Application Research and Development of BIM Technology in the Field of "Wide-Civil" Engineering

Mimi Zang

1779262717@qq.com

Nanchang Institute of Technology, Nanchang 330013, China.

Abstract. The concept of BIM technology is introduced, and the current technical core and application status of BIM are summarized. On this basis, the practical application of BIM technology in the planning, design, construction, operation and maintenance of wide civil engineering is analyzed and studied. The conclusion shows that the application of BIM technology in "wide-civil" engineering projects is conducive to the rational use of capital costs and obtain better project benefits. In the context of digital economy, the integration and development of BIM technology and "Wide-civil engineering" is an important symbol of the informatization and networking of wide-scale civil engineering construction industry. In addition, to make the application of BIM technology in construction projects more in-depth, it is necessary to have a scientific technical management system, broaden the channels of publicity, and cooperate with enterprises and schools to cultivate information-based BIM talents.

Keywords: BIM technology, wide-civil engineering, building information modeling

1 INTRODUCTION

With the "New infrastructure construction" in full swing and the rapid development of China's modern digital economy, the construction industry has ushered in both opportunities and challenges. Although the domestic construction industry has developed rapidly, the development model is relatively extensive. This is a problem that has always existed in the development of the domestic construction industry, and so far, practical solutions are still needed. This way of development in the construction industry will lead to increased costs, low efficiency, which is not in line with the country's concept of sustainable development. The energy consumption of the domestic construction industry is higher than that of many Western developed countries, the main reason is that the current level of domestic building informatization is still relatively backward.

BIM, Building Information Modeling, is based on the relevant information of the construction project to construct a three-dimensional building information model to visualize the building information (Yan,2020)[1]. BIM technology is based on computer network data simulation technology, and its application has greatly promoted the development of large-scale civil buildings. Since entering this century, China's construction industry has achieved remarkable results under the guidance of BIM technology, which makes the information BIM talents to master the relevant content is particularly important.

ICBBEM 2023, May 19-21, Hangzhou, People's Republic of China

DOI 10.4108/eai.19-5-2023.2334423

2 THE DEFINITION OF BIM AND RESEARCH STATUS AT HOME AND ABROAD

BIM technology is the key to the three-dimensional technological transformation of the construction industry, and it is also a data tool. BIM mainly uses computer information technology to process information, simulate the construction of three-dimensional building information model, and truly present the actual situation of the construction project. Integrate project data and information management. BIM technology implements different functions in different specialties, and as a modern information technology in the construction industry, it has powerful data processing functions to facilitate civil construction. Due to the deepening of industrialization, the BIM platform has built a database of building models, providing valuable data resources for the intelligent management of built and unbuilt projects.

BIM technology was developed and used earlier in foreign countries. BIM technology was first proposed and used in the United States, and the use of BIM technology is conducive to the rational use of capital costs, to obtain better project benefits. Other countries have also developed and applied BIM technology (Li,2023)[2]. Charles Eastman, the father of BIM, first proposed BIM technology, used computers instead of manual construction drawings (Vitasek,2019)[3]. G Avan Nederveen & F Tolman created "the term of BIM", combined "Building product models" with "Product information models" to build a "Building information model"; BIM godfather Jeny promoted the use of BIM technology, emphasized that BIM is a management process.

BIM technology has been used in China since early 21st century, BIM technology has gradually improved in China, the application and promotion of BIM technology will be the focus of the future wide civil construction industry. Wang Weixin analyzed the CCR definition method, obtained the statistical CCR classification, and constructed the corresponding expression model based on the IFC standard(Wang, 2022)[4]; Fei Pan and Sherong Zhang studied the integrated management of civil and hydraulic BIM in 3D WebGIS (Pan, 2018)[5]; Zhu Yan analyzed the coupling evolution characteristics of regional BIM policy and BIM typical projects in time and space by using coupling model (Zhu, 2022)[6].

In the wide civil field based on BIM technology, that is, the use of computer technology to simulate construction, expose various problems that are not easy to find in the construction process, especially in the two-dimensional drawings, in advance, correct and solve them; Integrate all the work and links of the project to achieve the scientific planning of construction project.

3 THE CORE FEATURE OF BIM TECHNOLOGY

Databases is the key core of the BIM platform. The building information resource database is constructed by using computer science technology and 3D simulation technology.

3.1 Design Drawings

Based on BIM technology visualization function, coordination, simulation and optimization, design drawings. The drawings drawn by BIM technology are different from the construction

paper drawings provided by the design institute: the design institute provides design drawings such as foundation, steel bar, beams and columns, decoration; while BIM technology simulates and optimizes the drawings, simulates the construction, predicts and prevents risks, ensures the smooth progress of the construction process, and ensures the quality and safety of the project. BIM technology optimizes design, splits processing components, automatically exports models, and detects collisions in different specialties (Wu, 2019)[7]. BIM technology combines unit models, draw the total construction drawings, facilitate the overall project planning and deployment.

3.2 Visualization

In the context of the digital economy, modern advanced technology should be used in construction to ensure the smooth implementation of project and meet the requirements of people in the new era. The construction of three-dimensional building information model based on BIM technology is visual. During the construction stage, the structure, material, size and other parameters of each component are managed synchronously, which facilitates the construction process, realizes three-dimensional planning, and reduces the gap between theory and practice. BIM 3D view successfully solves the defects of "imagination" method in traditional construction technology, plans and manages the construction process (He, 2017)[8]. Parameter visualization management ensures the accuracy of the construction process, and queries the data information in the BIM 3D building information model in time. The part and whole three-dimensional models provide information and data for engineering and technical personnel in the construction process, reduce the construction error caused by insufficient communication, and ensure the smooth implementation of engineering construction.

3.3 Simulation

The application of 3D building information model to display the overall effect of the project, simulate the construction process, and realize the project construction management. The real construction process is complex and changeable, even if sufficient preparation is made before construction, various conditions will occur in the actual construction. For example, unbalanced allocation of resource, unreasonable arrangements of equipment entry and exit, bad weather, defects in drawing design, substandard technology of construction personnel and so on, resulting in waste of resources, delays in construction periods, and overrun construction costs. BIM technology predicts problems and avoids risks by simulating the actual construction of a project.

3.4 Coordination

The data information of each link in the BIM system database is interrelated and logically close. The coordination of BIM technology makes equipment, structure and building interconnected. Based on the support of the BIM platform, the construction quality is strictly controlled in the engineering design, the work between the various majors is coordinated, the communication difficulties of each profession and the rework of nest workers are avoided, the resources and costs are saved, and the engineering design is completed efficiently.

The smooth implementation of building construction must ensure mutual coordination and communication between the construction parties. BIM technology standardizes the construction management of civil construction project, coordinate all participants and others, avoids unreasonable construction; enables the construction personnel and owners to achieve real-time

information exchange, coordinate construction, and ensure the quality and efficiency of the project.

3.5 Perfection

At present, the construction technology and management level of construction enterprises are restricted by the environment and resource supply conditions, and how to optimize the resources and efficiently construct the project under the same conditions will directly affect the smooth implementation of the project. BIM technology can perfectly deal with defects in the whole life cycle of traditional engineering projects, and achieve the goal of engineering optimization management under the condition of fixed resource consumption. BIM model provides data of measurement and release lines, component positioning, and component parameters in the process of construction, coordinates the processing of component information of various parts of the construction process, and provides change and adjustment information for all parties and majors in the construction of the project. The parameterization of BIM structure model ensures the optimal management of engineering construction process and plays an active role in the cost control of civil engineering.

3.6 Optimization

Engineering design deviations are difficult to avoid. Based on BIM system, the 3D building information model is constructed, and the design is optimized. In the current stage of engineering design, only relying on empirical design will make the related work become very difficult (Wu, 2022)[9]. With the support of BIM, designers optimize the design with the help of BIM platform, coordinate and cooperate with colleagues, and complete design tasks efficiently and smoothly.

4 APPLICATION OF BIM IN WIDE CIVIL ENGINEERING

4.1 BIM Technology Is Applied To The Planning Phase

BIM technology should first meet planning requirements. In-depth analysis of BIM technology, so that the design department can fully grasp this technology, and then complete the promotion and popularization work. The construction of civil engineering has the participation of different agencies, and different agencies have different requirements for construction, which leads to misunderstandings and contradictions. BIM technology can display engineering models, collect and sort out different opinions, coordinate the requirements of various agencies, feedback complete information as much as possible, and improve construction plans.

4.2 BIM Technology Is Applied To The Design Phase

BIM multi-dimensional intelligent building information model enables engineers understand the ideas of the design department clearly and intuitively. The BIM technology is applied to the design, and the three-dimensional building information model is generated to present the real situation of the project and the characteristics of key components. The internal analysis model is introduced into the finite element software by using BIM technology to analyse and optimize structures and materials for optimal economic benefits. At this stage, the design process due to insufficient development and coordination of the various functions of the software platform and

various problems, collision detection can be used to promote the effective improvement of the design.

BIM component library is one of the advantages of BIM design, and with the support of BIM technology, designers are in a good collaborative design pattern. BIM data resource sharing allows project personnel to be informed of the data and information of design changes in time, accelerate the transmission of information, and improve the efficiency and quality of design. The design of drawings needs to be continuously checked and mended to optimize and improve. Based on the BIM platform, all professional designers work together to complete design, strengthen communication between each other, find design loopholes faster, and improve design efficiency.

4.3 BIM Technology is Applied to Construction Phase

In the traditional construction process, due to the lack of risk assessment and non-standard operation, it often affects the smooth implementation of construction. The application of BIM technology in construction, simulate the construction process, visualize the engineering design concepts and ideas, three-dimensional the building models, use the associated data to enable the construction participants to achieve effective communication and collaboration, ensure the synchronous understanding of the construction plan, reduce data errors, and ensure the effective implementation of construction technologies and measures that meet the design standards. During the construction phase, BIM model can increase dimensions, enrich the database of the BIM system, and realize the synchronization of construction progress (Chuang, 2023)[10].

BIM technology is applied to simulate the construction process and scientifically manage the construction progress. The construction participants analyse the data in the specific construction, construction technology, construction process and other data through the network diagram and 3D animation generated by the BIM system, to ensure the safety and quality of the project and realize the modern management of civil engineering.

4.4 BIM Technology Is Applied To Operation And Maintenance Phase

The whole life cycle of a building includes four stages: planning, design, construction and operation and maintenance, of which the operation and maintenance phase is the longest. Through the planning, design, and construction of the building information models of civil engineering projects, the level of model informatization has gradually improved, and the database of BIM system has become more huge. The network digital information model based on BIM technology is associated with network data, and finally a BIM database is formed. Based on BIM database, convenient for operation and maintenance personnel.

4.5 BIM Technology Is Applied To Others

BIM technology plays an important role in the bidding stage, which is related to the prior control of bidding costs, reducing the bidding costs, and controlling the project costs. BIM technology is applied to the bidding stage, grasping the bidding documents, helping enterprises to select the best construction units and control construction costs. In the acceptance and settlement stage, with the help of BIM technology, the database is used, the engineering information is stored, and the information brand analysis is completed in combination with the regulations, laying a good foundation for the completion acceptance. The construction of BIM information database

by enterprises meets the needs of people familiar with the actual situation of the project in the promotion of the project, which is conducive to the comprehensive analysis of the cost coefficient and the overall grasp of the project. Some engineering designs still use paper drawings, but in actual construction, it will consume more resource costs and difficult to modify. BIM technology simulates projects through data integration and is easy to modify. At different stages of construction, the BIM database provides relevant data for the staff, integrates more design data, simulates the construction, and makes the project construction process smoother.

5 STRENGTHEN THE APPLICATION OF BIM TECHNOLOGY IN THE FIELD OF WIDE CIVIL ENGINEERING

5.1 Standardize Technology Management

The rapid development of BIM technology is both an opportunity and a challenge in the field of civil engineering in the future. At this stage, it is necessary to adopt standardized management methods to manage BIM technology scientifically and effectively. The American Institute of Architects regulates BIM technical management through the definition of the level of detail (LOD) of BIM models. LOD levels correspond to varying degrees of BIM models. Firstly, establish an inspection system to ensure the efficiency, safety and practicality of BIM technology. Secondly, establish a supervision system to supervise its application. Finally, improve BIM technology.

5.2 Expand Publicity

Over the past 20 years, the application of BIM technology has produced great benefits in China. However, the lack of publicity of BIM technology has led some engineers to use traditional techniques in civil construction. To promote BIM technology in China, it is necessary to increase publicity and publicize the practicality of BIM technology. First, BIM enterprises held lectures and invited BIM talents to give speeches to stimulate everyone's enthusiasm for learning. Second, enterprises exchange and learn from each other; enterprises and universities coordinate and cooperate to cultivate practical BIM talents.

5.3 Optimize and Improve Technology

BIM technology needs to be continuously improved in the future, using its visualization function, simulating and optimizing the construction plan, and selecting the optimal solution according to the implementation effect of the plan. The improvement of BIM technology can be based on the following two points: First, strengthen information security management. Information security is the focus of the construction industry at this stage, BIM technology is a data-based, networked technology, more attention should be paid to information security issues. Second, improve data processing methods. There are many users of BIM technology, including construction workers, Designers, general contractors and so on. All departments need a data processing method to coordinate the communication.

5.4 Industry-Academia Integration, Coordination of Talent Cultivation

The construction industry is facing structural adjustment and optimization, and enterprises urgently need many professional compound talents for interdisciplinary disciplines. Modern

civil engineering is facing transformation and is in urgent need of professional and technical personnel; The new generation of information technology and mechanical manufacturing concepts have been integrated into civil engineering, enhancing the informatization of traditional civil engineering majors and strengthening the market demand for BIM integration technology.

The teaching of the course based on the practical operation in school is beneficial to improve the students' ability of BIM technology practice. In practice, teachers and students interact with their brains and limbs, and learn the teaching content of the course intuitively and effectively. Facing the open environment and intuitively changing objects, college students become active participants, actively learning and applying, and improving their learning ability. Through students' hands-on operation, try to explore, turn passive into active, stimulate learning motivation, and strengthen innovation awareness and ability. Through the practice of hands-on teaching in school, to train more talents with strong applicability, connect with society faster and more directly, and serve the society.

6 CONCLUSIONS

The use of BIM technology in the modern building system makes the building model three-dimensional and visualized, and connects people from different departments, making the connection between different professions closer. BIM technology is applied to the field of “Wide civil” engineering, which is conducive to make rational use of capital costs and obtain better project benefits. To make BIM technology penetrate the field of architecture, it is necessary to have a scientific technical management system, broaden the channels of publicity, cooperate between enterprises and schools to develop informatization BIM talents. In the context of digital economy, the integration of BIM technology and “Wide civil” engineering is an important symbol of the informatization and networking in large-scale civil engineering construction industry. The effective application of BIM technology in the future also requires continuous exploration and improvement by engineering personnel, effective management of large civil construction projects, and improvement of the effectiveness of civil engineering.

REFERENCES

[1] Yan Y, XiaHou X.E. (2020) Application of BIM Technology in Undergraduate Study of Civil Engineering. Construction Economics. 41: 38-40. https://orcid.org/10.14181/j.cnki.1002-851x.2020S1038.

[2] Li R.Y., Zhao H. (2023) Research on Construction Organization Design and Engineering Cost Application Based on BIM Technology. In 2022 International Conference on Algorithms, Network and Computer Technology, ICANCT 2022. Virtual, Online, China. https://orcid.org/10.1088/1742-6596/2424/1/012034.

[3] Vitasek S. Zak J. (2019) Cost Estimation in BIM for Transportation Constructions in Czech Republic. IOP Conference Series: Earth and Environmental Science. 290. https://orcid.org/10.1088/1755-1315/290/1/012065.

[4] Wang W.X., Jia J. (2022) Research on Automatic Compliance Checking Method Based on BIM and Ontology Technology for Architectural Drawing. Journal of Northeastern University. 43: 1346-1353. https://orcid.org/10.12068/j.issn.1005-3026.2022.09.018.

[5] Pan F. Zhang S.R. (2018) Research on BIM Integration and Management of Civil hydraulic Engineering Based on 3DWebGIS. Computer Applications and Software. 4: 69-74. https://orcid.org/ 10. 3969/j. issn. 1000-386x. 2018. 04. 013.

[6] Zhu Y. Zhang X. (2022) Research on the Spatiotemporal Coupling Relationship between Regional BIM Policies and Typical BIM Projects in China. In 2022 International Conference on Smart Transportation and City Engineering, STCE 2022. Chongqing, China. 12460. https://orcid.org/ 10.1117/12.2658239.

[7] Wu L.Y., Ding Z.K. (2019) Construction of Civil Engineering BIM Laboratory and Implementation of Practical Teaching. Experimental Teachology and Management. 36: 194-203. https://orcid.org/10.16791/j.cnki.sjg.2019.02.048.

[8] He R. (2017) Discussion about Reform of Civil Engineering Course System Based on BIM Talent Training. Journal of Graphics. 38: 102-108. https://orcid.org/10.11996/JG.j.2095-302X.2017010102 .

[9] Wu W.L. (2022) Analysis of Dynamic Management and Resource Optimization of Construction Engineering Based on BIM5D. Construction& Design For Project. 210-212. https://orcid.org/ 10.13616/j.cnki.gcjsysj.2022.02.267.

[10] Chuang, T.Y. (2023) Change component identification of BIM models for facility management based on time-variant BIMs or point clouds. Automation in Construction. 147: 423-425. https://orcid.org/ 10.1016/j.autcon.2022.104731.