Research on Improvement of Inventory Management of Enterprises Based on MRP

Taking Diyan Knitting Co., Ltd. in Changle as an Example*

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Abstract—**In recent years, the total business sales of the textile industry in Changle, Fujian have grown rapidly. However, the inventory management of textile enterprises is generally poor, and there are problems such as the large proportion of business capital occupied by inventory and the high cost of inventory management. In order to explore whether the procurement model based on the material requirement planning (MRP) can solve the above problems, we have set the conditions according to the actual operation situation of a representative textile enterprise in Changle, simulated the quantity changes of the enterprise's inventory in 10 weeks on the condition of using the MRP procurement model, and compared it with the inventory quantity obtained by using the original regular purchase mode of the enterprise under the same other conditions. The results show that the MRP procurement model can effectively reduce the inventory of enterprises, reduce the proportion of business capital occupied by the inventory, reduce the fluctuation of inventory quantity, and reduce enterprises' inventory management costs. So the MRP procurement model is worth promoting to other similar enterprises.**

Keywords—inventory management; material requirement planning (MRP); textile enterprises

I. INTRODUCTION

The textile industry is the pillar industry in Changle, Fujian, China. From 2012 to 2017, the total business volume of the textile industry in Changle increased from 294.7 billion yuan to 172.92 billion yuan. The total number of textile enterprises is about 1,200 now, with an annual output of nearly 3.8 million tons of staple fiber, filament and yarn, and about 1 million tons of nylon civilian silk. The fabrics and lace products account for 1/5 of the Chinese market share, and several industrial clusters in chemical fiber, cotton spinning, warp knitting, dyeing and finishing, clothing, etc. have formed, and the largest textile

professional market in southeast China has been established in Changle.

However, it is pointed out that the following four problems are common in the textile enterprises in Changle. (1) The capital structure of the enterprise is not good; (2) the comprehensive operating cost of the enterprise is high; (3) the enterprise will be easily affected by the fluctuation of raw material prices; (4) and there are insufficient measures about energy conservation and environmental protection. The first three problems are all related to the inventory management of enterprises, reflecting that the inventory management of textile enterprises in Changle is worth improving.

Therefore, in this study, we have taken a representative textile enterprise in Changle as an example and analyzed the problems existing in its inventory management in order to explore whether the procurement model based on the material requirement planning (MRP) can improve the inventory management of enterprises. To this end, the conditions were set according to the actual operation of the enterprise, the quantity changes of the enterprise's inventory in 10 weeks on the condition of using the MRP procurement model was simulated, and a comparative analysis was conducted between the above quantity changes and those obtained under the condition of using the original regular purchase mode of the enterprise under the same other conditions.

II. INTRODUCTION OF THE EXAMPLE ENTERPRISE

The example enterprise selected in this study is Changle Diyan Knitting Co., Ltd. The company was founded in 2000 and is located in the Wenling Dongwu Industrial Zone in Changle District with excellent traffic conditions. Its main products are semi-finished fabrics, warp-knitted laces and fabrics. The annual output of the company is about 150 tons, and the annual turnover is between 30 million yuan and 50 million yuan. The products are not only sold in China, but also sold abroad. The company's annual export turnover is between 7 million yuan and 10 million yuan. The equipment of the company is produced in Germany, and the production process

and product quality of the company are at the upper-middle level in Changle.

III. ANALYSIS OF PROBLEMS IN INVENTORY MANAGEMENT OF THE EXAMPLE ENTERPRISE

A. Status of Inventory Management

The stocks of Changle Diyan Knitting Co., Ltd. mainly include raw materials, grey cloths, laces and shell fabrics. The proportion of each item's inventory is shown in "Fig. 1".
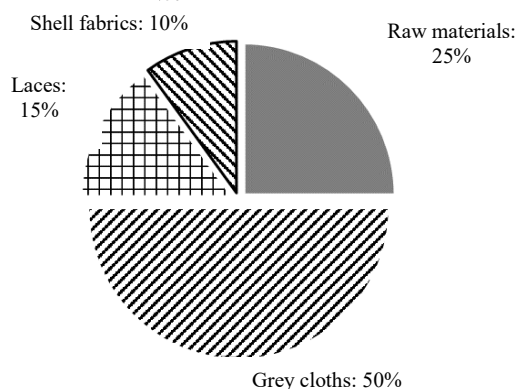

Fig. 1. Proportions of each item's stocks.

There are two logistics companies near the company's warehouse, which can quickly respond to the company's distribution needs, so the company's inventory management is basically not limited by problems in distribution. After years of continues improvement of inventory management, the inventory of the enterprise has been decreasing. However, due to problems such as the variety of inventory items, it is difficult for the company to manage its inventory very well, and the actual situation is still not so satisfactory. This has not only hindered the further improvement of the competitiveness of the enterprise, but also made it difficult for the enterprise to further deepen the cooperation with upstream and downstream partners in the supply chain.

B. List of Problems in Inventory Management

1) Low frequency of inventory turnover: The frequency of inventory turnover refers to the turnover times of inventory items in a certain period of time (usually 1 year), which is an indicator reflecting the frequency of inventory turnover, and it is calculated with formula (1).

$$ITO = \frac{T}{I} \quad (1)$$

ITO: Inventory turnover;

T: turnover;

I: Average inventory amount;

It can be known from formula (1) that the inventory turnover is directly proportional to the turnover and inversely proportional to the average inventory amount. Therefore, the higher the inventory turnover, the better the sale of products is;

and the smaller the inventory amount (quantity), the higher the efficiency of capital turnover of the enterprise is. This indicator can reflect the level of product sales and inventory management of the enterprise.

In order to calculate the inventory turnover of Changle Diyan Knitting Co., Ltd., we have collected the turnovers and average inventory amounts of the company from 2014 to 2017, and then calculated the inventory turnovers of corresponding years, which are shown in "Table I".

TABLE I. INVENTORY TURNOVERS OF CORRESPONDING YEARS OF THE ENTERPRISE

Year	Turnover (Thousand Yuan)	Average Inventory Amount(Thousand Yuan)	Inventory Turnover
2014	45,284.7	7,301.0	6.20
2015	40,113.0	6,803.3	5.90
2016	48,003.3	6,405.2	7.49
2017	50,467.0	6,092.8	8.28
		mean	6.97
		standard deviation	1.12

According to "Table I", the average inventory turnover of Changle Diyan Knitting Co., Ltd. from 2014 to 2017 is about 7, with a standard deviation of 1.12, which is lower than the average inventory turnover of the industry which is 11, reflecting that the efficiency of capital turnover of the company is low and the inventory management is not good. The average annual inventory amount is more than 6 million yuan, which takes up a large proportion of the operating capital of the enterprise and affects the capital structure of the enterprise. This is not conducive to the enterprise to control the cost of products to gain an advantage in the market competition.

2) Imperfect procurement mode: Changle Diyan Knitting Co., Ltd. has been using a regular procurement model. At specific time points, the procurement staff will predict the demand for raw materials for 20 days merely by his experience, and then adjust the demand according to a series of constraints, finally determine the quantity of purchase. In this process, factors to be considered include the quantities on hand of the wide variety of raw materials, semi-finished and finished products, the production capacities of different production lines, the customers' demands, etc. But there are not any scientific management methods or calculation tools to support and regulate the purchase. In practice, it is usually used to simply divide the raw materials to be procured into two categories: "commonly used" and "not commonly used", and to determine the different purchase quantities of the two appropriately. However, this kind of procurement often leads to a shortage of "commonly used" raw materials and too many "not commonly used" raw materials.

In addition, the "commonly used" raw materials in stock are usually placed in conspicuous and easily accessible positions, so the inventory quantities of them can be recorded accurately; however, the "not commonly used" raw materials are often piled up in the corners, or placed under other items, making the exact quantities of them difficult to be obtained.

In summary, there are many drawbacks in the existing procurement model. It is impossible to achieve accurate control of inventory quantity through this procurement model, and it is difficult to cope with the ever-changing customer demand and more and more complex production plans by using such a model. And this procurement model has greatly affected the operational efficiency of the enterprise.

IV. MRP-BASED INVENTORY MANAGEMENT IMPROVEMENT

A. About the MRP Procurement Model

The MRP procurement model is applicable to the production-oriented enterprises. In this model, enterprises calculate the quantity of raw materials (components) needed to produce the main products according to their production plan, the structure tree of the main product (material demand condition) and their inventory situation, and then determine the purchasing quantity of raw materials and develop the procurement plan (see "Fig. 2").
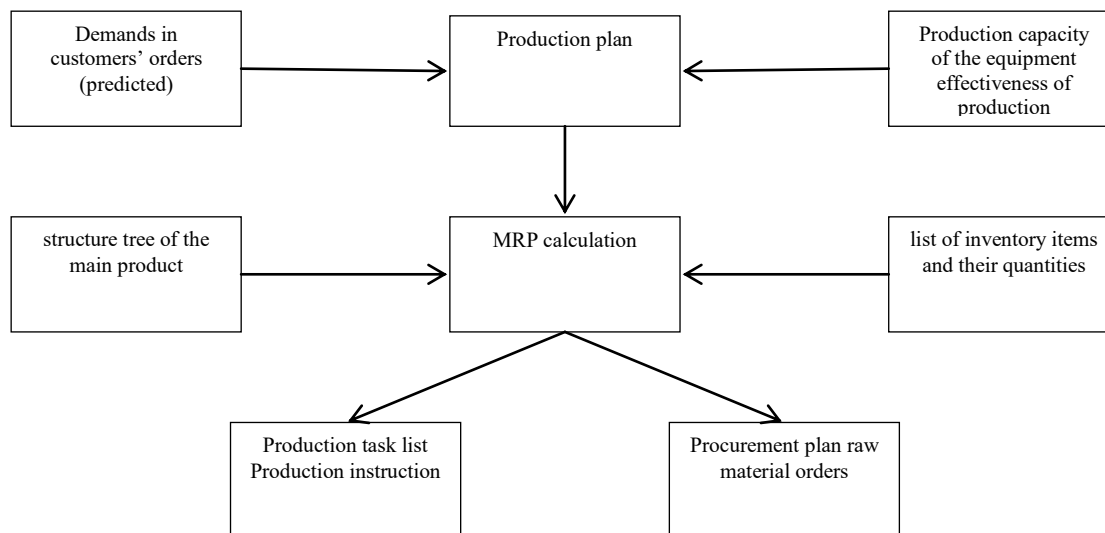

Fig. 2. MRP procurement mode.

The implementation of the procurement plan may include the following steps: (1) survey of the resources of various raw material suppliers, (2) supplier certification, (3) inquiry and negotiation, (4) identification and generation of raw material orders, (5) the ordered raw materials being sent, (6) tracking raw material orders, (7) checking and accepting the raw materials, and (8) settlement.

The MRP procurement model can ensure that the purchased raw materials meet the needs of the company's production and can meet the requirements of production plans with high precision and complexity.

B. Simulation of the MRP Procurement Model

We have simulated the procurement of raw materials of the grey cloths, the average daily demand for the raw materials of the grey cloths is 2.5 tons, and the average weekly demand is 17.5 tons, so the weekly demand is set to vary between 10 tons and 20 tons. The purchase point is set to the average demand of 20 days which is 50 tons. And it takes 1 week for the purchased materials to arrive. Considering the influence of seasonal factors on safety stock, the safety stock is set to 16.7 tons multiplied by the safety factor (1.0-1.5). A set of random numbers X1, X2, ... , X10 with values between 0 and 50 is generated by the computer, and the demand for the raw materials of the grey cloths in 10 weeks is simulated with the formula (2).

$$D_i = 10 + \frac{(20-10) X_i}{50} \qquad (2)$$

Di: Demand for raw materials of the grey cloths for the i-week (i = 1, 2, ... 10).

In the MRP procurement model, the company will send a purchase order to the supplier if the inventory quantity is smaller than the quantity of the purchase point. The purchase quantity is the demand quantity of the next production cycle divided by the leveling factor, which is 1 or 2 or 3. In this method the demand is distributed to the next few purchases. The company's inventory quantities for 10 weeks simulated through using the MRP procurement model are shown in "Table II".

TABLE II. Inventory Quantities Simulated Through Using the MRP Procurement Model

Week	Demand	Beginning Inventory	Ending Inventory	Purchase Quantity at the End of the Week	Arrival Quantity at the Beginning of the Week	Weekly Average Inventory
1	13	60	47	35		54
2	15	47	32	12.5		40
3	17	38	21	12	6	30
4	18	35.5	17.5	14.5	12.5	27
5	12	29.5	17.5	16	12	24
6	14	32	18	15	14.5	25
7	16	34	18	16.5	16	26
8	13	33	20	18	15	27
9	15	36.5	21.5	18.5	16.5	29
10	17	39.5	22.5		18	31

As can be seen from "Table II", even if the safety factor is increased to 1.5, that is, the safety stock is set to 24 tons, the MRP procurement mode can still meet the requirements.

C. Simulation of the Original Procurement Model of the Sample Enterprise

The originally adopted mode of the sample enterprise is the regular procurement mode. The main goal of this model is to ensure that there is sufficient stock of raw materials. Specifically, in this mode, the purchase staff will predict the demand for raw materials in 20 days according to his own experience and take this demand as the safety point, and set the purchase time point considering a period of 7 days for the

materials to arrive, and set the maximum stock quantity of each inventory item as the upper limit of the purchase quantity of each item. This model can ensure that the quantity of stock reaches the set safety point, so that the supply of raw materials can be completely guaranteed. But in this model, the connection with the actual situation of production and sales is neglected. Although it can prevent over-purchasing to a certain extent to set the maximum inventory quantity, it is still very conservative to use such a method, and there is still a lot of space for the inventory quantity to be reduced. The simulated results of the company's inventory quantity in 10 weeks using the original procurement model of the company are shown in "Table III".

TABLE III. Simulated Inventory Quantity of the Sample Enterprise Using the Original Procurement Model

Week	Demand	Beginning Inventory	Ending Inventory	Ending Purchase Quantity	Beginning Arrival Quantity	Average Weekly Inventory
1	13	60	47	35		54
2	15	47	32			40
3	17	67	50		35	59
4	18	50	32	36		41
5	12	32	20			26
6	14	56	42	32	36	49
7	16	42	26			34
8	13	58	45	33	32	52
9	15	45	30			38
10	17	63	46		33	55

D. Comparison of the Simulation Results

The comparison between the simulated inventory quantities using the MRP procurement model and the original

procurement model of the sample enterprise is shown in "Fig. 2".
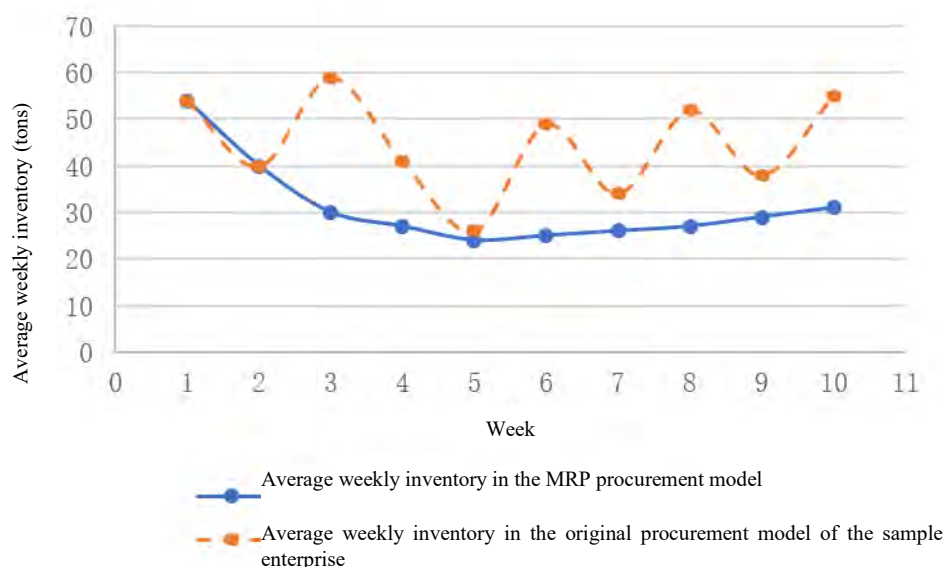
Fig. 3. Comparison of the simulation results of the two procurement models.

As can be seen from "Fig. 3" and compared with the original procurement model of the sample enterprise, the inventory quantity is smaller in the MRP procurement model. And at the same time, the fluctuation of the inventory quantity is also smaller in the MRP model. Specifically, the effects of the MRP procurement model can be summarized into the following two points.

1) Reduced inventory: The inventory quantity in the MRP procurement model is significantly less than that in the original procurement model of the sample enterprise. The reduction of inventory can not only lower the occupancy rate of inventory amount in the operating capital but also reduce the cost in inventory management. Maintaining the optimal inventory quantity can increase the liquidity of capital of the enterprise, reduce the comprehensive operating cost of the enterprise, lower the risk brought by the shortening of the product life cycle, and enable the enterprise to make more profits.

Smaller fluctuations in inventory quantity: The inventory quantity in the original procurement mode of the enterprise fluctuates relatively greatly, which has not only increased the difficulty in inventory management for the enterprise, but also caused troubles to the upstream and downstream partners in the supply chain under the influence of the bullwhip effect, such as misleading the production plan of the supplier and leading to its overstocking; increasing the production cost of products in the supply chain; extending the supply period of the supply chain and so on.

The MRP procurement model can improve the accuracy of demand predicting and reduce the fluctuations in inventory quantity, which will help to avoid losses caused by the above series of problems and enable the enterprise and its partners to obtain more economic benefits.

V. CONCLUSION

In order to explore whether the MRP-based procurement model can solve the problems existing in the inventory management of textile enterprises in Changle, we have selected a representative textile enterprise in Changle to study in this paper. After analyzing the problems in inventory management of the enterprise, we have set the conditions according to its actual situation, and simulated the company's 10-week inventory quantity changes using the MRP-based procurement model, and compared with the inventory quantity obtained by using the original quantitative purchasing mode of the enterprise under the same conditions. The results show that the MRP-based procurement model can effectively reduce the inventory of enterprises, reduce the proportion of inventory amount, reduce the fluctuations in inventory quantity and reduce costs in inventory management.

The textile companies in Changle are mostly small companies. Compared with the sample enterprise in this study, these small companies have less operating capital. Therefore, after improving the inventory management by using the MRP-based procurement model, they can get more business income and make more economic profits, so it is worthwhile to promote the MRP-based procurement model.

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