

Supply Chain Management Model of Engineering Materials: A Case Study

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Abstract: On the basis of clarifying the characteristics of construction products and engineering material supply chain, this paper compares several commonly used supply chain models, and points out that the implementation of supply chain mode in construction enterprises may reduce costs and enhance the core competitiveness of enterprises. Taking the supply chain reform of A construction company as an example, the value of supply chain management in practical is confirmed, and the overall management level of engineering materials is improved through supply chain management, and the maximum utility of supply chain management in reducing the cost of engineering project is brought into play, which is conducive to the long-term development of enterprises.

Key words: construction enterprise; supply chain management; supply chain model; engineering materials

I. Introduction

With the continuous deepening of economic globalization and technological change, as well as the rapid expansion of global manufacturing industry, supply chain is widely used in manufacturing industry and has made great achievements. It implies that supply chain management is imperative under the background of the rapid development of global economy in the new era. However, the "vertical integration" management mode has been adopted for a long time. Many general construction contractors have the management and even production capacity of building materials and large equipment, as well as a series of construction capacity from civil engineering and installation engineering. Although the traditional management model can realize the direct control of resources, it cannot meet the requirements of open global manufacturing environment and modern competition. Today, with the emphasis on quickly meeting user needs and responding to market opportunities, this integrated management model may not be able to achieve this goal. Supply chain management extends the vision of resource allocation from inside to outside, defines the functional division of enterprises in the supply chain, and puts forward a new method to increase market share.

Voordijk (1999) studied the relevant contents of integrated logistics in the development of construction supply chain. He creatively introduced the logistics idea of supply chain into the material management of construction projects. Since then, more and more domestic and foreign scholars have begun to study the engineering materials in the construction field from the height of the supply chain. Akintoye et al.(2000), through the investigation and research on the supply chain cooperation and management of the British construction industry, further analyze the early model of the construction supply chain, In his view, it is necessary for contractors to implement construction supply chain management (CSCM) to improve production planning and procurement. In addition, he also pointed out the factors

hindering the implementation of construction supply chain management, including the lack of formal supply chain management strategy and the lack of trust between the two sides. Koskela and Brijhoef (2000) deeply analyzed the logistics optimization problems of construction enterprises and formed a theoretical system focusing on the realization of high cooperation among participants in the supply chain. In his opinion, if all related enterprises in the supply chain can deeply cooperate and jointly manage, the optimal cost control of the whole supply chain management can be realized. Mamter and Mamat (2014) believes that the management of the construction supply chain runs through the entire process of construction projects, from design, procurement, construction to completion acceptance and delivery. It also consists of different organizations involved in the construction process including owner, designer, contractor, subcontractor and suppliers. A field study is done from the viewpoint of contractors, then analysed by using average index methods and presented in a statistical analysis. From the analysis, it reveals that effectiveness of practicing the SCM give a lot of good performances and granted benefits to contractor, and minimize waste of material and labor for construction project.

II. Theoretical background

2.1 Supply chain management of engineering materials

Engineering material supply chain management is not only a modern construction management concept, but also an advanced management model. It is a collaborative and integrated management mode focusing on the engineering project, sharing project information and facing all project participants (construction units, general contractors, suppliers, etc.), so as to realize the optimization of the overall project effect and the win-win of all relevant enterprises. Through information sharing, construction material supply chain can improve the efficiency and respond to market changes quickly.

Supply chain management covers the four aspects of supply, planning, logistics, and demand. It promotes management by meeting the needs of these aspects, and aims to maintain a balance between improving user service levels and reducing total transaction costs, with special emphasis on the establishment of long-term partnership between supply and demand. The general manufacturing supply chain structure mainly includes core node companies and upstream and downstream companies. However, from the perspective of construction companies, the engineering material supply chain consists of only two parts: upstream suppliers and core construction companies (general contractors).

2.2 Engineering material supply chain model

Enterprise type material supply chain structure is a management model centered on construction enterprises. In this mode, the construction enterprise owns part of the inventory, purchases raw materials from suppliers, and supplies the whole chain according to the progress of the project. This model can not only realize the integration of resources, but also concentrate the material demand of all projects under the construction enterprise, so as to better negotiate with suppliers on procurement related matters based on a larger procurement volume. Moreover, the structural characteristics of part of the inventory can respond more flexibly to the supply of materials. With its own inventory as the support, it has successfully avoided the undesirable consequences that occur when the materials cannot be in place on time. In addition, this model has changed the traditional non-interference between projects, greatly promoted the coordination of materials, and made it possible for engineering materials to flow in parallel between project departments.

The entire process of material management is under the supervision of the project department, which is a special part of this mode. In this mode, the construction enterprise will no longer interfere too much in the material management of the project department, and the project department will carry out all the contents of material management, but it must submit the material plans and relevant data to the enterprise for approval. In the early stage of

the project, the enterprise will select some personnel to temporarily form the project engineering department, responsible for the preparation of project materials procurement, management and other construction plans. During this period, the market condition and suppliers of relevant materials should be investigated, and the suppliers that meet the requirements in all aspects should be eligible for shortlisting, so as to establish the material supply chain of the project. This direct contact with the supplier will make information transfer more accurate. Due to the omission of the construction enterprise link, the project department takes over all the procurement work, and the project manager is fully responsible for it. For their own project plans and progress, the project department can certainly manage more detailed than the secondary enterprises. By eliminating an intermediate point, information will be transmitted more quickly and supplies will be prepared in more time than before, benefiting both sides.

With the emergence of the concept of third-party logistics and its great value in social and economic development, more and more construction enterprises have noticed this point and have begun to adopt logistics outsourcing to manage engineering materials. This third-party material management model presents significant advantages over the first two models. The third party logistics has stronger professional and material management ability, integrating the material needs of all enterprises on the chain. The huge demand makes it strive for more power to negotiate with suppliers. Furthermore, it has more space to choose suppliers at all levels. Through competition among them, it can eliminate those who cannot meet requirements, which not only ensures the quality of material procurement, but also controls the cost. The professional logistics team also makes the construction enterprise need not set up the corresponding management department for material management, which reduces the investment of human, material and financial resources, and helps the enterprise to obtain higher economic benefits. In addition, the form of third-party logistics has constructively solved the problems caused by the project arrears, and provided a guarantee for the progress of the construction project.

III. Case study

3.1 Case background

The main business of A company is to purchase and manage the engineering materials required by all the construction projects including three major building materials and materials with large consumption. In the past, the company uniformly managed engineering materials. The materials used by each project department for construction shall be purchased by the procurement department in a centralized manner and store them in the warehouse. The enterprise has set up many departments related to engineering materials, such as material planning department, procurement department, inventory department and material processing department. When engineering materials are needed for construction, the general process is that the project department first draws the material demand plans and sends them to the material planning office. After passing the approval of the department, the processing department will process the materials according to the production plans, and finally the processed materials will be delivered to the construction site by the transportation department.

However, there are many problems in this management mode. On the one hand, this all-inclusive mode not only requires sufficient preparation time, but also takes a long time to submit material demand plans, review plans and process materials. Once the plans are changed, the prepared materials may not come in handy or even be discarded, resulting in great waste. On the other hand, the managers of departments related to materials must have certain professional quality and good management ability. The employment and training of managers will undoubtedly increase the management cost of construction enterprises and reduce the benefits of enterprises.

3.2 Material procurement and supply chain reform of A company

After the implementation of the above management mode in the enterprise, there are both advantages and disadvantages. A serious problem is that the settlement of various project funds is usually after the project completion

acceptance, which means that the suppliers who provide materials cannot receive the payment in time, which brings great problems to the capital turnover of suppliers and even leads to the situation that suppliers refuse to cooperate. This vicious circle will inevitably cause great harm to enterprise.

With the continuous deepening of modern logistics thought and the rapid development of third-party logistics, the company decided to break the traditional management mode, imitate the manufacturing industry and adopt the way of logistics outsourcing. The plan was soon discussed and adopted, and the A company was officially established. The branch plays the role of third-party logistics, and most of the material management of the head office is entrusted to the A company, which constructs an embryonic material supply chain.

3.3 Material Supply Chain Reform Performance Evaluation of A company

Through the reform of the supply chain, the head office, the material branch and the material suppliers have formed a strategic partnership. From the perspective of the supply chain, I will mainly discuss the profitability of the material branch and the cost control of the construction project. Regarding the profitability of the A company. A company specifies the purchase price of required engineering materials according to the estimation of the overall project cost. On this basis, the material branch will negotiate with the supplier and agree on the purchase price in line with its own interests. This price is lower than that given by the head company. The difference is the interests of the branch. It is not difficult to find that the cheaper the purchase price agreed with the material suppliers, the greater the profit.

The following analysis of material supply chain cost will be explained in detail from two parts: procurement cost and inventory cost. After the implementation of the supply chain, the procurement of materials has changed from single small batch to large batch, and the material procurement cost of A company has been controlled. By comparing the price of several commonly used building materials with the market price at the time, it can be seen from table 1 that there is little difference between the price of small batch procurement and the market price. Combined with table 2, we find that the more the purchase quantity, the cheaper the purchase price, and the relationship between them is inversely proportional.

Table 1 Procurement of small batch material

Material	Model	Unit	Purchasing quantity	Market price(RMB)	1# work area	2#work area	3#work area
Threaded steel	Φ 20	ton	110	5010	5005	5002	5000
Cement	P.O32.5	ton	110	382	379	377	380
Concrete	C25	m ³	1200	408	407	404	405

Table 2 Procurement of large batch material

Material name	Model	Unit	Market price(RMB)	#1,#2, and #3 work areas	
				Quantity purchased	Purchase price(RMB)
Threaded steel	Φ 20	Ton	4782	7640	4120
Cement	P.O32.5	Ton	369	3500	349
Concrete	C25	m ³	420	31000	408

As for the control of inventory cost, A company has long adopted the traditional inventory management model, which is characterized by setting up inventory in the case of demand and supply mismatch. The construction company is responsible for the inventory management. In order to cope with the uncertainty of external market and internal demand, high inventory is often set, so that the material suppliers also set a certain amount of inventory to deal with the uncertainty of the demand of construction enterprises, which undoubtedly increases the overall cost of management. In the supply chain context, A company decided to adopt a new management model——Vendor Managed Inventory (VMI), which can be simply explained as that the supplier undertakes the responsibility of replenishing inventory for construction enterprises by sharing the current actual inventory and material consumption. It is a cooperative strategy to achieve the lowest inventory cost in the chain through a highly automated information system. This model requires A company to establish a material management information system with complete data, intelligence, efficiency, and rapid response, so as to realize the comprehensive informatization of material management in the supply chain. This kind of information interaction reduces the uncertainty of enterprise demand forecasting and greatly reduces the inventory cost of the A company.

3.4 Evaluation results and analysis

In the whole supply chain, whether the suppliers, A company can guarantee long-term stable and high benefits in this chain. As for A company, it can be seen from the above analysis that the material branch company is located at the core node of the supply chain, between A company and the suppliers. Through price negotiation between the two parties, the branch company can take advantage of the price difference to earn benefits and constantly make itself develop and expand. For A company, the material branch company undertakes a large number of auxiliary businesses, which can not only simplify the professional material management personnel, but also eliminate the need to set up a series of departments related to engineering materials, so that greatly reduces the business workload directly engaged in and the management cost. The construction company can focus on its core business and continuously improve the degree of specialization and core advantages. In addition, due to the concentration of huge demand, the material branch company can lower the purchase price as much as possible during the procurement period, so as to reduce the material cost of the project and realize considerable cost control. For suppliers, suppliers directly sign contracts with branch companies and settle material payments on a monthly basis, which ensures that material suppliers can obtain payment in time, thereby solving the problem of difficult fund operation of suppliers. Moreover, due to the transmission and flow of information in the supply chain, material suppliers can timely grasp the inventory and procurement information of engineering materials of the project department. As a third party, the material branch company realizes the material integration of several projects, which gives suppliers a huge supply, so that suppliers in the chain can obtain higher profits.

To sum up, in the construction supply chain context, A construction company has increased the value by using the third-party logistics services and realized specialized division of labor. The branch company uses its own professional advantages to carry out logistics business operations. While supply chain node enterprises enhance their value, they also provide a foundation for their own development.

IV. Conclusions

Engineering material management plays an important role in the process of construction enterprises trying to reduce costs and improve economic benefits. It is the key to promote the development and growth of construction enterprises. Therefore, we should pay enough attention to the material supply chain management mode. In order to gain a firm foothold under the fierce competition, it is necessary to conduct more basic research on the engineering material supply chain management, continue to optimize the model and improve the level of material management, which will promote the enterprises to obtain long-term, stable and high benefits.

However, there are still deficiencies and limitations in this paper. The research on the cost analysis is theorized,

and the model establishment is relatively simple. It does not fully consider the problems that may occur when the construction enterprise actually uses the supply chain management model, and the theoretical proof only take a material company as an example. The data are limited and no rigorous demonstration is carried out, thus related research in this field need to be deepened. We hope the future research will offer substantial new insights into effective material management in the context of supply chain.

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