Distribution Precision System in the Last One Mile of Steel Distribution

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Abstract. A serious management problem for steel distribution will be caused when downstream customers change their production modes from order forecast to pull production. To achieve the precision delivery to clients, DPS (Distribution Precision System) is designed by adopting modern logistics and lean manufacturing concepts in this paper. The application of DPS in WuHan BaoSteel Central China Trading shows that intelligent control, precise distribution and business process automation can be achieved under the condition of lean manufacturing. Furthermore, information barriers in the whole supply chain are eliminated to implement process share and improve the efficiency.

Introduction

Since the world has set off a new wave of innovation and revolution, the development and industrialization of mobile internet, intelligent terminal, big data, and internet of things technology has made a significant breakthrough in the field of traditional industries. For instance, intelligent manufacturing, intelligent transportation, and smart devices have converted the traditional industries into the high-speed development period. With the gradual appearance of overcapacity in Chinese steel industry and the contradiction between supplies and demands, steel companies become cautious in capacity expansion and structure adjustment. Competition among enterprises has gradually changed from output to the service for customers so that companies can focus their profit points on logistics as the third profits source. Thus, Chinese companies are paying more and more attention to steel logistics and information management so as to improve economic benefits and decrease the costs. Meanwhile, steel companies have turned to provide products and services with abundant contents. The boundaries between internet and manufacturing, as well as production and service, become blurring nowadays.

With the rapid increase of automobile production and intensified competition, production efficiency and cost control become an endogenous power for the high-speed development in automobile enterprises. Due to different production cycles and patterns, any fluctuation in the supply chain would cause unpredictable influences to the eventual assembly of the automobile in the traditional cooperation between steel and automobile industry. Consequently, a large quantity of inventory must be stored in each cache of the supply chain to ensure precise supply of material and parts within limited delay, which not only inhibits the efficient operation of the supply chain, but also bring continuous cost pressure in some certain period. However, by means of advanced visual information technology and mobile internet, it is possible to build a closer cooperation mode between steel companies and automobile customers.
Preliminaries

Distribution Precision System

In this section, DPS will be introduced. First, the situation of supply chain and steel distribution supply chain will be introduced. Second, the current problems of the supply chain operation will be presented.

In the traditional cooperation between steel and automobile industry, the companies’ production is organized in a predictive way. Based on the planned model and past production data, the companies’ operations are organized, including raw material procurement, preparation for processing ability, logistics distribution and safety inventory control. In the traditional cooperation between steel and automobile industry, any fluctuation in the supply chain would cause unpredictable influences to the eventual assembly of the automobile due to different production cycles and patterns. As a result, a large quantity of inventory has to be stored in each cache of the supply chain so as to ensure timely and precise supply of materials, which not only inhibits the efficient operation of the supply chain, but also makes the operation cost increase causing continuous cost pressures in a certain period. In order to ensure supply for customers, steel processing units have to store triple monthly requirement in the upstream supply chain (including in-process inventory, on-road inventory, inventory of raw materials, processing inventory, finished goods inventory, etc), which leads to high inventory and capital precipitation in the companies.

Current JIT (Just in Time) mode ensures normal operation of the supply chain. However, the following problems exit in the process of operation. First, high inventory exists in the supply chain. In order to ensure timely delivery to downstream customers, the upstream has to increase their inventories so as to guarantee the supply. JIT mode does not solve the problem of high inventory throughout the supply chain. Instead, it even aggravates the phenomenon of high inventory. Second, slow response exits. In current supply chain, information transmits in a single-point linear. Problems exist in any link may interrupt information transmission. As a result, procurement, processing and delivery instructions could not deliver normally, leading to a shut-down of the production line. Based on the linear transmission of distribution business, upstream suppliers have to wait for the information passed down by downstream. Then steel enterprises start to arrange their work, which causes a slow response. For the purpose of quick response, upstream suppliers arrange production in advance based on the past production data, bringing lower precision in the management and low accuracy of service. Service accuracy in the former distribution mode was calculated by day while it is calculated by hour after the application of DPS.

Nowadays, the information technology makes the boundaries among supply chain units disappear, and changes the mode of production management and information. It will also make business information more transparent and change passive acceptance to active acquirement. By fully sharing information of inventory, production capacity and logistics, managers could dynamically adjust safety stock, capacity allocation, and logistics scheduling. Consequently, the cost of the whole supply chain down is reduced. Finally, everyone in the supply chain can share the output of cost reduction and achieve win-win situation.

Data Monitoring in DPS

The development of information technology makes business cooperation, information share, and big data prediction possible. Through data monitoring, a large quantity of complex and real-time business information could be monitored in the distribution process, and dynamic information can be presented timely for quick response decisions. By combining dynamic data monitoring with visualization technology, supply chain units can realize real-time monitoring to the whole process information in all links. With mobile terminals, drivers can clearly acquire transport task and dynamic information during transportation. Logistics management persons and customers can clearly know transportation details, such as driving into the factory, starting to load, finishing loading, leaving factory, arriving at the destination, etc. With mobile terminals, customers could get
information about today and tomorrow's transportation plan and implementation situations anytime and anywhere. Then, they could track specific transportation condition and geographical position of each vehicle so as to achieve convenient preparation and adjustment. They could also get the changing information immediately and give feedbacks quickly. To improve the work efficiency in the automobile manufacturing enterprise in our country, Liu has constructed basic framework of lean logistics system and put forward related construction methods, as well as provided guarantee and foundation for the implementation of lean logistics system in manufacturing enterprises [1]. Meanwhile, Electronic data interchange (EDI) is produced according to the general standard format prescribed uniformly. The electronic computer systems of cooperative partners could exchange data and process the information automatically.

Management Refinement

Through the revolution of organizational structure, personnel organization, operation mode and management mode, the concept of lean production is introduced. It aims to compress invalid operation time in the production process as far as possible, and make full use of the effective operation time, so as to streamline all useless and redundant operations and enable the system to respond according to users' needs flexibly. "Multi-varieties, small batches, more batches” can be achieved. Modern logistics management mode is to decompose logistics links, define and optimize logistics process, achieve logistics tracking and dynamic adjustment by using information technology to collect logistics information [2,3]. Besides, it can improve the efficiency of loading and unloading, and reduce waiting time and invalid shift of vehicle logistics in the factory, so as to reduce logistics costs, improve arrival punctuality rate, and timely receive users’ requests.

Distribution refinement management integrates modern management thinking and information technology with actual work in the enterprises. Combining lean manufacturing [4] with modern logistics, supply chain management is proposed to adapt to new manufacturing modes of strategic users, continually enhancing the level of strategic cooperation and gather/lock users. It not only upgrades level of processing and distribution supply chain management, but builds an intelligent, automatic, and visualized collaborative platform. Owing to virtue of mature network platform, the collection of model plans, forecasting demands, releasing plan management of producing, logistics management, business process control, early warning, and satisfaction evaluation, are integrated to provide customers with reliable control plan of whole process and achieve refined management.

Implementation of DPS

Technology Roadmap of DPS

DPS is a management system of steel distribution under the conduction of lean manufacturing and modern logistics. Meanwhile, it integrates with current operation performance of steel processing centers for downstream users, and aims to find a better way to solve timely and precision delivery problems. It attempts to solve high inventory problems in the supply chain. Details are shown in Figure 1.

Business flow chart and function structure of DPS

Business flow chart gives a brief introduction for steel distribution business. Through application of DPS, information could be shared among all links of supply chain, enabling each link to make business preparations, such as preparation of raw materials, processing capacity, and transport capacity. It makes it feasible for all links to have spontaneous adjustment ability and enhance response speed of supply chain as shown in Figure 2.

Implementation of DPS

Step (1) Designing management processes and solutions

While model production plans of the vehicle company are shared in the whole supply chain, demands of raw materials and supply of products can be calculated for all links in the supply chain,
based on the unit consumption data. And with fluctuations timely delivered to the whole supply chain, all links would have consistent fluctuate and frequency, so as to reduce bullwhip effect and guarantee downstream raw material supply while reducing safety stock.

Figure 1. Implementation of technology roadmap in automobile steel distribution business.

First, Lean Manufacturing is Integrated with the Whole Supply Chain. Information sharing and delivery among all links of supply chain helps all units to dynamically establish reasonable products inventory. According to delivery, demands and production plans of the upstream and downstream in supply chain is generated. During the process of inventory establishment, production plans are converted to steel demands in the near future.

Secondly, Logistics Links and Refined Arrangement are Finished. As steel transportation is a kind of heavy logistics, distribution companies have to handle internal logistics and external logistics. According to logistics distribution route optimization, effective logistics distribution on
the GIS (Geographic Information System) has been designed and implemented an optimum distribution solution due to traffic problems [2]. In the internal logistics, processed small coils and board packages are always distributed to different places in the warehouse. Unavoidably, vehicles have to route between all products warehouses. Refined management can help to determine the path of a vehicle according to storage location. Standard labor hour can be designed according to cargo types (plate, coil) and equipments. As a result, the routing plan of every vehicle and deliver plans of every transportation unit is generated. The distribution information will be sent to logistics board and mobile applications of drivers.

Last, Task Pushing and Early Warning Mechanism is Established. According to business procedure and standard labor hour, links of task pushing and early warning are formulated to load information received from the supply chain into internal business chains. At the same time, the abnormality and fluctuation in the business chain can be shared so as to wipe out information asymmetry in the supply chain.

**Step (2) Developing information system to support distribution precision management**

DPS focuses on refine management and logistics organization, planning layout of lean manufacturing and inventory coefficient setting. Also, it achieves fully information transmission and sharing, unifies operation rhythm of supply chain and flattens fluctuation in the supply chain.

DPS could be used by customers, processing and distribution centers, and logistics service parties. These roles can allocate demands and production capacity flexibly, quickly responding to customers’ demands, and achieving precise distribution service. DPS can help customers guarantee intelligent, automatic, visual and mobile service in steel supply chain.

**Economic Benefits of DPS**

**Achieving Operational Monitoring of Processing and Distribution Business.** DPS is also a kind of process management, which generates operational standard of process and distribution supply management after confirming business implementation process, decomposing business procedures and blocking out process indicator standards. Internet makes us acquire the operational data and monitor each key point in the supply chain. With the popularization of GIS, we have designed dynamic route plan of logistics system on the GIS platform without any delay. We also can accomplish many other functions such as forecasting, warning and reminding of abnormal inventory, etc. as shown in Figure 3.

Figure 3. Logistic control and warning board in DPS.
Promoting Improvements of Business Efficiency and Management Precision. DPS can greatly enhance overall efficiency and precision management by adopting refine management. While customers’ demands in JIT distribution are met, lean manufacturing could reasonably control inventory level and guarantee profit. Comparison results are shown in Table 1.

Guaranteeing Refinement of Scene Management Through Modern Logistics Organization. DPS reasonably arranges loading plan and separation through intellectualized methods, improving maximum usage efficiency, and reducing waiting time of vehicles. It could inform operational personnel to load quality and safety requirements. Using the spare time of operational personnel through planning board, DPS could adjust coil stock and reduce time of locating goods.

Leading Service Ability Improvement for Suppliers in Upstream of the Supply Chain. On the one hand, DPS helps to make management requirements and standards more precise and quantitative. On the other hand, suppliers could optimize their own management mode, procedure and requirements, so as to further meet the requirements of steel distribution center. Then, suppliers would develop the business cooperation with companies healthily and sustainably.

<table>
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<th>Type</th>
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<th>After implementation</th>
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<td>Working out production plan</td>
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Conclusion
To ensure the normal operation of the supply chain in the steel distribution, DPS is designed to solve the management problem caused by downstream customers changing their production modes from order forecast to pull production. By adopting modern logistics and lean manufacturing concepts, DPS aims to find a better way to solve timely and precision delivery problems for downstream users. The application of DPS in the field of automotive steel distribution shows that the overall inventory of supply chain could be reduced with promoting the efficiency of supply chain and decreasing the overall cost.

References