

ANALYSIS AND EVALUATION OF POSSIBILITIES FOR IMPLEMENTATION OF BIM IN A SMALL CONSTRUCTION COMPANY

Jakub Vojta¹, Petr Matějka²

¹*CTU in Prague, Faculty of Civil Engineering, Department of Construction Management and Economics, Thakurova 7, Prague, 166 29, Czech Republic, vojta-j@seznam.cz*

²*CTU in Prague, Faculty of Civil Engineering, Department of Construction Management and Economics, Thakurova 7, Prague, 166 29, Czech Republic*

Abstract

The research is intended to emphasise the importance of BIM systems throughout the entire lifecycle of a construction. It explains the matter of BIM to the professional and general public. It also includes a case study into the implementation of BIM systems in a small construction company. This concludes in a discussion of the need for quality cooperation between the individual subjects in a construction project.

Keywords

Building Information Modeling; construction company; construction project, implementation

Introduction

The theme of the research - Analysis and evaluation of possibilities for implementation of BIM in small construction company - was selected due to its topical nature. The English abbreviation BIM best sums up the designation *building information model* [1]. Currently BIM systems are used only in part in the Czech Republic, but in the future far greater emphasis will be placed on them than is currently the case. And so construction companies should initiate the implementation of these support systems in time so that they can best apply them to the construction market in the future.

The aim of the performed research is to provide information in general about BIM systems and the potential for their use, in particular in a small construction company. One of the other aims is at least in part to explain the matter of the implementation of BIM systems to other people who read the research. The research also explains and analyses the influences on work and economics of a small construction company which arise from the introduction of BIM systems. Another aim of the research is to evaluate the possibilities for implementation of BIM systems in an existing small construction company. One of the individual aims is also to explain the benefits of BIM systems. The benefit of the research for the actual investors is that it is worthwhile to have quality project documentation made, even at the price of higher costs. The more detailed the elaboration of the project documentation is, the more likely it is that there will be only minimal changes and the discovery of errors during construction. Generally the costs associated with dealing with these shortcomings are several times higher than is their resolution during the project phase of the project.

A small construction company was selected because the current professional literature dealing with this theme looks at BIM management only at the general level. Then the case studies made out for the implementing BIM systems in a company focus primarily on large construction companies. But in order for the principle of building information models to be used to the maximum possible extent, it is necessary for there to be a broader involvement of small construction companies which the large companies use for subcontracting activity.

The results of the research will be well applicable in practice, because the conclusions from the case study of the research will be used as the basis for a decision on the implementation of BIM systems in the existing company in which I currently work and which is currently considering the introduction of BIM systems on the basis of my comments. This can serve as the basis for the decision-making of another construction company of similar scope of activities. The research could also be used by someone who is interested in the implementation of BIM systems, be it activity of an academic or commercial nature.

The research itself can be divided up into three basic parts. The individual parts focus on the matter of introducing BIM systems, primarily in small construction companies. The research isn't intended for promoting its conclusions as the best possible procedure during the implementation of BIM, but as one of the possible methods. The individual phases follow on one from the other and are linked in the final context.

Methodology

The first part of the research focuses on the matter of BIM systems in the general conception. In this part the reader should be familiarised with the basic information about BIM systems. There is an explanation here of what BIM actually is, and on the basis of which principles it works. Then the first part focuses on the reasons for the creation of BIM systems and their history. In the first part of the research there is also an overview of certain systems which are currently used. As a result of the great number of different products from different manufacturers on the market, it is not possible to mention all the available products or manufacturers. In the first part the research the attempt to

explain how BIM systems are used around the world and in the Czech Republic continues. In the first part it will be possible to discover what the main advantages and disadvantages associated with BIM systems are. This phase also contains information about the use of BIM in the context of the building lifecycle. In the conclusion of the first part of the research, systems are given which are more suitable for small construction companies focussing on construction implementation. But the systems mentioned need not be decisive for any study of the research. In the case study separate research will be performed from which it may be seen that completely different BIM systems may be suitable for the given construction company. In the first phase of the research consideration is also given to the behaviour of investors in the project phase of the project. The first part of the research is of a theoretical nature, and so to a significant extent is based on the findings and conclusions of experts who have dealt and are dealing with this matter, so all the received information incorporated in the research has its own source acknowledged in the research.

The second part of the research deals with the actual implementation of BIM systems in a construction company. Here there is an outline of the procedure for implementing BIM systems. In the second part the possible risks associated with the actual implementation, including an explanation of the enumeration of costs for the actual implementation, will continue to be given. In general terms here the factors will be given which a company should focus on before starting the actual implementation of the systems into its production. This primarily involves the selection of system which would be the most advantageous for the company, the company's technical equipment, the working level of human resources within the company etc. Then in the second part we can find an analysis of the influences of introducing BIM on the work and economics of a construction company, including a warning of the different impacts according to the focus of the company on the construction market. In the conclusion of the middle part of the research we can then find potential recommendations for how a company should proceed if it is seen that for some reason BIM systems are not suitable for it.

In terms of the number of employees, the construction company selected and examined by the case study is one of the small construction companies on the Czech market. The construction company was founded in 1997 as a limited liability company, and it was to expand its field of activity on the construction market compared with its parent company, which had been founded in 1990. The construction company is authorised and has its own trademark. The examined company remains the holder of an ISO 9001 certificate. At the time of its greatest expansion, the company had approximately 70 employees. As is the case in most small companies, this company is managed by an absolutist director. This type of management almost backfired in 2007 when the director of the company underwent long-term hospitalisation and could not perform his function in full. It was only thanks to the strong foundations of the company and absence of significant financial undertakings that the company managed to get through this period. After the return of the company's management, a decision was taken on its reduction to approximately its current level. In this way the company also unwittingly prepared a reduction in operating costs for the start of the economic crisis in 2009, which it experienced, but up to now it has not faced a serious threat to its existence. At present the company has 17 employees, and it realises its needs via sub-contracting companies as needs be. The company, with its headquarters in the Plzeň region, focuses primarily on the construction market in the central part of the Czech Republic. In its activities the company has implemented many construction projects both in the private and public sector of orders. At present it tends to focus more on the private sector. Approximately 50% of the orders gained consist of orders implemented by investors who have been in contact with the company in the past. In this group of customers there are investors to whom the company has been recommended by satisfied customers. The construction company pays very great attention to its good name and the spread of positive

references. The company in question does not require deposits from investors, but it invoices retrospectively, which meets with positive reactions from investors and gives a professional impression. This behaviour tends to be commonplace for large construction companies, but it is seen only rarely in such small ones. The construction company pays attention primarily to quality before the implementation preparation of a construction project. It always tries to prepare a potential investor for the most expensive variant with an outline of possible savings. But savings must never be at the expense of the quality of performance of the work or the quality of materials. This always involves either conceptual savings or savings on the required standard of the investor.

The third and last part of the research contains a case study. The case study focuses on a description of the construction company, including its personnel organisation and focus on the construction market. The company's business policy and its vision is also mentioned here. One of the main parts of the case study is the selection of suitable BIM system. To this end an investigation is being carried out amongst the workers and management of the company. On the basis of the information gained and consultation with experts who deal with the matter, those BIM products were chosen, which would best correspond to the requirements of the company. The next phase includes the collection of information about selected BIM products and their comparison. Then on the basis of a multi-criteria decision-making the final order in which BIM products will be recommended to the given company will be drawn up. The best evaluated BIM system is then subjected to the actual analysis. The analysis of the selected BIM products primarily discovers the main impacts of implementation of the selected BIM element on the work and economics of the company. Depending on an evaluation of the analysis it is necessary to propose changes in the running of the company so that implantation can occur. This applies in particular to cases where a company is not ready for the implementation of BIM, where the implementation of BIM is unsuitable for the company for some reason, or where the implementation of BIM would not meet the required recommendations.

Conclusion and discussion

If the conclusion of the research shows the unsuitability of introducing BIM in the company in question, this does not necessarily mean that the actual implementation is unsuitable in general terms. This possibility is always open, and the company should carry out a broader re-evaluation of the current working processes or own policy towards customers. In view of the introduction of the BIM systems in the public orders sector, it may be assumed that over time there will arise a need for the use of BIM in the private sector too. The investors themselves will be the main ones pressing for this change. In the future the construction company will have to consider the current functioning and attempt to change its attitude so that it can succeed in the competitive struggle amongst the individual companies on the market.

The anticipated conclusion of the research is the finding that for such a small construction company it is pointless to introduce some of the complex BIM tools, and not only from the economic aspect, but also from the aspect of product usability. So the matter of BIM implementation will probably involve partial applications which will help the company gain information from the building information model. This information will then be used for the generation of price bids with the aim of participating in tenders. In the context of building implementation it will then involve elements which help monitor and check the actual development of a construction and can record deviations from the original assumptions. These are primarily deviations in the time and financial performance of the original plan. As the company used for the case study deals primarily with the implementation of constructions and not project activity, the feedback, for example from the changes in project

documentation, is transferred via the construction company to the party implementing project documentation.

The research has a positive benefit not only for the company, the management of which will decide on the implementation of BIM systems on the basis of the research results, but it could be a useful guide for similar companies which are also considering switching to the principles of building information models. One of the themes which could lead on from the performed research is an evaluation of the implementation of BIM systems in the construction company, for example at a time five years after its implementation. Here it would be possible to evaluate whether the benefit of BIM was what the company had expected, and whether due to the BIM elements the company had also developed both professionally and economically. But in this case it would be very difficult to find a company in the Czech Republic which worked exclusively using BIM systems. In most cases on the domestic market there is only partial application of BIM because these elements are not often used.

The problem during the performance of the research is the insufficient treatment of the entire BIM matter in Czech and insufficient number of documents used under Czech conditions. There is a greater number of foreign publications in this respect [2, 3], but the majority of these publications work with the same basic information and repeat conclusions already published elsewhere. The BIM theme has been presented in general terms, and now it is necessary to go deeper into the matter and attempt to convince all the subjects who participate in the building lifecycle that this progressive approach represents a promise of future effectiveness, economy, transparency and quality.

References

- [1] MATĚJKA, P., HROMADA, E., ANISIMOVA, N., DOBIÁŠ, J., KOVÁŘ, P., KOZÁKOVÁ, I. *Základy implementace BIM na českém stavebním trhu*. Prague: Fineco, 2012. ISBN 978-80-8659-010-3.
- [2] EPSTEIN, E. *Implementing Successful Building Information Modeling*. Norwood: Artech House, 2012. ISBN 978-16-0807-139-5.
- [3] SMITH, D. K. a TARDIF, M. *Building Information Modeling: A Strategic Implementation Guide for Architects, Engineers,* John Wiley & Sons, Inc. 2009. ISBN 978-04-7025-003-7.

Acknowledgment

This work was supported by the Grant Agency of the Czech Technical University in Prague, grant No. SGS14/016/OHK1/1T/11