Research on Application of IPD to Overall Collaborative Innovation in Green Building Design

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ABSTRACT

From the perspective of transaction cost economy, this paper first analyzes the special attributes of green building design innovation. Second, it is revealed that the integration in traditional delivery models, such as DB and CMc, has collaborative limitations. Then, the paper explores IPD’s comparative advantages for solution of overall collaboration in green building design innovation. Finally, results provide IPD’s application conditions.

KEYWORDS

Integrated project delivery, design innovation, green building, and overall collaboration.

INTRODUCTION

Under the traditional project delivery models, local collaboration of supply-side in construction doesn’t meet the requirement of design innovation in green building for collaboration, which leads to low-quality development of green building in China. The main behaviors of local collaboration’s defects are as follow: 1) the differences of project supply and demand sides’ opinion about green investment value have a bad effect on the smooth progress of integration task, and 2) there is a lack of standards and systems for the integration of green building design [1]. The main reason is that the integration task of green elements involves massive research and development and can be solved only by overall collaboration of supply and demand sides, which is unavailable under the traditional project delivery models. For that reason, this paper first analyzes the collaborative feature of Integrated Project Delivery (IPD), and then explores its comparative advantages and application conditions for solution of overall collaboration in green building design innovation. The paper aims to provide management reference for improving the innovative performance of green building design.

ANALYSIS OF MASSIVE RESEARCH AND DEVELOPMENT AND OVERALL COLLABORATIVE DEMAND IN GREEN BUILDING DESIGN INTEGRATION

Compared with conventional engineering design and individual professional
technological innovation in construction project, the feature of design innovation in green building is wide application of new green technologies, at the same time, the difficulties lie in full integration of green technologies, owner’s demands and project’s boundaries among different fields after the evaluation criteria system of green building is settled. Therefore, the complexity and interaction of realizing green requirements in the complicated condition give the characteristic of massive research and development to the design integration task in green building, which results in particularity of the project in task execution and resource dealing.

Furthermore, Williamson thinks that there’re three factors which affect the level and characteristics of transaction cost: asset specificity, uncertainty and frequency [2]. Therefore, from the perspective of transaction cost economics, the implementation and transaction characteristics of the above tasks can be summed as follow: 1) task outcome is of asset specificity, particular purpose and fixed receiver; 2) the process and outcome are uncertain because of wide involvement and complicated division of labor in the research; 3) overall integration means that the tasks of research and development are numerous, the collaborators’ transactions centered on supply and demand of the research and development resource are frequent and the opportunity cost of resource input is high, yet the results might fail to achieve stable expectations. As a consequence, the design integration in green building needs special collaborative management. On one hand, it’s in need of various resources; on the other, incentive and coordination control are both important for the resource owners. Construction project’s convention is engineering design contracting, but the bureaucratic vertical integration seems to be preferred because of its advantage in solving resource demand and coordination control problems. In other words, in the context of diversified project organization, only inter-organization overall collaboration can reduce transaction costs, enhance collaboration efficiency and achieve element integration in green building design.

LOCAL COLLABORATION PROBLEMS OF TWO KINDS OF PROJECT DELIVERY MODELS IN GREEN BUILDING DESIGN

Literature shows that common project management models at present which are applicable to green building include DB (Design-Build), CMc (Construction Manager-constructor) [3].

DB model is a generic term for a variety of general contracting projects and can be leaded by the designer, constructor or both. The integrated internal arrangement provides an opportunity for the designer to gain the rights of income and control in the process of research and development. Specifically, the designer can control constructability integration scheme and the right of income which is made by extra optimization, also, construction information resource and high-qualified construction coordination are dominated, so the designer can be stimulated to optimize integration tasks, which facilitates the project optimization.

The essence of CMc model is to provide the construction manager with incentive and control-facilitated organization conditions by organization integration of design and construction to enhance collaborative efficiency in green building design. The construction manager has the contractual rights and obligations of design supervisor and general contractor of construction and undoubtedly bares the risk of profit loss caused by the insufficiency of green building design constructability optimization. So
the constructability optimization of the designer will be supervised and coordinated by the construction manager.

Whether DB or CMc, they can only provide a kind of organization condition of integration in green building design innovation, that is, constructability integration of constructor’s interest. For other integration tasks unrelated to constructor’s interest, the two models fail to provide solutions to incentive or control. So the constructor has no intention of innovating the construction technology or dynamic coordination in calculating construction costs and providing empirical information. More collaboration problems lie in: design integration of green technology and engineering elements need collaboration from the green building product supplier in information and optimization, in this case, the motivator and the controller should be owners of the supply contract. While under the DB and CMc models, upstream product suppliers, particularly owners are not the coordination subject; owners usually try to reduce project involvement and participation to identify responsibilities and reduce risk, which resulting in a lack of cooperation between the project participants and a little chance of project improvement.

IPD’S COMPARATIVE ADVANTAGES FOR SOLUTION OF OVERALL COLLABORATION IN GREEN BUILDING DESIGN INNOVATION

The management characteristic analysis of IPD model in the perspective of collaboration.

IPD, a kind of delivery model of construction projects together like DB and CMc, is a new direction of project delivery model at present. In 2007, American Institute of Architects and its California Council released Integrated Project Delivery: A Guide, which defines integrated project delivery as a kind of project delivery model that integrates people, systems, business structures and practices into a process. This process utilizes the talents and insights of all the participants to optimize project results, add value for owners, reduce waste and improve the efficiency of design and construction [4].

After analyzing the specific contents of the guide, it can be found that compared with the traditional delivery models, IPD has some advantages: 1) the goal of cooperation. IPD stresses when applying new technology in project construction, the problems of system conflict and requirement integration. And the challenging goal has to be combined with the best sustainable result. 2) The key point of the cooperation process. IPD chooses the integrated innovation in the early design stage especially decision-making as the key point of the delivery. 3) The cooperative subject. IPD emphasizes multi-party and inter-organizational team as the cooperative subject especially the decision-making subject to carry out integrated innovation task in design stage. 4) Specialization in cooperation. Collaborative specialization of the inter-organizational team is the most typical part of the IPD cooperation. It refers to that under the premise of determining the optimal design, the working sequence of optimal design, requirements of working capacity and undertaking ability should be well matched. 5) The leadership and governance of cooperation. Collaborative work of design optimization is held by owners instead of contractors in traditional delivery models. The multi-party agreement hosted by owners involves positive value proposition, compensation structure.
The comparative advantages analysis of IPD model in green building design innovation.

Compared with collaboration limitations of local integration under the DB and CMc models, IPD’s overall integration sets up a specialized, inter-organizational team to deal with collaboration management problems. Therefore, IPD is applicable to the efficiency as well as transaction incentive and control in the massive research and development of green building design integration.

SCALE ECONOMIES OF SPECIALIZED TEAM IN COLLABORATIVE INPUT.

Study on the process of green building design innovation shows that cooperation based on collaboration can deliver new knowledge of development process which uses "innovation spiral" as basis, especially the new knowledge of collaborative management processes, including environmental monitoring, boundary management, opinion unification and negotiation. However, in the process of design integration, the participants have to devote much time, manpower and interactive information to explore collaborative paths[5]. If these collaborative knowledge generated from research and development tasks can be used repeatedly, then the delivery costs and transaction costs can be reduced greatly, which leads to scale economy. In local integration of DB and CMc, design innovation subjects usually are professional designers. Because of “case by case” of optimum proposal and temporality of cooperation team, collaborative knowledge cannot be reused through multiple cooperative partnership. However, in overall integration of IPD, IPD group was a full-time team that exercises its function of cooperation management in the design phase of the project. So the experience can be replicated, and the full-time team can obtain scale economy of collaborative knowledge from a large number of research and development cooperation management.

REMISSION OF INTER-ORGANIZATIONAL DECISION PROCESS ON COORDINATION CONFLICT.

The key design decisions are based on the IPD team evaluation, and team members can be participants or other stakeholders in the project. The content of green building design scheme mainly involves matching of technical parameters (including materials, equipment, components, and construction technology and so on) and economic parameters (including the construction period, the project life cycle, the consumption amount and dynamic price of resources) between the professional design and the total design. Under the condition of local integration, DB or Comic’s team decision structure only focus on constructability of design integration scheme, while IPD has an inter-organizational dynamic network that involves not only owners, designers, constructors as team core throughout the entire process of project, but also suppliers, operators and consultants when necessary. The new team decision structure facilitates a better multi-objective decision. In fact, the IPD team decision process is the process of team opinion convergence and conflict reconciliation. The project objective determined by this method can eliminate the potential top-level conflict in the implementation process, and make the optimization program more reasonable and easier to control and implement.
RETRAIN OF TEAM GOVERNANCE LED BY THE OWNERS ON INNOVATIVE OPPORTUNISTIC BEHAVIOR.

The introduction of the IPD can promote the owners greatly involved in the design innovation of green building and input great concern and innovation resources. With the unclear content and boundary of innovation and the strict accountability of obligations, the traditional DB and CMc contract keeps the contractors from innovation. Based on the traditional contract framework, IPD agreement can be used to place research and development tasks related to innovation in an independent agreement. The allocation of collaborative responsibility has different states from the mutual exemption to limited accountability, and the project risk is borne by all participants, which can promote innovation from constructors. In addition, IPD is hosted by the owners who can control opportunism behavior caused by multi-party agreements exemption mechanism, so the individual research and development in local integration of DB or CMc model transform successfully into collaborative research and development of overall integration.

THE BASIC CONDITIONS OF APPLYING IPD MODEL TO GREEN BUILDING DESIGN INNOVATION

Firstly, trust and structuring are the basis of IPD team collaboration. Due to the special governance mechanism of the IPD team such as the compensation structure based on long-term earnings expectations and risk sharing, etc. The operation of IPD needs to be built on the internal trust of the inter-organizational team. This requires both effective communication techniques and the governance content structuring on the premise of reaching a consensus.

Secondly, trust is based on the inter-organizational team’s understanding of collaborative innovation value, the participation value and their relationship. Specifically, it is to establish the performance measurement and evaluation system of integrated research and development activities in the green building design to reflect the value of collaboratively integrated project relative to the non-collaboratively integrated project. Compensation and reward are calculated based on the project values and should be proclaimed in the form of contract items.

Thirdly, IPD principles are particularly applicable to multi-party arrangements for contractual environments based on DB and CMc models in construction projects. IPD, as delivery method and principles using integration thought, its engineering application should be a kind of collaborative improvement or correction method to the traditional delivery mode based on the integration principle. As for the part of coordination improvement, the consistency maintenance of the existing contract system should be taken into consideration.

SUMMARY

From the perspective of transaction cost economy, this paper first analyzes that the special attributes of green building design innovation are massive research and development, which can only be solved by overall collaboration based on team among organizations. Second, it is revealed that the integration in traditional delivery models,
such as DB and CMc, has limitations because they can only solve constructability problem. Then, the paper explores the integration features in IPD and presents its comparative advantages for solution of overall collaboration in green building design innovation. Finally, results provide IPD’s application conditions: structured, trust-based collaboration and consistency maintenance of contracts.

REFERENCES

4. Information on: www.aia.org/ip_default