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A Study of the Application of Supply Chain Management in Construction Industry

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Abstract: The concept of construction supply chain (CSC) is defined firstly. Then the authors depict a typical construction supply chain model from the perspectives of partners involved in construction process, analyze the characteristics and attributes of CSC, and identify some problems in CSC. Based-on the definition and principles of supply chain management (SCM), the concept of construction supply chain management (CSCM) are also described in detail. From the perspective of relationship management, a framework for integrated CSCM is developed to guide the effective implement of SCM in construction industry, which includes contractor (supplier) selection, conflict management, risk management, innovation management, performance management and information supporting system. Finally, traditional construction management approaches are compared with integrated CSCM approaches.

Keywords: Supply Chain Management; Construction Supply Chain; Construction Supply Chain Management; Construction industry; Performance

1. INTRODUCTION

Under the increasingly competitive global market, with the support of the rapidly developing information technology, the traditional enterprise management mode is changing revolutionarily, and the new enterprise management mode which is based on the supply chain management has been paid more and more attention to. Supply chain management (referred to as SCM) originated from the just in time (JIT) and the total quality management (TQM) theories. After being researched and practiced by numerous scholars and enterprises, the supply chain management has become an advanced enterprise management mode, and someone has listed it in the fifth generation innovation category. In order to carry out the integrated management to the parties involved in the producing process, including all the parties that are close to the product itself such as suppliers, manufacturers, distributors and customers, to fulfill the core ability of the product manufacturing core enterprise, to respond to customer demand quickly, to guarantee the enterprise performance's continuous improvement, and to improve the enterprise core competitiveness, the SCM emphasizes to manage from the system point of view. SCM advocates that the enterprise should establish development strategies which can strengthen its core ability while allowing it to have a long-term cooperation relationship with other enterprises, and pursuing the win-win goals for the enterprises on the supply chain, rather than the traditional development mode that is large and comprehensive or small while comprehensive, or compete without cooperate.

SCM is originated from the manufacturing industry and being widely applied in that industry, however, with its continuous application in the practice and the continuous improvement of its theoretical system, since the 1990's, the application research and practice of SCM in the construction industry has been paid more and more attention to by foreign scholars and construction agency. With the successful application of other industries for reference, many construction agencies began to improve organizational performance, perfect the relationship with participants and enhance market competitiveness with the aid of SCM. Research and practice show that the integrated supply chain management which is based on the cooperative competition has becoming

one of the key factors to improve the performance of construction.

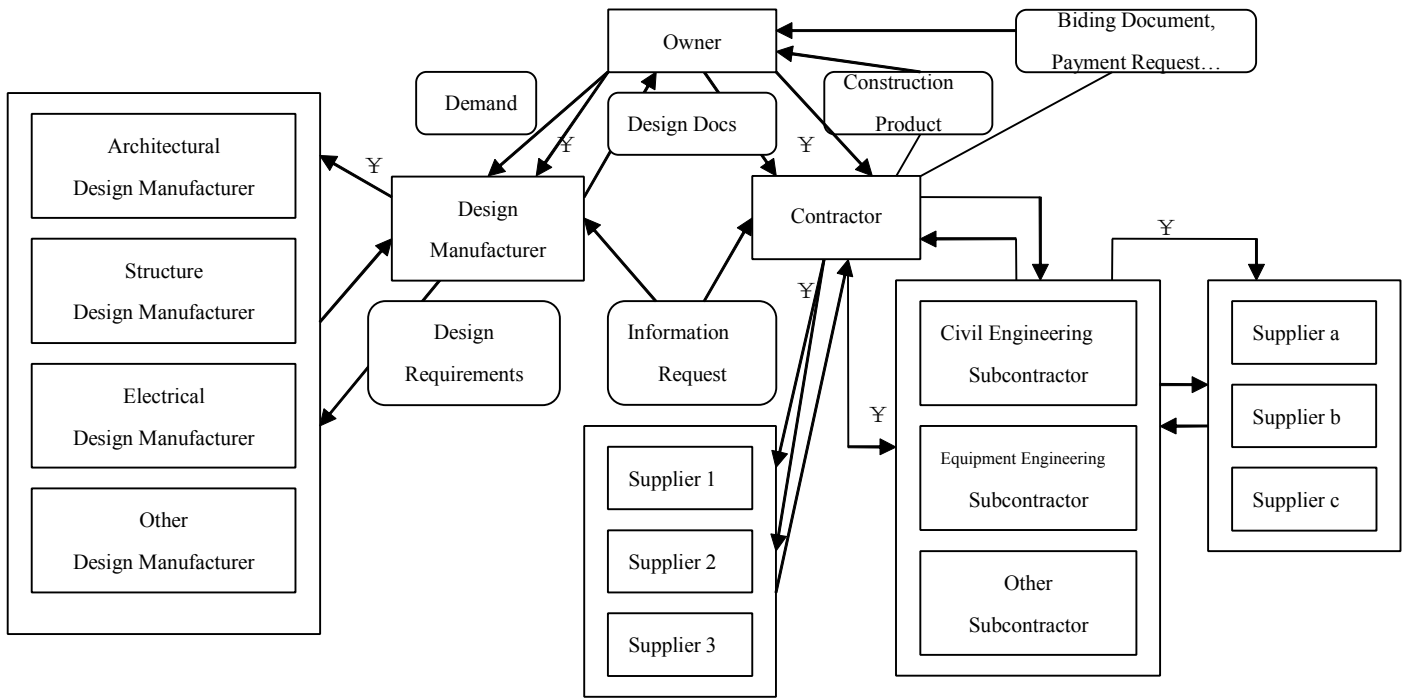


Fig. 1 Model of construction supply chain

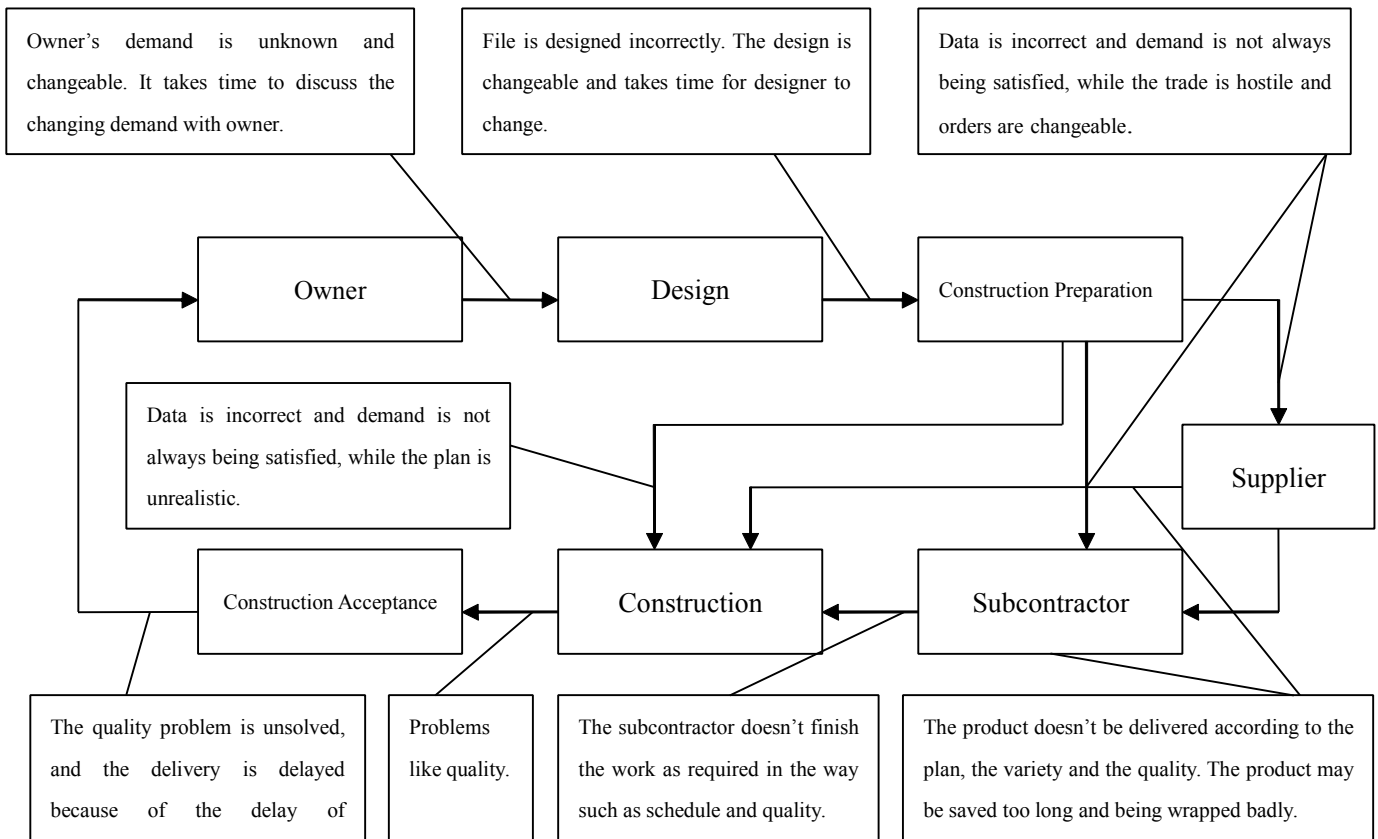


Fig.2 Identity some problems in CSC

2. CONSTRUCTION SUPPLY CHAIN

2.1 The definition and model of construction supply chain

Generally, the traditional industries' supply chain is a network of supply and demand which is made up of raw material suppliers, manufactures, wholesalers, distributors and customers. According to this understanding, the thesis gives out a generalized definition of constructing the supply chain in the view point of constructing the project's life cycle: construction supply chain refers to the construction network which consist of all the activities and organizations related to the stages like owner's project requirement, project definition (including prophase work like feasibility study and design), project implementation (construction stage) and preservation after the project being delivered for use, and the construction process such as the expansion and removal of the buildings. Considering the factors like construction industry's current operation mechanism and the operability of SCM in construction industry, the thesis also gives out a strict definition of constructing the supply chain: construction supply chain refers to a construction network mainly consists of design and construction which are the two key construction process, and is centered with subcontractor, while being built by subcontractor, designer and owner. The construction supply chain mentioned in the following content refers to the strict one.

Combined with the definition of construction supply chain, Fig.1 gives out the model of constructing the supply chain from the angle of the participants of the constructing process. Fig.1 shows that constructing the supply chain involves three beneficiaries, namely owner, design manufacturer and contractor. Design manufacturer includes agricultural design manufacturer, structure design manufacturer and electrical design manufacturer and so on. Contractor includes civil engineering subcontractor and equipment subcontractor and so on, while all the subcontractors have their own supplier. Construction supply chain becoming more and more complex as many participants keeps joining in.

2.2 The characteristics and attribute of construction supply chain

Construction supply chain is a typical supply chain according to the make-to-order. In terms of structure and function, construction supply chain has characteristics like concentrated, temporary and complexity. All the material used in the construction products like buildings and structures are assembled in construction site reflects its concentration. Compared to the traditional construction industry that finishing the mass production in the factory and selling the products through the distributor and retailer, nowadays, "building factory" concentrates on a single product: the worked is started through a one-off construction project, and the product transferred into the only customer's hand, namely the owner, right after being accepted. As for the temporary, it refers to the project management department that has to be established when a new project comes into being, while being cancelled after the project's accomplishment. This characteristic makes the construction supply chain becoming instable, if taken the independence of the agricultural design and construction into consideration, the construction supply chain will be both instable and dispersible. Complexity reflects that construction supply chain should include multiple construction stage, numerous participants, large construction scale, long construction cycle, uncertainty factors and so on.

Considering the relationship and behavior involved in the supply chain, construction supply chain should have three attributes which are network, attitude and collaboration. Network reflects that construction supply chain is to construct organization network or a network organization to satisfy various customers or owners in the construction field. Attitude refers to the attitude of the participants, and it has a great influence on the behavior of the organizations and individuals on the supply chain, such as the attitude based on partnering, framework agreements and technique can result in the supplier's rational behavior. Collaboration is a new strategy to improve to improve the organization's competition advantage, and being aimed to finish the project as required on time with the lowest cost. The collaboration attribute not only require the participants on the supply chain to establish a high trust mechanism, constraint mechanism and information share mechanism, but

also ask all the participants share the same goal.

2.3 Problem existing in the construction supply chain

With the development of the technology and the society, our country's construction industry has changed a great lot in the way as management method and means. But the research and practice has proved that compared with other industries, the construction industry still has the shortage like low efficiency and serious waste. Fig.2 shows the existing problem in the view point of construction supply chain. From the figure we can see that most of the problems occur in the boundary of different participants or different stages, and it provides a reference to solving the problem.

3. CONSTRUCTION SUPPLY CHAIN MANAGEMENT

Started with the systematic thoughts, centered with manufacturers, SCM make the customers' requirements come true in the right time according to the right number, right quality, right state, right and right spot (namely 6R) by carry out the integrated unified management and control through the efficient management system, which is used to manage all the activities (such as logistics, information flow and cash flow) and all the participants (including supplier, manufacturers, distributors, retailers and customers) involved in the producing process with the lowest price.

Since the 1980's, SCM has been widely used in the manufacturing industry. The enterprise's performance has improved a lot, the production cycle has been shorten, the quality and reliability of the products has been enhanced, both the inventory and waste has been reduced, and the production cost has been reduced greatly through the SCM. However, SCM is still a relatively new concept, the foreign application and study about this field began in the 1990's.

The successful application of SCM has been paid more and more attention to by the scholars in construction field since the 1990's. Since the SCM advocates the management thought of downstream supply chain integration and the unisonous win-win strategy, people think that with the application of the basic principles of SCM in the construction field, it is highly possible to make the new management mode becoming the most suitable mode after the partner management mode. People regard new management mode that applying the SCM in the construction field as the construction supply chain management (CSCM).

At present, there is no accurate and unified definition for CSCM. Edum-Fotwe defined CSCM from two levels. First level is the independent enterprise level, which is focusing on the operation problems existing in the production process. The other one is the product level, which is focusing on the management problem involved in the production process based on the customer's demand. Based on the basic principle of SCM, and combined with the characteristics of the construction industry itself, the thesis gives out the definition of CSCM:

CSCM is the integrated unified management which is regard contractor as the core and is for all the activities and participants that involved in the construction project's production process (such as design and construction), with the help of the collaborate win-win business strategy between the design manufacturer, contractor, owner and suppliers. CSCM not only emphasizes the cross-functional integrated management within the enterprise, but also stresses the cross-company integrated management in the external of the enterprise. By establishing the same strategic objectives within the enterprises, the perfect trust and cooperation mechanism and the collaborative work mode and information sharing mechanism, the enterprise can improve its performance and respond to the customer's demand quickly, thereby enhancing its core competitiveness. CSCM is not only a kind of modern construction management ideas, but also a advanced construction management mode.

4. THE FRAMEWORK OF INTEGRATED CSCM MANAGEMENT

SCM is not only a series of individual business management, but also a kind of integrated value stream management. Nowadays, both the competition and collaboration are very crucial, in order to solve the problem in construction supply chain, the new integrated CSCM mode should be carried out in all industry range. Integrated CSCM refers to establish a virtual organization including all the participants based on the same goal (namely reducing the total cost). Within the organization, members optimize the production process and organization objectives, and thereby make the overall performance of the construction supply chain realize continuous improvement through the information share and the coordination and cooperation of resources like funds, manpower and material within the members. It can be seen that CSCM insist on that the organizations within the construction supply chain should have the coordinate and cooperate integrated management strategies that have the same culture, same standard and share information.

Integrated CSCM framework consists of five relationship management bodies and a support system. Five relationship management bodies include contractor (supplier) selection, conflict management, risk management, innovation management and performance management. Support system is the information support system.

The contractor (supplier) selection is closely related to the successful implementation of the integrated CSCM. Different from the supplier selection of the traditional industry supply chain management, since the construction industry has its own special construction procedure, both the contractor selection and the supplier selection are crucial for the successful implementation of the integrated CSCM. Usually, the contractor selection is carried out through bidding, but under the CSCM environment, the factors that being considered is different between constructor selection and traditional bidding selection. Integrated CSCM contractor (supplier) selection chooses to focus on contractor's early performance and credibility. By establishing a fair, transparent selection procedure and standard, contractor (supplier) selection can be made according to the "best value" choice and consultations. The "best value" here refers to the future optimal combination made up of by contractor (supplier), design manufacturer and owner, which can maximize their advantage, reduce the total cost and create the beat value.

Conflict management is one of the most important content of management that any organization showed as a team should concern. Integrated CSCM involves many beneficiaries like owner, designer, contractor and supplier, since their own management activities and management objectives will definitely create many disputes and conflicts, establishing an effective conflict resolution mechanism is meaningful. Integrated CSCM conflict resolution mechanism includes establishing selective conflict solution, hiring neutrality dispute consultants, establishing CSCM conflict management committee, proposing the resolution of dispute and building conflict warning system, etc.

Due to the fact that construction supply chain is temporary and complex, integrated CSCM becoming more risky and make the risk management becoming one of the important component of the integrated CSCM. Different from the risk management of single enterprise or organization, integrated CSCM emphasizes on the synergy identification of the potential risk and the application of comprehensive risk analysis method, which also emphasize the formulation of the perfect risk share agreement.

Innovation is the power and security of the enterprise development. Integrated CSCM also needs innovation to improve the operation performance of the entire construction supply chain. The innovation management under the integrated CSCM environment is based on the corporation innovation agreement between the construction supply chain management parties, and promotes the mutual coordination and communication, and the effective implementation of CSCM through the process that the participants of the supply chain (especially the owner) becoming more and more aware of the professional knowledge and total goal, by launching cooperative research, development and common education.

Performance has become an effective way to evaluate enterprises' or organizations' success and failure. Performance management is very important to integrated CSCM, which not only can provide reference to the improvement of measures of integrated CSCM performance, but also will enhance the successful implementation of integrated CSCM. The performance management under the integrated CSCM environment includes establishing expected CSCM target and agreement, carrying out CSCM performance evaluation and third-party comprehensive evaluation, forming performance evaluation report, establishing an effective CSCM performance improvement mechanism (such as incentive mechanism), making the performance improvement collaborative strategy, etc.

The collaborative work and management of all the participants in the integrated CSCM need good information communication and information sharing, and the information support system of the integrated CSCM provide the solution and approach for it. This information support system consists of electronic commerce system, plan management system, construction management system, group decision support system, CSCM optimization and simulation system and CSCM system agreement, etc. The favorable information support system and information sharing mechanism can guarantee the successful implementation of integrated CSCM.

Those who need a specification is, the thesis only gives out the framework of the implementation of integrated CSCM in the construction industry, and there is no detail discussion because of the limit of the length of the article. The implementation of integrated CSCM is a complicated system work, and based on the framework of integrated CSCM, it is very necessary to carry out in-depth and meticulous research for each part in the future.

5. THE COMPARISON OF TRADITIONAL CONSTRUCTION MANAGEMENT APPROACHWS AND THE CSCM APPROACHES

CSCM comes form the basic principle of SCM, thus CSCM differs from the traditional construction management method the traditional construction management method. Table 1 shows the differences between those two methods.

The table shows that CSCM has several key strategic thinking like the long-time cooperation relationship within the participants, the integrated management of the whole cycle and whole industries, the quick response, information sharing, collaborative work, same strategic goal, etc.

Table 1 Comparing traditional construction management approaches with integrated CSCM approaches

Traditional Construction Management Approaches	Integrated CSCM Approaches
Based on Project Management	Based on Supply Chain Management
Independent Management in Design and Construct Stage	Lifecycle Management
Single and Nonstandard Engineering Facilities and Construction	Standard, Modular and Assembled Engineering Facilities and Construction
Loss Compensation	Reduce the Cost of Key products by Making Strategic Alliance to Solve the Payment Problem
Competitive Tender	Emphasize Establishing the Long-Time Cooperation to Realized the Win-win Goal
Information Hiding	The Widely Use of Communication and Information Technology Transparent and Share the information
Delayed Payment of the Funds	The Instant Payment of Fund and the Minimize Funding Cost
Long and Uncertain Delivery Lead Time	The Short and Stable Assemble Cycle
Advanced Transportation of All the Materials	Materials being Transported to the Site According to the Construction Progress

6. CONCLUSION

CSCM has become a kind of new construction management mode, based on the win-win collaborative business strategic framework established by the owners, design manufacturers, contractors and suppliers, with the help of the advanced information technology, all the activities and participants that involved in the production process of the construction project are being managed with the new mode. More and more research and practice has proved that, the application of SCM in the construction industry has provided an advanced, suitable and effective construction management mode for the acceleration of the reform of construction industry, the increase of the enterprises' core competitiveness, the improvement of the construction performance and the approaches to compete with the rest of the world under the economic globalization.

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