Analysing the implementation motivations of BIM Technology in Construction Project Management

Peter Mesaros, Marcela Spisakova, Tomas Mandicak
Technical University of Kosice, Faculty of Civil Engineering, Vysokoskolska 4, Kosice, Slovakia
tomas.mandicak@tuke.sk

Abstract. Construction project management is a difficult process. It includes a lot of participants in the construction project and the relationships between them. Currently, the construction industry is increasing demands on technology. BIM is a progressive intelligent 3D model-based process that gives architecture, engineering, and construction (AEC) professionals the insight and tools to more efficiently in planning, designing, and buildings and infrastructure managing. The research discusses the issue of implementation motivations of BIM using in construction project management. The main aim of the paper is to analyse and give an overview of motivations groups of BIM in construction project management.

1. Introduction and problem statement
Building information modelling (BIM) is becoming a global language for the infrastructure and construction sector, enabling greater collaboration and movement of capabilities across borders. BIM presents a digital form of construction and asset operations [1]. BIM is a digital representation of a building's technical characteristics. It is a 3D digital model that includes all physical and functional details of the building [2]. It brings together technology, process improvements, and digital information to radically improve client and project outcomes and asset operations. BIM is a strategic enabler for improving decision making for all stakeholders across the whole lifecycle [1]. It provides the building industry with different opportunities to share building information with all related groups, from designers to technicians and managers, throughout a construction's service life. The process helps mitigate the different communication and harmonization challenges between design, construction, and management groups [3]. As BIM technology becomes mature, more and more facilities have corresponding BIM models created in the design and/or construction phase [4].

Building information modelling can be understood as
• a parametric tool;
• a communication and collaboration tool.

Building information model presents a database of building information that can be represented as a 3D model extended by information. Thus, the model as a parametric tool contains geometric and non-geometric information. The user of BIM acquires visual, as well as numerical information about the structures, elements and materials used and their parameters. It is important to realize that the goal of BIM is not to create only a 3D model but to provide complete, reliable, accessible and easily exchangeable information about the construction for everyone who needs it during whole lifecycle of
The building. BIM aims to achieve the standards of sustainability and objectives of the construction project. Besides, BIM tools provide the ability to estimate costs of construction projects (4D) and imagine a logical order of timeline and steps of works (5D) [5].

The process of using BIM models for communication and collaborative purposes, leading up to and through construction, during whole life cycle of building. When well implemented, the use of BIM as a tool for communication and collaboration can lead to higher design quality and quality of the realized building, as well as increased efficiency and costs savings [6]. BIM can be used for integrated communication and collaboration between different stakeholders, from the same as well as from different project phases. During the project planning and execution of construction projects, comprehensive exchange of information between project participants in different project phases takes place. Consequently, a coordinated exchange of data and structured data management between the project participants is required. Information is always linked to an information carrier which contains the data to be submitted [7]. The information flows (based on a classification of stakeholders) are distinguished as follows:

- the owner and client;
- agents of the client (e.g. planners);
- builders, contractors or companies;
- third parties (e.g. authorities) [8].

Information flow is based on a 2D data exchange. BIM has already begun to change the way designers work with other stakeholders. Application of BIM technology provides platform for BIM interoperability. Promoting the decision-making process at an early stage of designing a construction project necessitates a solid combination between BIM tools and sustainability standards in order to evaluate the various impacts in terms of design, operation, and maintenance in addition to applying multi-dimensional visualization technology that promotes the concept of sustainable built environment [9].

Importance of BIM interoperability use based on the levels of building information modelling. Currently, there are 4 levels of BIM [10]:

- Level 0 - represents a lack of its BIM collaboration. At Level 0 there is no collaboration among the parties comparing information about a built asset. Most data like 2D drawings, and also information exchange is done using paperwork.
- Level 1 - when data has considered as a form of structure, means BIM has reached Level 1. The CAD is now either 3D or 2D, and some different parties achieve collaboration.
- Level 2 - collaboration introduces between the teams and the team follows the process of BIM. However, there is a lack of a single source of data, but any data collected about a built asset gets shared.
- Level 3 - complete and total collaboration in planning, construction and operational life cycle of a built asset gets achieved. The team shares collect and stores the data using a single source of data. This universal approach to constructed asset data is known as ‘Open BIM’ – hence, this is the construction industry’s ultimate goal.

2. Building information modelling in Construction project management
According to the BIM industry working group, BIM technology has substantial organizational impacts through BIM implementation in Construction Project Management (CPM) [11]. The management of construction projects is also specific in that there are many participants with different interests. Another study claims that stakeholder collaboration expands organizational boundaries which enhances the performance of the project organization during the design and construction process [12]. For this reason, it is likely that BIM technology has an important place in the management of construction projects. Another study drew attention to the possible needs for the implementation of BIM technology in the
The implementation of BIM technology needs, among other things, to change business processes [13]. Another author confirmed the benefit in the form of a more accurate way of working [14]. The benefit of the implementation and use of BIM technology also stems from the effort to reduce the demands on materials (in terms of demand), other resources, including costs [15].

The use of BIM technology is based on several surveys in the project phase, up to 54.88% and overall before the construction projects (51.90%). BIM is used to a lesser extent during the construction phase, like 34.67%. The research suggests further information on the use of BIM in the management phase of the building show. This is used only in a limited number of cases (8.82%). A frequent reason why BIM is not used even in the use phase is that the building owner has not further purchased a building management information system, or rather the selected BIM software is not compatible with the building management information system [16]. BIM has great potential to streamline construction project management processes. Despite the fact that construction project management is a demanding process, automation in control activities is of great importance for the productivity not only of the projects themselves but also of the management activities [17], [18]. BIM can also be used in the management of smelting projects and urban planning. An analysis of the details of the architectural study of the building (for example, drawings to understand the functional and physical attributes before starting construction of the project) are available earlier. This advantage can then reveal the more conflicts that can be brought about by later construction. Using BIM you will get more information about the physiological results of housing [19].

The BIM technology used in urban planning has a lot of information that can be used by several construction projects that will be implemented in the area in the future.

3. The implementation motivations of BIM Technology
One of the main motivations of BIM implementation represents financial benefits [16]. Several other studies have confirmed the solution to the problem of reducing costs in the management of construction projects. These surveys also highlighted the importance of BIM in the educational process as well as in the relationship of sustainability [20], [21], [22]. Contractors declare a 1% - 2% reduction in the cost of systems in the sector in the case of a large project. In some cases, and research, this is specified as economic motives, not only financial. Motivations can be divided into Social and Economic motivations according to this study [23].

The social motivation of project participants to implement BIM technology may reflect the administrative need to meet certain criteria of formal and informal requirements of organizations, or industries. There is then a great expectation from the active use of BIM technologies and industry expectations and technologies [24]. In this case, BIM technology may appear as a solution that will bring the desired fulfillment of measurable goals, however, with such a reason for implementation, they cannot meet expectations in terms of outputs. Therefore, for this reason, the social motive should not only be to meet certain requirements for the implementation of technologies, but also the expected outputs from them.

The results of several scientific studies show that in the case of influential and complex innovations (including BIM), innovation implementation activities are simply or not always reflected as passive compliance with external institutional pressures without economic rationality [16], [24]. In this connection, it is not always just about the basic motivations associated with social consideration, but also economic, where the participant expects a certain financially measurable consideration. The type of project and its nature are among the important motivation factors for the implementation of BIM. This results in an impact on the economic motives of the BIM implementation [24], [25]. Other motivators are other phenomena, such as the participant's involvement in the project, or the use of BIM technology by other participants in the management of the construction project.
Other participants in the implementation also talk about the legislative framework. Also, other impacts of using BIM can lead to incentives to implement the solution. For example, this is with scheduling and time saving [26].

Based on a number of theories and studies, basic groups of motivators for the implementation of BIM technology were defined. These are the main groups that contain several motivators. More information in Table 1.

| Groups                  | Implementation motivations |
|-------------------------|----------------------------|
| Economical              | Social                     |
| Technical               | Status of project participant |
| Legal                   |                            |

These groups represent a rough boundary and delimitation. Several motivators can be defined in each group. this should be the subject of further research and clearly identify these motivators, which need to be addressed later.

4. Conclusions
The implementation of BIM technology has its pitfalls. On the one hand, there are indisputable advantages and benefits from the use and implementation of BIM technology in construction project management. On the other hand, there are challenges in implementing BIM in construction practice such as:

- Overcoming the resistance to change, and getting people to understand the potential and the value of BIM over 2D drafting
- Adapting existing workflows to lean oriented processes
- Training people in BIM, or finding employees who understand BIM
- The understanding of the required high-end hardware resources and networking facilities to run BIM applications and tools efficiently
- The required collaboration, integration and interoperability between the structural and the MEP designers/ engineers
- Clear understanding of the responsibilities of different stakeholders in the new process by construction lawyers and insurers [12].

In any case, implementation motivators need to be addressed and specified if we want to improve the use and implementation of BIM technology. This research analysed and specified the main groups of motivators for the implementation of BIM technology. Based on a large number of sources in the form of several world surveys and studies, the main implementation motivators were specified. This is a necessary step for further research. On the other hand, it must be said that this is the area of research. Clearly define specific motivators in individual groups on the basis of an overview of further studies, but mainly communication with experts in the industry. Subsequently, use quantitative statistical methods and precisely define these motivators and their weight.

Acknowledgments
This work was supported by the Slovak Research and Development Agency under the contract no. APVV-17-0549 and paper present partial research results of project VEGA 1/0828/17 “Research and application of knowledge-based systems for modeling cost and economic parameters in Building Information Modeling”.

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