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The establishment and performance measurement of general contracting enterprise's supply chain management system

Zaolong Jiang^{1,2*}, Qingfen Gan¹¹College of Civil Engineering, Hunan Univ., Hunan 410082, (CHINA)²College of Civil Engineering, Xi'an Univ. of Architecture & Technology, Shanxi 710055, (CHINA)E-mail : jiangzaolong70@163.com

ABSTRACT

General contracting mode has the advantage of combining design and construction process together; however, the traditional way of management has restricted the development of general constructing enterprise. Based on the theory of supply chain management, this paper aims to establish an efficient-operated system of construction supply chain whose center is the general contracting enterprises. The measures include outsourcing non-core business, establishing a suitable organizational structure with the optimized business processes, setting up a strategic partnership and establishing the information sharing platform. Besides, the paper develops a performance management system and selects benchmark method to evaluate the effect of supply chain management. The main innovation of this paper is to apply the supply chain management to the general contracting constructing mode, which plays a guiding role in the process of implementing the supply chain management.

KEYWORDS

General contracting enterprise; Supply chain management; Supply chain management system; Performance measurement.



INTRODUCTION

Since 1990s, the supply chain management theory has been applied in China's construction industry. This theory of management, emphasizes on "horizontal integration" that pays attention to efficient circulation of information flow, material flow and cash flow among the participating enterprises, shows great advantages in management^[1]. Christopher, expert of supply chain management pointed out: "The competition in 21st century will be no longer the individual competition between enterprises but the competition between supply chain^[2]." Thus, in the new period, the supply chain management will have a great impact on the market competition.

The general contracting mode, in which the general contractor is responsible for both design and construction process, has the advantage of optimizing the workflow; however, very few general contracting enterprises implement supply chain management. The traditional way of management aims at maximizing profit, rarely considering the owners' satisfaction and cooperation with other companies. Some contractors' business extends to numerous upstream business which has lead to a large, complex internal structure, and the incompact link among the departments will result into laborious management. Moreover, there are numerous participants in the general contracting projects, like owners, suppliers, subcontractors, etc. In the long run, it is not merely a competition between project contracting enterprises, but the competition throughout the whole construction supply chain.

From the above analysis, as the main competitor in the construction market and the center of the construction supply chain, it's essential for general contracting enterprises to implement supply chain management to improve the competitiveness of themselves and the whole supply chain.

ADVANTAGES ANALYSIS OF IMPLEMENTING SUPPLY CHAIN MANAGEMENT IN GENERAL CONTRACTING ENTERPRISES

The implementation of supply chain management has the following advantages:

(1)Conducive to the tender offer of the general contracting enterprise. Those general contracting enterprises who imply the supply chain management can maintain stable relationship with some suppliers. In the project bidding process, general contractor will more easily to grasp the market dynamics price of materials, equipment and other resources,thus can bring the benefits of better tenders, less bidding risk as well as time-shortening of tender offer^[3].

(2)Saving the cost of the general contracting enterprise. When implementing the supply chain management, general contractor can intensively purchase material and equipments of several projects, which will significantly reduce the construction cost. In addition, the general contractor and suppliers can share inventory information, thus helps the supplier better develop materials production and distribution plans, ultimately reduce the costs caused by insufficient material supply and inventory costs.

(3)Reducing the risk of projects. The long-last construction projects will encounter many risks, most of which is due to the lack of common interests and close cooperation among each party. Under the supply chain management, there will be a high level of information sharing, it can help the involved parties to develop measures to prevent the potential accidents and take measures immediately, so as to reduce the impact of risks.

(4)Conducive to the long-term development of the general contracting enterprise. Frequent cooperations between general contractor and their business partners can bring high efficiency of constitution so that the general project contracting enterprises can win more market share in the cut-throat competition^[4]. Along with an increasing number of suppliers and subcontractors who come to seek cooperation

opportunities, general contractors can find better partners with strong core competitiveness, and ultimately improve the competitiveness of the entire construction supply chain.

SUPPLY CHAIN MANAGEMENT SYSTEM CONSTRUCTION OF GENERAL CONTRACTING MODE

Outsourcing non-core business

The primary task of the general contracting enterprise to implement supply chain management is to outsource non-core business. Enterprises can analyze the growth and resources by evaluating various business data including administrative expenses, revenue and expenditure as well as other aspects of the implementation. By evaluating the results, they optimize and integrate business which is beneficial to design and construction as well as weaken or strip out vulnerable and resource-occupied business. Through outsourcing, enterprises can put the saved money and human resource to the construction of contracting company's core business. Also, it makes better management of the supply chain process and high-efficient project accomplishment so as to achieve win-win cooperation throughout the supply chain enterprises.

Establishing of organizational structure with optimized business processes

Generally, the organizational structure of general contracting enterprise is not well formed in China. Most companies implement a four-level management model, which is “corporation-branches-project departments-operating teams”. Excess management levels result into a series problems such as poor information circulation and low quality of project management^[5]. Overall, the top priority of structural optimization is to clarify the function system and business system. The matrix organizational structure can enhance horizontal ties among departments, which is complied with the requirements of supply chain management.

To reduce management layers, branches can be revoked and all the projects will be under direct leadership of the headquarter. For those project-broad-distributed enterprises, they can set several regional project centers to better control the projects. Meanwhile, regional project centers can coordinate the use of machine and the dispatch of materials among the projects in it's precinct. In addition, the general contracting enterprises need to simplify the process of dialoguing with external companies to improve the efficiency of communication. One possible approach is to set up an external relation department to deal with affairs with owner, suppliers, subcontractors, etc, especially those urgent and complex work.

The optimized organizational structure is shown as in Figure 1.

Establishing strategic partnership

There are many participants in the construction supply chain, as the center of the supply chain, general contracting enterprises have the right to choose its suppliers and subcontractors. Firstly, the contractor should decide the length of the relationships according to their needs, if the relationship is short-termed, then a normal partner can be selected. However, to seek a long-term relationship, the contractor should choose competitive partners who can add value to the supply chain, then they can form a “risks sharing and benefit sharing” partnership. Secondly, a selection criteria is necessary when implementing the selection, meanwhile, qualitative or quantitative methos can be applied to analyze each index. In the implementation of cooperation, the general contracting enterprise needs to evaluate the effectiveness of the partnership in order to decide whether to continue or terminate the relationship.

Establishing the information sharing platform between supply chain partners

When establishing the information sharing platform, security should first be taken into consideration. In order to reduce the risk of internal information being spied by others, the cooperative enterprises must take permission control on information access so that the other parties can only get the

information which is really useful for their work. In this way, it can not only protect core secret of the cooperators, but also improve their feedback speed of the information. Besides, the general contractor should develop unified standards for information to make files transferred in standardized format so as to improve the working efficiency.

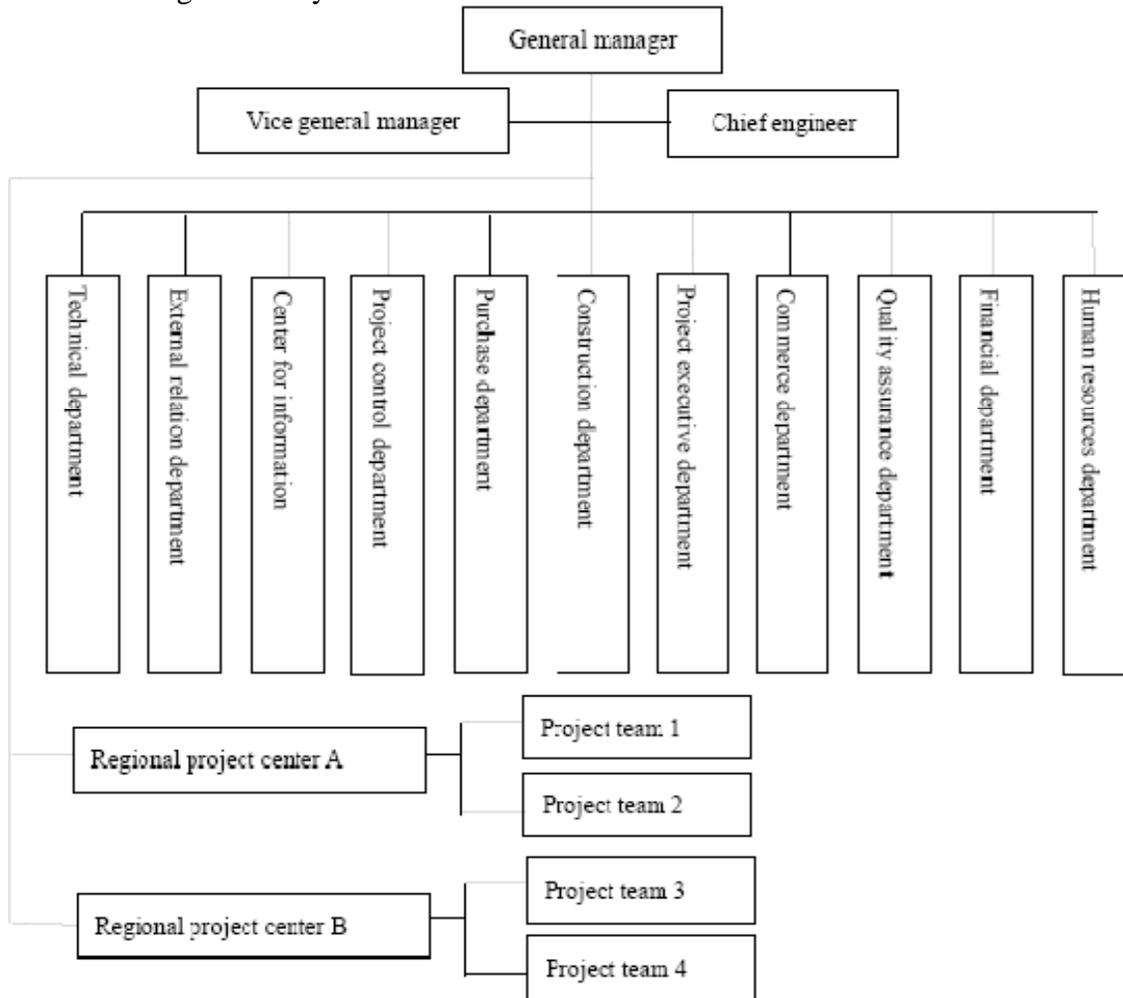


Figure 1 : The optimized organizational structure of the general contracting enterprise

The conceptual model of information sharing platform is shown as in Figure2. The platform includes four sub-platforms. The first is cooperative relationship management platform on which the contractor can make scientific evaluation of the partners and manage the cooperative relationships. The second is project management platform on which general contracting enterprise can control the construction site of every project. By this means, the managers of the headquarter can make guidance to the construction site when emergencies occur. The third is purchasing and inventory management platform which can realize centralized purchase as well as timely supply of equipment and materials. The fourth is performance measurement and encouraging platform on which the general contractor can announce the performance evaluation results of every project in time. In this way, the partners can know well about the operation of the supply chain, meanwhile it can inspire the low performance partners to improve their effectiveness.

SUPPLY CHAIN PERFORMANCE EVALUATION OF GENERAL CONTRACTING MODE

In the process of implementing supply chain management, the general contractor should formulate a set of feasible methods to make a timely evaluation of the supply chain. With the advantages of both qualitative and quantitative methods, benchmarking method is done by comparing the gap between enterprise's current performance value and the industry benchmark value. As a result, problems will be discovered in the process of supply chain and feedbacks will be timely replied to the partners thus to optimize the processes and gradually improve the overall efficiency of the supply chain^[6]. The specific implementation steps are as follows:

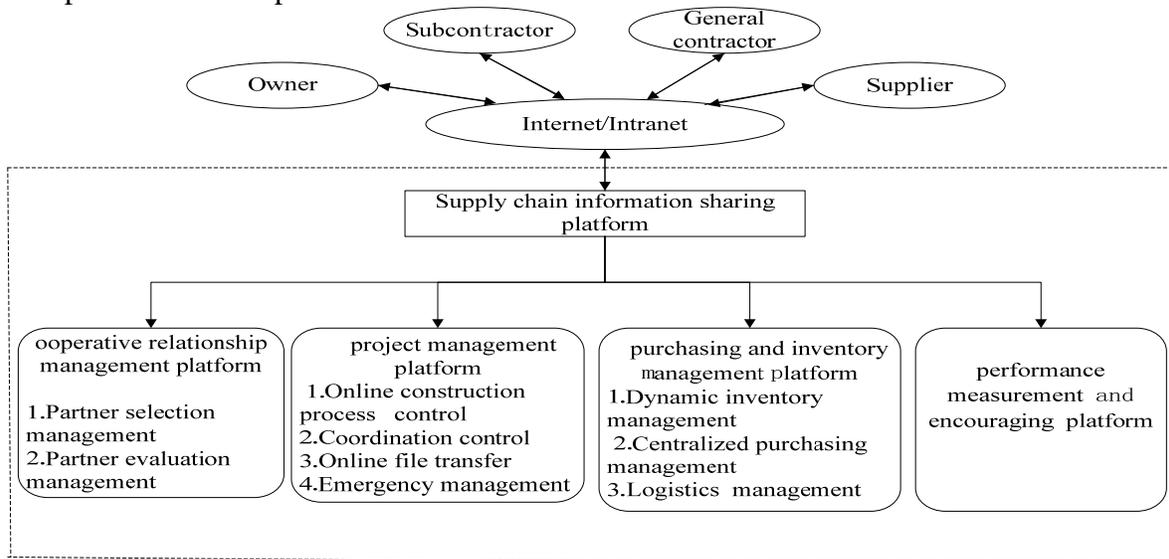


Figure 2 : The information sharing platform of the general contracting mode

Establishing Supply Chain Performance Evaluation System

The indexes selected should fully reflect the operation of the supply chain; meanwhile, China's accounting and statistical system should be taken into account so that relevant data are accessible and easy to quantify. To establish the index system, several methods can be applied such as theory analysis, expert consultation method, and frequency analysis method^[7]. According to the above principles and methods, the index system is established as shown in TABLE 1.

TABLE 1 : Performance evaluation index system of the general contracting supply chain

the first layer index		the second layer index
The overall operation effect of supply chain	Owner satisfaction (A)	A1. The rate of good quality
		A2. The rate of timely completion
		A3. The project cost control ability
		A4. Owner complain rate
		A5. Rework rate
Agility (B)		B1. Bidding rate
		B2. The response time of supply chain
		B3. Contract compliance rate
		B4. The ability of duration control
		B5. Risk control ability
The internal operation effect of supply chain	Operational capability (C)	C1. Market development ability
		C2. The ability of the general contracting
		C3. Project cost level
		C4. Turnover time of capital
		C5. Inventory turnover

The external operation effect of supply chain	Profitability (D)	D1. Market occupancy
		D2. Return on assets
		D3. Cost-profit ratio
		D4. Labor productivity
	Cooperative partnership (E)	E1. Partners delivery rate and completion rate
		E2. Supplier's qualified products rate of
		E3. Core enterprise accounted for the proportion of supplier's business
		E4. Core enterprise accounted for the proportion of subcontractor's business
		E5. The degree of information sharing

Standardizing Attribute Values

The benchmark values can be determined with reference to operation data of the advanced enterprises or the best historical operating data of the general contracting enterprise itself, for those values which are difficult to get, we can use the expectation values by doing a research. After getting the current values of the supply chain and the benchmark values, we should standardize the property values. There are two cases: one is when the attribute values tend to be the larger the better (e.g. engineering margins), the other is when the values tend to be the smaller the better (e.g. rework rate). The corresponding attribute value is calculated as follows:

Case 1: $S_j^d = 10S_{ij} / m_{ij}$

Case 2: $S_j^d = 10m_{ij} / S_{ij}$

In the above formulas, S_{ij} represents the benchmark value, m_{ij} represents the current value of the supply chain.

Calculating the Performance Evaluation Value

The performance evaluation value can be gotten by calculating the weighted average of the attribute values. The calculate model is as follows^[8]:

$$\beta = \sum_{i=1}^p (\varepsilon_i \sum_{j=1}^{[f(i)]} \theta_{ij} (\frac{m_{ij}}{S_{ij}})^{\rho(i,j)})$$

$$St : \begin{cases} \sum_{i=1}^p \varepsilon_i = 1 \\ \theta_i = \sum_{j=1}^{[f(i)]} \theta_{ij} = 1 \\ 0 \leq (\frac{m_{ij}}{S_{ij}}) \leq 1 \end{cases}$$

In the formula: $i = 1, 2, \dots, p$; $j = 1, 2, \dots, [f(i)]$, p represents the number of the first layer indexes; β represents the performance evaluation value ; ε_i represents the i^{th} weight of the first layer index; θ_{ij} represents the j^{th} weight of the second layer index under the i^{th} first layer index; $[f(i)]$ represents the number of the second layer index under the i^{th} first layer index; θ_i represents the $[f(i)]^{th}$

weight of the second layer index; $\rho(i, j)$ is an adjustment coefficient, when the attribute value tends to maximize, take $\rho(i, j) = 1$, and when the attribute value tends to minimize, take $\rho(i, j) = -1$.

We can use the Delphi method, AHP or expert rating method to get the weights of every index. The final value of β can be described as the follow situations:

- 1) When $\beta < 65$, it indicates the performance of the supply chain is lower than the average level of construction industry.
- 2) When $65 \leq \beta < 75$, it indicates the performance of the supply chain is in the middle or even lower level of construction industry.
- 3) When $75 \leq \beta < 85$, it indicates the overall performance of the supply chain is good and it is in the good level of the construction industry.
- 4) When $85 \leq \beta \leq 100$, it indicates the performance of the supply chain is excellent and it is in the industry-leading level.

Due to the level of performance evaluation value, as the center of the construction supply chain, the general contracting enterprise can take some measures to improve or keep the performance level. When the value is lower than the average level of the industry, the enterprise should call the cooperators of the supply chain to analyze the causes of the disparity, then take actions such as restructuring the supply chain business processes, eliminate non-core businesses, strengthen cooperation and so on. When the value is above the average level, the enterprise should seek an advancement space while maintaining the recent performance level.

CONCLUSIONS

Implementing the supply chain management has many advantages for the general contracting enterprise, meanwhile, it can reduce the risk of the projects and improve the operational efficiency, finally help to raise the level of construction industry in China. The paper provides some methods to implement the supply chain management: by outsourcing the non-core business, the general contractor can focus more resources to build the core competitiveness; the optimization of organizational structure can improve the communication efficiency and operational efficiency within the enterprise; establishing strategic partnership can improve the stability and efficiency of the construction supply chain; and setting up an information system provides an information platform for the supply chain parties. In addition, by applying benchmark method to evaluate the performance of the construction supply chain provides a feasible way to optimize supply chain operations processes.

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