

Exploitation and Benefits of BIM in Construction Project Management

Peter Mesároš¹, Tomáš Mandičák¹

¹ Technical University of Košice, Faculty of Civil Engineering, Vysokoškolská 4, 042 00 Košice, Slovakia

peter.mesaros@tuke.sk

Abstract. BIM is increasingly getting into the awareness in construction industry. BIM is the process of creating and data managing of the building during its life cycle. BIM became a part of management tools in modern construction companies. Construction projects have a number of participants. It means difficulty process of construction project management and a serious requirement for processing the huge amount of information including design, construction, time and cost parameters, economic efficiency and sustainability. Progressive information and communication technologies support cost management and management of construction project. One of them is Building Information Modelling. Aim of the paper is to examine the impact of BIM exploitation and benefits on construction project management in Slovak companies.

1. Introduction

The exploitation of progressive technologies in the construction project management represents a greater potential each day [1]. The possibility of using new technologies in construction project management (especially for cost management, cost reducing, design of buildings, drawing and planning of construction projects generally) is steadily increasing by developing of new software solutions [2]. According to Mesároš et al. [3], cost management is therefore an essential condition for the effective management of construction projects. In fact, the cost reducing is not the only one benefit of exploitation progressive technology. According to other researchers, it is nowadays necessary to analyse the other benefits that new technologies bring in every area [4]. In construction project management, BIM technology is one of the possible and available solutions for the above mentioned tasks.

BIM (Building Information Modelling) therefore was generally mentioned and defined in a number of publications, conferences and workshops. Other authors [5] were talking about BIM like the term that is increasingly getting into the awareness in construction industry. The first mention of the BIM concept was recorded in 2002. Very often, the concept of BIM is perceived as a computer program or a 3D model that is only part of it. BIM concept has several definitions [5]. Building information modelling is the process of creating and data managing about the building model during its life cycle. According to National Institute of Building Science, information obtained through information modelling are crucial for effective and accurate design of construction documents, construction planning, cost estimating and predicting traffic building. Information modelling thus not only creates a 3D model, but 4D (time), 5D (cost) and XD model [6]. In addition, it is possible to say that BIM is the tool for managing relations between the participants a construction project [7]. BIM is currently the most common denomination for a new way of approaching the design, construction and maintenance of buildings [8].



Due to the overview of available resources and of the discussion of BIM, it may seem that we shall all was said about BIM and that this tool is often used. There is a question whether this is actually true. Do the construction companies really use this tool as spoken about? And what is perception of construction companies on BIM tool? What are benefits of exploitation of BIM? There are only a few questions, that are necessary discusses in BIM topic. That is basic of this research problem, what was formulated to these research questions:

- What are benefits of BIM using?
- What is perception of this benefits by construction companies?
- What is exploitation level of BIM in construction companies?
- What is impact on the biggest benefit of BIM using?

There are some questions that is necessary to find the answers, when we are analysing the issue of BIM in selected market or environment in construction project management.

2. Literature review

The issue of BIM is devoted to a series of authors. In terms of the status of basic research questions it is the right to talk primarily about research aimed on benefits of using BIM technology. According a lot of studies and investigations, cost reducing is one of the biggest benefit of BIM exploitation. Next benefits was set as time reducing, productivity increasing and more. One of the biggest benefit of BIM exploitation in construction project are cost reducing and control. It represents 60 % of respondents in their research [8].

The other authors were talking about benefits in their investigation too. They mentioned s mainly budget aspect and design aspect as main benefit [9].

Between mainly benefits of BIM exploitation it can be possible include time reducing and cost reducing in construction project management [10]. It confirmed research realised by Ian and Damian. In addition to the above benefits, the authors mentioned the saving of human resources.

Other research study confirmed savings of project cost by using of BIM [11]. The biggest benefit is time reducing in schedule preparing trough BIM technology. This research described possibilities of measurement in the issue of BIM exploitation and benefits. The main area of investigation for measurement of BIM benefits was specified [11]. Between main area it was selected by research results especially area: changes to processes, IT investments to supported improvements, business performance improvements and improved profit and ROI. Overview of selected researches and investigation is more detailed described in table 1.

Based on a lot of researches and literature resources about benefits of BIM, the list of main benefits was done for purposes of this research:

- cost reducing in construction project management
- time reducing in project documentation,
- time reducing for the entire lifecycle of the construction project, including the design phase,
- faster access to information and relevant documents all participants of construction project,
- increasing of employee productivity,
- increasing of financial control,

- support and facilitate of decision-making,
- increasing the quality of the documents, the elimination of error documentation,
- elimination of errors in the construction process – increasing of construction quality,
- increasing revenues from contracts.

Table 1. Overview of selected researches and investigation on benefits of BIM exploitation

Researchers	Year of publication	Researches and publications	Issue of research
Bryde, Broquetas and Marc Volm	2013	The project benefits of Building Information Modelling (BIM)	Benefits of BIM exploitation on construction project
Laine, Hänninen and Karola	2007	Benefits of BIM the thermal performance management	Benefits in the issue of thermal performance management
Latiffi, Mohd, Kasim and Fathi	2013	Building Information Modelling (BIM) Application in Malaysian Construction Industry	Among other things, they discussed the issues of benefits of BIM using in Malaysian construction industry
Yan and Damian	2009	Benefits and barriers of Building Information Modelling	Comparison of benefits and barriers in USA and UK construction companies
Barlish and Sullivan	2012	How to measure the benefits of BIM – A case study approach	Comparison of maturity models used for measurement of BIM benefits and literature review this topic
Glick and Acree	2009	IPD and BIM: Benefits and opportunities for regulatory agencies	Open questions of connections between IPD issue and BIM issue
Azhar	2011	Building information modelling (BIM): trends, benefits, risks and challenges for the AEC industry	Main benefits of BIM using in construction industry
Haymaker and Fischer	2001	Challenges and benefits of 4D modelling of the Walt Disney Concert Hall project.	Case study of benefits on selected building
Khanzode, Fischer and Reed	2008	Benefits and lessons learned of implementing building virtual design and construction (VDC) technologies	Benefits of building virtual design implementation

3. Methodology

3.1. Research questions and aims

Based on the evaluation of the current state of art, basic research questions were raised:

- What are benefits of BIM using?
- What is perception of this benefits by construction companies?
- What is exploitation level of BIM in construction companies?
- What is impact on the biggest benefit of BIM using?

The subject of research was Slovak construction industry. Construction project management and BIM exploitation in Slovakia is not well researched, despite frequent discussions on this issue.

Based on the determination of research questions, the research objectives have been set. Main objective of this research was to analyze and quantify the benefits of BIM using in terms of Slovak construction project management. Another aim of research was to examine the exploitation of BIM tool is in Slovak construction industry. Based on this aims of research, the partial aim was set: answer to the question “what is impact of the biggest benefit of BIM using on construction project management.

3.2. 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. Total were interviewed 1276 of respondents (construction companies in Slovakia). It participated in the questionnaire survey 85 respondents. It represents a return of 6.66%. Generally, it is possible to return to the level of 4.31% is considered as good. Research sample is more described in Table 2.

Table 2. Research sample

Research group	Number of respondents	Respondents in %
Divided according to company size		
Large enterprises	7	8.24%
Medium sized enterprises	23	27.06%
Small enterprises	27	31.76%
Microenterprises	28	32.94%
Divided according to participant of construction project		
Main contractor	31	36.47%
Sub-contractor	23	27.06%
Investor/developer	12	14.12%
Designer	19	22.35%
Divided according the exploitation of BIM		
Exploitation of BIM	21	24.71%
Do not exploitation of BIM	64	75.29%

3.3. Data processing method

Data were evaluated based on several statistical methods through software STATISTICA version 12. When processing the results of research conducted within the research, mostly descriptive and inductive statistics were used. When evaluating the results of the research areas, importance index was used on the basis of which the ranking of benefits of using BIM technology has been compiled. This importance index was used by Mutesi and Kyakula in research of ICT benefits in construction industry.

Index importance is determined by the relationship $I_i = (\sum w_i \cdot F_{Xi}) 100 / 5n$, wherein:

I_i - Importance index

w_i - weight is based on the Likert scale (1-5) (the weight given to response; 1=1, 2, 3, 4 or 5 is response frequency = very weak/low)

F_{Xi} - Response rate

n - Number of respondents

Due to the nature of the problem and the main objective of the paper appropriate statistical methods that can detect and analyses relationships between research groups - Kruskal-Wallis test was selected. To determine the answer was used "Likert scale ranging" from 1 to 5 on the basis of fixed values the arithmetic average of the values has been done for the selected area under consideration. It means performance of companies. 1 - is very low performance and 5 - is the very high performance. This data was comparison with cost reducing indicator and profit.

4. Discussion and results

The issue of use of BIM technology as already outlined, it is current topic. This research had among others to answer to the question: How BIM is used in the Slovak construction industry. This state is shown in Figure 1.

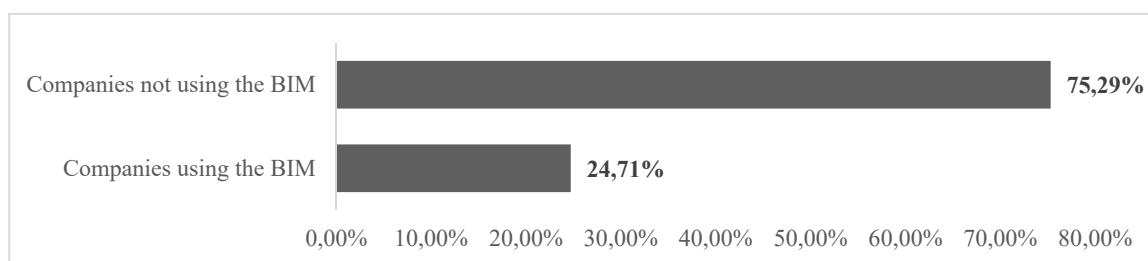


Figure 1. Exploitation of BIM technology in construction project management in Slovakia

In spite of often discusses of BIM technology, it is using in a low rate. Only 24.71 % respondents are using BIM technology in construction project management. It is very low value. A lot of construction companies do not use BIM technology. These companies try the quantifying benefits of BIM exploitation. All results are in Table 3.

Table 3. Ranking of BIM benefits in Slovak construction project management

Benefits and advantages	Importance index	Ranking
cost reducing in construction project management	89.34%	1
increasing the quality of the documents, the elimination of error documentation	87.56%	2
increasing of financial control	75.36%	3
time reducing in project documentation	62.36%	4
faster access to information and relevant documents all participants of construction project	60.98%	5
elimination of errors in the construction process – increasing of construction quality	54.89%	6
time reducing for the entire lifecycle of the construction project, including the design phase	51.47%	7
support and facilitate of decision-making	48.79%	8
increasing revenues from contracts	44.52%	9
increasing of employee productivity	39.84%	10

The biggest benefit of BIM exploitation presents cost reducing in construction project management. It achieved 89.34% importance index. In comparison with other research in other countries, that's not surprising. The second biggest benefit of use of BIM technology represents increasing the quality of the documents and elimination of error in documentation. Importance index of this benefit is on level of 87.56%. Other benefits are increasing of financial control, time reducing in project documentation, faster access to information and relevant documents all participants of construction project, faster access to information and relevant documents all participants of construction project, elimination of errors in the construction process – increasing of construction quality and time reducing for the entire lifecycle of the construction project, including the design phase. All of these benefits achieved more than 50%. Next benefits didn't achieve more than 50%. This ranking of benefits shown main advantages and quantifying these advantages based on Slovak construction companies. This ranking shows the biggest benefit of BIM exploitation. It is very necessary explores the impact BIM exploitation to cost reducing. Next figures describes impact rate of BIM exploitation to cost reducing.

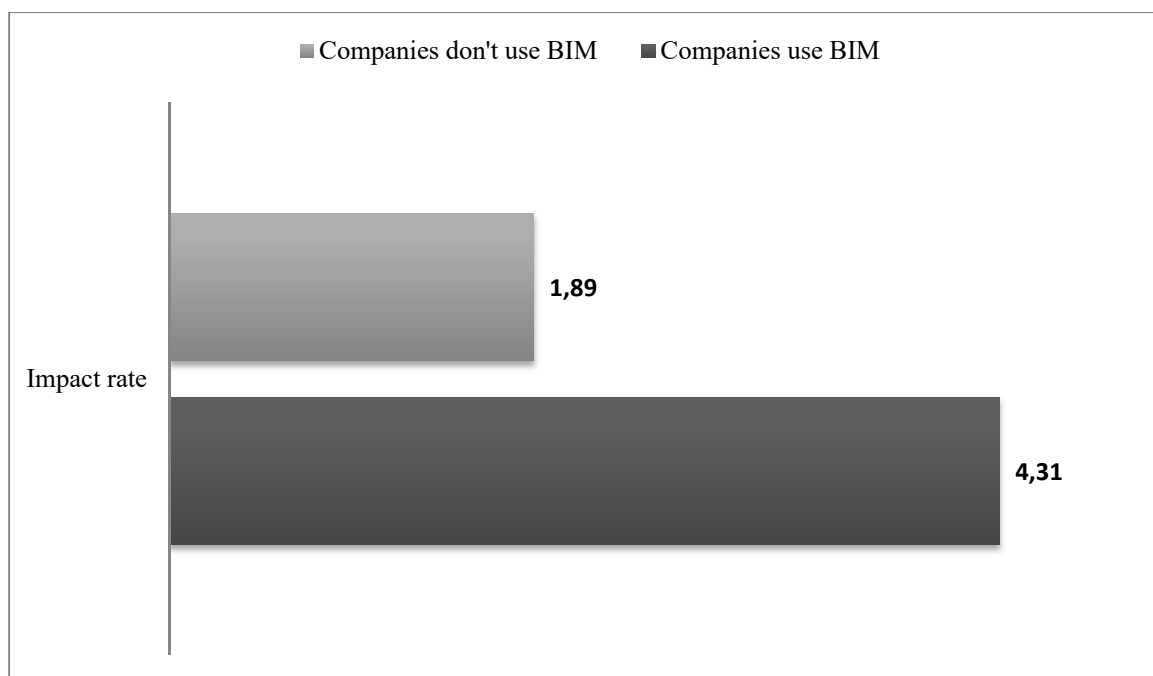


Figure 2. Impact rate of BIM exploitation to cost reducing in construction project management in Slovakia

This research confirmed impact BIM to cost reducing. Companies used BIM technology achieved bigger impact rate than companies don't use BIM technology. BIM technology has impact to cost reducing. This is often reason, why this companies want to implement BIM technology.

5. Conclusions

BIM technology offered a lot of functionality and it's very helpful tool in construction project management. Cost management is very important part of construction project management. Accurate and information based cost management may have a serious impact on the success of construction project. BIM technology has a lot of functionality, includes cost management too. Research tried to provide the answers to benefits of BIM technology. Ranking of benefits was based on Slovak construction companies. As examined, quality of documentation and cost reducing are the biggest benefit of BIM technology.

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