PACKAGING MATERIAL INVENTORY MANAGEMENT AS A TOOL INCREASING THE LEVEL OF CUSTOMER SERVICES IN THE B2B MARKET

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Abstract

In the current highly competitive environment, it is more and more difficult for companies to differentiate physical products. This is why in the last decades companies have been reacting to the growing competition by offering additional services and customized solutions. Services play an important role in creation and maintenance not only of customer satisfaction, but also of customer loyalty, and they are becoming one of the deciding areas of acquiring competitive advantages. An important role is played by services connected with delivery. Their basic components are reliability and completeness of deliveries, and adequately short delivery times. It is also necessary to take account of competitive prices. To meet these requirements, it is essential to cooperate across the entire supply chain, especially in the area of sharing information about customer requirements. However, if any of the entities is not willing to share information, suppliers cover the requirements of their customers using their inventory. This paper deals with the problem of pallet inventory management as a part of transport packaging for a pulp and paper company with respect to fulfilment of customer requirements concerning supplier services and more even utilization of production capacities. The paper presents the outcomes of the performed analysis of the current management of orders and pallet deliveries, and a proposal of a new method of their management through optimization of their inventory management. The outcomes were achieved through directed research, the method of directed interviewing, statistical data analysis, and a modified ABC method for differentiated inventory management.

Keywords: Inventory management, packaging material, customer service, pulp and paper company

1. INTRODUCTION

In the period of growing competition in global markets, it is not enough just to supply quality products, but it is also necessary to differentiate products in the area of the level of services. The service level requirements reflect the level of the customer knowledge and value, and they result from an agreement between partners in a business relation [1]. The basic prerequisite for providing services is availability of the product required by the customer in stock, or the possibility of manufacturing and delivering it within the required time period. Therefore, an important role is played by services relating to delivery. The basic attributes of these services are reliability and completeness of deliveries, and reasonably short delivery time. The basic question for each supplier is thus how many products and in what stage of the manufacturing process they should keep in stock to be able to satisfy their customers' demand. The level of kept inventory is thus the benchmark for availability of a certain product [2]. Another criterion is competitive prices, which puts pressure on reduction of all costs, i.e. also the inventory cost. Customers nowadays also have significantly higher expectations in the area of provision of precise information relating to their orders. To meet all these requirements, it is necessary to cooperate across all the supply chain, particularly in the area of sharing relevant, precise, and correct information about the customer requirements [3].The focus of competitiveness thus moves from products themselves to supplier abilities created by all the supply chain, i.e. also by packaging suppliers. The packaging management, which supports production processes, is one of the corporate activities to be shaped by the firm's involvement in the value network and striving for creating strategic benefits [4].

This paper aims to propose a new way of pallet supply management as a part of transport packaging for a pulp and paper company. The essence of the solution is introduction of available inventory of selected types of pallets using ABC analysis. A part of the solution is shift of the customer order decoupling point to the supplier of these pallets with respect to the growing customer requirements concerning supplier services, particularly reliability of delivery with concurrent cost reduction relating to more even utilization of manufacturing capacities.

The applied research methods and sources included the targeted literature search in the scientific literature focused mainly on inventory management in supply chains and utilization of a modified ABC method for differentiated inventory management. They also included the method of in-depth interviews with managers in the chosen company, the analysis of the current way of order management and pallet deliveries with respect to the end customer requirements and daily data of pallet orders for 2016.

2. THEORETICAL BACKGROUND

The stronger the relationship between business partners, the more difficult it is for the competitors to assert themselves in this market [1]. Proper management of relationships within the supply system should result in minimization of potential risks [5], achievement of a competitive level of customer services, and increased profits of all the partners involved in the system. Integration of supply systems and their management leads to achievement of the synergistic effect, which becomes a key success factor. It involves the principles of communication, coordination, which result in increased performance of the whole system [6]. However, if the supply chain lacks confidence or willingness to deepen cooperation, and particularly to share information by even a single segment, there is basically artificial distortion of the customer demand in the transfer of information about it to the suppliers. This adverse supply chain phenomenon is known and described as the bullwhip effect [7] [8]. Also, a segment with a higher negotiation power affects inventory allocation in the system to its benefit [6] [9]. It makes decisions about the position of the order decoupling point, where two ways of supply chain process management meet, i.e. the push principle controlled by the prediction, and the pull principle controlled by the order [7] [8]. As a result of this, such inventory allocation and volume in the supply chain does not always have to be optimal from the point of view of the system as a whole. In such cases, the other suppliers are forced to secure orders of their customers with inventory created on the basis of demand forecasting. Their structure and volume then can be decisive for performance of the entire supply chain.

However, the inventory management models described in the scientific literature are limited for practical use by availability of necessary input information, particularly about the cost in the required structure. Practical application of a solution to this problem is mentioned e.g. Munzarová and Machac [10], who, with respect to absence of relevant costs in the calculation system of the respective company, proposed a modified costless stochastic model, called an MQ-model. As the optimizing criterion, they choose e.g. maintaining a minimum inventory volume while optimizing the risk of its depletion and occurrence of an inventory shortage. Particularly for the reason of the high labour-intensity of designing inventory management models are, on top of that, suitable rather for optimization of one or several items of inventory often supplied in large quantities.

Inventory in manufacturing companies could represent as much as 20% of the corporate assets, and they are interspersed among a lot of inventory items. At a medium-sized company, this may represent thousands of items of material or finished products. Therefore, it is not possible, but also not purposeful, to pay the same attention to all inventory items. And so companies usually take a differentiate approach to their management, where inventory is viewed in accordance with the resulting effect of individual inventory items on the company's success [2] [8] [11]. Inventory is in the practice mostly divided into categories with different importance using ABC analysis [12]. On the basis of the classified importance, some inventory groups can be stored, while some others can be ordered as late as at the moment they are needed.

ABC analysis is based on the well-known Pareto Principle. It belongs to Multi-Item management methods, and it is often the first step in improving the supply chain performance [13]. The primary reason for inventory classification by ABC analysis is creation of corresponding level of control for each determined inventory group [2]. ABC analysis is applied on the basis of a set of inventory items arranged in descending order according to a chosen characteristic, e.g. the value of consumption or sales of the stored items in the analysed period. It is recommended to choose a period that is between 12 and 24 months long with respect to seasonality of demand. Then, a cumulative percentage of individual items, e.g. in the total consumption, is calculated, and inventory items are divided into groups A, B, and C (the number of groups can be larger) in descending order of importance. The division of items into groups is subsequently adjusted on the basis of next points of view, e.g. a high price of the item, its high importance for smoothness of manufacturing or assembly, difficult acquisition, a long lead time. The group of the most important inventory, group A, is managed using Q systems of inventory management, group B is managed by P systems, based on fixed moments for ordering. The least important items, group C, are usually managed by P systems, or two-bin systems for regular and safety stock. It is suitable to conduct ABC analysis both from the financial point of view and from the point of view of consumption in pieces, and compare how classification if individual items into groups differs.

The currently applied methods also include the methods of differentiated inventory management, considering multiple-criteria decision-making in the interest of creating an effective inventory control system, and thus also more effective inventory management [12]. For example, XYZ analysis makes group X of inventory items with constant consumption, high demand predictability, and fast-moving items, group Y comprises inventory that is usually consumed variably, and group Z includes items consumed irregularly, items whose consumption is hard to predict, and slow-moving items, e.g. spare parts inventory [8].

3. INVENTORY MANAGEMENT OF PALLETS AS PACKAGING MATERIAL FOR PAPER

3.1. Identification of a problem with pallet supplies

The problem of inventory management of wooden pallets as a part of packaging material for thin printing papers was solved by a pulp and paper company. This type of paper is intended mostly for printing instruction leaflets to various products. The paper mill is an important player in the global market of the given product and has a good image as for the quality of paper and provided services. It can see its main competitive advantage in services particularly in high reliability of deliveries and short delivery times. The agreed delivery time is 48 hours. The company supplies about 100 customers/processors with printing paper in the Czech Republic.

The inventory of thin printing paper is primarily kept by the company in rolls on the basis of a global medium-term demand forecast. Paper is finally cut up to the dimensions required by the customer. Cutting up at a given time as such is not a significant problem. A bottleneck from the point of view of time is arrangement of pallets for shipping and transport. The reason lies in the fact that there is a wide range of sheet size types, and so a lot of different types of transport pallets are needed to fit the paper dimensions precisely. About a hundred pallets of printing paper are shipped to the customers every day. Demand for individual sheet sizes, and so also for the corresponding pallets, is variable and irregular, and it is not possible to forecast it even on a short-term basis.

Pallets are manufactured and delivered to the paper mill by two smaller specialized companies situated near the paper mill, which alternate with deliveries on the basis of an agreed schedule. Pallet orders are placed with the suppliers every business day before 11am, and the supplier only has 24 hours to manufacture the required pallets and deliver them to the paper mill. With the exception of standard supporting wood blocks, no other components can be manufactured until an order is received. The pallet manufacturers face problems of two kinds: in the case of an order of a large quantity of pallets of different dimensions, they can only be delivered within the given time limit with extraordinary efforts, while in the opposite case the company's working capacity is not used sufficiently. This has a negative impact both on the quality of manufactured pallets, and on the

supplier's costs. However, low quality or missing pallets also cause problems to the paper mill with respect to its commitments towards printing companies. Therefore, the paper mill has decided to establish closer cooperation with the pallet suppliers, which should result in their more stable manufacturing process to minimize the above mentioned problems with pallet supplies.

3.2 Solution and analysis of outcomes

It seems to be the basic idea of solution to switch from the "just in time" system of manufacturing pallets to a system using, at least partially, certain safety stock of pallets that can be manufactured in advance on the basis of a forecast. However, it is not possible to apply such an order settlement method in this case to the entire range of used pallet types. The paper mill documentation implies that about 350 different size types are used, and a vast majority of them are only used rarely and sporadically. It would be practically impossible and also uneconomical to keep stock of all the size types. This gave us an idea to determine inventory using a differentiated way of inventory management with the help of ABC analysis. However, its utilization for the given purpose was far from simple, and it required gradual solution to a number of partial problems in the following steps:

1) The statistical analysis was based on a data matrix containing chronologically arranged orders of individual types of pallets and their quantities (number of pieces) on the respective days of the monitored quarter. A quarter was chosen to have a sufficiently large matrix for statistical analysis and a period that is short enough to fix forecasts for the next period. The data matrix for the first quarter of 2016 contained 1,130 order items, and 17,228 pieces of pallets of 357 different size types were ordered. Similar quantities were also recorded in the other quarters of 2016. The data matrices were exported to MS Excel and adjusted to enable sorting, filtering, and grouping on the basis of more points of view.
2) To apply the ABC method, it was first necessary to identify distribution of frequencies of individual pallet types in the entire spectrum of size types (i.e. how many times a given pallet type was ordered in the given quarter) in the given period. Another examined parameter was the number of ordered pieces of each pallet type. Subsequently, the data matrix was arranged according to individual pallet types, and partial sums of the number of orders and the number of ordered pieces were identified. Arrangement of orders by pallet type and by number of orders is shown in **Table 1**.

Table 1 Pallet type frequency distribution for Q1 2016

Pallet size type	Absolute frequency of deliveries	Relative frequency	Cumulative relative frequency
720X1020	84	7.43%	7.43%
465X720	27	2.39%	9.82%
495X720	19	1.68%	11.50%
515X720	19	1.68%	13.19%
630X880	19	1.68%	14.87%
650X900	19	1.68%	16.55%
670X930	18	1.59%	18.14%
740X1040	17	1.50%	19.65%
535X720	16	1.42%	21.06%
540X720	14	1.24%	22.30%
630X910	14	1.24%	23.54%
950X540	1	0.09%	99.91%
980X1295	1	0.09%	100.00%
357	1130	100.00%	X

The next step was to determine the volume of safety stock of the selected 10 pallets, which was done **Table 1** shows that the first 10 most frequently ordered types represent 2.8% of all 357 ordered types and, at the same time, they cover 252 of 1130 orders, i.e. 22.3% of the total number of orders. Next tables were analogously made for the parameter of the total number of ordered pieces and for all the other quarters of 2016. On the basis of the outcomes, it was decided to make pallet group A, managed through safety stock, every time of 10 most frequently used pallet types in the respective quarters in accordance with the order frequency criterion taking account of and with correction according to the number of pieces. All the researched cases proved that these selected 10 types cover about 20% of the total number of deliveries and the number of pieces.

3) using common statistical analysis. The average volume of one order in a given period and the standard deviation were calculated from the data submatrix of each of the selected pallet type. Supposing at least approximately normal distribution of the number of pieces in a delivery, the chosen probability was 98%, with which the determined level of inventory will not be depleted. This level of the inventory shortage risk proved to be sufficient, particularly because potential shortage of the inventory has no fatal consequences for the manufacturer. Missing pieces can be manufactured subsequently together with the other currently manufactured pallet types.
4) Another difficulty of the solution consists in the fact that the proposed stored quantity is calculated from the data of one quarter, but it will not be used until the following quarter. Therefore, it would be convenient to make a demand forecast, i.e. the need for pallets, for the following period. However, as there is no data available for making time series of selected pallets, a so-called “naïve forecast” was applied. This forecast assumes that the demand in the following period will be the same as in the current period. The model can then be dynamic made by conducting a new analysis in each finished period, and this analysis is used again as a forecast for the following new period.
5) To verify functionality of the proposed procedure, a simulation model applied to 2016 data was created. The procedure of the simulation model will be shown on the example of the most frequently and in the largest volumes ordered pallet size type (720x1020). The first quarter analysis resulted in proposing prompt stock of 22 pieces. This number was applied to the actual data of orders in the second quarter. We found that the stock shortage was in 6 of 84 orders, so the success of covering the number of orders from the inventory was 91.9%. As for the number of ordered pieces, the success of covering them from the inventory was 88.8%. All the other 10 selected pallet types were assessed similarly, and the average success of covering the demand from the inventory would be 80.2%, or 82.4% respectively. The data for the third quarter and the fourth quarter were assessed in the same way and with similar results. This implies that the proposed model is functional, and it was recommended to try it out in practice.

4. CONCLUSION

The growing customer requirements concerning services connected with delivery, particularly their reliability and short delivery times, and the parallel pressure on cost reduction require close cooperation of the members of supply systems, including packaging suppliers. Therefore, a way of pallet inventory management to be introduced by the pallet suppliers was proposed on the initiative of the pallet purchaser in order to make their manufacturing more even and thus to ensure high quality of pallets, reliability of printing paper deliveries, and reducing the costs relating to deliveries. The proposed way of order and supply management with the help of prompt stock of selected group A pallets could even be further improved by making forecasts of the demand for the selected pallet types more accurate if the time series of the demand for the selected group A pallet types were monitored and evaluated. It is also possible to recommend consultations with the workers of the sales department, who should have the current information about the expected changes in the paper mill’s customer structure. They could also change the portfolio of the paper sheet size types, i.e. also the required pallets. Another possibility of application of the proposed way of managing prompt stock is at the supplier of honeycomb boards for completion of packaging. Application at this company would be particularly desirable in

view of the quality problems. The thing is that short delivery times do not make it possible for these boards to dry out properly. The proposed way of inventory management in the selected pallet types is being piloted at the company in the first half of 2017. Providing the testing is successful, the company is considering its introduction in the routine operation.

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