Research on BIM Based EPC Project Lifecycle Information Management

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Abstract: The construction mode and management mode of Chinese traditional construction industry are slow in informatization and digitization. This paper takes the information management of Engineering Procurement Construction (EPC) projects as the research object and Building Information Modeling (BIM) technology as the means to build a BIM cooperation platform in the information management of EPC projects, proving that the use of BIM technology in the whole life cycle information management of EPC projects can solve the problem of "information island" and promote the transmission and sharing of information in the whole life cycle of projects. To realize the dynamic monitoring of project safety information, and provide theoretical reference for realizing more efficient information management.

Keywords: EPC Projects, BIM Technology, Full Life Cycle, Information Management.

1 INTRODUCTION

In recent years, the problem of relative separation of each stage has emerged in our large complex engineering projects [1]. There are barriers in the process of information data transmission in the whole life cycle of the project, which makes it difficult for managers to accurately grasp and effectively control the actual situation of the project. Combined with the advantages of EPC mode and BIM technology, the information management of collaborative projects in the whole life cycle can promote the information sharing and transmission between various stages and solve the problem of "information isolated island".

Cheng Xing et al. [2] took actual projects as examples to study the application of BIM in each stage of EPC projects, and analyzed and summarized the advantages of BIM application in EPC projects. Guo Ziqi et al. [3] put forward the method of applying BIM information model to the cost management of EPC projects, achieving the purpose of cost saving and providing a feasible idea for the combination of EPC project cost management and BIM technology. She Jianjun et al. [4] proposed a BIM based knowledge integration management model for EPC

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projects, which orderly and systematized project knowledge. Amos Darko et al [5]. found through their research that BIM technology plays an important role in project risk management.

To sum up, scholars have studied and explored the management of BIM technology in the aspects of cost, risk, and knowledge integration of EPC projects, but there are few researches on BIM technology in the whole life cycle information management of EPC projects. Therefore, the author takes the information management of EPC projects as the research carrier and BIM technology as the auxiliary tool to build a BIM based information management collaboration platform for EPC projects in the whole life cycle, to break the barriers of information transmission and promote the transmission and sharing of information in the whole life cycle of projects.

2 THE DEFINITION OF THE CONCEPT OF RESEARCH OBJECT

2.1 Conceptual Characteristics of EPC Projects

Engineering Procurement Construction (EPC) refers to a construction mode in which contractors' contract for the whole process or several phases of a construction project's design, procurement, construction, and trial run according to the contract agreement and are fully responsible for the quality, schedule, and cost of the project [6]. And projects with this contracting process are called EPC projects.

EPC general contractors have greater freedom to play, and can carry out more effective supervision and management. In the EPC general contracting mode, the design, procurement, and construction can cross each other in the schedule according to the project requirements, so that all stages of the project construction can be effectively communicated and coordinated, to improve the construction efficiency of the project.

2.2 The Value of BIM Information Management

1) Implementation of associated modification: The software developed based on BIM can directly carry out 3D visual design, and provide the required data information such as model and plan for the subsequent stage. This greatly improved the shortcomings and deficiencies of the information sharing in the segmentation design in the CAD era, and reduced the occurrence of the failure to discover the design errors in time under the traditional mode, which would lead to the subsequent need to spend a lot of time and human and financial resources to remedy the situation. The BIM has the function of automatic coordination for modification. When the design is modified, the modified part can be synchronized to other associated content. It not only improves the design quality, saves people, money, and time, but also coordinates the information transfer and sharing between different specialties and different stages. It provides an important and reliable guarantee for the completion of the final goal [7].

2) Reduce repeated input of information: As the carrier of data, BIM can integrate different content data such as structural analysis and schedule management at each stage, so that data can be shared. In the process of schedule control, cost management, energy analysis and other work,

the required information can be directly extracted from the BIM database for research, and the results can be fed back to the database to prepare for the subsequent environment. Each link does not need to repeat the input and export of data, and will not cause data omission and loss. The information reuse rate of the whole life cycle of construction projects is improved.

3) The collaborative work of all participants is realized: All participants can obtain the required formal documents from the platform according to their own needs to meet the needs of collaborative work and project negotiation.

4) Improved degree of automation: the virtual construction of BIM can predict possible problems and dangers before construction, and then optimize the construction scheme and adjust the schedule based on this, which greatly improves the degree of automation in the construction process.

5) Support operation and maintenance activities: BIM database and the constructed information cooperation platform can be used to provide data protection for operation and maintenance stage, and provide comprehensive and perfect data support for building maintenance management software. Eliminate the phenomenon of data fragmentation when the information of design, construction and other stages is transmitted to the operation and maintenance stage.

6) Data interoperability: Data storage, exchange and sharing based on BIM can realize smooth interoperability among all links in the whole life cycle of the project and avoid the problem of "information isolated island".

3 BUILDING AN INFORMATION MANAGEMENT COLLABORATION PLATFORM

3.1 Information Flow Between Project Participants

The responsibilities and roles of the participants in the EPC project lifecycle are different. Therefore, it is necessary to extract the required information and start the work. Then, the information generated by each participant is synchronized to the BIM database to coordinate the work of other participants [8]. The specific content is shown in the figure below, in which the light blue area is the direct participant of the project, and the other participants are the associated participants.

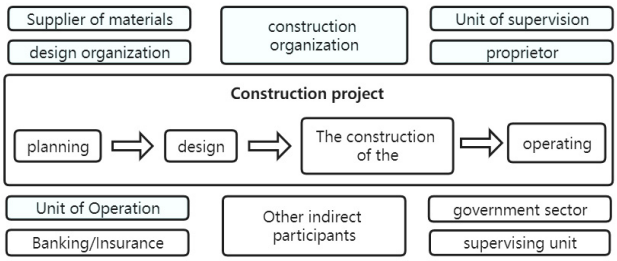

Figure 1. All parties involved in the whole life cycle of the construction project

There are different parties involved in each stage of the EPC project lifecycle to work together. Therefore, there are many participants and they communicate closely with each other. The flow of information between project participants is shown in the figure below.

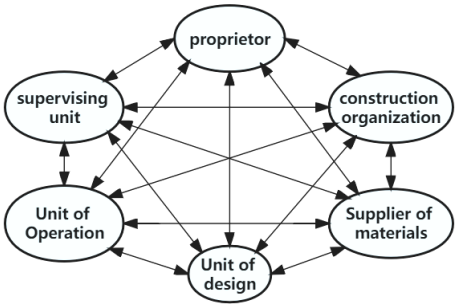

Figure 2. Information flow between key participants in the project

3.2 The Construction Principle of Information Management Collaboration Platform

1) Real-time: The information collaboration platform should ensure that all project participants can work at any time and place, and are not limited by time, space, and other factors [9]. In addition, the information collaboration platform should ensure that participants can obtain the required information and data at any time to complete their own work. The construction of the platform should aim at strengthening information cooperation and sharing, strive to eliminate barriers to information transmission, and improve the quality and efficiency of information management. Ensure that the platform synchronizes and updates the real-time status of construction projects at any time. Solve problems in time, ensure and coordinate the smooth work of project participants.

2) Fluency: The information management cooperation platform should ensure the high efficiency of information exchange and transmission among participants and between different stages. Therefore, the collaborative platform needs to provide data exchange functions between IFCs to assist BIM in building a complete data system and ensure the smoothness of information transmission.

3) Security: Due to the characteristics of multi-subject construction projects, the construction scope of each subject is different, so it is necessary to establish security measures to protect the interests of all parties from the harm of virtual network risks. It is necessary to build the information cooperation platform with security, establish access rights, improve security measures to ensure the information security in the whole life cycle of project construction.

3.3 The Content of Information Management Collaboration Platform

1) Establish BIM database. It is beneficial to realize the information integrated management of EPC projects and meet the data acquisition requirements of EPC teams and participants. Participants can extract data information from the database according to their own needs, and upload the data and results generated by the work to the BIM database after completing the work content they are responsible for.

2) It is equipped with BIM software to satisfy the information management and application of all participants in the whole life cycle. In order to satisfy the information management and application of EPC project participants, the software equipped should meet the application in the process of project implementation. Information interaction between BIM software is the basis of information collaboration platform.

3) Information management of EPC project participants. Each participant can have different permissions according to their own needs to obtain information and data from the collaboration platform, and the management authority of the EPC general contractor should be the highest level to ensure that the project information is fully mastered.

3.4 Establish BIM Model in EPC Project

The establishment of BIM model for EPC projects is the core of applying BIM to the whole life cycle information management of EPC projects. The integration and interaction of information in the project is also realized based on BIM data. Extract the information in the basic data layer to build the BIM information model. BIM models and projects are associated with the collaboration platform to ensure the transmission and sharing of information data in the whole life cycle of EPC projects.

4 INFORMATION MANAGEMENT FOR THE WHOLE LIFE CYCLE OF EPC PROJECTS

4.1 Information Interaction Management Between Three Stages of The EPC

The three stages of the EPC include the engineering phase, procurement phase and construction phase. The EPC project has many participants, which increases the difficulty of coordination for the general contractor [10]. Therefore, an information management framework for EPC projects based on BIM should be established to give full play to the advantages of BIM, improve the information management ability and help the integrated management of design, procurement, and construction of EPC projects.

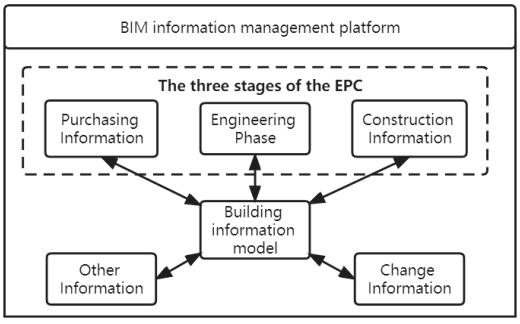

Figure 3. Information interaction between EPC three stages

4.2 Information Interaction Management of EPC Phase 3 and Operation Phase

The information of the project operation management phase also needs the support of the information of the EPC phase, to carry out regular maintenance and management of the project. The efficient interaction of EPC phase 3 and operation phase information can ensure that the service performance of building facilities is always maintained in a good state, extending the service life, and realizing sustainable application.

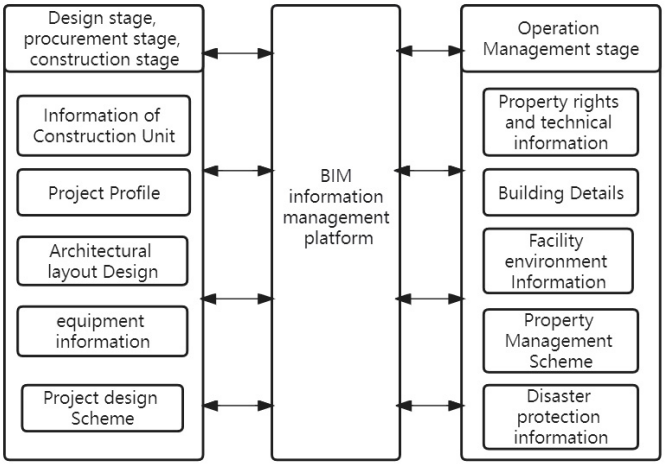

Figure 4. Information interaction between EPC three stages

4.3 EPC Project Life Cycle Safety Monitoring Information Management

1) Security detection process: effectively distinguishing and identifying security vulnerabilities during the construction period of the project is the key to ensure the safety of the project. Through the information collaboration platform built by BIM technology, project participants can simulate the whole process of EPC project before the project starts. Identify possible security problems and formulate security prevention plans. The following figure shows the security management system built based on BIM technology.

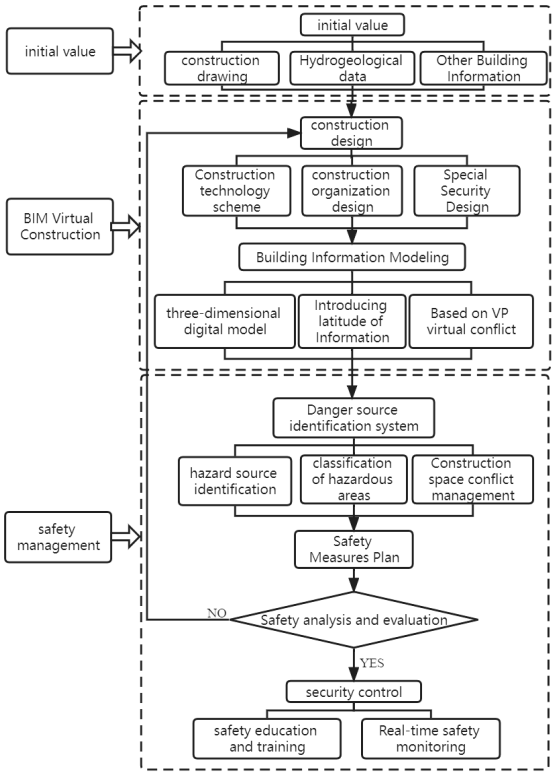

Figure 5. EPC Phase 3 and operation phase information interaction

Project managers can accurately identify construction risks, formulate scientific prevention plans, and implement integrated construction plans. With the real-time performance of BIM technology, security risks can be dynamically identified to reduce unnecessary losses.

2) Safety inspection of virtual construction: the information cooperation platform built based on BIM can carry out visual supervision on the entire construction process. The participants can timely understand the requirements of the work and their own responsibilities, and it is convenient for managers to grasp the use status of materials on site. The information data of each stage and participants are timely fed back to the BIM collaboration platform, which is convenient for managers to efficiently evaluate construction schemes, find problems and loopholes, analyses, and solve problems. Truly achieve the security of information science control and management.

5 CONCLUSIONS

BIM technology helps EPC projects carry out information management, breaks the information barriers of information data transmission at all stages of EPC project life cycle, and solves the problem of "information island". BIM based EPC project collaboration platform can promote

information transfer and sharing at all stages of the project. It facilitates the reliable and convenient information exchange in the whole life cycle of EPC projects, realizes the cooperation and information integration between each stage of the project and each participant, improves the efficiency of information management, and makes the project obtain considerable benefits. In addition, the safety management system based on BIM technology can accurately identify project risks and prevent and avoid them, which greatly reduces unnecessary project losses and reduces construction costs.

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