

# Research on the Whole Process Cost Management of University Capital Construction Based on BIM

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**Abstract-**With the rapid development of China's construction industry, labor, materials, machinery and other costs continue to rise, the cost of huge energy resources are no longer meet the strategic requirements of sustainable development. The construction of information infrastructure management model is to subvert the speed of a trend which cannot be halted the traditional mode of construction management,so the construction project cost management is facing a huge impact. Nowadays, the management mode of building information has been gradually applied to the construction cost management of university capital construction. In view of the construction project, the information is easy to happen in the process of information transfer, information lag and loss, prone to communication barriers, affect the subsequent construction of the overall control of the project cost. Analyzes the problems existing in the engineering cost management mode of University, from the project management mode, technical content, application level and the various stages of the project cost control and other aspects of the different angles and dimensions. So as to provide some valuable references for the application and development of the BIM technology in the university infrastructure projects, and in order to provide some reference for the construction of the University of science and technology management.

**Keywords-***BIM; university infrastructure; the whole process; project cost management*

## I. THE PRESENT SITUATION OF UNIVERSITY INFRASTRUCTURE MANAGEMENT

The construction of the capital construction projects in Colleges and universities is related to the long-term development of the school. The construction project investment is more from the government investment, which requires strict construction period and high quality requirements. The infrastructure of the traditional management mode, communication between universities and design, construction, supervision, audit and other project participants in the whole process of the construction process prone to known information is not balanced, some information loss phenomenon. This cooperation obstacle caused by information asymmetry, in different stages of the whole process of construction project cost management work efficiency and effectiveness will produce some bad effects. Therefore, how to identify construction project information and specification, to make it efficient, reduce cost effectively improve work efficiency and shorten the construction period, is an important problem facing construction in colleges and universities, and BIM is the information exchange provides

important technical guarantee to resolve the problem.

## II. THE TRADITIONAL MANAGEMENT MODE OF UNIVERSITY CAPITAL CONSTRUCTION

### A. Unity Form Management Mode

The core functions of the system management mode is set according to the business division and related departments, are responsible for the pre construction, planning feasibility study, bidding management ,construction management, budget management and file management. This model is easy to appear the lap gap between cross management departments, the effectiveness and timeliness of communication resources between the known information sharing can not guarantee. Therefore, the conflict between the tasks, out of touch with the functional departments buck passing phenomenon is easy to appear, in the meantime some key information may be lost, serious impact on the work effectiveness, and there is a big disadvantage in the whole process of cost management.

### B. General Contracting Management Model

University of large construction projects will generally use the general contracting management model for project management. The general owner commissioned a construction unit or by several construction units, construction joint or cooperative body composition as the general construction unit construction management. This model has been widely used in the management of university infrastructure projects in recent years, which is beneficial to contract management, quality control, construction period and cost. But in view of the construction industry, artificial materials, machinery and other expenses prices continued to rise, in this model, the actual decision design stage for the construction of model predictive of poor, easily because of the emergence of a large number of architectural design and functional requirements of the engineering change, easily lead to huge energy waste of resources.

As a result, the management mode of capital construction in Colleges and universities has begun to gradually do not adapt to the development trend of the modern information society. On the basis of this, we need to use the management mode of building information, and it is an efficient choice for the construction management of China's colleges and universities at this stage to meet the needs of the development of the times. Efficient and reasonable infrastructure management mode can control the engineering quality and engineering cost from the macro level, and

provide favorable conditions for the dynamic analysis and control of cost in the whole process of cost management and process.

### III. BIM SOURCE, TECHNICAL CONTENT AND ITS CHARACTERISTICS ANALYSIS

In 1973, affected by the global oil crisis, the United States needs to consider the whole industry to improve the efficiency of the problem, BIM concept began to sprout. In 1975, "the father of BIM" - Professor Eastman Chuck of the Georgia Institute of technology in his research topic "Description System Building" in the creation of the BIM concept. Nowadays, BIM technology has been gradually realized the visualization and quantitative analysis of building engineering, and improve the efficiency of engineering construction.

BIM is equivalent to an information sharing platform; its essence is the data of engineering design and construction management tool, the parameter model for the project planning, operation and maintenance of the entire life cycle of information resource sharing and transfer. Relevant staff to effectively integrate various architectural information and make decisions for the design team, as well as the parties to provide collaborative work. Therefore, the application of BIM plays an important role in improving production efficiency, saving cost and shortening the time limit for a project.

BIM technology has the following characteristics:

#### A. Visualization:

That can be directly felt in the form of; therefore, the future of the construction industry is of great significance. The construction drawings are usually two-dimensional graphics, using only information expression of the various components of the line drawing in the drawings, but the structural form of architectural entities requires the relevant technical personnel to imagine modeling in your own mind. And the characteristics of the BIM visualization, the previous lines of the components to form a three-dimensional solid graphics. In the BIM building information model, the design, construction and operation maintenance of the whole life cycle of the project can be carried out under the condition of visual communication, coordination and decision-making.

#### B. Information Sharing and Collaborative Work:

Support the international general three data standard IFC, IDM, IFD data model; you can call each other related software data, thus improving the compatibility and interoperability. Create a good data exchange platform, can be directly read all the relevant data information and automatic processing, so that the effective connection of information transfer. The real time deviation analysis of the "calculation contrast" window, shorten the working hours of settlement and audit, improve the efficiency and quality of the settlement work. In addition, the use of BIM can quickly import and construction of the relevant laws and regulations, the fee standard and the contract rate adjustment, etc., to facilitate the project management, improve the efficiency

and accuracy of the settlement audit.

#### C. Parameterization:

The new model can be established and analyzed by changing the parameter values in the model, which is based on the parameters rather than the numerical model. Intelligent design can be completed directly, and the parameters are connected, when the parameters change, the software will automatically complete the parameter matching and the position adjustment in the three-dimensional model. At the same time, BIM model parameters can be through the virtual collision detection experiment, can effectively communicate and coordinate the cross impact of the professional issues. To solve the problems in professional conflicts in the design phase, to provide an effective path for professional work, reduce unnecessary waste of resources, largely to strengthen project management, shorten the construction period, reduce the construction cost, the project cost control.

#### D. Simulation:

BIM simulation is limited to the building model can only simulate the design, but also can simulate the use of building related exercises. In the design phase, BIM can be designed to carry out functional simulation experiments, such as: energy saving simulation, emergency evacuation simulation, sunshine simulation, etc.. In the bidding and construction stage can be 4D simulations (3D model development time and project), can optimize the construction organization design, simulation of the actual construction schedule and construction, increase coordination between the professional, reasonable control of time and cost. At the same time, can also carry out 5D simulation (cost control based on 3D model), cost control, processing can be carried out daily emergency of post operation and maintenance phase of the simulation, such as evacuation simulation, earthquake flood fire escape simulation etc..

#### E. Optimization:

In fact, the whole design, construction and operation process based on BIM is a continuous optimization process, which can be optimized for the BIM and its corresponding optimization tools. The optimized processing of BIM can be considered from the following:

1) *Project scheme optimization:* The economic benefit of project design and cost management is related to each other, and the influence of design change on economic benefit can be calculated in real time. In this way, the evaluation of the design scheme will not only stay in shape, but also can choose the project design which is more conducive to their own needs, to achieve the maximum value.

2) *Design optimization for special projects:* For example, curtain wall, roof, large space of special design, because the construction is difficult, more easily the quality of the project. Such building components in the investment and workload also have a certain proportion, the use of BIM and matching optimization tools to optimize the design and

construction program, you can have a significant effect on the duration and cost improvement.

*F. Integration:*

Based on BIM technology from the design, construction to the late operation and maintenance is throughout the whole life cycle of the project management of the integrated management. The core of BIM technology is one formed by the three-dimensional computer model of the database, not only contains the design of information construction, but also can hold built from design to use, or even the whole process of the end of the cycle of information.

**IV. ANALYSIS ON THE APPLICATION VALUE OF BIM IN THE COST MANAGEMENT OF CAPITAL CONSTRUCTION PROJECTS IN COLLEGES AND UNIVERSITIES**

With a history of capital construction projects in Colleges and universities, the architectural style reflects a school's historical background, cultural atmosphere and the spirit of the whole style, so for the architectural design of the overall high requirements of capital construction in Colleges and universities.

At the same time, most of the university funding infrastructure projects in government investment, so for the entire university infrastructure project investment and the final project cost determination, need to be more clear, open, transparent and reasonable. BIM technology applications can be produced in the following aspects:

A. Using the visibility of BIM technology, it can be more convenient and intuitive display of the building model, which is conducive to the leadership decision-making and follow-up construction process of dynamic analysis and rectification. Application of BIM technology can be in the project decision-making stage in accordance with the existing building and structure and other information to build three-dimensional model. Can be more intuitive to see the layout of the proposed project and the function of the proposed project, and can facilitate the communication and exchange of information between different professionals, and to modify in time to minimize the change in the later period. Is conducive to the leadership from the overall grasp, clear positioning, rational decision-making, reduce the possibility of subsequent changes in the construction of the increase, to reduce the subsequent construction of the project cost to lay a good foundation.

B. Using BIM technology information sharing and collaborative features, can make information more open, transparent, real-time deviation analysis, improve work efficiency, reduce the construction cost of the project and the completion of the settlement of disputes. BIM model contains a large amount of information, the image of the specific and intuitive, the project features, leakage and drawings, such as the description of the description is more accurate. To reduce the risk of inadequate construction projects due to the lack of accuracy in the construction of the project, increase the transparency of the project bidding; effectively guarantee the public, fair and equitable. At the same time, the communication between the information and

the sharing of resources, is conducive to the overall control of the macro and the mutual communication between different professionals .Thereby reducing the risk of unnecessary construction, to a large extent, control the overall project cost.

C. Using the characteristics of BIM technology, to reduce the engineering changes and claims in the construction phase. For the project cost in the impact of larger building materials designated brands, models, and the implementation of dynamic correction analysis. Reduce the amount of work, price and other work to repeat the work, improve work efficiency, is conducive to the completion of the project settlement. The characteristics of BIM technology parameters can effectively reduce the collision between the professional. For the subsequent construction process due to the professional impact of the demolition, reconstruction of the increase in the reduction of the change to make the overall control. Therefore, this kind of characteristic is advantageous to the construction cost control in the construction stage of the construction of the University, reduce the increase of the change, and reduce the cost of the project.

D. By using the characteristic of BIM technology, the simulation experiment can be carried out in the design stage. In the bidding and construction stage can be carried out 4D simulation (three-dimensional model plus the development time of the project), but also can be carried out 5D simulation (based on the 3D model of cost control). So for some lighting effect, energy saving and environmental protection requirements and the specific circumstances of the fire evacuation, can effectively use the characteristics of BIM simulation. In the early stages of decision-making, design and construction and maintenance of the late stage, in front, in the matter of the angle of the reasonable control of the project cost, help to implement the whole process of dynamic management.

E. Using the BIM optimization of the entire project from the whole life cycle design, construction and operation of a continuous improvement process, the infrastructure projects for the design style of higher requirements and use requirements are also strong. BIM and its supporting various optimization tools for complex projects to show the superiority of the unprecedented superiority, design and construction scheme optimization design processing, can reduce the time limit for a project, effective control of project cost.

F. Using the characteristics of BIM integration in the late stage of the maintenance of the obvious advantages. When the project needs maintenance through the query BIM model, you can quickly locate the location of the fault may occur, to carry out maintenance work. Thus reducing the waste of a lot of manpower, financial resources, material resources and time, improve work efficiency, save money.

## V. THE CONCRETE APPLICATION METHOD OF BIM TECHNOLOGY IN THE CONSTRUCTION COST MANAGEMENT OF UNIVERSITY CAPITAL CONSTRUCTION

### A. Decision-making Stage

The decision of capital construction project is very important. According to the characteristic of the project, the BIM model is built, and the input parameters of the model are consistent with the actual parameters of the project. In addition, you can use the Internet, the relevant software to check the price information or related estimates, to facilitate the calculation of the project cost. After the BIM model is established, the BIM visual features can be used to analyze the effect of the project after the completion of the project. In handling the preliminary procedures can also give construction related regulatory approval to provide a good visual experience, in order to find the problem in a timely manner, shorten the time to declare the approval, is conducive to the preparation of investment estimates.

### B. Design Phase

It is generally believed that the design cost accounts for only 1% of the total cost of the project, but the impact of the total project cost is as high as 75%, so the design stage is the key stage of the whole process cost control. Combined with the estimate index, determine the demonstration project construction project by BIM model, analyzes the professional engineering cost limit, detailed design information, such as the division, the specific function of building body embedded reserved holes, pipeline arrangement, supporting pipe network layout. And easily related to cost control project cost, from the overall control of the overall cost of the project.

### C. Bidding Phase

A large amount of project information is stored in the BIM, which is easy to query, so that the calculation and valuation of the project quantity in the bidding phase is more convenient. The stored information can be used in all aspects of the project construction, and effectively avoid the leakage of items, the repeated calculation, error calculation input and so on. Through these information, can make the construction more open and transparent, to make the bidding work more fairness and justice, in order to increase competition in the market, help to reduce the follow-up project cost control in the process of unnecessary disputes.

### D. Construction Stage

The BIM model used for 4D simulation (3D model development time and project), but also can carry out 5D simulation (cost control based on 3D model), such technology can simulate the construction process, construction scheme and construction technology to optimize the management of the project as a whole. In addition, BIM also has the function of the database; project management personnel can be in its help to quickly calculate the demand for raw materials. It is convenient for the scientific material supply and construction organization, which is helpful to the cost accounting in the process, which is beneficial to the

control of the dynamic factors in the final settlement of the project.

### E. Completion Settlement Stage

After the completion of the project, the shortcomings of the traditional method of settlement of the completion of the settlement is long, the process and the parties involved in the information and communication difficulties. Using the BIM model for the advantages of completion settlement is in a short time and simple operation, because BIM has the function of database, can directly extract relevant information, in the process of engineering cost information update, can accurately and quickly complete the settlement audit. In addition, the advantages of BIM in engineering changes are also great, such as the change of the quantity of the project. By using the BIM 3D model formed by both parties in the bidding process, the original component to modify, update data, generate a new volume and price data for comparative analysis, improve the analysis efficiency and integrity. Therefore, based on the BIM project completion settlement, can reduce the deviation, improve the accuracy of the completion of settlement data, and reduce the project completion settlement disputes, reasonable control of the project cost.

## VI. CONCLUSION

Nowadays in colleges and universities in the process of new and renovated project, participants is more, a larger amount of information, traditional way of engineering cost management and information communication mechanism can't meet the requirements of modern construction engineering cost management work. The whole process cost management of capital construction in Colleges and universities should meet the market requirements of building information. The whole process of cost management in construction of BIM based management mode, to optimize and improve the current cost management mode, help to improve the efficiency of cost management in each stage, the dynamic relation between various stages of cost management, improve the overall level of cost control. It can effectively control the total cost of construction projects, reduce the waste of energy resources, and make the construction cost control more standardized and rational.

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