Discussions About Supply Logistics in Automobile Industry of China

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Abstract. Based on the research of lean production, the lean supply theory is a development of the lean concept from the production field to the supply field. After that, it is developed integrated lean supply which is a kind of collaboration in the first level and provides components with higher quality and lower cost for assembly plants in larger size, higher level, shorter time and enterprises in the supply chain for a long term and it could finish the process of supply with higher lean requirement on the premise of highly integration. The supply chain system in automobile industry is very complicated. At the same time the operational efficiency of supply logistics will directly influence the final profit of enterprises in the supply chain. However, in the process of implementing lean supply logistics, due to the lack of specific and systematic theoretical guidance, the research results are not satisfactory. This article base on the perspective of collaborative innovation, and through collaborative innovation of supply-chain, production and distribution logistics in different stages of logistics operation to realize logistics integration of a enterprise successfully.

1. Introduction
At present, there are nearly 4,000 component manufacturers in Chinese automobile industry which are small and scattered. Assembly plants are seriously vertically integrated. Around every large assembly plant, there is a vertical single coordinating system which consists of larger number of component manufacturers. For example, Shanghai Volkswagen has over 500 component suppliers; FAW and Dongfeng Automobile Corporation have more than 1,000. This results in an attaching developing model. Because there are plenty of components to assembly a car, to lower the risk of purchase, an assembly plant often has more than two suppliers to supply one component, which makes the supply network more complicated.

Now, there are a lot of problems existing in the supply logistics of Chinese automobile manufacturers, which have greatly influence its operational efficiency. So, how to extend the real lean concept to application of supply logistics to reduce logistics waste, lower purchase lead time and decrease the Bullwhip effect of supply logistics have been an important task facing Chinese automobile manufacturers.

2. Related literature
Lean supply discusses the breakthrough of vertical integrated relationship between assembly plants and component suppliers. It is different from traditional researches about relationship between suppliers and manufactures. In traditional supply chain, suppliers and manufacturers are only two pitch points which are linked through logistics, information and capital flow. While in integrated supply chain, the lean theory treats the relationship between assembly plants and component suppliers as a being and an entity.
Richard Lamming thinks that lean supply chain management requires both parties to consider the cooperative relationship as “quasi-industry” which has its own organization, goal, communication mechanism and company culture.

In 1992, he put forward the concept of “lean supply” in his book lean supply: strategies about relationship between innovation and suppliers which describes lean supply as a strategic model of relationship between assembly plants and component suppliers. He thinks if component suppliers link with several assembly plants at the same time, it is impossible to be a gentle one-to-one relationship but a combination of several complication factors.

In 1996, Womack and Jones in his book lean thinking put forward a powerful weapon against waste: lean thinking which emphasizes on using less and less input (less labor, equipment, short time, small court) to get more and more output and keep closer to customers and offer them what they really need. He increases the waste to 8 kinds and summarized 5 basic principles of lean thinking: determining the value of a certain product exactly, identifying the value flow of every product, keeping the value flow constantly flowing, consumers pulling the value from producers and forever pursuing perfect. Lean thinking begins to be popular in every industry including logistics. In the article Development of suppliers: LEAP Project, D. Brunt summarizes the model of lean network purchase.

Logistics concept is introduced to China comparatively late. Most researches on logistics in China mainly focus on the single function of logistics operation, especially in the circulation area. And logistics researches of automobile manufacturers mainly concentrate on component purchase and assembly logistics, which is lack of production logistics and integration researches and cannot lift logistics development to the height of enterprise strategy. In China, there are mainly Tianyu and Zhu Daoli making a primary introduction of lean concept and methods in 1999 in the article lean logistics in which they think lean logistics is applying lean thinking to manage the enterprise logistics activities. They also point out that in China logistics have not been widely applied, so making researches on lean logistics is the base of efficiently taking logistics management one step further in practice.

In the book Logistics Engineering Research, Wang Zhitai defines lean logistics as logistics activities which is guided by lean thinking and can overall realize lean production. He also puts forward two principles of lean logistics: having models but set and service-pulling. Besides, he summarizes 4 characters of lean logistics system: pulling model, high quality, low cost and continual improvement. Diversification.

Based on the general situation of supply logistics of automobile manufacturers, this paper discusses the methods and measures of lean supply logistics in Chinese automobile manufacturers mainly from the aspects of supplier management, material purchase and inventory strategies.

3. Improving measures of lean supply logistics of automobile manufacturers

3.1. Building lean supplier management system

In the supply chain, cooperation of enterprises does not reflect strategic cooperative partner relationship. Long time cooperation does not mean both parties’ cooperation is strategic, which mainly depends on the depth of cooperation, attitude of dealing with market changes and solutions, information exchange and cost transparency in the process of cooperation. Among suppliers management, assembly plants blindly pursue low purchase price instead of considering suppliers’ research and development ability, reputation, size and enterprise developing strategies. They take price as the only decisive factor to choose suppliers and change suppliers at random according to the supply market. This leads to suppliers lower their loyalty to the assembly plants and hide the specific condition and cost details of the products, which will result in both cooperative parties only pursue short time benefit and no further and deep cooperation.

As for supply, automobile component suppliers in China can only get some information about rough month demand forecast, orders and frequent emergent orders. Suppliers and assembly plants do not make strategic studies on joint retrieval measures. So some key information such as inventory cannot
be shares among enterprises for consideration of their own benefit. This leads to not smooth logistics, unreasonable supply structure and even frequent shortage of goods under the pressure of high inventory.

As for suppliers management, lean production thinks the development of main manufactures depends on collaboration whose product quality, cost and management quality will eventually reflect on the quality cost and management of main manufacturers. Therefore, it suggests establishing a mutual trustworthy strategic cooperative partnership between main manufacturers and collaborations. The selection of suppliers will directly decide the lean efficiency of production and logistics operation. And much waste can be avoided from the selection of suppliers. So, lean suppliers must meet the following QCD (Quality, Cost, Delivery deadline) conditions:

1. Suppliers should have integrated operation management system to ensure the stability and continuity of supply.
2. Managers should have strong sense of quality and quality guaranteeing system to ensure the quality of incoming materials.
3. Have the manufacturing capacity and developing potential which is needed for a enterprise’s development
4. Reasonable cost price
5. Diversification, domestication and modernization of suppliers
6. Give preference to suppliers in a certain distance such as one hour drive to realize lean logistics.

To make sure suppliers meet QCD, enterprises need to establish lean supplier management system which includes suppliers’ information base, platform, catalogue and daily evaluation. The whole system is aimed at realizing mutual benefit. After the system is established, QCD is used as evaluation indicators whose setting is shown as the figure 1:

**Figure 1:** QCD Evaluation Indicators

In doing specific evaluation, quality, cost and delivery deadline are set a corresponding score and a criterion of scoring and taking of points is also needed. Taking “cost reduction” for instance, setting its score a certain one, the requirement is the range of cost reduction compared with the same time in last year. If cost does not reduce, then it will be taken off some points.
So from the setting of indicators, we know lean evaluation of transportation suppliers does not only mean sending the goods to the assembly plants punctually, safely and quality guaranteed, but also high requirement of improving sense of suppliers.

3.2. Material purchase and inventory strategy

Inventory refers to the goods or commodity that is kept in storage. Inventory management operation is a transition point of supply logistics which is in charge of receipt and dispatching of goods. It is an important part of supply logistics. But inventory is believed as one of the largest waste in lean supply, so enterprises often pursue “zero inventory” as possible as they can. But zero inventory does not mean no inventory but as less inventory as possible. So how to control unnecessary waste from material purchase is a very important for supply logistics. And lean logistics is pull-type logistics management, which means demand decides logistics operation. If we want to eliminate inventory waste in every part of supply logistics, the purchase plan must be exactly right, which depends on the production plan that decided by the market and sales forecasting. Therefore, to lower the purchase and inventory cost, enterprises must exactly predict needs and reasonably control inventory.

3.2.1. Predict needs exactly

Enterprises production decides the quantity demand of material supply based on the demand for various types of materials. It is made according to the market demand for the product, while supply plan depends on the kind, structure, quantity and quality of the product, consumption quantity of various materials and production time order which is decided by the production plan. So supply plans should make an exact demand prediction of quantity of various raw materials and purchase goods including kind and quantity and delivery deadline. Thus it can guarantee normal production, cost reduction, acceleration of cash flow and improvement of economic benefit. Therefore, making feasible production plan, deciding reasonable material consumption and stocking quantity is the key to exactly predict needs.

3.2.2. Control inventory reasonably

Supply logistics interrupt will lead to suspension of production. So to guarantee normal production, there must be some funds and material reserved. On one hand, it must guarantee the need for normal production which is turnover inventory, and deal with emergent situation which is safety inventory. On the other hand, it is a good way to save cost that reasonably control inventory, dynamic change inventory, reduce funds tied up. Enterprises, taking the JIT model which requires supplied materials sending as the request time, place and quantity can make the inventory zero or close to zero.

Automobile manufacturers make purchase based on the demand prediction and inventory management strategies of Market Department. But it is a very complicated work about how to comprehensively evaluate quality and price. So according to lean thinking, we build the following purchase model.

① Assumptions
- Product is produced according to orders, not priority. And just take consideration of important goods. The total number of material kinds P is known.
- In product purchase, there is fixed purchase cost relating to kinds instead of quantity.
- In product purchase, there is variable cost (unit price) relating to both kinds and quantity.
- All cost is known or can be known through calculation.
- Ignore depreciation expense.
- Factories have max and min capacity constraints.
- The lead time of material purchase is known. The materials on the process of transportation is considered as supplier inventory and can be punctually sent.

② Sign descriptions
- T: stages of production plan. Each stage can be shown as 1, 2, 3...t...T
- P: kinds of materials. Each kind can be shown as 1, 2, ...p
- MaxC1: Max production capacity in stage t.
- MinC1: Min working utilization rate in stage t.
\(M_t\): Max capacity of storage.

\(f_t^P\): Fixed purchase cost of materials in stage \(t\).

\(c_t^P\): Variable purchase cost of materials in stage \(t\).

\(h_t^P\): Inventory cost of every unit of rest \(P\) from stage \(t\) to stage \(t+1\).

\(d_t^P\): Quantity demand for \(P\) in stage \(t\).

\(s_t^P\): Inventory quantity of \(P\) at the beginning of stages.

\(x_t^P\): Purchase quantity of \(P\) in stage \(t\).

\(\delta_t^P\): take 1 when purchasing \(P\) otherwise take 0 in stage \(t\).

\(b_t\): Fixed cost of starting work.

\(k_t^P\): every unit of variable cost of processing \(P\).

The first constraint condition in above models means continual relationship of various materials inventory. The second stands for the upper line of inventory quantity. The third means no order no replenishment and the fourth means production capacity constraint.

4. Conclusions

Based on the developing situation of Chinese automobile industry and logistics, this paper studies introduction of lean logistics to automobile manufacturers from the angle of supply logistics. Based on other theory and practice, it is shown that lean logistics plays a very important role in lowering cost, cultivating competitive advantages. Certainly, there are a lot of problems in the process of introduction. Though many enterprises are pursuing lean production and lean logistics, most of them lack of enough preparations, explicit implementing procedures and clear improving goals. So it does not bring expected benefit because much work just stay in the surface such as new concept of management, clear working place(at the expense of high cost)and more new machines. While essential change of attitude, eliminating waste, lowering cost ans improving integrated operation level are not done. Therefore, when enterprises introduced lean logistics to production, they should avoid taking all work equally important, but implementing it in several stages based on enough preparations, integrating implementing plan and good control ability. Thus, Through collaborative innovation of supply-chain, production and distribution logistics in different stages of logistics operation, eventually logistics integration can be realized inside a enterprise through the supply chain and further among enterprises.

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