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Effect of controlling systems on reducing the total cost of construction project in construction phase - Empirical study in Slovak SMEs

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ABSTRACT : *Cost planning and checking a real state is one of the conditions for successfully manage to construction project and construction enterprise. Efforts to reduce the total costs of construction project are one aim for reaching and realization of the objectives. Implementation and use of controlling is one way to achieve these goals. Currently, there are several ways to automate and systematized these activities. One of them are Controlling systems, as a part of Information and communication technology or systems. Article discusses the issue of impact controlling systems on total cost of construction project and reduces total costs in the construction phase of construction project. The main objective of this article is to confirm the hypothesis that verifies to the following statement: Enterprise size has an impact on the use of Controlling systems and it has impact on reduce of total cost of construction project in the construction phase. In other words, the effect of the use controlling systems to reduce of total cost of construction project in Slovak medium-sized enterprises will be more than in Slovak small enterprises.*

KEYWORDS -*Cost reducing, Controlling systems, construction project management*

I. INTRODUCTION

The use of information and communication technology (ICT) in the management of business processes is increasing. The issue dealt with by several authors. Basl, Gála and other authors [1,2] have this issue well processed on a theoretical level. Basl discussed particular the development of enterprise systems at different levels in their publication [1]. Gála and other authors discussed information systems and their increasing generally [2]. In it also it specifies the position of controlling systems (CSs). Čarnický [3] more defined Controlling systems for enterprises in various sectors. Kršák et al [4] discussed the issue of the use of ICTs for modeling of finance in various companies.

The use of selected ICT and systems in the construction sector describe other authors. Acar et al described the increase in the use of ICT for small and medium sized enterprises (SMEs) in building construction [5]. Adriaanse and other authors [6,7] specified the use of ICT in construction as the use of ICT in construction projects in United States.

Estimating the cost of construction projects and building relationships dealt with by other authors [8,9]. Currently Cost estimating and subsequently checked with the controlling systems in close relationship [8]. Monitor cost is important at every stage of the building project. Controlling systems are information systems that perform the functions exercised by the controlling in enterprise [10, 11].

According to E. Mayer [12] controlling is a management process focuses on operating result, which is realized by means of planning, monitoring and verification. Controlling is based on the harmonization of the objectives set out by managers and staff and objectives set out by enterprise. Controlling has a major role to ensure long-term company's survival and stable employment.

These tasks require coordination management system that can be achieved by establishing an appropriate organizational structure and integration objectives with planning and information systems.

Reduce the costs of managing construction projects closely related to the concept of sustainability in construction. Efforts to minimize costs are also associated with other conditions for sustainability in construction [13], such as the reduction of CO2 emissions and reduction of waste and so on.

II. METHODOLOGY

The Reducing cost is a worldwide problem. Enterprises also seek to minimize the cost of the management process. Controlling systems represent an auxiliary tool for cost control and reductions. First, it is necessary to define the use of controlling systems for the management of construction projects in the construction phase. The next step is to determine their impact on reducing costs in the construction process.

A. Objectives and methods of research

In the article they were used empirical methods of research. Within the empirical methods were used on a larger scale observation, mainly questionnaire survey. The methodological framework during the research:

1. Determine the subject and scope of research.
2. Selection of the research group and content.
3. Processing questionnaires for data collection.
4. Data collection.
5. Evaluating data based on the detection levels of importance factors examined.
6. Verify the statistical significance of the results based on the Kruskal-Wallis test.

The research was aimed at assessing the impact of the use of controlling systems on reducing the cost of management process of construction project in the construction phase. The definition of this phase for this research was mainly for the following reasons:

- Other studies have shown the greatest justification for controlling in construction phase of the construction project.
- The construction phase requires the biggest amount of funds.
- The biggest differences between planned and actual costs are at this phase.

The main objective of this paper is to answer whether the use of controlling systems has an impact on reducing the cost of managing construction projects in the construction phase. A further aim is to describe how it differs depending on the size of construction enterprises in Slovakia. Or, how used Controlling system is in Slovak construction enterprises.

B. Data obtaining

The questionnaire survey is the fastest and most effective way of obtaining the necessary information. The questionnaire was designed and distributed in electronic form. For preparation of the questionnaire was used online platform FORMEES which permit the questionnaire in electronic form, accessible to him of the selected target group respondents based on the destination address where the questionnaire is placed.

The survey sample was approached by e-mail with the request to participate in the research. Total were interviewed 1276 of respondents (participants of construction projects). It participated in the questionnaire survey 125 respondents (all size of enterprises), but only 48 SMEs completed the entire questionnaire to use in our research.

C. Research sample

The research sample consisted of medium, small and micro enterprises. They operate on the Slovak construction market are carried out mainly construction projects in Slovakia.

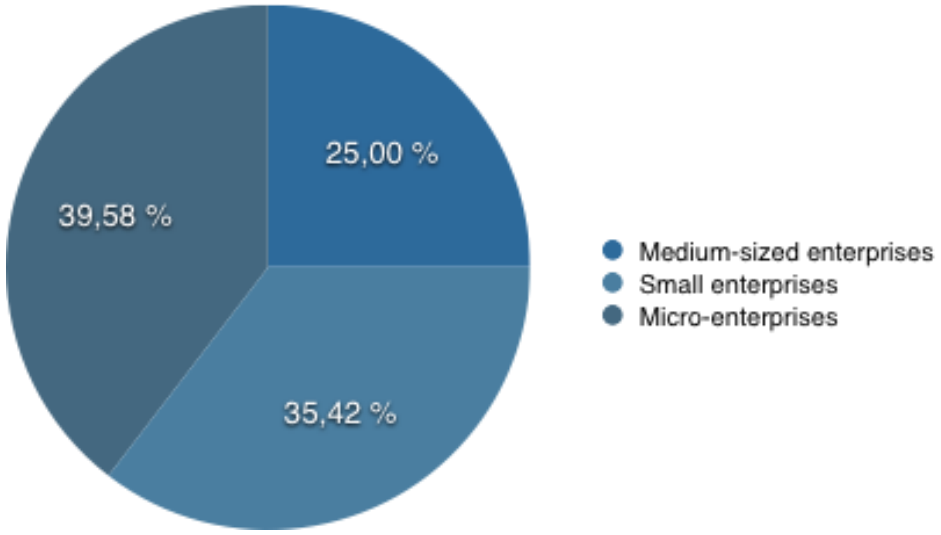

Fig. 1 Characteristics of the research sample by size of construction enterprises

D. Data processing

The obtained data were evaluated based on several statistical methods through software MS Excel and statistics. Results of the research were based on a descriptive and inductive statistics.

Evaluation of data was based on the use of so-called exploitation rate, respectively impact rate. Arithmetic average of the selected area was determined by the average value. The range was fixed by Likert scale (1 to 5). Using the measured has been made arithmetic mean of the values for the selected area under consideration.

Statistical significance was tested by Kruskal - Wallis test at the significance level $\alpha = 0.05$. Kruskal - Wallis test (Kruskal - Wallis ANOVA) is a direct generalization of the Wilcoxon two-sample test case for independent samples. Kruskal - Wallisow test is similar to the non- parametric one-way analysis of variance.

III. RESULTS

Controlling systems are effective tools for cost planning in construction projects. However, currently there is no research that would monitor the use of controlling systems in construction enterprises in Slovakia. What is an actually using the tool of Controlling system by SMEs in Slovakia? What influence has Controlling systems to reduce on total costs in the construction phase of construction projects? Just the results of this survey were closely monitoring the situation in the Slovak construction companies.

Based on experience abroad, we have assumed that SMEs use this instrument to a lesser extent. This assumption was supported by several facts:

- All solutions in the implementation of ICT solutions are more expensive. The same applies to controlling systems.
- Medium and small enterprises use ICT to a lesser extent. This fact is based on previous researches.
- Decision matrix in SMEs is much easier. This stems from fewer managers. In SMEs, it is not more levels of management.

Based on these facts, we assumed that the exploitation rate of controlling systems in SMEs is relatively low. Empirical expressed, the average exploitation rate of controlling systems in the construction phase of construction projects is a less than the value of 3.5 in SMEs in Slovakia.

Based on these discoveries comes the assumption that the enterprise size does not play an important role in using Controlling systems in the SMEs in Slovakia.

Figure 2 contains the results of the use of controlling system in construction phase of construction projects, depending on the division of construction enterprises by the size.

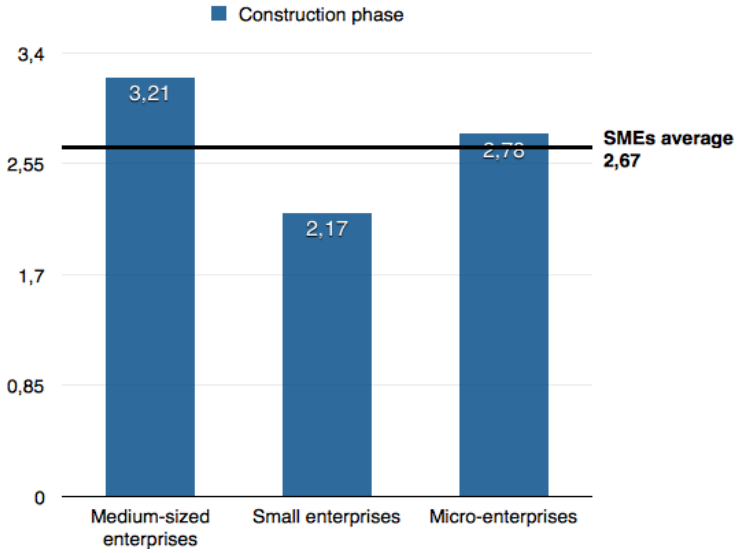

Fig. 2Exploitation rate of controlling systems in construction phase

As can be seen in Figure 2, Medium-sized enterprises have reached the level of 3,21 and 2,17 level of small businesses. Micro level reached 2,78. All values are relatively low. This is confirmed by the average value to the SMEs reached 2,67. On the basis of this argument can be said that SMEs use tool controlling system a small extent.

Within the research, we also addressed in detail the breakdown by size of enterprises and their behavior and the use of controlling systems. As can be seen in Figure 2, Micro-enterprises use tool the Controlling system to a greater extent than small enterprises.However, Kruskal-Wallis test showed that this behavior is not statistically significant. On based on Kruskal-Wallis test we cannot say at the level of 95% that the individual size groups of enterprises to use this instrument to a greater or lesser extent.

Important perspective on the issue brings detect impact on reducing the cost of managing construction projects in the implementation phase. Several surveys and sources say that the main reasons for the use of ICT is the reducing of cost for selected activities. This assumption has been established for monitoring and controlling systems use impacts in construction phase of construction project. Monitored factor is the size of construction companies. In other words, research monitored dependence of the effect on reducing of total costs in the construction phase from different sized of construction enterprises. Results included in Figure 3.

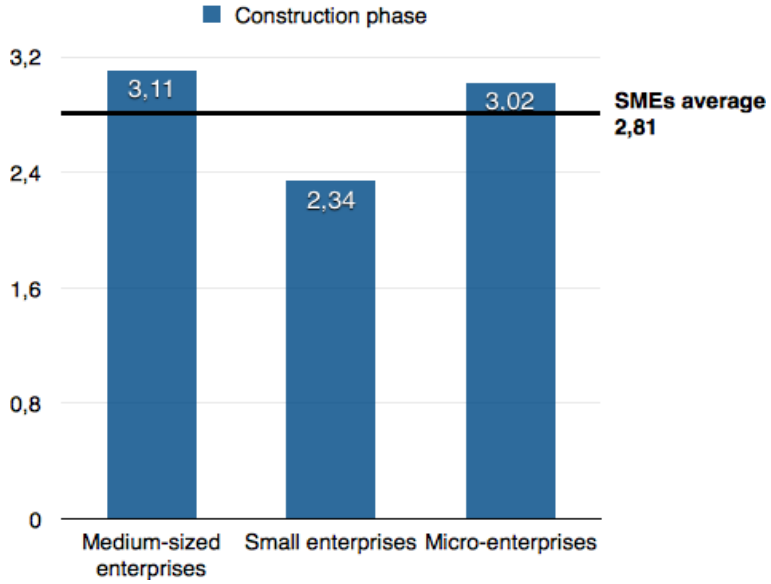

Fig. 3 Impact rate of exploitation of controlling systems on reducing the total costs of construction project in construction phase – breakdown enterprise according to enterprise size

Based on the results it can be concluded that the impact of the use of controlling systems not related to enterprise size. While medium-sized enterprises achieve the greatest degree of effect on reducing total costs in the construction phase, but micro-enterprises achieve greater level of impact than small enterprises. Kruskal-Wallis test did not confirm correlation between the results in selected groups of construction enterprises on the level of 95% s. It was reached p = 0.1478. Based on this facts it can be state follow, that enterprise size it does not play an important role even in the use of controlling systems and even with their impact on reducing the total cost in the construction phase of construction projects. It must be recalled that the results of the research identifying the situation of SMEs. For large enterprises could be other results. This issue will be analyzed in the future, which it will also attend by large construction enterprises operating on Slovakia.

Within the results must mention other findings resulting from the research. Although it was not confirmed the relationship between enterprise size and use and impact on total cost reducing, on the other side the results were found to be other dependencies. Figure 4 shows the results of the examination of enterprises that use controlling systems and total costs reducing in the construction phase.

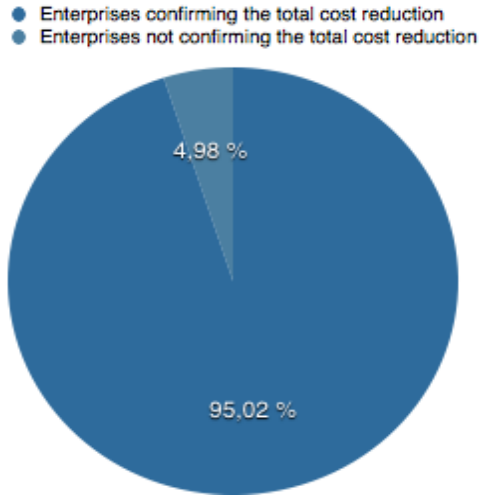

Fig. 4 A positive impact of use the controlling systems on reducing of total costs in construction phase of construction project (in percentages)

Enterprises that use controlling system confirmed the positive effect of reducing the total cost in construction phase. Total confirmed it to 95% of the enterprises. Conversely, enterprises that don´t use controlling systems, but they do controlling activities manually, these enterprises did not record the reduction of total costs in the construction phase. The total of these companies achieve total cost savings to only 5% of enterprises (Figure 4). It also confirmed the overall impact index of the use of controlling systems to reduce total costs in the construction phase (Figure 5).

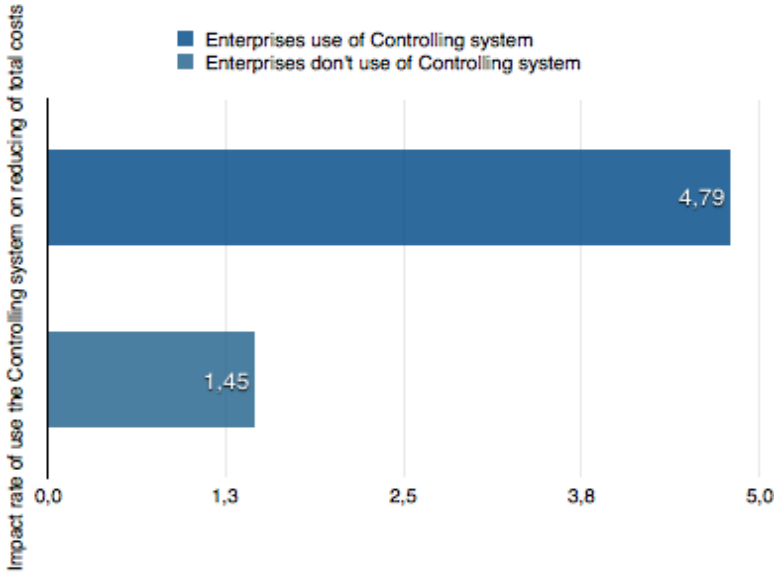

Fig. 5 Impact rate (index) of use the controlling systems on reducing of total costs in construction phase of construction project

Construction enterprises that use controlling systems reached a degree of influence on reducing the total cost at 4.79. It is very high value. Construction enterprises that do not use controlling systems have achieved the degree of influence on reducing the total cost level to 1.45. This dependence was confirmed by the Kruskal-Wallis test with $p = 0.0103$. It showed a clear benefit and dependency of use the controlling systems for the purpose of reducing the total cost of construction enterprises in the construction phase.

IV. CONCLUSION

The issue of use of controlling system in construction is a highly topical issue. Generally, the use of ICT in is the first step towards automation of selected activities. The same applies in the implementation of controlling activities in the construction. Controlling is especially important in the construction phase of construction projects. The results of a survey conducted on the Slovak construction SMEs have shown a degree of exploitation controlling systems. In the SMEs is relatively small. As shown by the survey, the greatest barrier to the implementation of controlling systems in SMEs present investment costs. Research has not shown a relationship between the actual impact on reducing the total cost and size of the enterprise. On the other hand, the research revealed a correlation between the use of controlling systems and the positive effect of reducing the total costs in the construction phase of construction projects. This has been confirmed by the Kruskal-Wallis test. Research shows that the use of controlling systems has a positive effect on reducing total costs in the construction phase for any size construction enterprise. It does not matter on the size of the construction enterprise.

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