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Current Problems in a New Distribution Center Under Labor Shortage

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Abstract. With economy globalization, the distribution center becomes very popular in the supply chain. A well-equipped distribution center empowers a company to deliver products and service to customers whenever it is required. Under-staffing is becoming a severe issue among a lot of distribution centers, which directly affects normal operations including unloading and loading, sorting and shipping activities, and these factors lead to a poor on-time delivery rate to customers. In this paper, we take an automotive accessories manufacturer and distributor as an example. We analyze its existing problems by comparing the corresponding process and data.

Keywords: Distribution, supply chain management, labor shortage, slip sheet loading.

1. Introduction

Different to the main function of the warehouse, a distribution center focuses on the flow for both product movement and information transaction between suppliers and customers [1]. The problem considered in this paper is similar to the Fast-Moving Customer Goods company.

1.1 Related Literature

Researchers have considered how to maximize the Customer Service Level (CSL) under limited production capacity [2]. They developed a CSL model by ranking customers priorities so they can keep the CSL with fluctuated demands. This paper was more focus on product supplies allocation and work out the sensitivity weights of the model which can be the reference to define constraints. There are also many studies on inventory management with a risk management focus [11,12], but our paper differs from this literature stream by examining logistics activities.

1.2 The Focal Company

This paper is based on the practice of an international firm, and we refer to it as HOP. The problem facing by HOP is that they need to pay more overtime wages, arrange more air freight, and maintain a high inventory to keep normal customer service level, and all of these are costly. While the root cause of the problem (labor shortage) cannot be cured, without an effective solution to relieve the pressure of labor shortage, the problem will become more and more serious, leads the whole company to a risky condition.

2. Statement of HOP Current Problems in New Distribution Center

2.1 Distribution Map of HOP Manufacturing Plants and Warehouses

Before 2018, HOP had three main manufacturing plants located in Kansas, Oklahoma, and Ontario with distribution centers. They mainly produce towing products and winter products as well as simple injection molding and hair planting products with high degree of automation. Meanwhile, HOP has another three distribution centers held by Carrand, Bell, and ACME before the acquisition. They are very typical importers, and their warehouse is used for stock, and the products were mainly imported from China.

2.2 The Reason to Launch a New Distribution Center

Ortiz Duran & Hawks worked on the project for a fast-moving consumer goods company which was similar to the procurement network at HOP. They established a model to calculate the Total Relevant Cost (Transportation Cost + Holding Cost + Distribution Center Handling Cost), it was shown that Total Relevant Cost of the entire supply chain could be saved by about 4.4% through adding distribution center to centralize inventory [3].

HOP merged with various companies not only to accommodate their product line but also to reduce its competitors, because some of their suppliers and customers were overlapping. Customers have different brand preferences, and subsidiaries of HOP had different requirements on their suppliers, the integration process after acquisition was not smooth as expected. Sometimes there were goods from the same supplier to different distribution centers of HOP, but they could not consolidate those shipments due to different delivery locations, resulting in waste of resources. Geographically, the distribution of these factories and distribution centers was reasonable, but considering the compatibility of product categories, the excessively decentralized distribution status affected the overall control.

Different to decision making on transportation, inventory and information sharing, decision about a distribution center in the supply chain will be more sophisticated, as it is related to facility and equipment which are costly and hardly to be relocated [4]. There are lots of factors affect location selection decisions, such as natural resources, labor, taxes, tariffs, and political elements [5]. To HOP, the target market customer is the main factor for decision making.

Because of constantly stable development of the American automobile aftermarket and the positive prospection for the future. HOP plans to expand the market as a long-term strategy. Meanwhile, spurred by a reduction in the corporate tax from 35% to 20%, HOP received a series of favorable public policies, and finally HOP Manufacturing Corporation decided to establish a new distribution center in 2016 to meet the growing demand for storage and transportation.

2.3 New Distribution Center Location and Functions

The concept of a distribution center was introduced in the early 1990s, Bancroft compared the handling in warehouse and distribution center, and he suggested to remove some operations in warehouse and most focus on receiving and shipping, which towards to mainly activities in distribution center [6]. The function of the distribution center can be extended to a make-bulk / break-bulk consolidation center, a cross-dock facility, a transshipment facility, an assembly facility, a product fulfillment center, a depot for returned goods, etc. Higginson & Bookbinder, Daskin, Snyder, & Berger considered the location of the distribution center based on various conditions and used the models to optimize the fixed cost of facilities, transportation cost, integrated location and routing problem, integrated location-inventory problem, and planning under uncertainty [7].

HOP launched a new distribution center in Edgerton, 80 miles from its headquarters which is about 1-hour driving. The new distribution center located near Logistic Part of Kansas City and only 8 minutes driving from the BNSF which is very convenient for container loading, unloading and transportation. BNSF owns about a quarter of America's rail infrastructure, has more than 40 intermodal yards across the country, and in Kansas it has a large logistics park, which attracts lots of importers and retailers.

The function of this distribution center is to transfer all finished products, including the shipment with selling package from overseas and all finished products from other 3 manufacturing facilities. The activities include but not limited to unloading, picking, sorting, storage, and shipping. As the new distribution center put into operation in July 2018, HOP closed the distribution centers in Carson, CA, Urbandale, IA, and Tarpon Springs, FL. The distribution function in Miami, OK was also closed. The rest plants in Emporia, KS and Blenheim, ON Canada keep running but their distribution centers are only for semi-products and materials.

2.4 Main Complains from Customers and the Root Cause of Problems

With the first shipment arrived in Edgerton in July 2018, HOP closed the distribution centers in Carson and Urbandale gradually. In the meantime, the new distribution center handled all imports from abroad, it also handled inventories transferred from other distribution centers. We can find that the cargo volume reached peak in August 2018.

It was clear that HOP was not well prepared for this situation, as the entire distribution center had only 40 staffs at the beginning, compared with 64 before the rest of the distribution centers were laid off. However, the standard allocation to fully run the new distribution center is more than 100 employees. Even though the workers worked overtime and switched from the original day shift to 2 shifts, the delay of transshipment occurred every day. HOP received customers complaints about late shipments because of manpower shortage in Edgerton and chaotic inventory transfers between different distribution centers. The manpower shortage caused delays in each step of distribution center's operations. Based on an annual report of 2018, the on-time delivery ratio from HOP to customers dropped to 90%, and the record in 2017 was 98%. The delay is mainly due to the slower handling of each order in the distribution center which was 30% longer than the normal processing time. The late delivery led to more complaints from customers, some customers canceled their orders or required air shipment to get expedite delivery. To meet customers' requirements, HOP aired almost 10 tons from China to the US in 2018, which cost extra US$300,000 on air freight.

In fact, in the meantime, HOP has been trying to recruit new staff, offering salaries well above the local average, but the situation was not recovered. We learned that Kansas is an agricultural state with a very scattered labor force. The population to entire state of Kansas was just over 2.41 million, and Edgerton, the city in which the new distribution center located. As you can easily find that the unemployment rate in Kansas was lower than the whole country. The unemployment rate in the United States has been declining for nearly a decade, which is a sign of economic recovery.

As the problem of labor shortage could not be solved quickly and effectively, the operation pressure of distribution center became more and more stressful, and the customers complained more and more fierce. Therefore, how to reduce the overall operation pressure in distribution center has become a pressing objective.

3. Analysis of HOP Current Problems in New Distribution Center

3.1 Distribution Center Activities Analysis

In order to get a clear map to the activities in distribution center, we specify the tasks with spent time. Currently the activities in distribution center can be split into three parts, they are inbound activities, in process activities and outbound activities and each task can be listed in Table 1, note ST for "standard time" and we will use it for time calculation in the later section.

Table 1 Process Activities in Distribution Center

	Tasks	Nomenclature
Inbound Activities	Receiving	ST_1
	Unloading	ST_2
	Put-away	ST_3
In Process Activities	Sorting	ST_4
	Order picking	ST_5
	Packing	ST_6
Outbound Activities	Loading	ST_7
	Shipping	ST_8

From the literatures regarding to distribution center operations, we have learnt that the most time-consuming activity is order picking because it is related to traveling in the facility. We got a relatively average standard time by counting the operation time from dozens of groups of different products, so this time is just a relative standard and cannot represent all the categories. If the product is very special, we will time the task case by case.

Due to the company's privacy, the data we chose for the employee wage is the median number of warehouse-related industries in Kansas in 2018, which was US$13.56/hour. Then we choose a single item, that means only one product is loaded in a container. The dimension to the carton is 38.5*38.5*8.5 cm/ case, and normally the loading quantity is 5208 cases/ 40'HQ. The total time we calculate for distribution workers to finish the whole process is 80.4 hours and the result is presented in Table 2.

Table 2 An Example to Activities Time Calculation in Distribution Center

Tasks	Nomenclature	Standard Times
Receiving	ST_1	2 Minutes/ Container
Unloading	ST_2	16 Hours/ Container
Put-away	ST_3	1 Hour/ Container
Order picking	ST_4	30 Seconds/ Case
Sorting	ST_5	6 Seconds/ Case
Packing	ST_6	5 Seconds / Case
Loading	ST_7	4 Hours/ Truck
Shipping	ST_8	2 Minutes/ Truck
Container loading quantity: 5208 Cases/ Container		

From the sample we calculated the relevant cost for the shipment completed the whole process in distribution center and the total cost is about USD$ 1090. Base on the yearly quantity of containers and cases handled in year 2018 the variable cost to the tasks was almost 3 million US dollars. Of course, it only covers the cost when every task moves smoothly without any incident of each step.

3.2 Upstream Suppliers' Activities Analysis

In fact, the supplier's task is to translate the customer's requirements into real operation. Yan & Tang described in great detail what suppliers can do in pre-distribution mode which including bar coding, labeling, sorting and delivering to store directly by cross-dock [8]. This article gave us a great enlightenment, and we began to consider whether our suppliers could divert part of distribution center activities, to reduce the existing labor shortage pressure.

Once the production is finished, our supplier will load the goods and submit the required documents according to the required delivery, after that the shipment is completed. We released loading requirement to the suppliers and asked them to separate the goods according to the item in the case of single purchase order shipment, that is, one item is loaded after the other item is loaded completely.

If multiple orders are loaded together, we required shipment to be separated according to the order number, that is, one order is loaded after another order is loaded completely. Most of our shipments are multiple-order shipments. In the case of multi-order shipment, there will be different orders with the same items, it still needs a lot of manpower to arrange the unloading and sorting after container arriving in distribution center. An effective way to reduce these activities is the batch packing, and pallet is common method of batch packing.

We intended to calculate the supplier's time cost in the form of pallet, which mainly involves three tasks-stowing cased onto pallet, wrapping pallet with plastic wrap and loading pallet into container. The product in the previous section is used to make the pallet, and the time obtained is shown in table 3, SST stands for "supplier standard time".

Table 3 Standard Handling Time for Supplier to Load Pallet

Tasks	Nomenclature	Standard Times
Stowing cases on pallet	SST_1	3 Minutes/ Pallet
Wrapping pallet	SST_2	1.5 Minutes /Pallet
Loading pallet	SST_3	4 Minutes /Pallet

Different type of pallet has different size, the US standard pallet size is 48×40 inch and typically height is 5 inch. The existing dimension will occupy the container space so pallet loading will always decrease the container utilization. Slip sheet, like pallet, are made by brown paper but can save 10% space against pallet [9]. Therefore, we considered using slip sheet instead of pallet, which can take the function of pallet, and be more optimized in terms of cost as well as container utilization. However, if there is no equipment to support loading, the time will double when compared with pallet. Solving these operational problems can improve system efficiency [10].

3.3 Activities Comparison Between Suppliers and HOP Distribution Center

Our primary purpose is to see whether the workload in distribution center can be diverted to the upstream suppliers to effectively save operation time. We analyzed the time by floor loading and slip sheet loading for a single product for the whole inbound, in process and outbound process, using the size of the previous product. The result is shown in Table 4.

Table 4 Standard Handling Time Comparison between Floor Loading and Slip Sheet Loading

Tasks	Standard Times	
	Floor Loading	Slip Sheet Loading
Receiving	2 Minutes/ Container	2 Minutes/ Container
Unloading	16 Hours/ Container	2 Hours/ Container
Put-away	1 Hour/ Container	12 Minutes/ Container
Order picking	30 Seconds/ Case	3 Minutes/ Slip Sheet
Sorting	6 Seconds/ Case	2 Minutes/ Slip Sheet
Packing	5 Seconds / Case	5 Minutes/ Slip Sheet
Loading	4 Hours/ Truck	2 Hours/ Truck
Shipping	2 Minutes/ Truck	2 Minutes/ Truck

From above sheet, we can find the total time needed for whole process of slip sheet loading is only 14.3 hours, which can save 82% comparing with floor loading pattern. The data gives us much confidence that the slip sheet is workable.

HOP has more than 3000 SKUs, we need to aware that each item has different package sizes. It means each slip sheet will be a unique one without standard pallet size. We need to adjust size of slip sheet with rational quantity, in order to maximize the utilization of container loading rate, on the other hand, we also need to consider quantity of brown paper, shrink wrap, corner board and other materials used to make a slip sheet because every piece of them costs money.

In addition, we also need to select suppliers to perform the project because not all suppliers are willing or able to do this project. Some suppliers have a small amount of goods, simply is hardly reach the quantity of full container. Some suppliers think that the operation of slip sheet so difficult to their capability. So, we chose two large suppliers for the pilot. Both suppliers have been working with HOP for more than 20 years, which is a relatively sticky community, and they also have enough volumes to optimize through constant practice. These improvements can save inventory expenses and reduce risks [11-14].

4. Conclusion

This paper mainly analyzes the current situation that HOP encountered, to understand and identify the problem. Based on the principle of bin packing, we found several practical items will be selected to test the saving of operation time when normal boxes are replaced by slip sheet. We also calculated the proportion of whole operational activities and check which part can be transferred. After that we would choose capable suppliers to carry out the transferred operational activities.

Author in Brief

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