearity is present is confirmed by the values of Tolerance=1 and VIF=1. The Durbin-Watson (DW) value of 1,681 confirms that autocorrelation does not exist, while the normal distribution of standardized residuals has been checked visually and confirmed by the P-P plot of collected and expected values (both presented by Figure 9).

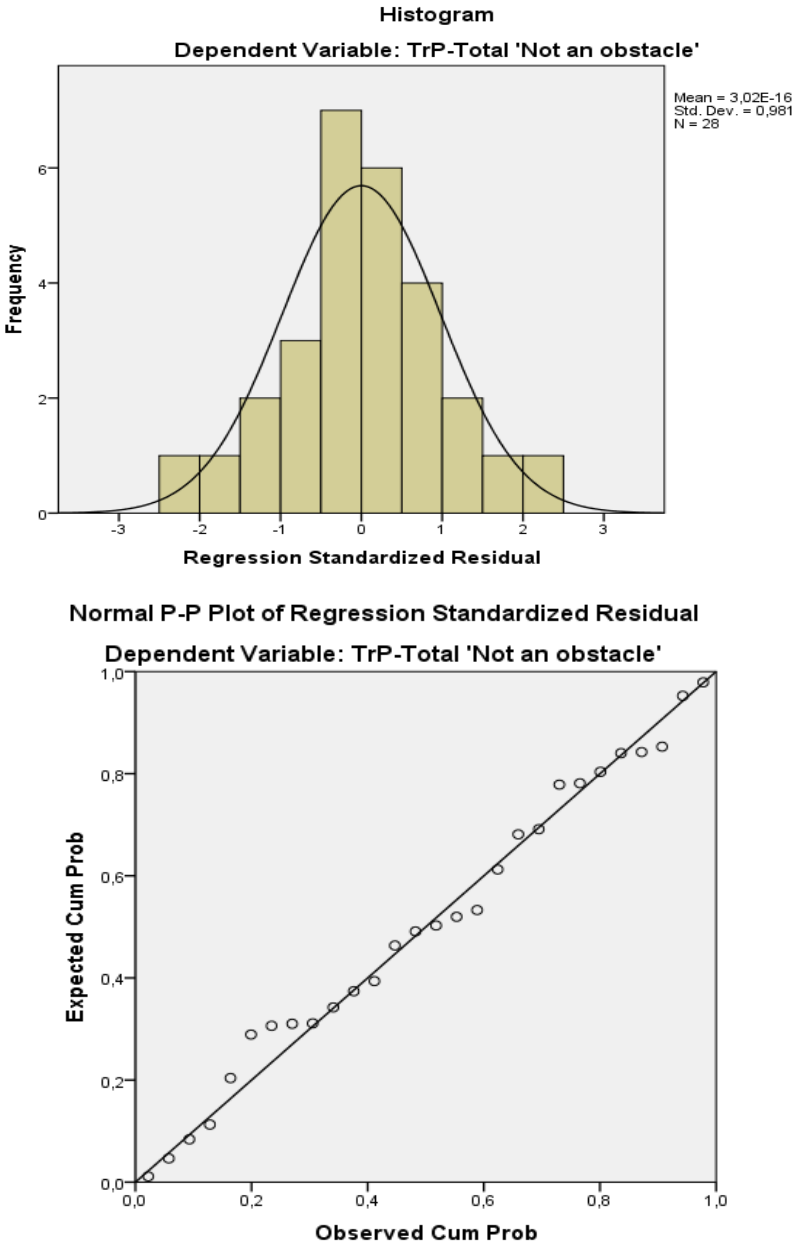


Chart 9. Histogram of standardized residuals and P-P plot

Source: Authors' analysis performed in SPSS

The non-existing heteroscedasticity of the residuals' variance is confirmed by the non-signficant correlation among the values of absolute residuals and the predictor variable, calculated by using the non-parametric, Spearman correlation coefficient (see Table 4).

Table 4. Result of the heteroscedasticity analysis for the regression model

Correlations

			TrP-Total 'Not an obstacle'	absres
Spearman's rho	%ICT inEmpl	Correlation Coefficient	,521**	-,190
		Sig. (2-tailed)	,005	,332
		N	28	28
	TrP-Total 'Not an obstacle'	Correlation Coefficient	1,000	-,118
		Sig. (2-tailed)	.	,551

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

Source: Authors' analysis performed in SPSS

Thus, by using both administrative complexity and costs of establishing a start-up enterprise, there is an empirically verified causal relationship between the quality of the BI process and the performance of E-Government processes.

3. CONCLUSION

In this study, performance of e-Government processes, viewed from the perspective of its users, is empirically verified as being predicted by the correct KPI definition, which confirms our hypothesis. This finding demonstrates the significance of the methodological role of the Business Intelligence and Key Performance Indicators in developing the tools and approaches, to be applied in the public sector. In addition, the selected research topic emphasizes the role of e-Government in supporting the entrepreneurial development and national competitiveness.

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