The Study Base on VMI in Inventory Management of Chain-supermarket

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Abstract: With the beginning of the theory on supply chain management, this paper analyzes the existing problems of inventory management in supermarket chain, and introduces the technology of VMI. According to the inventory analysis, evaluation and improvement of chain-supermarket, this paper establishes the inventory management model base on VMI, in order to improve the level of inventory management of chain-supermarket.

Keywords: Chain-supermarket; Supply Chain Management; Inventory; Vendor managed inventory

I. Theoretical Study of Inventory Management

Chain-supermarket is a typical price-based industry, and the difference in the products' sales price is the main performance on the competition. As is known to us, the products all coming from suppliers, the supermarket can not reduce costs in production, so they can only control the management of commodity circulation to cut cost. Inventory management is an important aspect of commodity circulation management, and it works a crucial role to reduce the cost of sales. In order to reduce the cost of inventory and improve distribution efficiency, this paper analyzes the existing problems of inventory management in supermarket chain, and establishes the new inventory management model base on VMI.

Attributed to domestic and foreign scholars, the studies on the traditional single-stage inventory have been more perfect and mature, including the classical strategy of Order Point Control, MRP, MRPⅡ and so on. However, the inventory management of supply chain simply stays in the traditional patterns. There is a long way to change the traditional inventory management into supply chain inventory management for China.

A.   What is inventory
Inventory refers to reserving materials or commodities in order to reduce the risks of uncertainty in the production and business activities. The objective of supermarket's inventory is to ensure the normal supply of goods and avoid the loss because of shortages.

B.   What is VMI
Vendor Managed Inventory refers to a new mode that supply-side manages the buyer's inventory level, that is to say, the supply-side determines when to replenish goods and how many goods to fill. This is a supply chain management technology which can reduce logistics costs and compress inventory. VMI technology can replenish the goods with the most efficient method for different goods. According to the VMI, the suppliers can use database and information-processing technology to monitor the level of product inventory and forecast commodity flows. Therefore, it could avoid stock-out effectively.

This paper introduces VMI technology into the inventory management of chain-supermarket, in order to improve the existing level of inventory management.

II. Inventory Management Analysis of Chinese Supermarket

There are many business modes of supermarket in China, such as standard chain-supermarkets, warehouse supermarkets, convenience stores. Whether to adopt a single store operation, chain management, or mixed operating supermarkets, in the environment of supply chain management, the main problems of Chinese supermarket can be integrated into the following aspects.

C.   Lack the concept of viewing the supply chain as a whole
Evaluation of the supply chain is a comprehensive indicator, whose ideological essence is using a series of measures to increase the efficiency of the whole supply chain, rather than the performance of a prominent node. In China, the inventory management of chain-supermarket tends to fall into treat the performance of distribution center as the whole supply chain performance.

D.   Poor communication between the supermarkets and suppliers
The premise of supply chain management is to delivery the information timely and accurately between enterprises, but information system of most enterprises does not integrate well. To a certain extent, this situation lead to the sluggish of information systems, such as information lag product by business response to customer demand. Just because of this lag, the bullwhip effect will be to further enlarge, thus affect the overall efficiency of the supply chain.

E.   Ignore the impact of uncertainty
The operation in supply chain exist many uncertainties, such as order lead time, transport situation, the production of suppliers, store sales, transport time and changes in demand. Many supermarkets ignore the impact of uncertainty on

inventory as well as the real cause of uncertainty, and led to the supermarket can not control the inventory completely.

F.   Simple the inventory control strategy

The purpose of inventory control is to ensure the continuity of the supply chain and meet the uncertainty. It requires enterprises to understand the uncertainties, and then formulate the appropriate inventory control policy by the tracking information. It is a dynamic process, because uncertainties are constantly changing. However, many chain-supermarkets adopt uniform inventory strategy, without considering the uncertainties of demand.

G.   Lack mutual trust and long term cooperation

Most supermarkets and suppliers are lack of mutual trust and long-term cooperation, so the uncertainty is magnified when it passed the supply chain. Therefore, it may reduce efficiency of overall supply chain.

III. Inventory Management Model Base on VMI

H.   Model
1) Model Export

According to the status of chain inventory management, this paper presents a new model which meets the following conditions.
- Cost is the primary factor considered in inventory management.
- This paper set "s" as the safety stock, and operate inventory policy using (s, S). That is to say, When the stock is less than "s", it must immediately issued an order to keep the inventory levels achieving S; otherwise, no order.
- By using the new model, suppliers can check inventory levels and demand situation, and then replenish goods to the distribution center. We set "T" as replenishment cycle, and introduce "Q" as replenishment quantity

In the above-mentioned conditions, we should obtain not only the need of the stores, but also get the ordering, inventory and long-term average expected total cost. Only in this way, can we get more optimal T and Q.

In order to solve the problem, we should make the following assumptions.
a)   The delivery time among the manufacturers, distribution centers and warehouse centers is zero.
b)   The forecast demands of each distribution center made by suppliers are correct.
c)   The demand from customers accords to the "Poisson Distribution", also they are independent and identically distributed.

At the same time, we introduce the following notation.
- K_R ：The fixed costs required for a purchase (Yuan/time)
- C_R ：Unit purchase cost (Yuan/piece)

- K_D ：The fixed costs required for a time delivery (Yuan/time)
- C_D ：Unit delivery cost (Yuan/piece)
- h ：Unit inventory cost required for a time of retailers (RMB / week)

Based on the above description, K_R and C_R are the cost taking by the purchase，and "h" is the cost of the retailers' inventory，then K_D and C_D are the cost required by delivery.

If the customer demand of each store is a random process, and it also meets the Poisson Distribution whose parameter is λ1. We set C = C (Q, T) as the long-term expected average total cost. So we can get the following requirement.

Min C(Q,T)
St.   Q≥0
       T≥0

Solving model:

$$T = \sqrt{\frac{2(K_R + K_D)}{h \sum_1^n \lambda_1 (K_R + K_D)}} \qquad \ldots \ldots (1)$$

$$Q = \sqrt{2h \sum_1^n \lambda_i (K_R + K_D)} \qquad \ldots \ldots (2)$$

2)   Pay Attention

The new inventory management model can to some extent reduce inaccurate information from demand prediction. We should attention that the model mainly emphasized on the initiative of the suppliers. This model provides that the supermarkets should pay attention to establish partnership with the suppliers and improve the information systems. They mainly reflect in the following points.

a)   Improve the information systems

At present, The information system of domestic supermarket is relatively backward, and many devices are introduced only when building the new distribution center. But, the development of information system carries out a critical influence on the other nodes in the supply chain.

Based on the supply chain management, the new inventory management system requires the suppliers to be able to keep track and check the sales information and inventory consumption information of chain-supermarket. Only in this way, the new model is able to quickly respond to their needs change. Therefore, it is important to establish a sound and transparent information system when operating the VMI strategy.

b)   Use Joint Distribution as soon as possible

Joint Distribution refers to combine many chain-supermarkets together to come to rationalization of the overall logistics and distribution. Under the principle of mutual reciprocity and benefit, all enterprises which take part in the Joint Distribution are supposed to build distribution centers together, make common plans, and implement common distribution for the same regional.

c) establish the performance evaluation of supply chain inventory

It is essential for chain-supermarkets to establish the performance evaluation. Only in this way, can the supermarkets reflect the operations of the supply chain scientifically and objectively, take effective inventory strategies, and optimize the supply chain management.

B.   Process Design

In order to apply the inventory management based on VMI, we should abide the following steps, as shown in Figure 1.

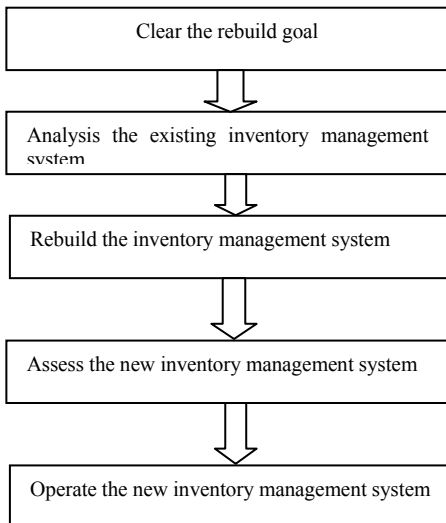●   Step 1: Clear the rebuild goal of inventory management system. That is to establish an inventory management system which has a certain size, variety and volume of distribution centers based on supply chain.

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┌─────────────────────────────────────────┐
│          Clear the rebuild goal          │
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┌─────────────────────────────────────────┐
│ Analysis the existing inventory management│
│ system                                   │
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│   Rebuild the inventory management system │
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│  Assess the new inventory management system│
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│ Operate the new inventory management system│
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Figure 1 the general process of rebuilding VMI

●   Step 2: Analysis the existing inventory management system. That is mainly to analysis the status quo of existing inventory management system, including methods of inventory management, effects of inventory management, condition of kings of hardware and software and logistics personnel status.

●   Step 3: Rebuild the inventory management system. Under the principles of stability and development, it is necessary to design the processes and patterns of new inventory management system, and then lays out the workflow based on VMI model.

●   Step 4: Assess the new inventory management system. That needs some mathematical models which are used for forecasting and decision-making to analysis and assess the new inventory management system. If the existing problems are resolved, it works; otherwise, re-engineering.

●   Step 5: Operate the new inventory management system. It is essential to operate the new inventory management in accordance with the results of the above steps strictly. If it runs well, we can make it up; otherwise, reengineering.

IV. Conclusion

This paper proposed a method of inventory management can effectively solve the problem of domestic chain-supermarkets, such as inventory backlogs, out of stock frequently, failing to fully exploit the reservoir area, and serious damage of cargo. And it also gave the advices to enhance the economic benefits of the supermarket and rebuild the distribution center.

However, limited by the level of knowledge and the paper length limitations, the analysis of this paper is not very profound. We sincerely hope that this paper would be able to play the role of attracting valuable opinions in the inventory management, especially in the supply chain management.

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