

Research on applications of Building Information Modelling (BIM) in construction project management information systems

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Abstract. With the development of modern society, the building trade has passed the golden period of rapid growth. In the past few decades, the professional level of the building trade has been continuously improving, and the efficiency of engineering construction has been developed to a certain extent. However, it cannot be ignored that in the context of positive developments, adverse effects also have occurred. This requires a corresponding reform in the information management of construction projects to obtain stable and maximum returns. In order to ensure the final effect and final quality of construction projects, the role of BIM technology in construction project information management is very important. This article will briefly study and analyse the application of BIM in construction projects.

1 Introduction

China's economy continues to grow steadily, and the construction management level of the building trade in China has also been improved, which puts forward higher demand for the building trade. Therefore, the application of BIM technology can effectively deal with some problems in construction management, and thereby improve the quality of construction. Also in the actual operation of construction projects, the use of BIM technology can create more favourable conditions. In addition, beside playing a certain management advantage in the construction field, BIM technology can also provide the 3D model in advance, making more scientific arrangements and planning for the preliminary preparation of the construction project.

2 Basic conception

2.1 Building Information Modelling (BIM)

Building Information Modelling is referred to as BIM, which displays building data in a three-dimensional view to achieve the summary and integration of various information in construction. In the process of using BIM, not only can the bump problems that may exist in the architectural design be detected, but also the entire time progress and cost planning of the construction project can be roughly judged according to the construction situation of other elements such as time in the construction project through animation.

2.2 Characteristics of BIM

BIM has six main characteristics in general, they are visibility, simulation, information completeness, optimization, drawing-making, and information correlation.

2.2.1 Visibility

Visibility mainly appears in the form of three-dimensional models in BIM technology, showing the overall architecture of the entire project more specifically and comprehensively, covering up the disadvantages of the traditional plan, and designing a more intuitive and reliable model. In the traditional project management process, drawings are usually drawn by hand by architectural designers, so it is easy to miss some content. At the same time, these drawing methods can easily affect the architectural quality and safety of the later construction. However, with the time passing, some relevant data can be applied to three-dimensional building simulations. In this way, the visibility of BIM technology can be used to demonstrate the actual situation inside the building, and it is convenient for personnel in later construction to carry out the construction.

2.2.2 Simulation

BIM technology also possesses the advantage of simulating the whole process of building construction, for instance, the preliminary scheme design. And the contingency plan of all the possible problems that may occur in the construction stage can be formulated in time by using BIM technology, and specific solutions will also

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be provided. In the design stage, simulation tests of the construction project can be carried out and actually simulate the real state of the building in three-dimensional space, which belongs to the simulation of BIM technology. And this can enable the relevant engineering design technicians to complete the simulation of the building emergency passage through the corresponding parameters. At the same time, it can reasonably adjust the cost of the project, and then reasonably improve the economic benefits of the building.

2.2.3 Information Completeness

Information completeness is reflected in the fact that BIM technology can describe 3D geometric information and topological relationships of construction objects, as well as complete construction information description, such as object name, structure type, building materials, engineering performance and other design information; construction process, schedule, cost, quality and manpower. Construction information like machinery and material resources can also be described. Besides, it is the same with maintenance information such as engineering safety performance and material durability; engineering logical relationships between objects, etc.

2.2.4 Optimization

As a matter of fact, the entire process of design, construction and operation is a process of continuous optimization. Of course, there is no substantial and necessary relation between optimization and BIM technology, but on the basis of BIM technology, better optimization can be done, involving project alternatives optimization, design optimization of special projects and so on.

2.2.5 Drawing-making

Using BIM technology, in addition to the output of building plan, elevation, part and detail drawings, it can also produce collision reports and component processing drawings, such as the output of construction drawings and component processing guidance construction drawings. The construction drawings include:

- Collision between building and structure.
- Collision of various specialties inside the equipment.
- Collision between architecture, structure and equipment.
- Solve the pipeline space layout.

The Component processing guidance involves component processing drawings, component production guidance, and digital manufacturing of prefabricated components implementation.

2.2.6 Information correlation

BIM model is the carrier of the integration of various related information, and it is also the only carrier of engineering informatization. In each stage of the project, the BIM model is created and updated with different professional information by various participants, and this

information is integrated in the BIM model, and stored in the server in digitized form to form a database, which is used by end users ultimately.

3 Applications of BIM in each stage of engineering

3.1 The application of BIM in design project engineering planning

BIM technology is used in architectural design to effectively enhance the overall value of the project. It can not only improve the effectiveness of the project, but also enhance the rationality and scientificity of the design. Besides, in the planning stage of the construction project, the builder can conduct in-depth analysis according to the relevant design scheme. In this way, the cost of construction project can be controlled. Moreover, BIM technology can control construction management according to the needs of the owner. And in the planning stage, the relevant designers can use the owner's architectural needs and positioning to carry out further analysis and exploration.

3.2 The application of BIM in the decision-making stage of construction projects

There are many factors affecting buildings, such as building pattern, surrounding environment, geological conditions, etc., all of which will affect the construction quality of construction projects. Therefore, in the decision-making stage of construction projects, in-depth analysis should be carried out according to its influencing factors. In the traditional management method, a large amount of information needs to be collected about the environment and geological condition around the building. As a result, it is difficult to deal with the great deal of information. At this time, BIM information technology can be adopted to perform simulation on the project in order to deeply grasp the basic structure and form of the building.

3.3 The application of BIM in the design stage

In the design stage, the traditional design method can only presents the construction drawings in the two-dimensional planar state, and cannot show the internal situation of the building structure. Therefore, it is necessary to use BIM technology to better manage the work of various functional departments of the construction project. Moreover, it can choose different software to manage and apply all aspects of the construction project, so that it can not only quickly find out the problems in the system management process, but also avoid some design problems.

3.4 The application of BIM in the construction stage

During the construction process, safety is always the top priority of the overall building project. Hence BIM technology must be applied to the construction management of infrastructure construction in order to greatly improve the efficiency of construction management. Furthermore, relevant personnel can also build a three-dimensional management model according to the actual service situation of BIM technology and the particularity of construction project management. In addition, in the architectural model, the following three levels are mainly included, data source, model layer, and application layer. Among them, the model data source is mainly from the 3D model layer, and the model layer is based on the data information, and then generate building three-dimensional information model according to the actual construction situation. As for the application layer, it primarily plays the role in effectively manage and control the planning, safety and detection of the construction process, optimization of various programs and other aspects, so as to effectively improve the work efficiency of the construction site.

4 Applications of BIM in specific departments of the building trade

4.1 The application of BIM in quality management

The quality of construction projects is not only related to the service life of the building, but also plays a very important role in the life safety of users. Therefore, this puts forward higher requirements for managers in construction management. Firstly, BIM technology has a very important role, it needs to carry out reasonable analysis and planning of each link of the construction project, and take certain measures to deal with safety hazards, for example, the selection of three-dimensional building models, which can more clearly and directly see the problems in the construction process, solving and dealing with them in time, and thus improving the safety of the building. Secondly, BIM technology can not only play a role in the preliminary planning and actual work of the construction project, but after the successful completion of the project, BIM technology can keep monitoring and analysing the building at any time, which is more important for the safety and stability of construction quality.

4.2 The application of BIM in material management

In construction management, materials often play a crucial role in the entire project. Because the price of materials is the value of materials to be paid for construction projects, the efficiency of construction is also deeply affected by materials. From the perspective of the application of BIM technology, BIM technology can classify and sort out the materials of the project, and through the resource storage information of the BIM platform, it can timely present various information of

certain material, such as price, quantity, quality, etc., and calculate the rationality of using the material according to the data evaluation to ensure that the selected materials meet the basic requirements of construction, and ensure the rational use of funds with greater efficiency. If there are clear requirements for the quality of the construction project, BIM technology will choose a more appropriate management mode for various materials, effectively avoiding the possibility of material damage or unusability resulting from unclear storage methods, which can reduce unnecessary cost consumption in material management.

4.3 The application of BIM in progress management

Although the building quality of the construction plays a decisive role in the implementation of specific project, the construction schedule also occupies an equally important position. BIM technology plays an indispensable role in the deployment between the building quality and construction schedule. Firstly, BIM technology can monitor the actual construction process in real time, such as allocating the construction personnels reasonably, arranging the construction personnels to more suitable positions according to the actual technical expertise, clearing responsibilities and personal obligations, reducing a series of problems caused by unreasonable and unfair work arrangements, and optimizing and adjusting the whole process of construction at any time. Secondly, the use of BIM technology can effectively improve the overall efficiency of construction. BIM technology will supervise and analyse all construction conditions at any moment, follow the construction arrangement to adjust and plan, and reduce the delays caused by problems in the project.

5 The development prospect of BIM

The application of BIM method to construction project management, construction management and engineering cost management can greatly improve efficiency, reduce engineering construction costs. It plays a role in the informatization, intelligence and sustainability of construction projects, and have been widely used in foreign construction projects. Because of the advantages of BIM method such as visibility, simulation, coordination and drawing-making, BIM technology has been applied to most developed countries, and most of them are used in the work of architectural design units and engineering construction units.

China's BIM technology is still in the growth stage and is one of the necessary trends for the development of the future building trade. In China, the use of BIM is regarded as one of the important indicators of enterprise evaluation ability in the *Special Qualification Standards for Construction General Contractor Enterprises*. Construction enterprises use BIM to establish a leading group, strengthen coordination and cooperation with their departments, improve management level, and improve the company's strength. China State Construction, China Railway Construction Corporation Limited, PowerChina

and other mega-construction companies all stipulate that BIM companies or enterprise BIM organizations should be established. For a long time, China's relevant management departments have vigorously promoted BIM technology, and collected a large amount of information on BIM technology from developed countries, actively introduced BIM technology, and carried out in-depth research and development. In addition, because the current application of BIM technology is not very perfect, it can be discussed and studied from the following perspectives:

- Firstly, improving the depth of the use of BIM technology in construction projects. The application depth of BIM technology in China is relatively shallow, for example, when building a three-dimensional architectural model with data information of construction projects, attention must be paid to checking all links and animation. Moreover, in the process of actual operation, we can continue to strengthen the application of BIM technology, so as to improve the efficiency of construction project management.
- Secondly, BIM technology can also be applied to various engineering stages, and each participant in the project can shift its own management mode from a single structure to the BIM technology management mode, in order to meet the needs of the development of the times, and then build a new management model and give full play to the real value of BIM technology.
- Thirdly, improve the standards of construction projects. The goal of using BIM technology in construction projects is mainly to manage the whole process of construction projects and share information with other participants, and consequently improve the efficiency of every link of construction projects.

6 Conclusion

BIM technology is an advanced technical concept, which runs through all stages of construction projects. It can effectively improve the work efficiency of each stage, and is also an important condition for promoting the future development of the building trade. In addition, BIM technology can effectively help the building trade to implement modern information management.

In general, with the strong support and promotion of BIM technology, construction projects have greatly improved the quality and work efficiency of related work, and have been optimally allocated and applied in terms of construction capital investment. This shows that BIM technology provides a very important impact in construction engineering, and has huge development space in China's engineering construction. In the pre-construction stage of the project, the establishment, analysis and research of three-dimensional graphics can be used to predict the implementation process. In the implementation stage, controlling the implementation process by digital means can complete the implementation process in an orderly manner while reasonably arranging the use of personnels, equipment and facilities. In the final link of construction, BIM technology can play the function of supervision and

management, improve the safety and stability in the later stage, and can have a due influence on all areas that must apply BIM technology in home and construction projects. Therefore, vigorously carrying out the development of BIM technology in the field of construction project management and applying it to construction projects can improve the comprehensive management level of the entire enterprise, and at the same time drive the long-term and steady development of the entire industry.

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