Research on the Construction of Construction Engineering Cost construction Information System Based on BIM Technology

Bei Wu*, Huimin Liang, Yansiyi Shi and Junhui Zhu
Tianjin University Renai College, Tianjin 301636, China

*Corresponding author e-mail: wubei007007@163.com

Abstract. This subject is based on cost construction and BIM technology, researches the project cost construction system based on BIM technology, analyses the system's related business processes and system processes; through analysis of the existing cost construction system, finds the existing system Existing problems, it is concluded that applying BIM technology to the project cost construction system can directly solve many problems faced by traditional systems. It analyses that the two systems can exchange data through the data interface. Finally, a cost construction model based on BIM technology is constructioned. Through the research in this article, I hope to apply it to the actual production and life of the enterprise, bring benefits to the enterprise, promote the informationization and systemization of the cost construction of the enterprise, and provide accurate data support for the project decision makers of the enterprise in the future.

Keywords: BIM technology, construction engineering cost, information system, cost construction.

1. Introduction
A large number of practices and studies have shown that the application of BIM technology in engineering valuation can more directly, quickly and accurately calculate the quantity of most engineering projects, solve the problem of inaccurate and delayed costs in traditional engineering costs in China, and promote project decision-making, construction, bidding, construction, completion and transfer of projects and other projects throughout the process of cost construction issues to improve the level of refined construction of the project. BIM technology has a profound impact on the engineering cost process. BIM-based collaborative construction has begun to be applied and gradually promoted in the construction industry. However, the research on how construction enterprises should carry out the cost work based on the collaborative construction of BIM and improve the quality and efficiency of cost has rarely been involved. To this end, this article takes an engineering construction enterprise as an example, and proposes a BIM-based engineering cost construction system architecture [1].
2. Overview of related concepts

2.1. The concept of BIM
In the 1970s, thinking of simulating the definition of information presented by buildings, Charles Eastman, Jerry Ryder and McGraw-Hill proposed the concept of building simulation. The national building information simulation standard proposes: to simulate enterprise construction information in digital form, including the physical and functional characteristics of construction information. It provides an information sharing platform for different users, and all decisions are closely related to it; at different stages of the project Based on the building information model, reasonable editing is performed to extract the relevant information needed to achieve real-time construction of the project. As shown in Figure 1 [2], it is the scope of application of BIM. According to the status quo of the country's late-stage technology using building information models, a unified application standard has not yet been formed. Relevant standards are being formulated, an information database for construction projects is established, and simulation models are used as carriers of information data, which is actually a digital system Information model, which is based on the construction project proposal, and on this basis, helps the managers of the enterprise to manage the entire project.

![Figure 1. Application scope of BIM.](image)

2.2. Analysis of the advantages of applying construction information simulation for project construction
In traditional construction project construction information systems, due to the participation of large project construction units and departments, information input can only be left at the interface of the department or individual project, often with a lag, and it is difficult to transfer the entire project to each other in a timely manner, preventing the information from being collected The project will inevitably lead to the phenomenon of computer applications that are not related to each other in terms of functions, mutual assistance, information sharing and exchange, and information that is disconnected from business processes and applications. In addition to the construction information simulation function of project construction information systems based on the advantages of traditional construction information systems, it must also meet the following requirements [3]:

(1) Requirements for comprehensive construction. People are more and more emphasizing the comprehensive construction of projects, and the requirements for information systems are getting higher and higher. Such as: project construction goals, feasibility studies, decision making, construction, planning, supply, implementation control, operation and construction combined to form an integrated
construction process; various functions of project construction, such as cost construction, schedule construction, quality construction, contract construction, information construction, together to form an organic whole.

(2) Requirements for full life cycle construction. The concept of life cycle construction is to consider the entire life of the project, so that various problems in the project are carried out throughout the life cycle of the project platform process. The overall goal of the project is to consider the construction and construction of the project to achieve the best.

3. Basic Structure and Main Functions of BIM-based Engineering Cost construction System

The BIM engineering cost construction system needs to be developed based on the BIM platform software together with the BIM construction platform. The BIM model and basic information are derived from the engineering construction BIM model. The engineering construction BIM model includes construction information such as line, area, volume, and construction practices. The detailed operation structure of BIM project cost construction system is shown in Figure 2 [4].

![Figure 2. BIM Engineering Cost construction System Operation Structure.](image)

3.1. Main functions of the base layer

The basic layer of the system consists of various data information, including construction data (structure, walls, doors and windows, decoration, etc.), engineering valuation data (fixed consumption materials, consumption, fixed base price, market price, etc.), engineering calculation rules (different Types of engineering quantity calculation methods, calculation rules), data archiving rules (engineering data classification methods, indicators), construction capital raising rules (construction capital raising rules, methods). The main function of the base layer is to provide rules and data construction for the operation of the entire system, to perform data classification and construction, and to extract data [5].

3.2. Main functions of the middle layer

The middle layer of the system includes engineering cost construction function modules, which mainly include three functions: BIM calculation and pricing, BIM data archiving, and BIM construction capital increase, which belong to the operation layer. The engineering calculation and pricing work in the BIM calculation and pricing function module will be completed by a computer. Through the high degree of automation of engineering calculation and pricing, the high efficiency and high quality of the costing work will be achieved. The BIM data archiving module archives and organizes historical projects, and modularizes, divides, stores, and retrieves historical engineering data in accordance with predetermined rules to realize the reuse of historical engineering data. The BIM construction capital raising function module provides historical engineering construction data for capital raising as a reference for constructioners in the early stage of capital raising, realizing highly automated calculation of construction capital raising projects, reducing the workload of constructioners and increasing capital raising [6].
3.3. Main functions of the interface layer

The user interface layer provides users with the final cost results, and the cost results can be directly viewed at the user interface layer to realize the one-click generation and export of finished cost products. At the interface layer, users can query the construction cost of a certain sub-item / single item / unit / project, and can trace back the calculation process and pricing process of a specific project, and check and analyse the cost results. Realize automatic statistics, generation and archiving of engineering cost indicators, and can perform vertical comparison (comparison of different stages) and horizontal comparison (comparison of similar projects) on investment and engineering quantity indicators, and analyse the reasons for differences in project investment.

4. construction of construction project cost construction system

Project cost construction is only a branch of enterprise system construction, but it is extremely important because the quality of the system directly affects the overall interests of the enterprise. An excellent cost construction system can reduce unnecessary expenditures of the enterprise, can help the enterprise to reasonably manage the cost, adapt to the company's own business processes, and conduct a comprehensive analysis based on the project cost construction system to meet the company's Requirements for cost construction systems.

4.1. Overall construction of Construction Project Cost construction System

In calculating the project information of the cost and finance department, it will focus on the relevant project information, cost information and other relevant information in the document, and then the final cost will be integrated into the project construction. Responsibility for budgeting reasonable cost planning target costs and ultimately increase profits throughout the enterprise, as shown in Figure 3:

![Diagram](image_url)

Figure 3. Overall construction of the construction project cost construction system.
4.2. Cost Interface Model construction
As an interface between two different modules for data exchange channels, its reasonable construction can effectively improve the function of the entire system. Based on the industry cost interface model, the standard-based class mainly completes the data interaction model and cost data. The modelling software mainly completes the building information model simulation project. On the one hand, the project staff performs modelling based on paper drawings. On the other hand, the model can be directly imported into the model and then converted into an electronic drawing, modelling, information, and the entire project. Modelling, others may perform information extraction based on this model.

The project department uses the intuitive features of BIM modelling and applies it to project cost construction, which can effectively guide the cost of the project and effectively control the cost of the project. With the assistance of Navisworks and project, the construction progress is simulated, and the deviation of the progress is visualized through comparison with the on-site progress, and the corresponding progress adjustment measures are formulated to provide guarantee for improving the progress construction and control ability. At the same time, the model integrates resource information such as cost, labour, and materials to optimize the resource investment plan [7].

5. Functional analysis of building information simulation data platform
The establishment of building information simulation models will generate huge amounts of data, and the cost construction of many enterprises is ineffective. Therefore, data simulation models are established for information construction to realize the exchange of simulation data between systems.

(1) Increase the value of data. Due to the large amount of construction project information, and during the project construction process, the information changes greatly, the maintenance workload is also very large, and the cost information application is small. After the data simulation model is established and the information construction is established, the project cost information can be extracted in real time to improve the information utilization rate. (2) Achieve data communication between departments. Due to the resistance in the concept, system, and technology formed by the division of departments, a real-time and dynamic data exchange platform cannot be established. Data simulation model is established after the information construction is established, the data exchanged has dynamic performance, which improves the collaboration ability of the department. (3) Improve cost construction information. The cost data is sorted, built, and stored, and the cost information catalog is gradually built and improved, to provide support for enterprise information resource sharing and business collaboration. Through the construction of the cost construction system, standardize the collection, integration and construction of cost construction information, and gradually form the sharing of information resources for each project of the entire company, so that business decision makers and managers can grasp relevant information in time and obtain valuable information as needed.

6. System configuration

6.1. Security configuration
The security configuration of this system mainly includes two aspects: system operation security and information access security. The system's operation security is mainly considered in three aspects: access control, firewall and virus protection; system information security guarantee will be implemented based on the CA authentication system.

6.1.1 Access control. Provides access control functions at all levels. Ensure system security from aspects of user authentication and authorization, database object access control, user operation authority control, system operation recording and auditing, data and system integrity, reliability and availability, and business rule-based access control. System users log in using the ca authentication verification mechanism.
6.1.2 Firewall. Multi-level filtering, monitoring, recording of external access behaviours, and security audits. The firewall implements three levels of auditing for visiting users, including no auditing, brief auditing (source, destination IP, date, time) and detailed auditing (involving content). The real-time monitoring record table of the firewall can display the records of data packets transmitted on the network in real time, including the rule number, time, user, source host, destination host, communication protocol, service items, amount of data transmitted, and connection time. This way you can know which users access which services at what time, and so on.

6.1.3 Virus protection. Viruses are the most common, cost-effective, and largest source of security in the system. The installation and implementation requirements of the virus prevention system are: can be configured for distributed operation and centralized construction, and consists of an antivirus agent and an antivirus server. Anti-virus clients are installed on key hosts of the system, such as key servers, workstations, and network construction terminals. The antivirus server can interactively operate the antivirus client for virus scanning and disinfection, and set virus prevention policies. It can perform virus prevention from multiple levels. The first-tier workstations, second-tier servers, and third-tier gateways can have corresponding anti-virus software to provide complete and comprehensive anti-virus protection.

6.2. System implementation
Building a building information simulation model will generate massive amounts of data. For cost construction, fixed information and cost construction are closely related. Therefore, in the process of building information simulation data processing, we mainly extract the original building letter data from the simulation model data for each stage of construction.

6.2.1 Model import. When the module creates an electronic drawing and enters the system, the system can form an electronic drawing and import the model. You can click next to perform the model preparation function in the user's corresponding building model.

6.2.2 Data extraction. Select the model information, click to view the member information of the pop-up interface, and extract the member information. It is then stored in a simulation database system, extracting information from structural data, and providing data support to improve cost construction.

7. The specific application of BIM technology in the construction stage of construction cost

7.1. Construction project layout
The construction site of a construction project is small, compact, and subject to many disturbance factors, and it changes dynamically with the construction. It is difficult to divide the area for prefabricated components on-site by relying on the traditional two-dimensional construction plan. Based on factors such as on-site entrances and temporary storage sites, BIM technology is used to establish a three-dimensional site model for site layout. Firstly, the site area is reasonably divided according to the site floor plan, the tower crane positioning is determined by referring to the vertical transportation requirements and the component stacking order, and then the component stacking is arranged according to the transportation route and lifting scheme. The three-dimensional site layout allows the components to be stacked in one place, reducing transportation costs and improving site utilization.

7.2. Construction technology of construction project nodes
The traditional two-dimensional drawing split budget cannot consider the integrity of the components well, and it is easy to cause the prefabricated components to overlap accurately. The connection quality of the nodes of the prefabricated components is directly related to the overall stability, waterproofing quality, and Functions such as sound insulation effects, use BIM to consider the rationality of the connection between components from an overall perspective, and separately generate detailed
construction drawings of components to guide site construction. During the on-site installation process, it is difficult to overlap some prefabricated beams and cast-in-place columns. It is beneficial to establish a prefabricated component reinforcement BIM model. Through the inspection of the beam-column node 3D construction technology, it is found that there is an overlap between the two. According to the test results and the budget unit discusses the optimization and adjustment of the spacing and position of the reinforcing steel bars, and provides on-site workers with a thorough understanding to reduce the difficulty of the construction site and ensure the quality of the construction.

7.3. Simulation of Construction Engineering Hoisting Process
As the prefabricated wallboard has the characteristics of large size, heavy weight, difficult to hang and high positioning requirements, the construction sequence of the prefabricated external wallboard should be formulated before hoisting, that is, the wallboard elastic line, leveling of the pads, preparation of the prefabricated wallboard, installation of the inclined Support ground end, prefabricated wall panel hoisting, prefabricated wall panel rapid positioning, prefabricated wall panel fine adjustment, installation of fixed support upper fixed end, cast-in-place joint steel bar tying, machine wire box, wire tube embedding, cast-in-place cast-in-place node support Mold, precast wallboard grouting operation, wall concrete pouring, based on the BIM model, associate the Project schedule, import the lifting schedule of the precast wallboard broken down into the construction sequence into the software, and realize the 4D process simulation of the prefabricated exterior wallboard, Optimize schedule and lifting plan.

![Figure 4. Construction cost construction under BIM technology](image)

7.4. Comprehensive Optimization of Construction Engineering
Relying on 2D construction drawings for pipeline synthesis takes a lot of time to find problems between majors, and using BIM technology can accurately show the spatial layout and pipeline direction between majors under the 3D construction technology model, and quickly discover in advance Problems and develop pipeline arrangements. The construction project integrates the civil engineering specialty and the mechanical and electrical installation professional BIM model, and the indoor fire hydrant pipeline automatically avoids the sprinkler pipeline when the sprinkler pipeline intersects the indoor fire hydrant pipeline. The water supply, indoor fire hydrant, and sprinkler pipeline encounter electric bridges, warm ventilation the principle of pipe turning up was adjusted, and the BIM technology was used to perform collision detection on the pipeline to form a report on the results of the pipeline arrangement. Finally, the budget and construction parties were held to comprehensively arrange the pipeline to reduce the on-site rework.
8. Advantages of BIM technology cost construction information system for construction engineering

The BIM model of prefabricated building is established by the construction engineering unit in the budget link, including majors such as architecture, structure, plumbing and electricity, so that all parties can work together and process data on the same model during the stages of budgeting, production, and construction. This combination of BIM technology for the overall conception, comprehensive arrangement and coordinated operation of the building construction engineering model is conducive to optimizing budgets, reducing changes and improving assembly efficiency, and is suitable for the current development of prefabricated buildings in China.

(1) Integrating the entire industry chain. The BIM engineering construction engineering model can effectively take advantage of the multi-professional technical advantages and rich construction experience of construction engineering units. At the budget stage, production processes, construction methods, mechanical and electrical interiors, and equipment procurement and selection are considered to make the budget map more practical. And operability, to achieve the linkage and coordination of budget, production and construction links, so as to establish advanced technical systems and efficient construction systems.

(2) Reducing project cost. Under the current model, the economics of the budget plan has no direct interest relationship with the budget unit. Therefore, the budget unit is under consideration of factors such as safety and risk. The budget plan given is often conservative and causes some waste. Under the BIM construction engineering model, the total contract price is fixed. This system drives construction engineers to optimize budgets and organize construction carefully to reduce construction costs in order to have greater profit margins.

(3) Providing professional services. In terms of budget, from technical planning, plan budget, construction drawing budget to deepening budget, throughout; BIM, build professional models, conduct conflict detection and construction simulation, etc.; in component production, equipment configuration and process optimization, and increase automation; In terms of decoration, the integrated budget installation realizes the integration of mechanical and electrical decoration, the overall kitchen and bathroom achieves standardization and standardization, maximizes the use of building materials, beautiful and safe, and convenient maintenance.

(4) To achieve information integration. Under the traditional model, budget and construction are split, BIM software is different in each stage and specialty, and the coordination ability is poor. The data in each stage cannot be effectively circulated to achieve docking, which has a great obstacle to the development of information technology. The BIM construction engineering unit establishes various
professional BIM models in the budget link and directly imports the model data into the factory's CNC processing to ensure that the BIM model data is unique, accurate and comprehensive, and truly realizes information integration. In order to adapt to the development of prefabricated buildings, qualified budget, construction and component production enterprises should actively form engineering and construction complexes, with qualification requirements, project performance, and financial risk-bearing capabilities that are compatible with the scale of the project, and establish an efficient organization. Construction system, with the help of BIM technology, to realize the information transmission and sharing in the stages of budget, component production and construction; construction units should preferentially choose construction engineering units when outsourcing, and supervise the entire process according to their own capabilities or entrusted consulting units.

9. Conclusion
Application of building information modelling technology. The use of building information modelling technology in the construction industry has become more popular recently. The application of building information modelling technology and the cost construction system of enterprises help enterprises to develop business and efficient cost construction. In this paper, the role information of cost construction is described, and the multi-operator model is proposed based on the comparison of building information modelling technology, cost information model and building cost construction.

References
[1] Changchun Guang, & Wu Feifei. Construction process construction of prefabricated building based on bim and RFID technology. Journal of Shenyang Jianzhu University (Social Science Edition) 12(02) (2015) 68-72.
[2] Bai Shu, Zhang Yankun, Han Feng, Zhang Dehai, & Li Wei. Value Analysis of Bim Technology in Prefabricated Buildings. Building Economy, 36 (11) (2015) 106-109.
[3] Liu Bo, & Liu Wei. Bim's Application Status and Obstacles in Domestic Construction Industry. Construction Economy, 36(9) (2015) 20-23.
[4] Liu Zhaoqiu, Li Yungui, Lv Xilin, & Zhang Hanyi. Application and development of integrated framework based on bim building structure construction model. Journal of Tongji University (Natural Science Edition) 5(07) (2010) 12-17.
[5] Liu Xiaoguang. Research on Bim-based Construction Engineering Information Integration and construction. Science and Fortune 12(26) (2015) 346-346.
[6] Yang Xin, & Jiao Ke. Development and application of bid-based collaborative building construction system gdad-pcmis. Civil Engineering Information Technology 14 (03) (2017) 22-28.
[7] Zhou Yun. Analysis on the training mode of architectural talents based on bim technology. China Real Estate Industry 17(32) (2017) 146.