Impact of ICT on Performance of Construction Companies in Slovakia

Peter Mesároš [1], Tomáš Mandičák [2]

[a] Technical University of košice, Faculty of Civil Engineering, Vysokoškolská 4, 042 00 Košice, Slovakia
[b] Technical University of košice, Faculty of Civil Engineering, Vysokoškolská 4, 042 00 Košice, Slovakia

peter.mesaros@tuke.sk

Abstract. Information and communication technologies became a part of management tools in modern companies. Construction industry and its participants deal with a serious requirement for processing the huge amount of information on construction projects including design, construction, time and cost parameters, economic efficiency and sustainability. To fulfil this requirement, companies have to use appropriate ICT tools. Aim of the paper is to examine the impact of ICT exploitation on performance of construction companies. The impact of BIM tools, ERP systems and controlling system on cost and profit indicators will be measured on the sample of 85 companies from construction industry in Slovakia. Enterprise size, enterprise ownership and role in construction process will be set as independent variables for statistical analyse. The results will be considered for different groups of companies.

1. Introduction

The performance of construction companies depends on several factors. A lot of competition, pressure to reduce costs and wide availability are the merits of the need to address the issue of performance of companies in selected sectors [1]. This opens up a number of questions how to increase performance of companies and what factors affect it. In the last decade, it is often solved the issue of the impact of innovation in information and communication technologies on the performance of companies [2]. It is very necessary to monitor the impact of these advanced technologies on the performance of companies [3]. This need was confirmed by Kršák et al. [4].

2. Theoretical background and problem statement

Corporate Performance issues or performance of companies are discussed by several authors and researchers. Rouse defines corporate performance as a composite assessment of how well an organization executes its most important parameters, especially financial parameters [5]. Performance of companies includes good values in cost reducing and increasing of production [6]. Santos and Brito define success factors for corporate performance as profitability, market value, employee and customer satisfaction, social and environmental performance. Consoli identified efficiency and effectiveness and Santos, Brito – profitability, growth and market value that in general covers the same financial aspects of performance [7]. Taruté and Gatautis said about corporate performance that it includes financial performance and strategic performance [8]. Other authors and researchers have done a series of studies and researches on the factors affecting corporate performance. Ullmann

already in 1985 made a survey on corporate social performance and financial performance [6]. Later independently to the previous poster, Karake performed further research in this area [10]. Marom described a theory, how to build corporate social and financial performance [11].

The other authors were focused on the interaction of information and communication technology. Taruté and Gatautis have performed the research on the impact of information and communication technology (ICT) on SMEs performance [8]. Lee et al. discussed the issue of company performance in the airline industry. Ayatse carried out a case study of cement factoring companies in Nigeria, where the impact of ICT on corporate performance was examined. Conclusion of this case study was the knowledge, that ICT have greatly improved corporate performance of cement manufacturing industries in Nigeria positively. It was also seen that production in Nigerian cement manufacturing industry improved significantly since the advent of ICT [12]. There is a large series of studies dedicated to the topic of ICT implementation impact on performance of companies. Janke and Packová recalled studies conducted by Schreyer, Van Reen et al., Brynjolfsson and Yang [13]. When assessing the impact of information and communication technologies on business performance different variables were used. The study conducted by Delina et al. investigated stock market reaction to the IT investment announcements in Czech Republic, Hungary and Slovakia as a whole region, not studying the differences among these three countries [14]. Other authors include cost reducing as a main tool for corporate performance. Generally, in Slovakia there is a lack of studies conducted on corporate performance in construction industry. That was the reason and space to carry out such a study in terms of construction enterprises in Slovakia. Overview of the authors and their studies are defined in Table 1.

Table 1. Overview of the authors and their studies about performance of companies [15, 16, 17]

Researchers	Year of publication	Researches and publications
Ullmann	1985	Corporate social performance and financial performance
Karake	1997	Company social performance (measured by reputation index and) and financial performance (measured by return on equity)
Mc Williams and Siegel	2001	Corporate social responsibility and financial performance
Marom	2006	Theory building for corporate social performance and corporate financial performance
Dielina and Tkac	2010	The impacts of specific ICT solutions on productivity
Ayatse	2012	Impact of information communication technology on corporate performance: A case study of cement manufacturing firms in Nigeria
Janke and Packová	2013	Impact of ICT investments on performance of companies in transition economies: Evidence from Czech Republic, Hungary and Slovakia
Taruté and Gatautis	2014	ICT impact on SMEs performance
Mesároš et al	2016	Business Intelligence impact on corporate performance in Slovak enterprises – a case study

All mentioned studies discussed the issue of corporate performance, but none of them discussed this issue in the construction industry in Slovakia. Mesároš et al. carried out a case study in Slovakia, addressing the impact of industry and Business Intelligence on the corporate performance [15]. The main research question is as follows: Has the ICT an impact on performance of the construction companies in Slovakia?

3. Methodology

3.1. Research questions

Based on the evaluation of the current state the research questions conducted in Slovakia were formulated:

- What is the impact of information and communication technology on performance of construction companies in Slovakia?
- What is the impact of BIM tools, ERP systems and controlling system on cost and profit indicators – performance?

3.2. Research objectives

Based on the determination of the research questions, the research objectives have been set. Main objective of this research was to analyse the impact of ICT on the performance of construction companies, generally. Another objective of this paper was to examine the impact of the chosen ICT tool as BIM (Building Information Modeling) tools, ERP (Enterprise Resources Planning) systems and controlling system on the performance of construction companies.

3.3. Data collection and research sample

Data collection was conducted by the questionnaire. Questionnaire was designed and distributed in electronic form. Questionnaire was produced by online platform FORMEES in electronic form. The research sample was approached by e-mail with the request to participate in the research. In total, 1276 of respondents (construction companies in Slovakia) were interviewed. 85 respondents participated in the questionnaire survey. It represents a return of 6.66%.

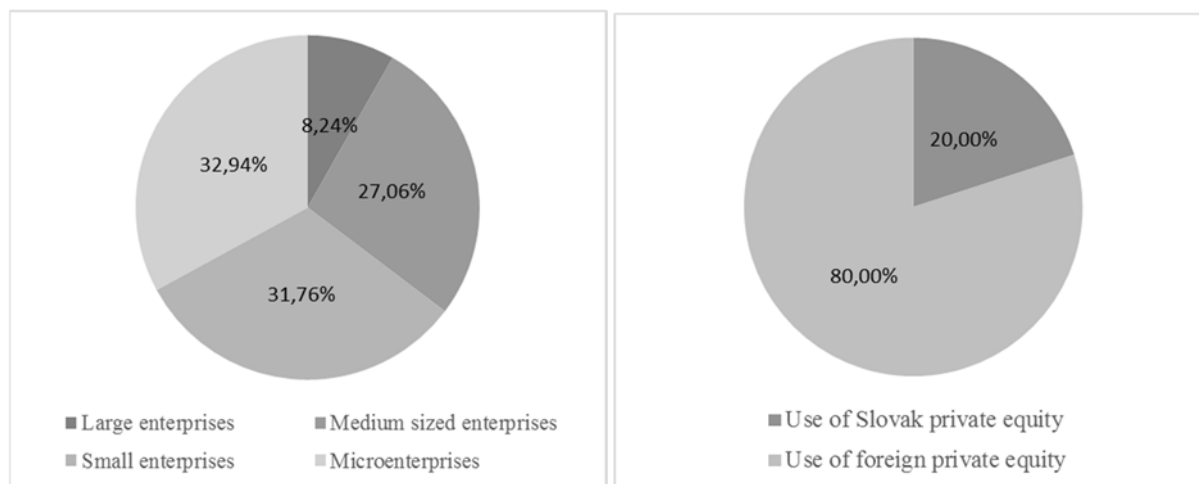Research sample is described in more detail in Figure 1 and Figure 2.

Figure 1. and Figure 2. Research sample by company size (1) and by owner of the company (2)

3.4. Data processing methods and research hypotheses

Achieved data were evaluated based on several statistical methods through software STATISTICA version 12. To analyse the differences between the research groups, the Kruskal-Wallis ANOVA test was used. Also, the "Likert scale ranging" from 1 to 5 on the basis of the fixed values was used where value "1" is a very low performance and value "5" is a very high performance. These data were compared with the cost reducing indicator and profit.

The research hypotheses were set as follows:

H1:   ICT has a significant impact on the performance of construction companies in general.

That means, that companies with active use of ICT achieve higher value (more than 3.5). This claim will be confirmed by Kruskal- Wallis test. Other hypotheses are extended from this main hypothesis and they are focused on BIM tools, ERP systems and controlling system.

H2:   Corporate performance of construction companies using BIM is higher than performance of the construction companies who do not use the BIM.

H3:   Corporate performance of construction companies using ERP systems is higher than performance of construction companies who do not use ERP systems.

H4:   Corporate performance of construction companies using controlling system is higher than performance of construction companies who do not use controlling system.

According to Kyakula, valuation of the hypotheses was based on the exploitation level as (Kyakula, 2011):

• Significant (level of use or impact > 3.5) or

• Not significant (level of use or impact ≤ 3.5). Statistical significance was verified by Kruskal-Wallis test.

4. Results and discussion

The perception of increasing of corporate performance is mainly linked with the increased profitability. This means cost reducing and increasing the profit. These data were provided and included in the research. Impact of the ICT in performance of construction companies in Slovakia has to reflect cost reducing and profit increasing. On the other hand, investments into ICT in generally were rapidly increased. It was reason for examined the level of investment in ICT was researched. For presenting the results, two groups of survey sample were created, namely: companies investing in ICT companies and companies without investments in ICT.

Hypothesis 1: ICT has a significant impact on performance of construction companies in general.
This hypothesis means that companies that invest to ICT have higher corporate performance than construction companies without investment to the ICT. That means cost reducing and profit increasing for this companies. This value was interpreted to the Likert scale from 1 to 5. Results were confirmed by Kruskal- Wallis test.
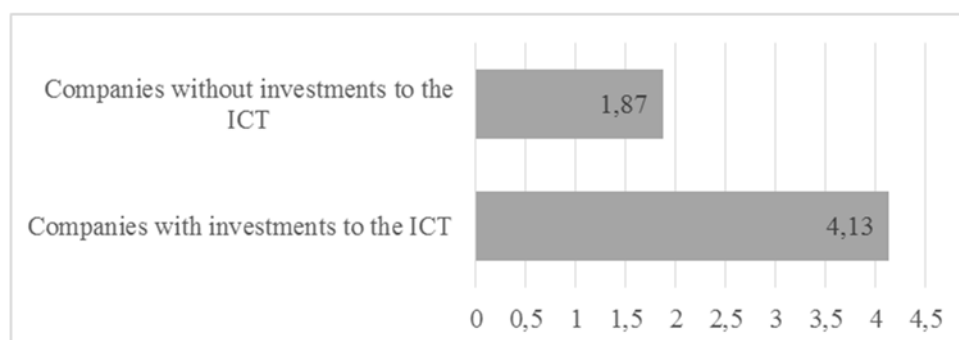

Figure 3. Performance of construction companies

Table 2. Kruskal- Wallis test for statistical significance of research groups (hypothesis 1)
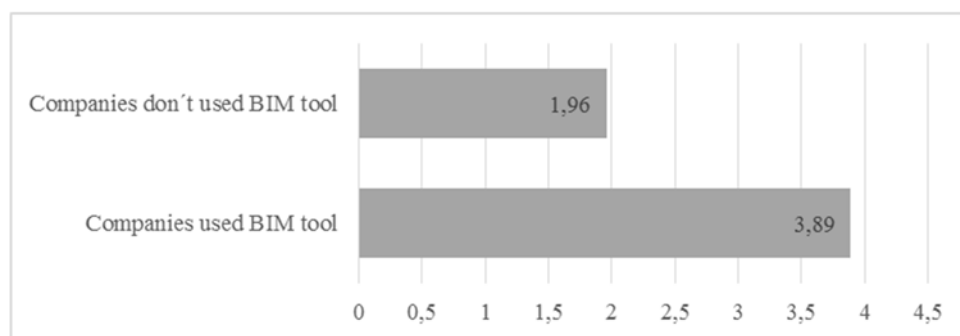
Construction group	**Kruskal-Wallis ANOVA based on ranking, Variable – investments to the ICT p=0,0265**		
	Code	Number of valid responses	Performance rate
Companies without investments to the ICT	1	57	4.13
Companies without investments to the ICT	2	28	1.87

Based on these results we can say that the ICT impact on performance of construction companies is relevant. This statement is confirmed by Kruskal-Wallis test (see table 2). Hypothesis 1 was accepted at the significance level $\alpha = 0.05$. Kruskal-Wallis test was value p=0.0265.

Next hypothesis discusses some of ICT tools as BIM, ERP systems and controlling systems in construction companies in Slovakia. All ICT has an important tool for everyday management activities in construction companies. It is very interesting comparison of corporate performance results in companies that using this tools with companies without using these tools.

Hypothesis 2: Corporate performance of construction companies using BIM is higher than performance of construction companies who do not use the BIM.

BIM tool presents an easy way for design of construction projects in all parameters together. It is a good tool for cost planning, project documentation and designing, time planning activities and other parameters of construction project in the phase of design and implementation too. Results of performance rate for companies used this tool are in Figure 4 and Table 3.

Figure 4. Performance of construction companies (BIM tool)

Table 3. Kruskal - Wallis test for statistical significance of research groups (hypothesis 2)

Construction group	**Kruskal-Wallis ANOVA based on ranking, Variable – used the BIM tool p=0,0398**		
	Code	Number of valid responses	Performance rate
Companies using BIM tool	1	21	3.89
Companies not using BIM tool	2	64	1.96

Based on these results it can be said that the BIM impact on performance of construction companies is significant. This statement is confirmed by Kruskal-Wallis test (see table 3). Hypothesis 2 was accepted at the significance level $\alpha = 0.05$. Kruskal-Wallis test achieved value p = 0.0398. Corporate performance of companies using the BIM tool is higher than companies that not using the BIM tool.

Hypothesis 3: Corporate performance of construction companies using ERP systems is higher than performance of construction companies who do not use ERP systems.

ERP systems are a very good tool for overall financial planning. This tool allows cost planning, controlling processes, accounting and other financial activities. Results of performance rate for companies using ERP system are in Figure 5. and Table 4.
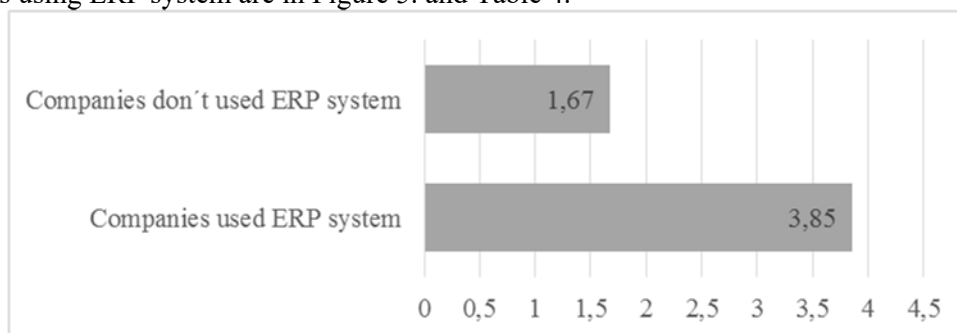

Figure 5. Performance of construction companies (ERP system)

Table 4. Kruskal - Wallis test for statistical significance of research groups (hypothesis 3)

Construction group	**Kruskal-Wallis ANOVA based on ranking, Variable – used the ERP system p=0,0494**		
	Code	Number of valid responses	Performance rate
Companies using ERP system	1	32	3.85
Companies not using ERP system	2	53	1.67

Based on these results it can be can said that the ERP system impact on performance of construction companies is significant. This statement is confirmed by Kruskal-Wallis test (see table 4). Hypothesis 3 was accepted at the significance level α = 0.05. Kruskal-Wallis test achieved value p = 0.0494. Corporate performance of companies using the ERP system is higher than companies not using the ERP system too. In spite of the high cost of the ERP systems implementation, this tool has an impact on overall performance of construction companies.

Hypothesis 4: Corporate performance of construction companies using controlling system is higher than performance of construction companies who do not use controlling system.

Last of the investigated ICT are controlling systems in construction companies in Slovakia. Controlling systems probably impact on financial performance. It is tool for cost planning, checking and cost management. More results are described in Table 5.
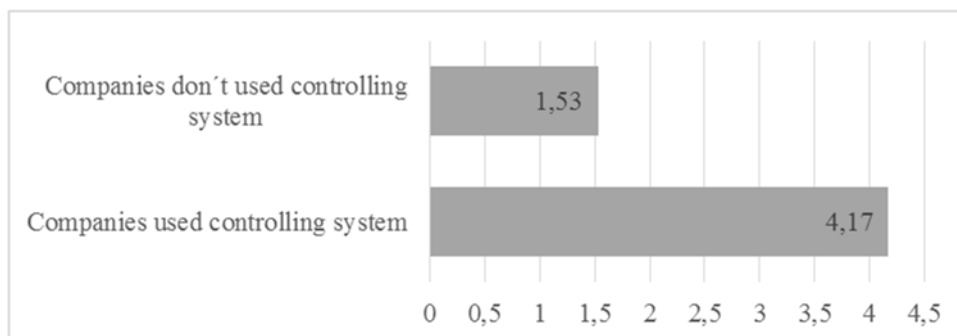

Figure 6. Performance of construction companies (controlling system)

Table 5. Kruskal - Wallis test for statistical significance of research groups (hypothesis 4)

Construction group	Kruskal-Wallis ANOVA based on ranking, Variable – used the controlling system p=0.0237		
	Code	Number of valid responses	Performance rate
Companies using controlling system	1	41	4.17
Companies not using controlling system	2	44	1.53

Based on these results controlling system impact on performance of construction companies was confirmed. Hypothesis 4 was accepted at the significance level $\alpha = 0.05$. Kruskal-Wallis test achieved value p = 0.0237. Corporate performance of companies using controlling system is higher than companies that do not use the controlling system.

Generally, ICT has a significant impact on the performance of construction companies in Slovakia. Adoption of ICT should be one of the main objectives for construction company managers. Next table shows confirmation of all the hypotheses.

Table 6. Kruskal- Wallis test and final results of hypotheses

	Final results of hypotheses		
	Hypotheses	**p**	**Result**
Hypothesis 1	ICT has a significant impact on performance of construction companies in general.	**0.0265**	accepted
Hypothesis 2	Corporate performance of construction companies using BIM is higher than performance of construction companies who do not use the BIM.	**0.0398**	accepted
Hypothesis 3	Corporate performance of construction companies using ERP systems is higher than performance of construction companies who do not use ERP systems.	**0.0494**	accepted
Hypothesis 4	Corporate performance of construction companies using controlling system is higher than performance of construction companies who do not use controlling system.	**0,0237**	accepted

5. Conclusions

Performance of companies depends on numerous factors. In many situations, it is perceived through the financial results (cost reducing, profitability, return of investment and so on). This research has shown the impact of ICT on the performance of 85 Slovak construction companies. Construction companies in Slovakia that have been using ICT more actively achieved a higher performance rate than construction companies that do not use ICT. Very similar results were obtained for chosen types ICT solutions. Controlling system is an effective tool and performance rate is higher than 4 out of scale. This is a significant impact on performance of companies. ERP system and the use of BIM tool has a significant impact on performance, too. This research confirmed the trend and has shown, that ICT has a real impact on performance of companies in construction industry of Slovakia. For future research, it is necessary to gain more specific information on communication technology and its impact on performance of construction companies.

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