Study on Promoting General Contracting Construction in China Referencing IPD Principles

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Abstract. Integration Project Delivery (IPD) brings innovation to the project management process with the concept of "integration", and forms a relatively rich IPD principles system, which can provide reference for the development of General Contracting construction. In this paper, IOS Management System theory was used to analyze the key issues in the management Idea/Ideology, Operation/Organization, and Stratagem/Strategy of the General Contracting construction. It was concluded that the rights and responsibilities of the project general contractor should be emphasized, the contract organization mode of the parties involved in the General Contracting project should be well constructed, and highlights for signing the project general contract should be proposed. Focusing on the above three aspects, the authors sorted out and analyzed the related IPD principles, then put forward specific proposals to promote the development of the General Contracting construction in China under the guidance of "management and technology integration", "organization integration" and "contract integration".

Keywords: General Contracting Construction, Integrated Project Delivery, IPD Principles, Management System

1. Introduction
The General Contracting construction is a very popular implementation mode in Architecture, Engineering and Construction (AEC) industry. In China, this mode has been vigorously promoted for its advantages, such as clear responsibilities between the projects participants, and high management efficiency. The General Contracting construction refers to the contracting mode in which the enterprises engaged in the project to carry out the whole process of the project investigation, design, procurement and construction in accordance with the contract signed with the owner, and are fully responsible for the quality, safety, duration and cost of the project. Generally, the General Contracting of a project maybe a general contract for Design - Procurement - Construction or a general contract for Design - Construction. The owner may also adopt other General Contracting modes according to the project characteristics and the principle of reasonable risk sharing \cite{1}. The General Contracting mode is conducive to giving full play to the management advantages of General Contracting enterprises, integrating the stages of project investigation, design, procurement and construction, realizing the unity of objectives, consistency of project plan and integration of construction management, clarifying the responsibility for project management, and improving management efficiency. At the same time, it promotes the transformation and upgrading of construction enterprises, and promotes the structural adjustment and resource integration of the AEC industry \cite{2}. China has accumulated many experience...
of domestic companies in undertaking international General Contracting projects. However, the mode of General Contracting is still in its infancy in China's local ACE industry. It is necessary to explore the operation methods of General Contracting which are suitable for the characteristics of domestic AEC industry.

Integrated Project Delivery (IPD) brings innovation to engineering management process with the concept of "integration". Many traditional delivery modes add the IPD principles of integration and collaboration to team building, collaborative design and construction management to improve construction efficiency [3]. In this paper, IOS (I for Idea/Ideology, O for Operation/Organization, S for Stratagem/Strategy) management theory was applied to analyze the key promotion items in the management Idea/Ideology, Operation/Organization, and Stratagem/Strategy of the General Contracting Construction. Based on the IPD principles, some suggestions were put forward to guide the development of the General Contracting construction in China.

2. Development of General Contracting Construction in China

In the international AEC industry, as a mature project contracting mode, the General Contracting mode has been widely used, and many project management theories based on the General Contracting mode have been formed [4]. With the development of market economy, China's modern engineering contracting model has gradually formed, which can be divided into three stages. Stage one: From the 1980s, drawing lessons from western project management concepts, a project contracting system suitable for market economic mechanism was gradually established. During this period, Chinese government promulgated a series of policies to guide the AEC industry to establish the fundamental construction management system, and carried out some pilot projects of General Contracting. Stage two: From the end of 1990s, with the development of Chinese construction enterprises, China has begun to cultivate and develop the General Contractors for foreign contracted projects, encouraging construction enterprises to go abroad and become bigger and stronger in the international AEC market. Stage three, since 2016, Chinese government has issued a series of policies to promote the development of the General Contracting in AEC field, promoting the General Contracting mode in the domestic AEC market, and promoting the adjustment of the industrial structure of the domestic construction enterprises, so as to serve the "The Belt and Road" national strategy better. Fig. 1 summarizes the three stages of the development of China's contracting mode in AEC industry.

![Figure 1. Projects' contracting mode in China](image)

The General Contracting mode has been developing for decades in China. Chinese enterprises in AEC industry has accumulated much practical experience regarding to the General Contracting. Especially, it has made great achievements in the field of General Contracting in international projects. However, at present, most domestic construction projects still adopt traditional Design-Bid-Build (DBB) mode. Currently, the General Contracting mode practices in domestic projects just have a smaller scope. Under the background that the central and local governments have issued relevant policies to encourage the General Contracting mode to land and promote in China, it is necessary to explore scientific management concepts to promote the development of the General Contracting in the domestic AEC industry.
3. Introduction of Integrated Project Delivery

Integrated Project Delivery (IPD) was defined by the American Institute of Architects (AIA) in *Integrated project delivery: A guide* published in 2007 [5]. IPD integrates people, systems, business structure and practical experience into a process of project delivery. In this process of integration, the participants of the project can make full use of their abilities to maximize the efficiency of the project and create greater value for the owners through cooperation at all stages of the project implementation [6]. There are three levels of IPD according to the degree of integration, and the contracting relationship among each project participant. The first level is standard IPD, each participant still adopts the traditional delivery mode, and carries out project management and cooperation with the idea of "integration and collaboration"; the second level is enhanced IPD, with a portion of participants signing multi-party cooperation contracts, or some clauses of the contract fulfilling the IPD elements of integration and cooperation; the third level is typical IPD, in which all the project participants sign a unified multi-party agreement, specifying the form of integrated delivery, risk and benefit sharing [7].

IPD mode integrates all kinds of resources, emphasizes the early evolvement of the main project participants, and emphasizes the collaboration in the whole process of the project, so as to shorten the construction period, reduce the waste of resources and maximize the overall benefit of the project [8]. From the perspective of implementation scope and integration degree, the scope of IPD mode is larger than that of General Contracting. The General Contracting mode could belong to the IPD mode of signing a multi-party agreement, that is, the second or third level of IPD. It has formed a good deal of IPD principles in the process of IPD development and practice. By combing the characteristics and advantages of IPD principles and drawing lessons from it, it is helpful to promote the development of China's General Contracting mode.

4. Application of IOS Management Model

According to *Integrated project delivery: A guide* issued by AIA, IPD principles are an important idea and theoretical foundation to guide project implementation of IPD model. The main IPD principles include *Early involvement of key participants, Mutual respect and trust, Mutual benefit and reward, Collaborative innovation and decision making, Early goal definition, Intensified planning*, etc. In this paper, the related IPD principles were sorted out and classified. Guided by the concept of "integration" of IPD, the authors analyzed how to promote General Contracting in China.

According to modern management theory, management mode is a set of operating system solidified in the process of management basing a specific management concept [9]. The formula can be expressed as:

\[ MS = f(I) + f(O) + f(S) \]

Where, *MS*: Management System

*I*: Idea/Ideology

*O*: Operation/Organization

*S*: Stratagem/Strategy

According to the above formula, this paper focused on the analysis of the development needs of General Contracting with respect to three aspects, such as management Idea/Ideology, Operation/Organization, and Stratagem/Strategy. Then, this paper put forward corresponding development suggestions according to the IPD principles.

In view of "management Idea/Ideology ", the General Contracting mode emphasizes the "overall" integration of project investigation, design, procurement, construction and other construction tasks, and the General Contractor works as the main body of responsibility to carry out the above tasks. Hence, for clarifying the "management idea" of the General Contracting, the rights and responsibilities of the general contractor should be emphasized.

In view of "management Operation/Organization ", the system structure of the General Contracting mode is usually composed of the owner, the General Contractor (independent unit or a consortium of several units), and other participants such as engineering consultants. Therefore, the
cooperative groups of the participants under the General Contracting mode should be constructed.

In view of "management Stratagem/Strategy", the signing of general contract is the most important part in the application of General Contracting. Therefore, the important steps of the signing contract, such as bidding, the definition of rights and obligations of all parties in contract documents, and the determination of contract amount, should be paid special attention to.

Fig. 2 shows the contents that should be emphasized when implementing General Contracting guided by the idea of "integration" in IPD, including management Idea/Ideology, Operation/Organization, and Stratagem/Strategy, as well as "management and technology integration", "organization integration" and "contract integration" corresponding to the three aspects.

**Figure 2.** Research approach of promoting General Contracting guided by IPD principles

5. Reference of IPD Principles to Promote General Contracting

5.1. Applying IPD Principles to Guide the General Contractor to Clarify Obligations and Responsibilities

The general contractor of a project is entrusted by the owner to undertake the whole process or several stages of a project, including investigation, design, procurement, construction and trial operation in accordance with the General Contracting agreement. The general contractor is the direct implementer of the project and is fully responsible for project’s quality, safety, duration and cost of the project. The IPD principles of Key Participants Bound Together as Equals, Jointly Developed Project Target Criteria, Intensified Design, Building Information Modeling, and Lean Design and Construction are all helpful to clarify the obligations and responsibilities of the General Contractor through management and technical means. Applying these IPD principles, there are some suggestions of the general contractor when undertaking project management:

1) To definite the project phases and project goal of each phase. The general contractor should divide the project phases according to the overall project objectives, formulate the objectives of each phase, and further form the project implementation process. Based on this, the detailed project implementation plan should be formulated to improve the overall efficiency of the project.

2) To give design the priority and focus on intensified design. In the early stage of project planning and design, the general contractor should fully understand and thoroughly analyze the owner’s intention, design requirements, and also the regulations and policies of the project’s location, and comprehensively consider the economy and rationality of the design scheme, so as to make the design first. The general contractor should give full play to the overall coordination and management ability of the project. In the stage of detailed design and construction, the importance of design work should run through the project all the time. It should follow the principle of Design-to-cost and optimized design to guide project planning, project organization and project construction.

3) To promote the wide application of building information modeling (BIM) technology. The general contractor should give full use of its management advantages to promote the integrated application of BIM technology in all stages of the project, use data sharing and information management technology to support decision-making, and promote the implementation of the project with the concept of lean design and lean construction [10].
5.2. Applying IPD principles to guide the project’s team building for general contractor
In addition to the two main participants of the owner and the general contractor, the General Contracting project usually includes the project supervisor, the cost consultant, quality-testing organizations and other participants. Thus, there are many participating units in the General Contracting project. There are many IPD principles that can help to guide the project’s team building, such as Early Involvement of Key Participants, Key Participants Bound Together as Equals, Mutual Respect and Trust, Willingness to Collaborate, and Open Communication. Under the guidance of these IPD principles, it is suggested that the following key points should be paid attention to in team building of General Contracting projects:
1) Early Involvement of Key Participants. The team building of General Contracting project should emphasize the early involvement of the main participants, so as to ensure that the main participants can play their respective advantages together in the early stage of the project, formulate and refine the unified project objectives, and guide the follow-up development of the project.
2) To promote collaborative and open communication. Technical means, such as information technology and multimedia technology, should be used to create an atmosphere of mutual respect, equal cooperation, timely communication, information sharing and open exchange for the General Contracting project, so as to promote team “integration” and efficient cooperation.
3) To give full play to the management advantages of engineering consulting enterprises. Engineering consulting enterprises with different roles, such as project supervision, cost consulting and project inspection, are one of the unique characteristics in China’s AEC industry. Under the General Contracting mode, they should give full play to the professional advantages of various types of engineering consulting, promote the development of the whole process of engineering consulting. The development of engineering consulting and the General Contracting will promote the “integration” of all participants in the AEC, and provide decision-making and consultation basis for the General Contracting project.

5.3. Applying IPD Principles to Guide the Signing of the General Contract
The signing of general contract generally includes the following steps, such as preparation of bidding documents (including contract terms), bidding, contract signing and so on. The IPD principles of Shared Financial Risk and Reward Based on Project Outcome, Collaborative Decision-Making, Liability Waivers between Key Participants, and Fiscal Transparency between Key Participants have important reference significance for the formulation of contract amount, risk treatment, the terms of payment and other clauses in General Contracting project [11]. It is summarized as follows.
1) To clarify the contract accounts settlement. In the general contract of a project, the settlement of the contract amount should be specified. The general contract of a fixed total price shall specify the scope of implementation of the contract. In the general contract with a provisional sum, how to calculate the project quantities and pricing should be clarified.
2) To clarify the way for dealing with contract risks. In bidding documents and contract terms of a General Contracting project, the way to deal with contract risks should be clarified, give different risk management ways to deal with different types of risks, such as risk aversion, risk transfer, risk sharing, or engineering insurance.
3) To pay attention to risk sharing and benefit sharing among project participants. The risk-sharing mechanism of each contracting party should be specified in the general contract, and the contract terms should be formulated on the basis of the principle of risk-sharing and benefit-sharing among the participants.
4) To clarify reasonable and feasible contract payment terms. Specific contract payment methods should be stipulated in the general contract of a project, which not only benefit the rational use of project funds, but also meet the requirements of the progress of the project, and at the same time have positive significance to protect the common interests of all contracting parties.
6. Conclusion
China’s AEC industry has accumulated some practical experience in the field of General Contracting, but it still takes time for the General Contracting mode to develop from pilot projects to full implementation in China’s domestic AEC industry. Under the background of promoting the implementation and development of General Contracting mode in China, this paper used IOS management model to analyze three key tasks for developing General Contracting mode in China: management Idea/Ideology, Operation/Organization, and Stratagem/Strategy. Corresponding to each task, IPD principles were analyzed and sorted. Guided by the “integration” concept of IPD principles, the paper put forward specific concerns and operational suggestions for the promoting General Contracting with a view of management and technology integration, organization integration, and contract integration.

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