

## FEATURES OF USING BUILDING INFORMATION MODELING (BIM)

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**Abstract:** Modern trends in the development of the construction industry require solving problems associated with increasing productivity, reducing costs and construction time. At the same time, new construction standards regarding the greening of production and social responsibility of business predetermine the need to introduce innovative technologies that ensure control and savings in the resources used, both during construction and during the operation of the building. In this regard, the effectiveness of using BIM (Building Information Modeling) has been proven as an innovative technology in construction, which allows you to construct complex structures quickly and efficiently.

BIM technologies (Building Information Modeling - information modeling of a construction project) provide effective management of design and construction, which as a result can significantly reduce the project implementation period, simplify the maintenance of the finished facility and extend its service life. Building information modeling is an innovative method of erecting, equipping, maintaining the operation and repair of a building, as well as collecting and comprehensive processing of information about the building during the design and construction process (architectural, technological, economic, etc.).

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BIM allows for the development of more accurate virtual models of a building in digital format for the purpose of constructing a facility, including design, construction, and production. BIM (Building Information Modeling) is a process for managing a digital model of a construction project at all stages of construction (design, construction, operation), which ensures the creation of an accurate and reliable multi-component information base for decision making.

**Keywords:** information technologies, building information modeling, digital model

### 1. INTRODUCTION

Building Information Modeling (BIM) has been proven as an innovative technology in construction, which allows you to construct complex structures quickly and efficiently. She is a information modeling of a construction project) provide effective management of design and construction, which as a result can significantly reduce the project implementation period, simplify the maintenance of the finished facility and extend its service life. Building information modeling is an innovative method of erecting, equipping, maintaining the operation and repair of a building, as well as collecting and comprehensive processing of information about the building during the design and construction process (architectural, technological, economic, etc.). The BIM allows for the development of more accurate virtual models of a building in digital format for the purpose of constructing a facility, including design, construction, and production. BIM (Building Information Modeling) is a process for managing a digital model of a construction project at all stages of construction (design, construction, operation), which ensures the creation of an accurate and reliable multi-component information base for decision making (Liu, Z.; Chi, Z.; Osmani, M.; Demian, P., 2023). The information modeling of a construction project) provide effective management of design and construction, which as a result can significantly reduce the project implementation period, simplify the maintenance of the finished facility and extend its service life. Building information modeling is an innovative method of erecting, equipping, maintaining the operation and repair of a building, as well as collecting and comprehensive processing of information about the building during the design and construction process (architectural, technological, economic, etc.).

### 2. MATERIALS AND METHODS

Information modeling includes all stages of the object's life cycle, which increases the efficiency of interaction between the design and contractor organizations. At the preparatory stage, the territory of future construction is studied; a conceptual BIM model is created; calculations are carried out and the volume of construction and installation work is determined based on the information model; geotechnical data are entered into the base model; a project presentation is created.

The main stage includes detailing the information model; filling with information about materials; coordination of related sections of the project. In this case, the main element of the system is a unified information model of the building, to which all participants in the construction process have access. This allows you to effectively carry out construction control functions, develop estimates and synchronize construction schedules. The use of BIM provides the developer with data about the construction site throughout the development and implementation of the project.

The ability to use BIM is determined by the maturity level (from 0 to 3) of this technology in accordance with the BS1192:2007 standard, developed in the UK based on ISO 19650 (2021)

Technology maturity level 0 includes CAD drawings, information exchange between project participants via electronic media, but excludes the ability to work in a common environment.

Technology maturity level 1 involves the exchange of information in digital format through a document management system, the presence of basic information and a conditional shared data environment. The data can be supplemented with 3D format. However, there is no necessary interaction between different project specialists.

Technology maturity level 2 is characterized by the interaction of various specialists with the model, through a software application using a common file format. In this case, you are allowed to use your own programs. This allows you to identify conflicts between systems and test different scenarios. At this level it is possible to analyze additional project parameters (4D and 5D) - time and cost.

Technology maturity level 3 provides for the creation of a multi-level unified environment that allows you to integrate the work of all project participants (architects, system engineers, contractors, developers, managers). This implies the integration of all project data and all stages of project implementation, taking into account international standards and the compatibility of all data with the IFC format. At this level, the information model is filled with operational data in real time, which can be used not only at the design and construction stages, but also at the operation stage, including the entire life cycle of the building. Currently, in many countries of North America and Europe (Great Britain, USA, Germany) approaches have been formed that ensure the implementation of BIM in the field of design and construction of facilities. In the USA, since 2003, a national BIM program has been created for the purpose of introducing BIM. In the countries of Europe and Asia, the transition to innovative technologies has been carried out since 2007. European countries have different populations, different construction ecosystems, methods of attracting investment in construction technologies, and are at different stages of BIM implementation (BIM adoption in Europe, 2021).

### 3. RESULTS

Experience in using BIM technologies at different stages of project implementation allows us to more deeply analyze the advantages and disadvantages from the point of view of managing construction processes. First of all, it should be noted that an important advantage of BIM technologies is the organization of a management system for the design and construction process. The parametric properties of a single information model make it possible to take into account all system changes that can be made by architects, engineers, and designers. The BIM model contains information about each element throughout the entire life cycle of the building, which is then transferred to calculation programs.

The main feature of the BIM model is to ensure interaction between project participants based on a single information model. This function is implemented through the use of cloud programs and services, which allows you to see dynamically changing current design data, exchange comments, and post photo recording results in a cloud solution. The use of the BIM model allows you to create a construction management system at a qualitatively new level, providing access to project data for all construction participants, receiving automated reports, generating accurate purchasing statements, centrally storing the history of project changes and data on the actual installation of structures. This allows you to reduce the design and implementation time of the project (20%-50%), reduce the time for approval and coordination (50%-70%).

The BIM model contains all the basic information about the construction site and is combined with a scheduling system, which allows for construction control within each process. Thus, the BIM management system in construction allows you to solve a number of problems on a single platform: compare planned and actual deadlines for completing work, exchange comments, receive analytical reports.

The use of a BIM model allows you to perform an engineering survey, taking into account data about the object and utility networks, including the search and selection of necessary elements, analysis of elements separately or in connection with adjacent systems; determining the location of elements in a building. Engineering systems in the BIM model include a data set with all the necessary information about the system, for example, for its scheduled or emergency repairs.

The use of the BIM management model in construction makes it possible to carry out an effective financial and technical audit, comply with the planned deadlines for completing work, and timely identify risks. The BIM management model allows you to receive accurate information about the status of project implementation (completing volumes) and correct comments at all stages of construction of the facility. This allows you to reduce the number of errors in design documentation by 40% and, accordingly, increase the accuracy of calculations (Honcharenko, T. at all., 2020).

Since financing is based on accurate data, it is much easier for the developer to stay within budget. At the tender documentation stage, the design organization or developer works with tables automatically obtained from the BIM model. Therefore, during the calculation, the human error factor is excluded. At the stage of drawing up estimates for the contractor, it is easier to justify the necessary costs for the project. The use of BIM technologies in construction allows specialists from different fields to: work with a building model simultaneously, superimposing the results of their work on each other, thereby obtaining a complete picture of the structure; view and edit a building model at all stages of construction; carry out experimental testing of the model under specified conditions; track automatic changes in data for the entire building model when changes are made to one of the sections.

#### 4. DISCUSSIONS

The most important condition for the implementation of BIM technologies is the creation of a BIM environment. BIM environment is a professional community dealing with information modeling technologies. Such an environment presupposes the presence of a main center that collects all information about the technology being implemented, develops plans, standards, regulations and transfers them to training centers. These centers prepare specialists and send them to design organizations for further implementation of the new methodology in construction organizations and management companies that create infrastructure for the transition to BIM.

On average, the cost of implementing BIM technologies can range from 5% to 10% of the company's total budget for the year. Based on the opinion of experts (Chan, [D.W.M.](#) at all..., Khosrowshahi, F., & Arayici, Y., 2012, Chien, K. F. at all...,2014), we can identify the key factors for the implementation of BIM: communication and information exchange; leadership; BIM training; BIM vision and strategy; availability of resources; motivation; choosing a BIM supplier; BIM implementation plan and policy; network relationship management; BIM performance measurement; senior management support.

It should be taken into account that the process of introducing BIM technologies into a construction company is fraught with risks, which are caused by the need to increase the competencies of company employees to work with BIM, and increased company costs due to the acquisition of new equipment and software. At the same time, the introduction of BIM technologies may require changes in the company's business processes, which will also lead to increased costs and require additional efforts from staff. Given that the implementation of BIM technology requires the availability of high-quality data, there is also likely to be a risk in the quality of the company's internal information used, including project data. Therefore, another risk is the data security risk that is associated with storing large amounts of confidential information.

BIM is an important growing trend in the construction industry due to its ability to provide.

#### 5. CONCLUSIONS

BIM is an important growing trend in the construction industry due to its ability to provide visualization of the entire construction project. The use of BIM can significantly ensure the sustainability of the development of the entire construction industry, especially in comparison with traditional tools for designing building structures. With the rise of sustainable construction, BIM is becoming more common than ever as a tool for reducing waste of time and materials. Environmentally, BIM can help reduce carbon emissions and optimize energy consumption of housing projects, overall improving energy efficiency in the construction process. At the same time, the use of BIM makes it possible to significantly increase the level of professional competencies of personnel, ensure increased labor productivity, optimize network models for the construction of facilities, which in general will ensure high socio-economic efficiency of the company's activities.

#### ACKNOWLEDGEMENTS

I express my gratitude to Assoc.Prof. Dr. Valentina Dyacona and Prof. DSc. Sevdalina Dimitrova for her assistance in editing and publishing this publication.

#### REFERENCES

- BIM adoption in Europe: 7 countries compared (2021). <https://www.planradar.com/bim-adoption-in-europe/>.
- Chan, D.W.M., Olawumi, T.O., & Ho, A. (2019) Critical success factors for building information modelling (BIM) implementation in Hong Kong. Engineering, Construction and Architectural Management Corpus ID: 201243427. URL: <https://ira.lib.polyu.edu.hk/handle/10397/94777>.
- Chien, K. F., Wu, Z. H., & Huang, S. C. (2014). Identifying and assessing critical risk factors for BIM projects: Empirical study. *Automation in Construction*, 45, 1-15. <https://doi.org/10.1016/j.autcon.2014.04.012>.

- Chen, Y., Wang, X. et al., (2023) Exploring Building Information Modeling (BIM) and Internet of Things (IoT) Integration for Sustainable Building. *Buildings* 2023, 13, 288. <https://doi.org/10.3390/buildings13020288>  
<https://www.mdpi.com/journal/buildings>.
- Information modeling of industrial and civil construction objects, (2021).Autodesk. [https://damassets.autodesk.net/content/dam/autodesk/www/campaigns/BTT-RU/BIM%20for%20buildings/Auto desk.pdf](https://damassets.autodesk.net/content/dam/autodesk/www/campaigns/BTT-RU/BIM%20for%20buildings/Auto%20desk.pdf).
- Khosrowshahi, F., & Arayici, Y. (2012). Roadmap for implementation of BIM in the UK construction industry. *Engineering, Construction and Architectural Management*, 19(6), 610-635. URL: <https://www.emerald.com/insight/content/doi/10.1108/09699981211277531/full/html>.
- Fiamma, P., & Biagi, S. (2023). Critical Approaches on the Changes Taking Place after 24/2014/EU in BIM Adoption Process. *Buildings* 13(4):850 DOI:[10.3390/buildings13040850](https://doi.org/10.3390/buildings13040850). [https://www.researchgate.net/publication/369525642\\_Critical\\_Approaches\\_on\\_the\\_Changes\\_Taking\\_Place\\_after\\_242014EU\\_in\\_BIM\\_Adoption\\_Process](https://www.researchgate.net/publication/369525642_Critical_Approaches_on_the_Changes_Taking_Place_after_242014EU_in_BIM_Adoption_Process)
- Liu, Z., Chi, Z., Osmani M., & Demian, P. (2023).Exploring Building Information Modeling (BIM) and Internet of Things (IoT) Integration for Sustainable Building. URL: <file:///C:/Users/irabe/Downloads/buildings-13-00288-v3.pdf>.
- Liu, Z., Liu, J., & Osmani, M. (2021).Integration of Digital Economy and Circular Economy: Current Status and Future Directions. *Sustainability* 13, 7217.
- «Levels of maturity BIM» (2021), Wiki Designing Buildings BIM, 13.01.2021. [https://www.designingbuildings.co.uk/wiki/BIM\\_maturity\\_levels](https://www.designingbuildings.co.uk/wiki/BIM_maturity_levels).
- Motamedi, A.; Hammad, A.; Asen, Y. (2014). Knowledge-assisted BIM-based visual analytics for failure root cause detection in facilities management. *Autom. Constr.* 43, 73–83.
- Su, F. & Ke, P. (2017). The Research on Hotspots and Foreground of International Library &Information Science (2014–2015): Full Sample Analysis of 27 SSCI Core Journals. *J. Acad. Libr.* 35, 11–19.