

The important role of BIM in construction project management, quality, and investment schedule control

Yuhang He*

Lanzhou University of Technology School of Civil Engineering, Lanzhou, Gansu, 730050 China

*Corresponding author. Email: heyuhang0317@163.com

Abstract. With the continuous development of the economy and technology in today's society, China's construction level has also made significant progress. At the same time, the complexity and difficulty of engineering projects have gradually increased as people's requirements for building functionalization, appearance, life span, green, and so on have increased. In addition, as the scale of engineering and construction continues to expand, engineering projects are vulnerable to the interference of many different factors. The project management is throughout the whole life cycle of the project. If the traditional project management method is followed, the problems of the construction schedule, construction quality, construction safety, construction cost control, etc., are very properly solved. Therefore, it is necessary to adopt new technology to fundamentally strengthen the construction quality and improve the construction efficiency of construction projects.

Keywords: BIM technology, engineering project management, construction efficiency.

1. The concept and core of BIM

BIM, whose full name is Building Information Modeling (BIM), is a data management tool applied to the construction-related industry and is a construction project information model established by computer programs in the digital information era. BIM technology can automatically detect the collision of construction projects and determine whether there are collision problems in the architectural design. Meanwhile, it can analyze the whole construction process of construction projects using time-related factors, including determining the cost and schedule control of construction projects, which can be shown directly in the form of animation. This provides a platform for various construction entities to work together.

The core of BIM technology is its powerful database. Completing the database requires integrating computer technology and 3D technology, and its completion is focused on BIM technology. The 3D database makes the construction industry reach a new level, and the database will be updated continuously as the construction plan progresses gradually. In addition, the data in the database will be updated throughout the operation and maintenance process in the later stage of the project. In addition, the data in the database is a whole, and a change in one of the data will lead to a synergistic change in the other corresponding data

Using BIM technology to collect information can create a good foundation for construction project management, ensure the overall quality of construction, improve the profitability of project construction, and provide more ideas for project construction management. Other units involved in constructing the construction project using the BIM model can also obtain a communication platform, which can effectively control the construction schedule and strengthen departmental coordination, making the overall management efficiency, the degree of integration of building information model, and resource utilization efficiency greatly improved. In this way, the purpose of improving productivity, shortening the construction period, and saving costs are achieved.

2. Features of BIM

2.1 Simulation

Before construction begins, the project needs to go through a survey and design phase. In the survey and design, a large amount of information is presented through drawings. Combining the

specific survey results, the selection of engineering construction process and structural design are explored, which is the premise and foundation to ensure the building project's construction quality and functional efficiency. However, in the traditional survey and design stage of construction engineering, it is mainly done on relatively abstract drawings, so it is not easy to accurately present the building information one by one in the way of drawing floor plans. The construction project can be modeled by applying BIM technology. By simulating the real situation, some low-probability risk factors can be shown. At the same time, it can also simulate and budget the construction cost of the building, so as to obtain more sufficient information and provide a basis for the construction and management of related projects.

2.2 Coordination

In the process of construction projects, there are many construction links and construction processes involved, so one department can't complete it. At the same time, the cooperation of relevant departments is also needed to ensure that each construction link is connected to complete the project successfully. Once a problem arises in construction, a meeting is usually required to solve it at this stage of construction. If a meeting is held, it is necessary to call the relevant personnel. On the one hand, although gathering together to discuss can solve the problem, on the other hand, gathering together can lead to the waste of human resources and affect the work progress. If with the help of BIM technology, coordination can be strengthened when problems arise in the project. Moreover, the relevant departments can be reliably and effectively organized in the application of technology to ensure that the problems are solved quickly.

2.3 Visibility

With the increasing speed of urbanization, the construction industry's development level is increasing, and the structure and functions of buildings are becoming more and more diversified and complex. To adapt to the development of modern construction technology, the construction industry should gradually eliminate the traditional way of working with drawings as the basic working model. Because the traditional CAD drawings are too abstract, the construction management based on drawings is already backward, which is not conducive to realizing construction and management benefits. But BIM technology has obvious visualization characteristics. By establishing a dynamic 3D model of the building, the location of the building components, the geometric features of the building, the various materials, the cost of the building and other aspects can be displayed visually and in detail to the relevant staff. This dramatically enhances the workers' understanding of the construction project and its efficient construction. It avoids all kinds of construction problems caused by the mistakes made by the construction workers against the drawings and enhances the overall construction efficiency of the building.

2.4 Optimality

It is a continuous optimization process during the whole design, construction, and operation phases of a project. Based on BIM, these processes can be better optimized. On the one hand, in the project design stage, BIM technology can combine cost and return on investment to help project designers optimize the project's design. On the one hand, in the middle of the pre-construction period of new projects, BIM technology can be used to simulate the critical parts of the project in an all-around way, after which the relevant construction drawings can be presented in three dimensions. Construction optimization can be carried out on this basis. This can lead to significant cost and schedule improvements.

3. Advantages of BIM in construction engineering management

3.1 Optimize the management mode of engineering construction

The use of BIM technology can optimize the traditional management mode of construction projects, to improve the management efficiency of the construction process, and then meet the development needs of construction projects. The so-called optimization is to improve things themselves by adjusting them. Although BIM itself does not have such a function, BIM is the basis for optimizing architectural design. In the construction process of many projects, information between different departments will not advance, which will affect the coordination among different departments.. The units involved in the construction can obtain the relevant information about the project through BIM technology on this platform, which includes the engineering resources, the layout of the building, the construction steps related to the time and other information, so that the resources can be fully utilized, as far as possible to avoid the resources of waste. In addition, the use of BIM technology has a strong continuity compared to traditional methods. By using BIM technology, project managers can record the information of each construction stage in detail. Through the information of multiple stages, project management can be optimized, and construction projects rely on the information of relevant stages integrated by the BIM platform to guarantee management effectiveness.

3.2 Enhance the economic efficiency of the project

The economic efficiency of construction projects can be significantly improved by applying BIM to construction project management. The project is built more efficiently than before. Therefore, the construction period is greatly reduced. The labor and machinery costs of construction projects are reduced. In addition, with the gradual development of science and technology, BIM technology can better coordinate the building facilities that gradually become intelligent. It greatly improves the efficiency of construction facilities. Through BIM technology to coordinate the construction projects, the human and material resources, ensure the quality of construction based on the maximum possible to reduce the consumption of resources, and ensure the progress, cost, and quality based on the maximum realization of the economic benefits of enterprises.

3.3 Realize project construction information sharing

In applying construction project management, BIM technology has the advantage of sharing. It can integrate the information in each construction process, build a data information sharing platform, and analyze and summarize all the project information. Therefore, the construction manager can know the current project construction details through the data information sharing platform to further rational management and promote the project's construction progress. In addition, BIM technology can accurately identify the unreasonable design of the project design drawings. Through BIM technology, the actual situation of the construction site can be shared and compared with the information related to the design drawings, thus providing an accurate and reliable basis for the construction enterprises to modify the construction design drawings and improve the efficiency of optimizing the design drawings. Therefore, BIM technology significantly reduces the possibility of secondary construction and construction risks.

3.4 3.4. Dynamic management of project construction

Simulation management of the whole life cycle of engineering projects through BIM technology can improve the coordination of project construction progress and can control the quality of project construction, the progress of project construction, the cost of project construction, and the construction personnel of the project. At the same time, this management mode can also dynamically manage the whole project construction process, providing a management basis that can make the project construction achieve orderly and standardized development. Simulation management lay the foundation for the development of intelligent management of construction projects.

3.5 Continuous improvement of project construction management

BIM technology has a continuous effect on construction project management, and project managers can continuously improve project construction management through BIM technology.

3.6 Improve quality management

On one hand, the overall quality of the construction project determines the service life of the building on the one hand and also involves the safety of the life and property of the building users on the other hand. Hence, the project managers are required to strengthen the supervision and control of the construction quality in the process of construction management. Using BIM technology, the construction plan can be escorted, and every detail in each link of the building construction process can be analyzed and controlled. Firstly, BIM technology can identify possible safety hazards and take countermeasures by simulating each construction link. At the same time, the three-dimensional building model can reflect the technical key points of each construction link very intuitively to achieve the purpose of improving the stability of the building. Second, even after completing the project construction, BIM technology can still follow up the overall quality of the construction project.

3.7 Perform material control

In the management of construction projects, construction materials determine the cost of the project and determine the quality of the construction project. From the aspect of capital cost, BIM can classify and file the data information about various project materials. In addition, the material control system of BIM software can ensure the quality of materials meets construction requirements by automatically synchronizing the information of material cost, specification, and quality, therefore, avoiding the possible waste of funds due to excessive cost investment. From the aspect of construction project quality, by using BIM to take different management and maintenance methods for different types of materials, the damage to materials caused by improper storage is reduced. In addition, BIM software can continuously improve the process of material management related to control, so it further reduces the economic loss in the construction process.

4. Application of BIM in construction project management

4.1 Decision-making stage of engineering project management

In the decision phase, the work includes investment opportunity study, preliminary feasibility study, feasibility study, and project evaluation and decision.

The best solution is determined through a comprehensive analysis and scientific evaluation of the design and construction options in the decision-making phase. Although this stage is not a large task, it plays a decisive role in the project's long-term economic benefits and smooth development. By using BIM technology in the project decision-making stage, the relevant personnel can integrate and analyze the geological and hydrological conditions of the construction site and various possible climatic problems through BIM technology to simulate various situations that may occur during the construction process, to improve the efficiency of project decision-making.

4.2 Engineering project management design stage using BIM technology

Previously, CAD software was generally used to design construction drawings for building structure design. On the one hand, CAD software greatly improves the efficiency of drawing compared with hand-drawn drawings. However, on the other hand, CAD software has a great disadvantage: the lack of correlation between individual drawings. If a designer wants to modify a part of a construction drawing, he needs to modify other related construction drawings simultaneously. Therefore, if designers can master BIM technology, they can use BIM technology to link all construction drawings in the design stage. Once they need to modify a certain part of the construction drawings, they only need to modify one drawing, and the rest of the related drawings will be modified

simultaneously. In addition, compared with CAD software, BIM software can realize more detailed construction drawings and more intuitive three-dimensional display. BIM technology not only has a vital role in structural design but also in drainage, lighting, shape design, decoration, and other aspects to provide strong support. It can be combined with the owner's real needs to optimize and improve the created building model. For example, in designing the greenery around the building, designers can directly add different weather and scenery around the building model to simulate the environment. On the one hand, this method can improve the realism of the building model, and on the other hand, this method can also facilitate the choice of different design options for the owner and the designer. The final decision is made on the most realistic design solution.

4.3 BIM technology in the construction phase of the relevant applications

By applying BIM technology to the construction phase, the construction company calculates the project construction volume through preliminary data modeling. It accurately calculates the project labor cost, machinery and equipment cost, material cost, total construction volume, and the specific progress of construction time. On this basis, project managers can draw up construction plans according to the corresponding conditions, providing theoretical guidance for the construction progress of the builders. In addition, project managers can also use BIM technology to control the machinery and materials required for construction, and BIM software can calculate the cost of construction according to the actual volume of work. Through BIM technology, project managers can provide a strong reference to the construction cost and arrange the use of resources accordingly. Avoid the waste of resources.

4.4 BIM technology in the completion stage of the relevant applications

By applying BIM technology to the completion stage of a construction project, it can exhaustively record the data formed in the various preliminary stages within the building information model. Often, the construction project will reveal a series of typical problems at completion and settlement. For example, errors in the data appear. These problems may greatly affect the operation and maintenance of the construction project later under certain conditions. Through this building information model, all project departments can follow up, view, and account for the project in a synchronized manner, and control all aspects of the construction project to ensure that no data errors occur in the construction project. The purpose of saving time is achieved. At the same time, BIM technology can also effectively summarize site-related information and design drawings. This can reflect the advantages of its integrated data management.

4.5 Application of BIM technology in operation and maintenance

BIM technology for timely post-operation and maintenance of construction projects is of great significance to enhance the building life and strengthen the project life cycle management. Currently, there are many shortcomings in the interaction and integration of information in construction projects' later operation and maintenance. In contrast, as an excellent information technology model, BIM covers the whole cycle of project information from design to completion and acceptance. Using BIM technology well, it can supervise construction projects in all aspects, prevent possible natural disasters in advance, and fundamentally eliminate accidents that endanger construction safety.

5. Conclusion

In summary, with the continuous promotion and application of BIM technology in the field of construction engineering, engineering project management has achieved remarkable results. To achieve a better performance of BIM technology in construction engineering management, it is necessary to strengthen relevant practitioners' skills learning and training to help them understand more deeply and master the use of BIM software. Actively improve the management effectiveness of building construction.

References

- [1] Zhang Lu. Analysis of energy-saving construction technology in the construction of building civil engineering [J]. Housing and Real Estate, 2018(15):245-245.
- [2] Zhao Defang. Analysis of the main points of energy-saving construction technology in the construction of building civil engineering [J]. Doors and windows, 2018, 3(135):260-260.
- [3] Xu Xiaowei. Analysis of construction schedule control and management measures for civil engineering [J]. Masonry, 2020(10):122-123.
- [4] Chen Xin. Trial discussion on measures to strengthen schedule management in construction project management in the new era [J]. Construction Technology Development, 2021, 48(5):76-77.
- [5] Hu Ke, Wu Yuqi. Design of project management information system for construction projects based on BIM network technology [J]. Modern Electronic Technology, 2021, 44(10): 77-81.
- [6] Qiu Youqun. Exploring the application of BIM technology in construction project management [J]. Jiangxi Building Materials, 2020, 40(10): 233, 235.
- [7] Niu Pengwei. The integration and application of BIM technology in construction project management [J]. Brick and Tile, 2020, 50(10): 102 - 103.
- [8] Qiang Shiwei. The integration and application of BIM technology in construction project management [J]. Green environmental protection building materials, 2020, 7(10): 147 - 148.
- [9] Hou Lei. Research on the application of BIM technology in construction project information management [J]. Building Materials and Decoration, 2018, 14(48): 150 - 151.
- [10] Huang Zhiguo. Research on the Application of BIM Technology in Construction Project Information Management [D]. Beijing: Beijing Jiaotong University, 2016
- [11] Bao Yunjun, Zhou Lijie. Application of BIM technology in construction safety management of building engineering [J]. Housing and Real Estate, 2020 (12): 142.
- [12] Li Jiaxiang. Application of BIM technology in construction management of building projects [J]. Henan Building Materials, 2020 (02): 13-14. Ma Jingfang. Discussion on specific measures for the application of BIM technology in civil engineering [J]. Smart City, 2020, 6(17): 161-162
- [13] Liu Jianxing, Lai Ruiji, Wu Quanguo, BIM technology in building construction enterprise application thinking [J]. Chongqing Construction, 2019 (12): 59-60.
- [14] Zheng Qiwen. The application of BIM technology in the project management of building decoration and renovation projects: an exploration and study of the project of Yangcheng Lake Outlet Town in Suzhou, China [J]. Construction-Building Materials-Decoration, 2020(11):17-18.
- [15] Liu Lingli. Analysis of the connotation of BIM technology and its value in improving the efficiency of construction project management [J]. Science and Technology Economic Journal, 2020, 28(16): 25.
- [16] Chen M.R., Fu B.C. Study on the status of application mode of engineering management information: taking BIM as an example [J]. Information Record Materials, 2018, 19(5): 36-37.
- [17] Wu Xiebin. Analysis of the application of BIM technology in the project management of construction engineering [J]. Fujian Construction, 2021(4):102-104.
- [18] Wang Xiaoguang. Experimental analysis of the integration and application of BIM technology in construction engineering project management [J]. Residence Industry, 2021(3): 165-166.
- [19] Wang Yu. The application of BIM technology in construction project management--Review of "A quick introduction to BIM design and template application for construction engineering" [J]. China Science and Technology Paper, 2021, 16(3): 360.
- [20] Gong Shengping. Project management and construction technology application of building decoration engineering [J]. Residence Industry, 2021 (2): 137-138.
- [21] Shang Chao. 5G and AI technologies help digital transformation of construction engineering project management [J]. Masonry, 2021(2):139-140, 142