

Research on the Application of BIM Technology in Engineering Cost

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Abstract

The traditional project cost mode is relatively backward, which affects the construction progress and brings a series of technical and economic disputes. With the gradual maturity of the construction industry informatization, the emergence of BIM has brought the dawn to solve this problem, and the comprehensive application of BIM technology has become a new trend in the development of the construction industry.

Keywords

BIM Technology; Engineering Cost Management; Whole Process Engineering Cost.

1. Introduction

BIM technology is an important technology type in the information age. It can be not only applied to the whole life cycle of construction engineering in the use process, but also can replace the traditional construction management and construction cost mode, and improve the professional and scientific nature in the construction process and cost process. At the same time, the technology can also provide data support for the project cost and construction through the form of model construction. This paper will elaborate the application research of BIM technology and engineering cost, and provide reference and guidance for the construction enterprises to implement the whole process control.

2. Connotation of BIM Technology

BIM technology is building information model technology, which refers to the use of different data and information of comprehensive construction engineering to create digital models, which is easy to show the form of construction engineering, and then achieve the purpose of comprehensive management of construction engineering. The process involves many links, such as simulation, modeling, optimization, etc., so the technology has the characteristics of simulation and integrity. The technology was first proposed in the 1970s, and new developments began until this century[1].

In the 1970s, the idea of BIM was first put forward, and then Charls Eastman, Jerry and other scholars conducted further research on the of BIM, and elaborated its concept. The United States made a relatively complete and systematic definition of BIM in the national BIM standard[2], It means that BIM is a digital display of the physical and functional characteristics of the facility to enterprises; The BIM, as an information resource, By establishing a sound information-sharing platform for various types of users, Can provide accurate and objective basis for enterprises or individuals involved in the project in its construction, operation and other stages; Apply the BIM technology to the project, In every part of the project, The designer can base the design on the BIM model, For effective editing and information extraction, So as to ensure that the whole project management period can be realized the system operation and coordination process. At present, there are many related research and applications of BIM

technology, but there are still many understandings and disagreement in the concept and connotation of BIM. This paper makes the following explanation of BIM [3]: ① BIM belongs to a basic data model. In such a data model, there are rich geometric information and non-geometric resources about buildings. Geometrical information mainly includes the building model of internal and external space structure of various geometric representation, is component related size information and positioning information, not only through the 3D form, also can show in traditional two-dimensional view, and there are certain correlation between these geometric view, changes on one hand, will cause the overall linkage change [4]. Engineering technology: Citation Edition, 2016 (5): 00037-00037.]. Non-geometric information should be selected according to the actual requirements of the project. The non-geometric information is also very different, and the non-geometric information required in different stages of the project is also different. For example, in a 3D model, if time, space and other information are added, it will become a 4D model, so that the progress can be controlled. Therefore, BIM should first belong to a huge information model integrating multi-dimensional data, which is also a common feature of most technologies with information data as the carrier. ② BIM belongs to a collaborative process. The application of BIM technology has changed the traditional design and construction process to some extent. In the traditional design process, various types of designers carry out the water design, usually first by the architectural designer, and the structural designer implements the structural design on this basis, and then to the water heating and electricity engineer. However, such a design process will appear in the form of different types of version drawings, and the collaboration efficiency between them is relatively low. The application of BIM technology will avoid this phenomenon, which can realize the parallel design between projects. On the same platform, various professional designers can operate at the same time and connect with other designers, so as to ensure the orderly connection of the whole design, and the mutual influence between various professional designs can be intuitively displayed at the same time. At the same time, the owner and the construction party can also communicate with the BIM platform to ensure the order and high quality of the project construction[5]. ③ BIM belongs to an integrated tool. As mentioned above, BIM is a basic modeling tool, and the core modeling software can usually be connected with multiple types of software, such as visualization software, sustainable analysis software, construction management software, and operation management software [6]. BIM tools show the integration can greatly reduce each link in the process of repeated modeling problems, and avoid the traditional project design process in the participants in the exchange of information block problems, can ensure the information exchange sharing become more efficient and convenient, improve the efficiency of the parties work together.

3. Analysis of the Application Status of BIM Technology

3.1. Analysis of the Application Status of BIM Technology in Engineering Cost

At present, the role of project cost management in construction management is more and more important, and with the advent of the Internet era, the promotion and application of various information technologies and platforms have gradually exposed the defects of the original project cost management methods and technologies. At present, BIM technology has been gradually accepted by the construction industry. Many technical research institutions and industry organizations have invested in the research and development of BIM technology, and various construction enterprises have achieved good results in the application of BIM technology. In the development process of this technology, there is a huge space for its value improvement. In the future, a large number of technical functions will be developed, so as to make the project cost management more efficient and convenient. At the same time, BIM technology also brings great opportunities for engineering cost management, through the data

model and information technology data analysis, can improve the level of engineering cost management, solve the shortcomings of the past, but due to the application of BIM technology requires a lot of material resources, financial resources, manpower, and difficult to quickly achieve the desired effect, lead to input and output cost performance is not high, social benefit and economic benefit is difficult to improve, and because part of the enterprise for BIM technology is still in the exploration stage, there are many problems in the application process. Therefore, it is necessary to deeply discuss the application mode of BIM technology, based on the practical problems and application situations.

3.1.1. Analysis of the Application Status of BIM Technology in Engineering Cost

As a data model integrating various information of projects, BIM not only changes the storage mode of traditional project information, but also realizes the rapid processing and sharing of information. More efficient information storage, processing and sharing methods bring new ideas and methods to the whole process of project cost management based on decision-making, design, bidding, construction and completion. Like in the decision stage, BIM model can be associated with project evaluation indicators to achieve the effect of intelligent decision making; In the design phase, Through BIM technology to implement multi-professional collaborative design, scheme optimization, pipeline comprehensive collision, engineering quantity calculation and other work, Can effectively reduce the design changes and rework, Bring about significant economic benefits; In the bidding stage, Taking the BIM model as part of the tender document, Reduce the loss of design information in the bidding process; During the construction phase, Whole-process management of the construction stage through BIM technology, Realize the reasonable arrangement of related resources such as personnel, materials, machinery and funds; At the completion and settlement stage, Using the perfection of the BIM model information at the completion stage, It can improve the efficiency and accuracy of completion settlement. At the same time, the project information of completed projects is integrated to establish an internal database, which can provide effective reference data for similar projects in the future. The application of BIM technology has improved the whole-process management of the cost to a certain extent, but there are still some limitations at this stage. The research in the stage of decision-making, bidding, construction and completion is still in the theoretical stage and does not produce outstanding practical application value. Moreover, the design stage with great application value is only limited to conventional functions such as collaborative design and collision inspection, and does not give full play to the potential value of BIM technology.

3.1.2. BIM4D / 5D Cost Management

In order to further tap the application potential of BIM technology and broaden the application scope of BIM technology, experts and scholars have integrated progress and cost data on the basis of 3D BIM, creating more informative BIM 4D and BIM 5D. Yang Zhenqing et al. simulated and tracked the project construction scheme through BIM 4D, which improved the quality of project schedule management; Sun Lei proposed the method of fine management of quantity, price and cost from human, machine, material, method and ring. However, BIM 4D only integrates the information of one dimension of progress, and its cost management value is not fully demonstrated. Meanwhile, BIM 5D that integrates progress and cost information can realize the cost management more efficiently. Therefore, based on the BIM 5D integrating cost and progress information, the scholars realized construction cost prediction, dynamic control and process, improved the quality and efficiency of cost management in the construction stage, constructed the framework of project cash flow analysis and financing analysis, which can analyze projects more effectively, developed a new calculation method of life cycle cost (Life Cycle Cost), and improved the efficiency and quality of project cycle cost calculation. Higher dimensional BIM 4D / 5D models often require more time and cost, and the marginal benefits

brought by information integration are more obvious. How to balance the cost and benefits is an important problem to be thought about in the application of BIM 4D / 5D technology.

3.1.3. BIM and Other Technologies are Integrated with Cost Management

While exploring the independent application of BIM in cost management, we also try to combine other concepts, technologies and management transaction modes with BIM technology, so as to maximize the value of BIM cost management. Such as the BIM and integrated product development model (Integrated Product Development, IPD) combine, Optimize the application environment of BIM with the concept of IPD information sharing, Improve the efficiency of project cost management, Create favorable conditions for the whole process of cost control; Combining BIM with mathematical methods, Extract the required data based on the BIM model, Combined with the mathematical model to establish the estimation model of the project cost; Integrating the BIM with the database technology, Realize the automatic extraction of engineering quantity and cost matching; Combining BIM with cloud-based data technology, Implement the interaction between the model and the field data, Collaboration between the managers, To a certain extent, to solve the information island problem; Combining BIM with big-data technology, From the perspective of information, the project cost management model is proposed. The attempt and application of "BIM +" has greatly enhanced the application potential of BIM technology and created more possibilities for the application of BIM technology in the construction industry.[7].

3.2. Risk Analysis of BIM Technology Applications

As an emerging technology, BIM technology still has many problems in the development and application, and there are many deficiencies and difficulties in the practical application.(1) The breadth of BIM technology applied to project cost management is not enough. Due to the excessive pursuit of the accuracy and efficiency of the cost, coupled with the lack of understanding of the technology, the project cost management work is not skilled, lack of application awareness, is bound to affect the project cost management work, waste time, increase the work burden. In addition, the current BIM technical data has not been further determined in the scope of the project, the lack of mining and utilization of technical advantages, and the depth and breadth of the application requirements are not high.(2) The coordination between BIM technology and engineering cost management is poor. Theoretically, BIM technology can coordinate to strengthen the level of engineering cost management work, but in practice, various departments failed to do a good job of coordination between various professional management, BIM technology and engineering cost management of collaborative insufficiency, thus increases the management difficulty, make the project cost cycle becomes longer.(3) The process problem of the project cost management. The managers fail to model BIM technology according to the cost work needs of different majors. They lack of computer software and hardware facilities, and the modeling speed is very slow, which affects the next process of project cost management.[8].

3.3. Countermeasures Analysis of BIM Technology Application

3.3.1. Standardize Technical Management

The rapid development of BIM technology has promoted better development opportunities for civil engineering, providing many conveniences for construction preparation, schedule management and cost control, but it also forms new challenges, so it is necessary to adopt standardized management means for this technology. First of all, it is necessary to develop an inspection system around BIM technology, to ensure its application efficiency and application safety, and to assess its practicability in engineering. Secondly, a supervision system should be formulated to control the application of BIM technology and provide a guarantee for its reasonable application. Finally, improve the work related to technology application. In order to

standardize BIM technology management, it is necessary to scientifically define the precision of BIM model. The American Institute of Architects has defined the degree of meticulousness (LOD) of BIM models. Different LOD levels correspond to different degrees of refinement of BIM models and have different effects (as shown in Table 1). Only with a perfect design can we give full play to its utility. Only by combining the actual situation of the project and fully considering many factors, can we ensure that BIM technology achieves twice the result with half the effort in the related work of civil engineering.

3.3.2. Implement Technical Publicity

The development speed of BIM technology is obvious to all, but there are still some engineers stuck to the traditional technology for civil construction. This kind of phenomenon is caused by the poor publicity of the application of BIM technology. In order to integrate BIM technology into the work of civil engineering faster, it is necessary to strengthen the publicity of this technology, so that the whole industry can fully realize the innovation and practicality of BIM technology. In order to apply more such technologies in civil engineering, relevant enterprises should hold relevant lectures on BIM technology and call on everyone to learn BIM technology. You can also invite more skilled BIM application personnel to give speeches, or send unit technical personnel to other enterprises with good application to learn. Only by personally understanding the powerful role of BIM technology in civil engineering can it strengthen the application of BIM technology.

3.3.3. Strengthen Technical Training

In order to achieve a better application of BIM technology, more management training is needed to apply the technology. The ability of managers to apply BIM technology for engineering management is closely related to its final application effect. The quality and quality of relevant personnel determine the application quality of BIM technology. Therefore, it is necessary to conduct regular training for managers to improve their professional skills and comprehensive quality, and strengthen the BIM technical literacy of managers, which can be realized by adopting the old and new working mode in related projects. Employees who master BIM technology can explain all aspects of professional knowledge to the new applications. In this way, managers can better understand the project situation and have a more intuitive judgment on the cost of each link of the project. In addition, it is also necessary to regularly organize management personnel to conduct out training, and enrich and innovate knowledge by participating in high-end talent exchange meetings, keep pace with The Times, and constantly improve their self-cognition ability.

3.3.4. Optimize Technical Simulation

The further promotion of BIM technology needs to make use of the visual advantages of BIM technology, and carry out dynamic simulation and optimization of the construction scheme, so that the implementation effect of various processes can be intuitively compared. By comparing and selecting the optimal scheme, the best scheme introduced by the simulated and optimized BIM technology can greatly improve the construction effect. Civil engineering needs to use BIM technology to simulate the application direction of optimization, mainly in the surrounding environment, construction site layout, cross operation process, earthwork excavation, concrete support removal, pipeline relocation, steel support erection, lifting and other aspects.[9].

4. Analysis of the Application of BIM Technology in Engineering Cost

Cost management includes the decision-making and investment stage, design stage, bidding stage, construction stage and completion stage.

4.1. Advantages of Applying BIM Technology in the Project Cost

Improve the management efficiency. BIM technology is the use of computers and corresponding software to simulate the construction project, providing construction information in the process of simulation and simulation, so that the construction team can understand the basic information and overall situation of the construction project from multiple angles, to provide convenience for the construction. In the project cost management, BIM technology can be used to master the construction requirements and the actual situation, give full play to the advantages of BIM technology, and build a three-dimensional model of the project, so as to make the overall situation of the building more intuitive and three-dimensional. Scientific analysis and design, avoid design mistakes, make the application of materials and technology more clear and targeted. Management personnel can be combined with the actual situation of building three-dimensional model, determine the construction management target and cost, and combined with the information and data, make the project cost management more perfect, meticulous, promote the project cost management gradually improve, and help enterprises or construction team achieved good results in the project cost management, solve the original technical shortage of engineering cost management or construction problems, improve work efficiency. At the same time, designers can use BIM technology, combined with the drawings, the list of materials and the construction technical requirements, to effectively design the project cost management scheme, to avoid many influencing factors in the project cost management. In addition, if the drawing is wrong or the project cost management is wrong, it will have adverse effects on the construction management and quality management, and it is difficult to improve the economic benefits of the project. Therefore, the three-dimensional model of BIM technology can clarify the content of each link of project cost management, provide material data and technical requirements, and reasonably promote the work process according to the progress of the construction site, so as to improve the level and efficiency of project cost management.

Reduce mistakes. Safe, stable and high-quality construction is the highest goal pursued by construction enterprises. Only by ensuring the safety and stability of construction, can we reflect the construction and management ability of the construction team and improve the economic benefits. However, the traditional engineering construction management often adopts the artificial way to manage the engineering cost and construction quality, and there are some problems such as high complexity and great construction difficulty. In some more complex engineering project management, due to the error of the project cost management, leading to mistakes in the construction, which not only affect the construction progress, but also increase the project cost, and affect the final economic benefits of the project. Therefore, need to use BIM technology in the engineering cost management, management personnel get more detailed, sound building information, and according to the actual situation of specific material application quantity, technical methods, etc., improve the integrity of materials and technology application, prevent the project cost management and construction design unreasonable accidents, so as to further improve the level of construction management and project cost management. At the same time, the maximum control of the project cost, to ensure the full use of materials and technology, to avoid material waste and economic loss, so as to improve the economic benefits of construction enterprises and construction team.[10].

Project cost management is an important part of project investment. It is necessary to start from the overall interests of the country, and make reasonable use of human, material and financial resources to achieve the maximum investment benefits. Speed up the project cost management of concise with the continuous development of construction industry, the original building form and management mode has been unable to adapt to the social situation, the BIM technology effective application in the process of construction engineering cost management, through the BIM technology itself to building site data survey and collection, in the form of

modeling construction simulation, and constantly optimize, can effectively speed up the intelligent development of project cost management. The biggest advantage of BIM technology is three-dimensional modeling, so that the project participants can understand the construction progress, track and query the material manufacturers, etc., to avoid mistakes caused by poor information exchange. It also makes the follow-up management work more efficient, effective, and truly realize the information, integration and intelligence of project management.[10].

Strengthening cost management BIM technology also plays an important role in the work of civil engineering cost management. In the design stage, BIM technology can build a design model based on the information of the flat drawings, and summarize the modeling and analysis of the components needed in the whole project. Find out the possible problems in the construction in advance through the building rehearsal, and then solve these problems one by one, to avoid repeating the design and modification scheme leading to the increase in the cost of the scheme. The optimization, deepening and splitting of the design scheme can greatly reduce the design difficulty, the design time required can be greatly shortened, and the design cost can be effectively reduced. At the same time, the appropriate optimization of the design can greatly reduce the construction difficulty of component lifting, reduce construction errors, improve the quality of the project, avoid the common quality problems caused by design problems, and then improve the overall quality of the project and reduce the follow-up maintenance costs. In the bidding stage, BIM mainly uses the model generation and production software for information measurement to achieve accurate management. According to the actual construction progress of the project, the engineering simulation can realize the combination of dynamic and static project. Reasonable use of BIM technology can minimize the manual error of traditional measurement. Relying on big data, cloud computing can quickly and excellently obtain a reasonable range of bidding quotation, effectively avoid the blind waste of cost, and strengthen the control of civil engineering costs. In the construction stage, the construction party can build a good model through BIM technology, which can make the resource allocation more reasonable, clarify the planning objectives, and reduce the cost waste caused by the wrong construction. By improving the deficiencies in the flat drawings and making a good purchase list, it is conducive to the reasonable arrangement of construction, the problem of insufficient construction area facing the construction site, and the accurate arrangement of construction. BIM technology in construction simulation work, to optimize the assembly process, and control the installation phase cost, reduce the sudden factors in the construction process, the possible problems, do early detection, early solution, ensure every step important program step by step, no delay the time limit for a project. Through the accurate control of the construction process and the construction materials, the reliable control of the construction cost is realized. In the completion settlement stage, BIM technology fully combines modern computer technology, advanced three-dimensional digital technology, through its digital, information and integrated characteristics of the construction information sorting, convenient to obtain the cost of various construction process, is conducive to reduce the cost of completion settlement [2].

2.3 Strengthening progress Management

Each stages of civil engineering are closely related and connected with each other, which makes it difficult to manage the construction progress. The application of BIM technology in civil engineering can implement comprehensive management of all stages of construction, so that it can form an effective connection, and be more convenient to obtain all kinds of engineering information at different construction stages, so as to facilitate the management personnel to comprehensively and effectively grasp the construction progress. The information management mode built on BIM technology is very convenient for engineering business communication. It can implement unified communication and integrate various construction information to realize barrier-free communication, avoid redundancy or loss of construction information, and reduce the efficiency of construction schedule management. The advantages of sustainability optimization

of such technology can optimize the BIM model according to different construction links with the gradual deepening of civil engineering, so that each construction link can be accurately controlled, and then the overall construction progress can be grasped, and the project management efficiency can be effectively improved.[11].

As the main application technology in the construction industry, BIM technology has the following functions: First, test functions. Before the project starts, the technology can master the whole project, adjust the data through simulation test to ensure the scientific and reasonable architectural design; second, the communication function. Creating digital information model through relevant software can reasonably plan various construction links and facilitate communication between subcontractors; third, check function. BIM technology can test the cost budget to ensure the rationality of the project cost budget; fourth, simulation function. Before the start of the project, apply BIM technology to conduct simulation tests, which can not only ensure the actual construction period, but also find out the problems in the construction process in time and formulate corresponding solutions.

5. Conclusion

To sum up, there are some problems in the project cost management mode which is widely popular in the market, which is easy to cause economic losses and delay of construction progress. Current BIM technology gradually mature, for the solution of this problem, BIM technology can through digital, information and integrated characteristics of the construction information, can prevent the emergence of some construction problems, for example because of different professional drawings conflict, resulting in the construction line collision, for some reason cause Low-rise residents perennial without sunlight, etc., the solution of these problems is likely to bring some unnecessary economic losses to engineering, to increase the cost. Therefore, it is imperative to study the application of BIM and engineering cost.

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References

- [1] B.D. Gao: Application of BIM technology in construction engineering cost management , Jiangxi Building Materials, 2021 (10),p. 335 + 337 + 339.
- [2] H.S. Liu , P. Li , Y.H. Zhou: National Defense Industry Press, Beijing (2008) management of design.
- [3] L. Han: Application of BIM technology in construction engineering cost management , Global Market, 2016 (30),p. 215.
- [4] X. Yao: Application of BIM technology in construction engineering cost management.
- [5] J. Zhu: Discussion on Application of BIM in Railway Design , Journal of RailwayEngineering Society, 2010(10),p. 478-489.
- [6] R.P. Xu: Chemical Industry Press, Beijing (2009) management of design.
- [7] Y.Q. Liu , H.Y. Wu , K. Chen : Overview of the application of intelligent construction technology in engineering cost management. Building economy, 2022 43(S1),p. 245-252.DOI:10.14181/j.cnki.1002-851x.2022S10245.
- [8] H.C. Wang: Research on the application benefit of BIM technology in engineering cost management . Bulk cement, 2022 (01),p. 54-55 + 58.
- [9] L. Ren: Analysis of the application of BIM technology in civil Engineering. Construction Machinery and Maintenance, 2022 (03),p. 233-235.
- [10] K.C. Wang: Research on the application benefit of BIM technology in engineering cost management . Bulk cement, 2022 (01),p. 54-55 + 58.

- [11] M.Y. Wang , M.M. Gong , N. Bai , W.F. Lan , Z.G. He: The practice study of BIM technology in engineering cost management . Smart Building and Smart City, 2022 (07),p. 118-120.
- [12] L. Ren: Analysis of the application of BIM technology in civil Engineering [J]. Construction Machinery and Maintenance, 2022 (03),p. 233-235.