Feasibility Study of Applying BIM Technology in Shantytowns Renovation Project

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Abstract. The transformation of shantytowns is a very important livelihood project in our country. After more than 10 years' efforts and vigorous efforts of the Chinese government, shantytowns have been improved and optimized to some extent. Based on BIM technology, this paper applies it to the actual shantytown reconstruction project. By using the powerful functions of Building Information Modeling (Hereinafter referred to as BIM) technology, the shantytowns renovation project is discussed from aspects of schedule control, construction simulation, collision inspection, rapid measurement and valuation, and process monitoring. Compared with the traditional methods, BIM technology has shown a good result, which has played a better positive role in the fine management level of shantytowns renovation projects, and promoted the healthy and orderly development of the construction industry.

1. Introduction
BIM is a tool that uses all kinds of information data collected from construction projects to build a 3D building model [1], and expresses the physical and functional characteristics of construction projects. BIM Technology can not only simulate the real environment of the building, but also directly reflect the design results [2]. BIM technology develops rapidly in China, not only obtains the support of national policy, but also receives high attention in theoretical research, and is often widely used in engineering projects [3,4]. The application of BIM Technology in projects can change the traditional management mode, so that the enterprise can realize fine management and enhance its core competitiveness.

Shantytown is a specific historical product in the process of urban construction and development [5]. Generally, it refers to the places where houses are concentrated in the scope of urban reconstruction and expansion, such as old cities, old areas and old buildings, which lack of planning, and have the disadvantages of poor performance of earthquake resistance, insufficient fire prevention and flood control, as well as inconvenient traffic. The existence of shantytowns in every city has affected the overall image of the city and restricted the speed of healthy development of the city. In the context of comprehensively promoting the transformation of shantytowns nationwide, there will be more and more shantytowns transformation projects. The government has worked out a popular support project for the reconstruction of old dilapidated houses, the improvement of housing quality and the improvement of living environment of poor families [6]. The shantytown reconstruction project has the characteristics of large scale and large volume, so it puts forward higher requirements for the construction unit in the management of talents and funds and the management of the collaborative work of all participants. BIM Technology has the advantages of platform effect, engineering data sharing, collision inspection, pipeline comprehensive optimization, etc., which can
better improve the quality of architectural design and meet the construction requirements of building function, social and environmental benefits, cost, construction quality, time, etc. BIM Technology is applied to the design stage of the project. By collecting information of each stage of the project, BIM information platform is built to enhance the cooperation ability among all parties, realize information integration and management, prevent project risks, improve project management level [7], and promote and ensure the successful completion of the project. It is of great significance to promote people's livelihood projects, solve the problem of shantytown transformation, and improve people's living environment and quality of life.

2. Advantages and value of BIM Technology in project engineering

2.1 Engineering measurement

The calculation of engineering quantity is the most basic task in project engineering. Only when the quantities are accurately counted can we continue to work out the project budget and project cost. Only by completing the work quantity statistics accurately, can the project successfully and efficiently complete the cost management work in the project settlement, project bidding, design change and other stages.

BIM software is used to build a three-dimensional model of BIM building. By means of parametric modelling, the components are parameterized, the construction process is standardized, and the materials have time information and price information. The two-dimensional of the project is converted into three-dimensional, which is more convenient for the analysis of the construction structure of the project and improves the efficiency of project management. BIM measurement software is used to calculate the quantities based on BIM model, and there is no need to model again. As long as the quantities in the project cost in Revit model file are exported, the quantities of each discipline can be accurately obtained in the project.

2.2 In terms of project pricing

The most important core of project management is to maximize project benefit and control cost effectively. Cost management is the basic project whether the project can achieve the expected effect, so it is necessary to control the cost effectively in the whole process. In the construction project management, BIM Technology can improve the level and efficiency of cost management. In the specific operation, it can be realized in the following aspects:

2.2.1 Model optimization

Based on the quota design and effective investment control, combined with the actual requirements of the owner and the outstanding problems of each specialty, the BIM model is optimized and an effective control scheme is formulated to avoid the impact in the construction process.

2.2.2 Monitor and adjust the data information existing in the model

Based on BIM Technology, fine management of engineering project can be realized. During the design period, the intelligent design of building structure can be directly carried out by adjusting parameters to ensure the overall rationality of building design. At the same time, during the construction period, it is necessary to obtain the basic data of the project in time, so that the construction party and the project department can realize the timely synchronization of information. With a detailed data base, it can better realize the dynamic cost control of the whole process of the project, and effectively control the project risk.

2.2.3 Build database and share data and information

BIM Technology is applied to upload the real-time data information of the project to the platform. Through the adjustment, addition and modification of these data information, the overall situation of the project can be reflected in a timely and accurate manner. Then through the correlation with the
data, cost risk management and decision quality can be realized, so as to improve the project quality, reduce the unprovoked loss of the project cost and increase the project profit.

2.3 In terms of project progress
Based on the BIM related software timeliner, the project schedule is controlled. Based on the BIM three-dimensional building model, the 3D model and schedule are combined to form the 4D of BIM. The actual progress and BIM schedule model are compared to monitor the construction progress in real time. This method is used for visual dynamic control of the construction progress, so as to ensure the realization of the construction progress management.

2.4 In terms of project quality
Based on the BIM project software naviswork, the quality control of the project is carried out. Based on the construction of BIM three-dimensional building model, using collision inspection software, the existing collision problems can be detected in time, so as to effectively prevent problems in the construction. Through the application of BIM Technology, it can realize the information sharing of all participants, improve the collaborative ability of managers, and play a very important role in improving the level of project quality management.

3. The application of BIM in the process management of the shed renovation project

3.1 Project overview
This project is No. 3 building of a resettlement community project of shantytown reconstruction in Zhengzhou City, Henan Province, with 8 floors above ground and a building area of 12699.89㎡. This project has a large number of subprojects, a large amount of funds and a long project cycle. BIM Technology has a great advantage in the management of the whole process of the project. This paper takes building 3 as an example.

3.2 BIM modeling
Using the method of turnover, using the existing civil engineering CAD construction drawings, using Revit software to create the three-dimensional model of BIM. Import the construction plan of the project into Revit, and build a 3D model according to the 2D construction drawing of CAD, as shown in Figure 1 and figure 2.

3.3 Application of BIM in rapid measurement and pricing of projects
In the bidding process of a project, it takes a long time and low efficiency to use traditional methods to prepare bidding control price [8]. The project company can use BIM software to build BIM building model, and through the use of Guanglianda pricing software, it can quickly and accurately calculate the project quantity and prepare the bidding control price. At the same time, the project bill of quantities can be compared with the relevant engineering data in BIM database to check the rationality of the project bill of quantities and provide basis for the formulation of project cost.
3.3.1 Preparation of bidding control price

On the basis of completing BIM building model, use GFC plug-in to import BIM model in GFC format into Guanglianda BIM civil engineering calculation software GCL, and use automatic statistical summary to get the bill of quantities. Then import the GFC file into the software GGJ of BIM reinforcement calculation of Guanglianda, and get the following model as shown in Figure 3. If different modules are selected, various bill of quantities can also be obtained, and the bill of quantities for reinforcement is shown in Figure 4.

Then import the bill of quantities automatically summarized into the pricing software of Guanglianda, automatically apply the quota sub items, and finally get the bidding control price of the project. The specific steps are as follows: the establishment of BIM model - the use of Guanglianda BIM civil engineering calculation volume - obtaining a bill of quantities - the use of Guanglianda pricing software - the use of Guanglianda to prepare the bidding documents.

Through the application of BIM Technology, different effects can be achieved in different project types, especially in the common concrete and reinforcement projects and the final bidding control price, and the error is relatively small, as shown in Table 1. It can be seen that the project company’s operation of this method to prepare the bill of quantities and determine the bidding control price can quickly complete the task and generate time and cost-effectiveness.

| Type                        | Number of personnel | Measurement and pricing | Concrete   | rebar     | Bidding control price |
|-----------------------------|---------------------|-------------------------|------------|-----------|-----------------------|
| Traditional measurement    | 10                  | 60(h)                   | 88.9 (10k RMB) | 98.5 (10k RMB) | 668.8 (10k RMB)      |
| BIM technical measurement  | 5                   | 60(h)                   | 83.5 (10k RMB) | 89.7 (10k RMB) | 638.8 (10k RMB)      |
| Benefit percentage          | 50.00%              | 66.70%                  | 6.10%      | 8.90%     | 4.50%                 |

3.3.2 Quick measurement and pricing

When the designer uses the traditional method to arrange all professional pipelines, he can only coordinate according to the two-dimensional plan drawings, and lacks the elevation of the pipelines. Therefore, when facing the complex problem of staggered pipelines, he can only rely on the designer's experience and imagination of the three-dimensional space position to judge the rationality of pipeline layout, which is not only time-consuming and labor-consuming, but also inefficient. The use of BIM Technology (Navisworks) can solve the problem of collision between different disciplines that may occur in the construction process in advance [9]. Generally, after the BIM building model is completed in the design stage, collision detection is carried out to reduce the occurrence of changes in the construction process, so as to improve the construction efficiency and reduce the project loss.
(1) Simulated collision inspection
First, transfer the model to naviswork for collision detection as NWF file from Revit software, as shown in Figure 5 and Figure 6. Select the required collision tolerance, run the detection, and finally get the number and location of collision points, and generate the three-dimensional solid diagram of collision points.

(2) Quick measurement and valuation of the changed quantities
In case of design change, the designer can modify the BIM model directly according to the requirements of the owner, and automatically calculate the quantities after modification. Through data association and remote update of the design model file, the construction enterprise can directly see the model after design change and the changes of the quantities after design change through updating the data on the platform.

In engineering, we often encounter the situation of change and calculation of quantity and price. BIM Technology can make the tedious work more accurate and fast. It can realize the effective management of design change and dynamic control of cost, reduce the labor volume of budget personnel, and improve the efficiency of cost personnel. The rapid measurement and pricing with BIM Technology enables the project company to quickly complete the visa work after the change, as shown in Table 2.

| Type               | Number of personnel | Measurement and pricing | Rebar engineering (10k RMB) | Change and increase (10k RMB) |
|--------------------|---------------------|-------------------------|------------------------------|-------------------------------|
| Traditional metering | 3                   | 8(h)                    | 20.5                         | 15.9                          |
| BIM Technology     | 1                   | 3(h)                    | 19.5                         | 15.2                          |
| measurement        |                     |                         | (10k RMB)                    | (10k RMB)                     |
| Benefit percentage | 66.70%              | 62.50%                  | 4.90%                        | 4.40%                         |

3.4 Application of BIM in project schedule quality management
In the process of construction, the government issued the key action of comprehensive air pollution control, which is known as the "stop work order". The stop work lasts for up to four months, even longer if the situation is special. This shutdown has caused great impact on cost control and schedule control of the project. BIM Technology can be used to reasonably arrange the construction schedule after the shutdown in advance to improve the efficiency of schedule management.

Firstly, the NWC file is exported by BIM 3D building model, and then the NWC file is imported into naviswork. As shown in Figure 7. Set various task progress information, related costs and other expense conditions in timliner. The actual start time and end time of the project, the planned start time and end time of the project, and various expenses are shown in Figure 8.
Compared with the traditional method of progress bar chart, it is not easy to adjust when the project is complex and the design changes occur. Using the BIM software (naviswork) to reasonably plan the construction progress after the stop work order is completed, and using the dynamic construction process simulation can make the construction party more intuitive and vivid to show the progress. BIM Technology is used for project schedule quality management, and the data information related to schedule in BIM model is associated with the model itself, so that the construction schedule can be observed and managed dynamically in real time. The project company uses BIM Technology to control the progress, which can realize the fine management of the project and improve the management level of the project, and produce the time benefit and cost benefit.

4. Conclusion
BIM Technology, as the main development direction of the construction industry, does not conflict with the traditional construction technology. The shantytown reconstruction project has the characteristics of large volume, long cycle, large capital demand and large risk, which is representative. The application of BIM Technology in the renovation project will highlight the advantages of BIM Technology throughout the whole project construction cycle and collaborative management. In this paper, through the feasibility study of the application of BIM Technology in the shantytown reconstruction project, the main conclusions are as follows:

(1) BIM Technology can effectively improve the efficiency of cost control. It has a good advantage in determining the bidding control price and quick measurement and pricing after design change. In the process of engineering construction, it can solve the problem of lag in process measurement.

(2) BIM Technology is used to effectively collect design information of all disciplines, so that designers can grasp the project as a whole, and better complete the project in progress quality control, collision inspection and other work.

(3) The time span of shantytown reconstruction project is long and the work quantity is complex. There are too many participants in the project and the information is not transmitted in time, which will lead to the difficulty of collaborative management of project managers and the inability to achieve refined management. By using BIM Technology, we can accurately control the cost, accurately complete the work of splitting and statistics, and improve the efficiency of construction and capital use. BIM Technology provides a new method for project cost management.

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