

# Research on Project Management Collaboration Mechanism Based on Bim

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**Abstract:** China's construction industry has long suffered from serious waste of resources, frequent occurrence of safety accidents, mutual closure of information between parties, lack of effective project collaborative management during the implementation of construction projects, low production efficiency, serious product quality problems, and advanced technology. The lack of applications, the lagging of its own technological progress, and other issues have been blamed, and the new collaborative management model of construction projects based on emerging technologies (especially information technology) has become an important technical method and technical means to solve these problems.

## 1. Introduction

The construction industry has been criticized for a long time due to serious waste, frequent safety accidents, closed information between parties, low efficiency, and product quality that does not meet expectations. An article published by The Economist in 2000 stated that there is 30% waste in the global construction industry; a survey by the U.S. Bureau of Labor Statistics shows that since 1964, the production efficiency of the construction industry has continued to decline compared to other non-agricultural industries, not agricultural. The industry's production efficiency increased by more than 200% during the same period. The global construction industry's cost overruns, delays in construction schedules, and the quality of the projects do not meet the requirements of the owners, as well as the resulting disputes between engineering participants, such as engineering changes and engineering claims, have led people's eyes naturally to seek better solutions. In order to improve the production efficiency of the construction industry.

Under the global competition, how to break through the development dilemma of the construction industry has become an urgent problem. By comparing the production level of the construction industry and the manufacturing industry, people regard the application and improvement of information technology in the construction industry as a breakthrough in the development of the construction industry. In the 1980s, the popularization and promotion of computer aided design (Computer Aided Design, CAD) technology made the architectural drawing from manual to electronic, improved the drawing efficiency, and enabled designers to transfer more energy and time to the deepening of drawings. Design and improvement have improved design quality. However, in the decades of application of this technology, it has gradually found its own defects and deficiencies in the global competitive environment. On the one hand, the final graphic file can only contain a small part of the information of the construction project; on the other hand, the information is split between different CAD drawings and specifications, and information collaboration cannot be achieved. CAD applications for the purpose of improving drafting efficiency can no longer meet the needs of the construction industry informatization under the trend of global competition.

In 2002, Autodesk, the world's largest 2D and 3D design, engineering and entertainment software leader, introduced the concept of Building Information Modeling (BIM). BIM, as a general term for digital modeling software, parameterizes real building information in a virtual environment. Based on this digital model platform, from the design, construction to the final operation and maintenance, the whole life-cycle information sharing and improvement of the entire construction project is achieved. An important feature of BIM technology that is different from traditional CAD design methods is to realize the coordination of information in the whole process of design,

construction, and operation and the working methods of participants through a three-dimensional common working platform and three-dimensional information transmission. The development of information technology in the construction industry has made up for the lack of information technology in the construction industry, created a collaborative working model of participants with BIM as the core platform, and is committed to ensuring the unity of the goals throughout the construction process. BIM provides information technology support for the improvement of production efficiency and the reduction of disputes in the construction industry.

## **2. Overview of Collaborative Research in the Field of Project Management**

Generally speaking, collaboration refers to the process and ability of two or more different systems and individuals to cooperate with each other, support each other, and coordinate to complete a certain goal. In 1965, Igor Ansoff, an American strategic management scientist, first introduced the concept of synergy in his book *Corporate Strategy*, introducing the concept of synergy to management. From a management perspective, synergy is the mutual cooperation of the company's business units, making the company's overall value greater than the simple addition of the value of the individual components. This concept emphasizes the economic meaning of “1 + 1 > 2”, that is, synergy is Potential opportunities for tangible and intangible benefits and the close relationship between this potential opportunity and the company's capabilities.

Engineering project management regards engineering projects as management objects, applying management concepts and functions according to the characteristics of the project's unity, constraints (quality, construction period, investment, etc.), life cycle, etc., so that the project can succeed under certain constraints. The general term for a series of tasks such as decision-making and planning, organization and command, control and coordination, education and motivation for all activities of the project. Engineering project management follows the common concepts and functions of management disciplines, and the concept of collaboration in management disciplines also applies to the field of engineering project management. The content of engineering project management involves the management of the entire process of project construction, ranging from project evaluation to project establishment, design, construction, and project use and maintenance. All the work that takes place around the project in this process is in the scope of engineering project management. With the development of science and technology, problems and disadvantages of engineering project management are gradually exposed. As the scale of engineering development continues to expand, the complexity of project organization structure, technology application, and information volume increases. These problems and disadvantages have led to an increase in disputes over engineering projects, with opposing attitudes among the parties. On the one hand, the confrontational attitude of the participants leads to increased costs and prolonged construction periods; on the other hand, the poor communication between the owner and the contractor, and between the contractor and the designer results in the designer's poor understanding of the owner's needs, and The designer's design plan cannot be accurately understood and implemented, and the final result of the project can only be inconsistent with the requirements of the owner.

Various problems that have occurred in the practice of engineering project management in the past decades have made experts and scholars in the field of engineering project management actively explore and study management models and methods adapted to new situations and new situations. Under this background, the research on collaborative management of engineering projects draws on advanced management theories and ideas in other fields, starting from two aspects: management theory and information technology. Management theory includes aspects such as the construction project procurement mode, the relationship between project participants, contract management, concurrent engineering, and coordination at all stages of project operation; in the area of information technology, the rapid development of science and technology and its in-depth application in the field of engineering construction, research on computer-based collaborative management of engineering projects has gradually developed, including BIM technology research and development, cloud computing, and so on.

### 3. Overview of Synergy Mechanisms

Meng Qi explained the definition and characteristics of the cooperative mechanism in detail: the word mechanism (mechanism) started from mechanical engineering, originally referring to the machine's structure and action principle. "Machine" refers to the machine, and "control" refers to restraint and control. The original meaning is the self-running function and association of the machine. It evolved along with the development of systems science, and is now widely used in various disciplines, with the analogy of the structure, function and interrelationship of systems. System mechanism actually refers to the material structure, motivations and control methods of system movement. In order to maintain its potential function and make it a specific manifestation function, it is a system that regulates the interactions, interrelationships, and mutual constraints between the various subsystems or elements within the system with certain rules, as well as internal, Essential way of working. From the perspective of system evolution, as the internal driving force of system evolution, the mechanism is a special set of constraint relationships within the system. It transforms the micro-level interaction of the system into the macro-level through the control, guidance and incentive of micro-level operation. Directional movement. Generally speaking, for a system to evolve, there must be an appropriate growth mechanism inside it, which corresponds to some kind of nonlinear relationship. It is an asymmetric selection amplification or attenuation mechanism, which can select, control, coordinate and guide internal or external relationships and things according to the needs of system evolution. The choice here is, on the one hand, choosing the materials and energy required to constitute the system, and on the other hand, choosing the appropriate organizational route, policy, steps, procedures, approaches, etc. The amplification here is an internal positive feedback incentive mechanism, which encourages internal members to cooperate and work actively. The coordination mechanism referred to in this article is the inherent specific working mechanism of project management formed by project participants in engineering project management due to mutual cooperation and competition on the basis of achieving overall project goals and various project goals.

### 4. Bim-Based Project Management Coordination Mechanism

The project management implementation route in the BIM environment, the main content is the detailed definition of the tasks and responsibilities of the participants under the BIM application. The following describes the specific implementation process of BIM application in the engineering project according to the working stage of the project participants.

Formulate the project charter By holding a project launch meeting, introducing the basic situation of the project, defining the project participants, clarifying the overall objectives of the project, the scope of the project, the overall plan of the project, etc., and determining the general owner of the owner, person in charge of each participant, and general coordinator And other key personnel information to enable participants to work towards a consistent goal.

Confirming the scope of BIM As different BIM applications involve multiple participants, the work content of each party needs to be defined in writing. The focus includes cooperation based on BIM applications, participation cycle, and output.

Forming an implementation team Form a joint project team including the participants, clarify the responsibilities and staffing of all parties, and form a project address book.

Preparation of implementation plan. Based on their respective service scopes, each participant compiles their own implementation plans based on the project objectives and total construction period requirements, and decomposes the service content in detail, reflecting the cooperative work of the unit and other units, the input, output, duration, The required resources and other information are collectively summarized to the owner to form the overall project plan.

Follow the implementation process. Each participant carries out work in accordance with the implementation plan of each party, reports the work results to the owner on a regular basis, and adjusts the implementation plan in accordance with the project progress and the owner's opinions in a timely manner.

Inspection and implementation results According to the building life cycle stage, according to the service scope and acceptance criteria of all parties, the results of the BIM application scenarios of all parties at all stages are checked and accepted by both parties.

Project summary After the application of the BIM scenario at each stage is completed, the owner is responsible for final evaluation of the implementation results, analysis of application results, process issues, etc., and formation of a summary report to guide the next round of BIM applications.

## **5. Participant Collaboration Mechanism Design under Bim Applications**

The collaborative mechanism design of the participants under change management Change management refers to the changes to the construction drawings etc. proposed by the contractor during the construction phase. By introducing BIM during the change process, it is possible to effectively verify the feasibility of the change plan and evaluate the risks that the change may bring. The BIM model is updated in real-time as the design changes, eliminating barriers to information transmission, reducing the time for information transmission and interaction between the designer and the owner, the supervisor, and the contractor, thereby making the claim visa management more time-efficient and achieving dynamic control and orderly changes. management. Calculating the amount of change works through the BIM model can effectively prevent the contractor from changing at will, and provide data basis for change settlement. This mechanism designs the coordinated work of all parties in accordance with the overall approach of change from proposal to completion in the actual project. The change process is divided into propose change, demonstrate change, and implement change. Change management consists of three main parties: the contractor, the owner, and the designer. According to the PDCA cycle strategy, a change request is submitted by the construction contractor. After the BIM model is verified, it is submitted to the owner and the designer for review. If the review is passed, the designer changes the drawing, and the owner makes changes and estimates. The contractor updates the BIM construction model as the change is performed.

Collaborative mechanism design of the participants under the construction scheme simulation The construction scheme simulation mainly occurs during the construction stage and involves the owner and the general contractor. Through BIM, you can simulate the constructability of the key or difficult parts of the project, and analyze and optimize the construction and installation plan by month, day, and hour. Simulation and analysis of some important construction links or construction guidance measures such as key parts of new construction technology and floor plan of the construction site to improve the feasibility of the plan; you can also use BIM technology in conjunction with the construction organization plan to conduct previews to improve complex buildings The feasibility of the system. With BIM's simulation of the construction organization, the project manager can very intuitively understand the time nodes and installation procedures of the entire construction and installation process, and clearly grasp the difficulties and points in the installation process. The construction party can further carry out the original installation plan. Optimization and improvement to improve construction efficiency and safety of construction plans.

## **6. Conclusion**

This thesis begins with the problems of backward technology development and project management in the construction industry, and studies the current status of collaborative development of information technology and project management in the construction industry at home and abroad. Based on the collaborative management research and BIM research under the engineering project management procurement model, the collaboration issues faced by the current implementation of BIM applications in engineering projects are discussed. The solution of this thesis is put forward-establish a set of project management flowchart suitable for BIM collaboration characteristics, and clarify the responsibilities and tasks of all parties.

## References

- [1] Li Heng, Guo Hongling, Huang Ting, Chen Jingyuan, Chen Jingjin. Research on the Application Model of BIM in Construction Projects [J]. Journal of Engineering Management, 2010.05.
- [2] Wang Xueqing, Ren Yuan, Yang Qiubo. The International Development Trend of BIM--Based on the Analysis of Website Contents [J]. Journal of Engineering Management, 2012.04.
- [3] Man Qingpeng, Li Xiaodong. Research on collaborative construction method based on pervasive computing and BIM [J]. Journal of Civil Engineering, 2012.2
- [4] Chen Yujun, Liu Yulong. Status and future of BIM collaborative design [J]. China Construction Information, 2010.04.
- [5] Yang Yu, Shou Wenchi, Wang Jun. Research on the Application of IPD-ish in BIM Projects: A Case Study of Chongqing DC Building [J]. Science & Technology Progress and Policy, 2012. 29 (18): 115-118.