

# Application of BIM5D Technology in Project Cost Management and Safety Management

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**Abstract:** With the continuous development of science and technology, the use of science and technology in civil engineering construction is advancing with the times, among which the use of BIM5D technology is an outstanding representative. BIM5D technology has a variety of characteristics, so in the construction process and safety management, it can collect and integrate the construction information and potential safety hazards at different stages of the construction process in advance, and finally show them in the form of information, providing help for the preparation of the construction plan and safety monograph.

**Keywords:** Project Cost; Dynamic Management; BIM5D; Preface

## I. INTRODUCTION

The construction cost management has the characteristics of dynamic change, sub item combination and non duplication. In the process of dynamic management of construction project cost at this stage, due to the lack of a perfect construction project management system, most construction project cost managers conduct cost management based on the bar chart and network chart, resulting in poor overall construction cost dynamic management effect. The application of BIM5D technology in the dynamic management of construction cost can achieve all-round and refined management through the construction of four-dimensional dynamic management and control model. Therefore, it is of great significance to properly analyze the application of BIM5D technology in the dynamic management of project cost.

## II. BIM5D TECHNOLOGY OVERVIEW

In the process of construction cost and safety management, BIM technology can also be called BIM5D technology. That is to add practice axis and cost axis on the basis of 3D model. The application of BIM5D technology in construction project cost evaluation can not only improve the efficiency of construction project cost estimation, but also fundamentally solve the problems of horizontal information loss and vertical information interaction.

## III. FEATURES OF BIM5D TECHNOLOGY

### A. BIM5D technology has visualization features

The BIM5D technology has the visualization characteristic, which is reflected in the precision of its technical application. The model information constructed can be three-dimensional. At the same time, all design errors are completely visible within the available accuracy range of the model, which helps to identify possible problems in the design, such as the conflict between the construction requirements and design results of the construction unit, the conflict between architectural design space and the defects of different professional models, and the

lack of architectural planning. In the BIM5D technical environment, the visual results of building information models are not only limited to results and reports, but also create a platform for cross departmental and multi-party communication, and communicate and make decisions at all stages of project construction.

### B. BIM5D technology is characterized by coordination

In the design process, designers of different specialties often have poor communication, which leads to conflicts between different specialties. Especially in the water supply and drainage planning, there will be more or less conflicts with HVAC, water supply and drainage, strong and weak electricity, fire protection, etc. BIM5D technology construction information model can coordinate conflicts between different disciplines and generate reports at the initial stage of construction, which helps designers to solve relevant problems before construction.

### C. BIM5D technology has analog characteristics

In the whole cycle of civil engineering construction projects, the simulation of BIM5D technology can be used to model the buildings to be built, and at the same time, some virtual scene things can be simulated. For example, in the design phase, the simulation characteristics of BIM5D technology can be used for energy saving simulation, emergency evacuation route simulation, sunshine simulation, heat conduction simulation, etc; In the construction stage, the simulation characteristics of BIM5D technology can be used to simulate the construction process of the proposed building; In the operation stage, the simulation characteristics of BIM5D technology can be used to conduct daily emergency avoidance simulation drills, such as earthquake escape and fire evacuation.

### D. BIM5D technology has the characteristics of optimization

In the whole cycle of civil engineering construction project, the construction process is accompanied by the optimization process. BIM5D technology can optimize the design, construction and operation process efficiently and quickly based on its own technical advantages. In the process of project construction, because the amount of project information received is huge and complex, BIM5D technology can be used to optimize the received information, simplify the complexity and save a lot of time. With the development of science and technology, today's civil engineering construction buildings are more and more complex, including more and more complex and diverse engineering information. With the optimization characteristics of BIM5D technology, the work efficiency of personnel has also been greatly improved. Instead of the past, BIM5D technology can improve the amount of information, simplify complex problems, and save time.

#### IV. APPLICATION OF BIM5D TECHNOLOGY IN PROJECT COST MANAGEMENT

##### *A. Advantages of BIM5D technology application in project cost management*

In the conventional cost management, the application of BIM5D technology can effectively eliminate the defects of high statistical strength and low accuracy of previous quantities. Combined with the application of BIM5D technology model's component information self identification, digital representation, embedded physical information self statistics and other functions, intelligent dynamic management of construction cost can be realized. Further improve the efficiency and accuracy of construction cost management; In case of engineering change, the comparison of quantities before and after the change can be carried out in the BIM5D technical model. It can not only improve the efficiency and accuracy of project quantity change management, but also avoid incomplete change data caused by too long change time, providing a basis for later project cost final settlement; The application of BIM5D technology in the construction process can effectively avoid the impact of deduction rule setting and model review on the calculation efficiency compared with the traditional drawing calculation planning, thus improving the efficiency of project cost management.

##### *B. Application process of BIM5D technology in dynamic management of project cost*

To apply BIM5D technology to the dynamic management of construction cost, first of all, build a three-dimensional model of the project, prepare price information files, import the model into BIM5D, select consumption quota, and enter progress information files. At the early stage of the project, the project cost management personnel can use BIM5D collision inspection analysis to develop a sound construction cost and schedule control plan. The progress information, price information and consumption quota information are organically integrated based on the operation of the three-dimensional model of the construction project. In the actual operation process, the construction cost management personnel can reasonably set the resource consumption based on the actual demand of the construction project and the specific cost control object.

In order to ensure the cost control effect in the construction stage, the construction cost management personnel can use BIM5D internal components, progress and equipment integration information, and use the earned value method to compare the BIM5D actual model with the budget model. The cost management personnel can actively communicate with the production department, the technical department, the engineering department, the commercial department, and the material department to build a BIM5D management model in which all departments participate. For progress management, cost management personnel are required to check the task status of this week in the weekly disclosure meeting of each participating department under the guidance of specific construction period. If late tasks are found in the task status of this week, the construction project cost management personnel need to timely adjust the resource allocation of each module. And update the construction cost management model.

The BIM5D technical model is associated with progress documents and measurement price documents to track the

implementation of the schedule in real time. The consumption of human resources, materials, costs and mechanical equipment shall be calculated comprehensively and accurately. On the basis of the establishment of the three-dimensional model, the progress information and cost information are added to build the professional model of each module. At the same time, based on the visual analysis of each module component of the construction project and the transparent management of progress cost, the progress measurement price file information is imported. Combined with the construction of information communication channel between 3D model and list information, the purpose of multi calculation comparison of construction projects can be achieved.

The cost management runs through the whole process of the construction project, including the decision-making stage, design stage, bidding stage, construction stage and settlement stage. In these five stages, the application of BIM5D technology in cost management can greatly facilitate the work of personnel, improve work efficiency and relieve work pressure. In the decision-making stage of project cost management, BIM5D technology can be used to query relevant data of previous projects and estimate the total investment amount of the project.

In the design stage of project cost management, quota design can be carried out by using BIM5D technology, which can improve the calculation depth and accuracy and reduce the related calculation workload. In the bidding stage of project cost management, the construction unit can provide relevant bidding quantities efficiently and accurately in a short time, reduce calculation errors, and complete bidding work with high quality by using BIM5D technology. In the construction stage of project cost management, due to the long time, heavy workload and many variables in the overall process, the number of changes in the construction process can be reduced by using BIM5D technology for virtual construction, collision inspection and other related technical means. At the same time, BIM5D technology is used to model the relevant construction models, track the on-site construction in real time, arrange the construction process more reasonably and effectively, optimize the construction process, save the construction cost, and realize the fine control of the construction cost throughout the cycle. In the settlement stage of project cost management, BIM5D technology can be used to achieve the settlement of final data through modeling and reduce disputes on related economic issues.

##### *C. Application prospect of BIM5D technology in dynamic management of project cost*

BIM5D technology started late in China's construction project cost management module, and the overall application technology is not mature enough. However, BIM5D technology has shown great advantages in construction cost management and cost control modules. Under the guidance of the overall process, dynamic and three-dimensional management objectives of construction project cost, BIM5D technology will be organically connected with the construction project cost management system. With the gradual improvement of BIM5D technology application standards for construction projects worldwide, BIM5D technology will become the main support for dynamic management of construction project cost.

## V. BIM APPLICATION VALUE OF CONSTRUCTION SAFETY MANAGEMENT

### D. Digital training of construction personnel

#### A. Identification of risk factors

For the safety management personnel, how to deal with the identification of potential safety hazards and influencing factors caused by various factors in the overall construction process is an important content. In addition to the identification of these influencing factors, the management personnel are required to deal with these factors accurately and prepare for the corresponding preparations in a timely manner. BIM technology can integrate various information components and actual construction progress into the safety system management system, which improves the height of safety management. Moreover, BIM can play a planning role in the construction progress, which includes many aspects, so that managers can design the overall building planning model, and play an all-round role in identifying more risk factors.

#### B. Division of hazardous areas

At present, in the actual construction process of most construction projects in China, the actual construction area is increasing year by year, which leads to the rise of space planning and construction during construction. Therefore, the traditional regional division mode is no longer suitable for the current architectural design mode. The application of BIM technology can divide hazardous areas in detail, and enable managers to understand and master the key content of safety management in building construction to a great extent. After managers understand and master, they can use more targeted management methods and means to optimize these divided key hazardous areas, continuously eliminate the potential safety hazards summarized in the construction process. At the same time, it is also necessary to better plan and strengthen the construction of the protection system, which can further ensure the safety in the overall building construction process and further grasp various unsafe factors.

#### C. Analysis of space conflict management during construction

At present, in the implementation of construction safety management in China, construction space conflict is a common phenomenon, and managers often neglect or do not pay attention to construction conflict management in construction. The conflict of construction space refers to the conflict between various departments in the internal construction process, which affects the overall construction process. The BIM5D technology used in the construction process can fully analyze and combine the characteristics of the building itself, so as to play a scientific, reasonable and effective design and planning role in the construction space. In addition, during the specific construction process, the project will be affected by the environment and other aspects. Therefore, if the management personnel want to complete the project objectives within the specified time, they need to make full use of the BIM5D technology, observe the changes of the external environment and the internal environment as well as the conflicts between the two environments in an all-round way, and take effective coordinated treatment in a timely manner. In order to provide support for the implementation of subsequent construction projects.

In the process of construction, most of the work needs corresponding equipment and technology to complete. If the safety concept and skills of the construction personnel are not in place, it will easily lead to operational errors and thus cause great potential safety hazards. Therefore, it is necessary to train the corresponding construction personnel in BIM concept and skills. The contents of various technical information contained in BIM are relatively complete and specific, which can make people intuitively understand and deepen their impression. Moreover, the construction personnel can master and learn the knowledge required by various construction processes by means of environmental simulation, and comprehensively master the key points of ideas and methods in various construction. During the specific implementation of the training, the actual operation training can be carried out for various mechanical equipment used on the construction site to achieve the full effect of digital safety training. At the same time, the cost has been saved to a certain extent, and the overall construction process efficiency and effect have been promoted.

### CONCLUSION

To sum up, the application of BIM5D technology in the cost management of construction projects has established a three-dimensional cost reporting model with timeliness, which effectively improves the cost management efficiency of each module of construction projects. Therefore, in the process of construction cost management, the construction cost management personnel can set the model data, quantities, time schedule and other data information in the same model system according to the actual situation of the project and using BIM5D technology. Combined with the introduction of the change capital information of the construction flow section, the dynamic, efficient and real-time control of the construction cost can be achieved.

The application of BIM5D technology can play a good role in ensuring the safety management in building construction. It can comprehensively analyze various problems reasonably and provide a large amount of data for managers to refer to. It ensures the safety and reliability of the overall design scheme and measures, reduces the probability of dangerous events in building construction, improves the safety of overall construction management, and promotes the smooth development of the construction industry.

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