Study on Application of BIM Technology in Power Engineering Costing

Minghao Song

North China Electric Power University, No.689 Huadian Road, Baoding, Hebei 071003, China

Keywords: BIM; Power engineering; Costing management

Abstract: With the power grid company entering the period of fine management, the control of power engineering cost has been paid more and more attention, and it is very urgent to strengthen engineering project cost management. Aiming to effectively control the construction cost of power engineering projects and maximize the benefits of power supply enterprises and relevant units, this paper attempts to study the feasibility of using BIM Technology in the field of power engineering cost management. Based on analysis of the main problems in each link of power engineering cost management, we apply BIM technology to propose the costing management mode based on BIM technology in different stages.

1. Introduction

At the same time that power companies are growing, their operating costs are getting higher and higher. One of the most important reasons for the increase in costs is the lack of effective management and control of power engineering construction in the process of project cost. This has also seriously affected the implementation of project budgets, the timely implementation of project funds, and construction schedule planning. Therefore, for power enterprises, it is very urgent to strengthen engineering project cost management.

Power engineering cost management has a strong professionalism, which not only involves the calculation and valuation of general civil buildings, but also includes professional knowledge such as power generation engineering and transformer engineering. This paper attempts to study the feasibility of using BIM Technology in the field of power engineering cost management. Based on analysis of the main problems in each link of power engineering cost management, we apply BIM technology to propose the costing management mode based on BIM technology in different stages.

2. BIM Technology Overview

The theoretical basis of BIM technology is mainly derived from CIMS (Computer/contemporary Integrated Manufacturing Systems), which integrates CAD (Computer Aided Design) and CAM (Computer Aided Manufacturing) in the manufacturing industry. Relying on 3D technology, BIM is a digital expression of the engineering project entity and its engineering characteristics. In engineering projects, BIM technology can realize multi-party information sharing among suppliers, contractors, designers, etc., as shown in Figure 1.

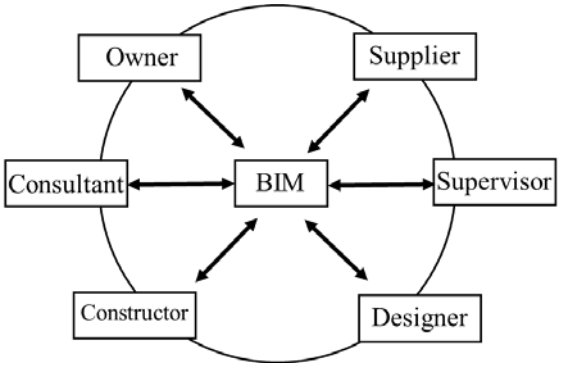

Figure 1. BIM multi-party information sharing mechanism.

BIM technology applying in engineering projects, it has the following characteristics:

(1) Coordination

The digital model of the BIM engineering project can identify and coordinate solutions such as collision problems and material arrangement problems encountered by different disciplines in the early stage of engineering construction. In addition, it can also coordinate design and construction issues that arise in the design, construction, and supervision of engineering projects.

(2) Simulation ability

The digital model of BIM can simulate the building model of the engineering project. 4D and even 5D models at any stage of bidding and construction can help establish a reasonable construction plan. At the same time, engineering projects based on BIM technology can discover problems such as pipeline collisions that may occur at the construction site during the design stage, and optimize the design and construction plan.

(3) Visualization

The BIM model is a three-dimensional physical model determined based on the construction plan. The 2D and 3D views of the model can be converted in real time, which has a great advantage over traditional CAD drawings.

(4) Parameterization

Taking Autodesk Revit 2014 software as an example, each part is a parametric model, which can be used to build a fairly accurate model**.**

BIM Technology is not just a software, but there are corresponding BIM application software in modeling, scheme design, visualization, operation management, etc., as shown in Table 1.

Table 1.BIM application software.

Category	Software
Core modeling	ArchiCAD, Autodesk Revit, Bentley, etc.
Conceptual design	Affinity, Onuma Planning Systems, etc.
visualization	Lumion 3DS Max, Lightscape, etc.
Comprehensive collision inspection	Navisworks, Project Navigator, etc.
Operation management	Navisworks, Archibus, etc.

3. Problems in Power Engineering Costing

China's power construction project cost control level is relatively backward. The project participants have poor cooperation and coordination, and lack of effective communication. In addition, the third-party cost consulting unit in the power industry lacks independence and is greatly influenced by the owner, so it lacks control and management of process dynamics. And the technical and economic cost control awareness of the management of the construction unit is weak, and the attention to the process cost control is not enough.

3.1. Investment Decision Stage

Overall, in the cost management of power engineering projects, the attention to the early investment estimation is not enough. Firstly, there is not enough time to recognize the technical requirements of the project itself, and the design depth is not enough, resulting in a large cost deviation. For some projects with political tasks, in order to achieve project approval, decision makers often take measures of rough design or reduction of investment scale, resulting in serious overspending in the later period. Secondly, the contract management is not rigorous, the responsibility and power of each participant cannot be clearly divided and effectively implemented, and the cost deviation cannot be constrained. In order to ensure their own interests, the consulting unit does not play an independent, fair and objective role as a third party, therefore, there is no effective control over the cost process.

3.2. Design Stage

In the process of electric power project implementation, in order to meet the opinions of the competent construction department, the designers have no power of innovation and lack the awareness of dynamic cost control. Changes in the design phase will lead to additional costs, resulting in over expenditure of project construction costs. In addition, the design contract price is calculated according to the total investment proportion of the project. In order to pursue profits, some design units tend to increase the product function to increase the total cost of the project. At the same time, the binding force of design contract terms is not strong, and the lack of necessary evaluation mechanism also makes the initiative of designers to optimize design weak.

3.3. Biding Stage

Biding division, blocking prices determination, bidding quotes analysis re all important factors that affect the cost management of the bidding stage of power construction projects. However, since the enterprise quotas of most enterprises have not yet been formed, most industries also adopt the fixed-price pricing method of budget estimates or budget bidding. Due to the strong professionalism of power engineering projects, the construction units are basically internal enterprises in the power industry, and there are certain industry monopolies and hidden rules in the bidding process.

3.4. Construction Stage

In the construction stage, it requires a large amount of resource including human, financial, material and technology, with many uncertain factors, high safety and capital risks, which is also the most prominent stage of coordination contradictions among all parties involved in the construction. However, there are many problems in the process of project implementation: the terms of the contract are not rigorous; the construction organization design is too formal; the quality of the employees is low; lack of dynamic cost control and supervision; disordered management of design change and site visa; blind pursuit of construction progress and son on.

3.5. Completion Stage

In the completion stage, it is necessary to comprehensively evaluate the project function realization, construction quality level, process management and control ability and investment benefit. However, in the process of project implementation, many disputes are caused by design change and cost supervision absence, which seriously affects the implementation of the project and the final determination of cost.

4. Power Engineering Costing Management Mode Based on BIM Technology

4.1. Investment Decision Stage

By using BIM technology platform, we can obtain preliminary visual information model for different construction schemes in the project decision-making stage, then estimate the corresponding quantities of different construction schemes, associate BIM model with investment estimation by the cost information in the database, and estimate the investment of different construction schemes.

With the help of the virtual construction and scheme optimization functions of BIM technology platform, we can fully compare and analyze each alternative construction scheme, which is helpful to deepen the preliminary planning of the project, improve the content of the feasibility study of the project, and provide strong support for the investment decision of the project.

For cost management in the decision-making stage of power engineering projects, we put forward the costing management and control mode based on BIM technology, as shown in Figure 2.

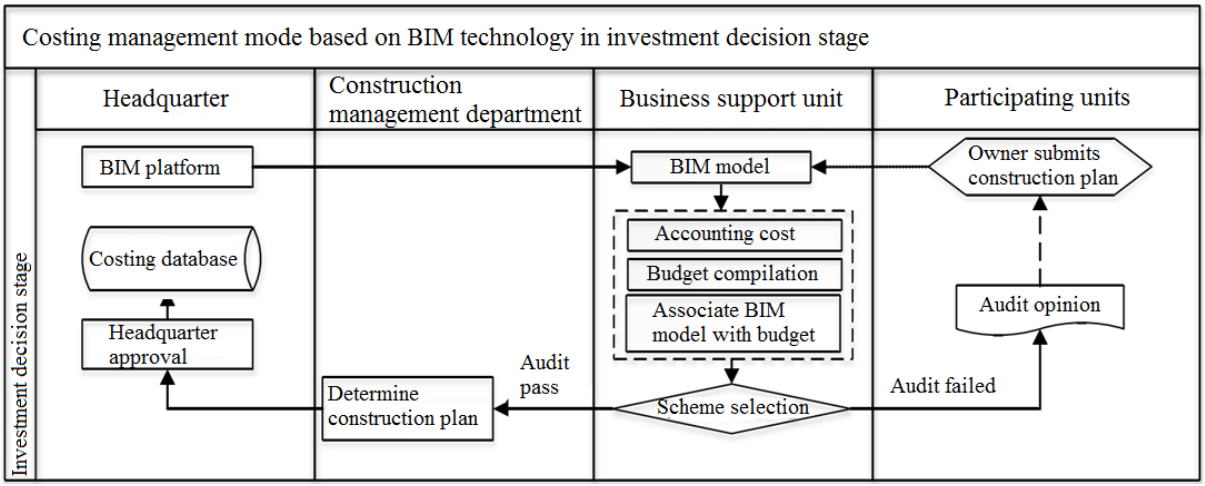

Figure 2. Power engineering costing management mode based on BIM technology in investment decision stage.

Under the support of BIM platform, it can help the engineering decision-makers to quickly and efficiently complete the project decision and the original accumulation of decision data. According to the data structure of BIM platform, technical information and economic information related to power engineering project decision-making are stored, which would gradually forms the database of power engineering cost estimation reflecting the characteristics of the project. It can effectively promote the process reengineering of BIM Technology in the power engineering decision-making period, fundamentally changing the traditional power engineering investment estimation method, and laying the foundation for later investment management.

4.2. Design Stage

The design of electric power engineering includes three stages: preliminary design, technical design and construction drawing design. In the first two stages, the quota index of the design scheme can be determined from the accumulated database, and the design quota index of each scheme can be compared and analyzed rapidly and dynamically. In construction drawing design stage, BIM platform can be used to directly and real-time extract and view the quantities, construction drawing budget, project progress information and design documents related to power engineering. In addition, the collision simulation using BIM Technology can correct the conflict of different disciplines in design before the delivery of engineering design.

For cost management in the design stage of power engineering projects, we put forward the costing management and control mode based on BIM technology, as shown in Figure 3.

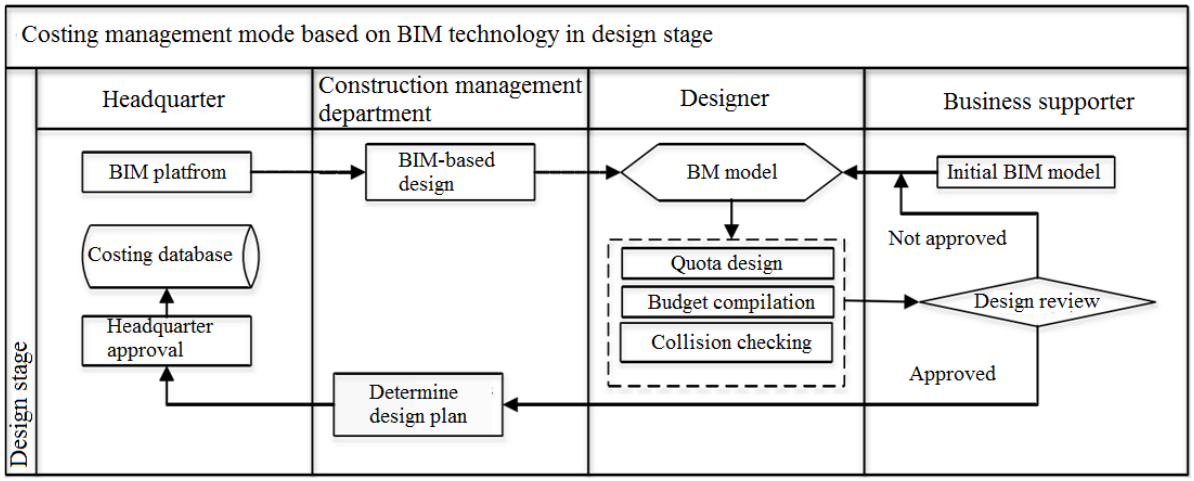

Figure 3. Power engineering costing management mode based on BIM technology in design stage.

Based on BIM Technology, the process reengineering of power engineering cost management in design stage is realized. BIM platform can associate BIM database in the primary stage of engineering design, to extract some basic cost data in the design process, which is conducive to quota design. In the construction drawing design stage, we can also apply BIM model to prepare accurate construction drawing budget, so as to facilitate the payment of project construction progress payment, procurement of equipment and materials, quota picking and other work.

4.3. Construction Stage

In the construction stage cost management of electric power engineering, BIM platform can be used for construction organization optimization, engineering measurement, engineering change, fund use plan and deviation analysis, claim management, project progress payment, etc. In order to facilitate the approval of the project progress payment by the construction unit, the quantity price flow and radio frequency technology in the BIM platform can be used to dynamically grasp the change of project cost according to the actual progress of individual project construction. In order to facilitate the construction company to reasonably arrange the construction personnel, count the quantities, and arrange the equipment and materials required for the construction project, the parametric model in BIM can be used to fine control the cost work in the construction stage. In order to facilitate the dynamic real-time tracking, supervision and management of project information changes in the whole life cycle of the supervision unit, BIM Technology can be used to make up for the determination of the existence of traditional supervision.

For cost management in the construction stage of power engineering projects, we put forward the costing management and control mode based on BIM technology, as shown in Figure 4.

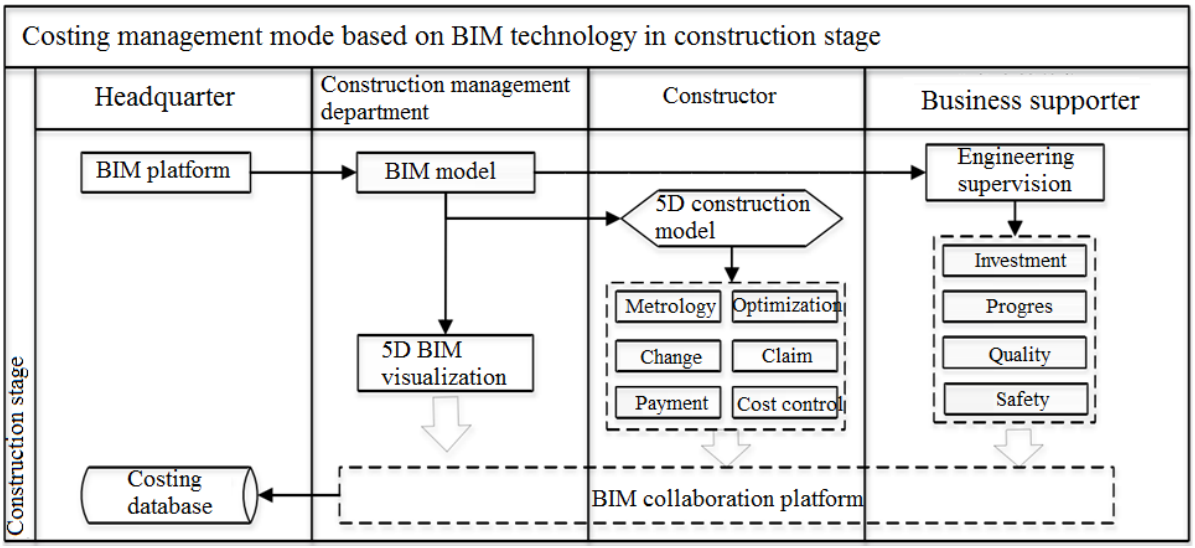

Figure 4. Power engineering costing management mode based on BIM technology in construction stage.

With this management mode, the participating units of the project use the BIM platform to cooperate with each other, and realize the real-time dynamic management in terms of project progress, quality, safety, cost, etc.

4.4. Completion Stage

Through the cooperation of BIM platform, the information of project implementation, project change, claim management, project progress, price of manpower, materials and equipment can be recorded in detail. The problems of incomplete settlement data and inaccurate settlement basis that exist for a long time can be solved. Therefore, it is conducive to promoting the accuracy of project completion and settlement.

For cost management in the completion stage of power engineering projects, we put forward the costing management and control mode based on BIM technology, as shown in Figure 5.

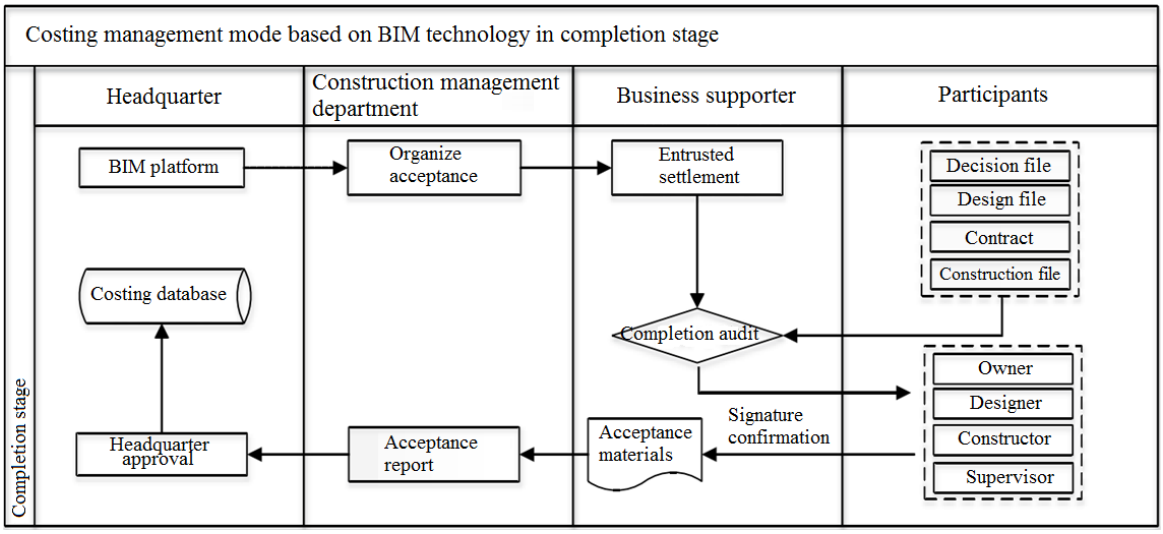

Figure 5. Power engineering costing management mode based on BIM technology in completion stage.

Under the cost control mode of project completion stage based on BIM Technology, the combination of BIM model and actual project can effectively simplify the work complexity of the construction unit in the completion settlement by using BIM Technology's design scheme comparison and selection, cost dynamic analysis, automatic calculation of quantities, progress quantities acquisition and other functions in cost management.

In the stage of project completion and handover, all kinds of information in BIM platform have been updated and improved continuously in the process of construction, which can fully reflect the actual construction situation of the project.

5. Conclusion

The effect of power project cost management would directly affect the interests of all parties of the project, so it is very important to promote in project cost management. With the continuous promotion and application of BIM Technology, BIM Technology is not only applied to the visualization and Simulation of project cost management, but also to integrate various cost data and information into the information management platform.

Aiming to effectively control the construction cost of power engineering projects and maximize the benefits of power supply enterprises and relevant units, this paper attempts to study the feasibility of using BIM Technology in the field of power engineering cost management. Based on analysis of the main problems in each link of power engineering cost management, we apply BIM technology to propose the costing management mode based on BIM technology in different stages.

References

[1] Yin, Yi Lin, Qian, Kun. Construction Project Cost Management Based on BIM Technology[J]. Applied Mechanics & Materials, 357-360:2147-2152.

[2] Vigneault, Marc-Antoine, Boton, Conrad, Chong, Heap-Yih, et al. An Innovative Framework of 5D BIM Solutions for Construction Cost Management: A Systematic Review[J]. Archives of Computational Methods in Engineering.

[3] Peter Smith. Project Cost Management with 5D BIM[J]. Procedia - Social and Behavioral Sciences, 2016, 226:193-200.

[4] Park, Chan-Sik, Lee, Do-Yeop, Kwon, Oh-Seong,etc.. A framework for proactive construction defect management using BIM, augmented reality and ontology-based data collection template[J]. Automation in Construction, 33:61-71.

[5] Nameless. BIM application in engineering cost management[J]. China Building Materials Science & Technology, 2014.

[6] Onyenobi T, Arayici Y, Egbu C, et al. Project and facilities management using BIM: University of Salford relocation management to Media City[J]. 2010.

[7] Redmond A, Hore A V, West R. Developing a Cloud Integrated Life Cycle Costing Analysis Model Through BIM[J]. 2010.

[8] Zheng, Hao Kai, Cao, Jian Wen. Discussing the Influence of BIM for the Construction Project Cost[J]. Applied Mechanics & Materials, 357-360:2533-2536.