STUDY OF INVENTORY MANAGEMENT SIMULATION ANALYSIS: THE CASE STUDY OF MILŠPED

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Abstract: *The aim of inventory management is to provide sufficient quantities of goods in the warehouse so that user requirements can be filled at any moment. Considering the stochastic nature of demands, it is increasingly difficult to manage inventories. Depending on the time of delivery, ordering costs, cost of holding and lack of inventories this objective can be achieved by applying some of the inventory management strategies. By processing and analyzing the data of 57 items held in the warehouse of 3PL provider Milšped for a period of one year we determine requirements applying some of the strategies of inventory management.*

Keywords: *Inventory management, simulation, 3PL*

1. INTRODUCTION

Before the company make a decision whether or not to manage inventories, it is necessary to consider the advantages and disadvantages of keeping them in stock. The main reason that justifies keeping inventories is an increase of the level of customer service, despite the high costs that emerges when inventories are kept. Keeping inventories in the warehouse represents bound capital, especially when there is a surplus in the warehouse inventories.

Inventory management involves finding the optimal balance between product availability and total cost of inventories. The goal of optimal inventory management is to achieve a minimum total cost of holding inventories. Also, a time during the orders' replenishment, levels of demand, costs of keeping stocks and consequences of lack of stock must be respected. One of the most important factors in selecting inventory management model is the nature of demand. According to the factor based on the demand of a product, it is possible to affect the order of product, purchase of raw materials and production schedules (Ballou, 2004).

2. STRATEGY OF INVENTORY MANAGEMENT

The strategy of inventory management is one of the techno - economic characteristics of the stocks. In practice, there are different strategies of inventory management, and only few, basic ones, will be shown. A very important part of the strategy of inventory management is a choice of parameters that defines it.

The first strategy is the (Q, R) strategy. In this strategy, inventory is managed by two parameters: quantity Q and the level Rn. Q is a replenishment quantity which will be supplied

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and Rn is the level on which a user makes an order. This strategy implies that lead time is known in advance and it is very suitable for inventory management in terms of stochastic consumption because the quantity of an item is ordered when it reaches a protective level of stock (Rn). In this strategy two extreme cases might happen and they are shown in the figure 1 (Vukićević, 1995).

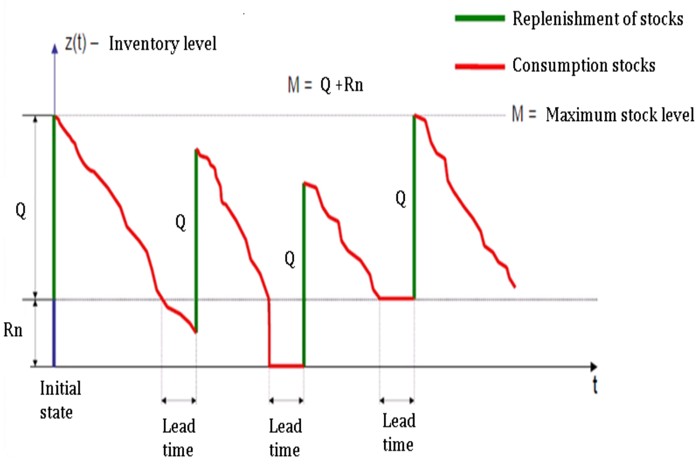

Figure 1. Strategy (Q,Rn)

Another strategy is (Q, W). In this strategy, inventories are managed by two parameters: Q and W. Q is a quantity of product to be replenished and W is interval between two deliveries. This strategy (Figure 2) is suitable only in cases with deterministic consumption (Vukićević, 1995).

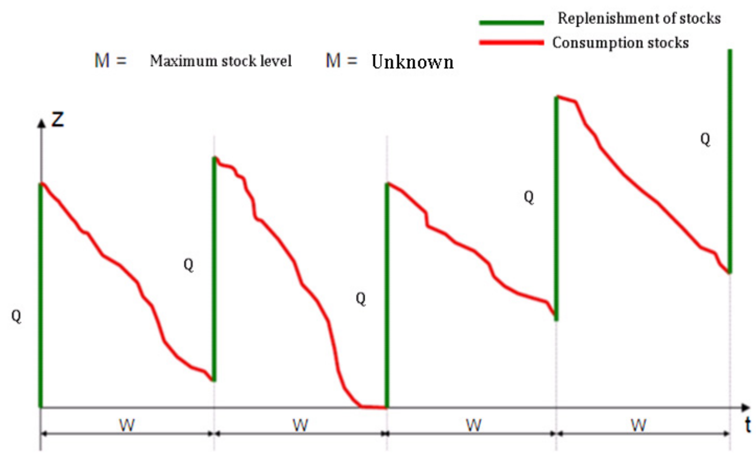

Figure 2. Strategy (Q, W)

The third basic strategy (Figure 3) is (M, Rn) strategy. This strategy implies that inventories are managed through a maximum permitted stack of inventory M and inventory ordering level Rn. In this strategy lead time between placing an order and the arrival of the order, as well as and storage capacity are known in advance. It is important that the warehouse can always be filled by the quantity that arrives. The disadvantage of this strategy is that the buyer knows the quantity of goods they can accept only when the lead time pass, respectively when the goods are delivered (Vukićević, 1995).

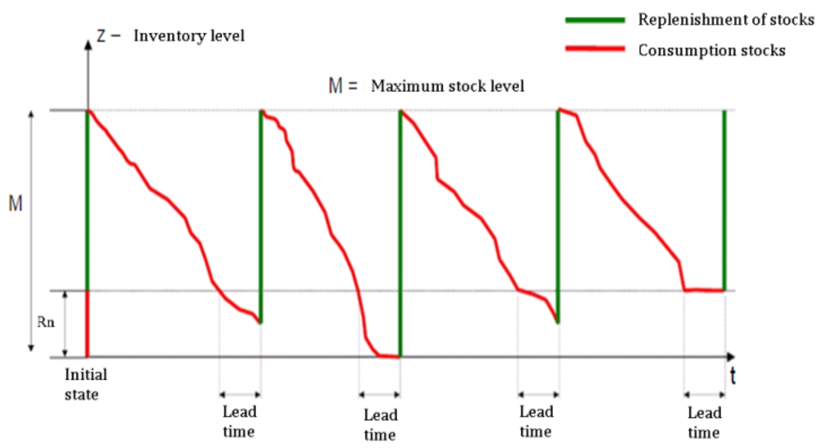

Figure 3. Strategy (M, Rn)

Finally, the last basic strategy is (M, W) strategy. In this strategy inventories are managed by maximum permitted quantity of inventories at hand (M) and time interval between two replenishments (W). This strategy (figure 4) is common in situations when one wants to ensure, respectively timetable of transport processes, whereby external transport unit executes a larger number of orders on the route of movement. In this strategy, in the case of intensive consumption the buyer may remain one period without the necessary stock, and, on the other hand, it may happen that the seller sells an extremely small amount of goods when consumption was extremely low in previous replenishment period (Vukićević, 1995).

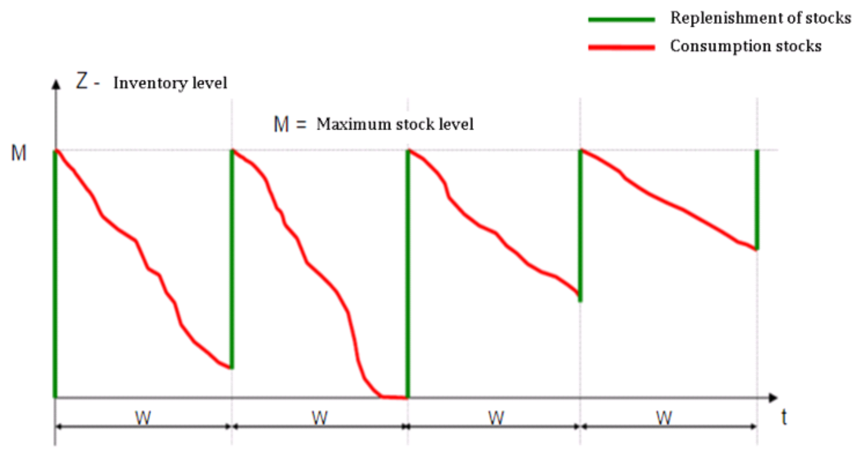

Figure 4. Strategy (M, W)

3. PROGRAM LOGWARE

The decision of which theoretical model to implement may be based on results of output data (in terms of overall costs) of Logware's module for inventories management. It should be noted that Logware provides data for only the first two basic inventory management models from previous section, i.e. (Q, Rn) and (Q,W). To get output results of the program, it is necessary to enter data based on average demand, the cost of a stock per unit, transportation costs per unit and cost of keeping stock per unit. Program requires information about delivery period, costs and ordering costs per unit of product. Since the company Milšped doesn't order products and doesn't manage inventories for clients, lead time is assumed to be 2 days. Also, costs of ordering and costs of transport by units of product are assumed to be 1 dollar. According to the results of the program the lower costs are achieved when (Q,Rn) strategy is aplied. In this strategy, the level of the average stock is small and therefore total costs are lower. However, each of these strategies has advantages and disadvantages. Benefits of strategy (Q, Rn) are given if the products are ordered individually. In this strategy the average level of stock is low, but on the other hand it is required continuous monitoring of stocks for each product individually. Strategy (Q, W) is used especially when company has batch ordering of products. This strategy requires smaller cost savings of ordering, transportation and unit sales price. However, the average level of stock is higher and therefore total costs are not optimal.

4. SIMULATION IN FLEXSIM

In order to realize simulation modeling of inventory levels of products that are kept at Milšped for a particular client it was firstly required to analyze one year data of those products relevant for simulation modeling. Analysis implied the determination of:

- The probability distribution of time between the inventory replenishments
- The probability distribution of replenishment quantities
- The probability distribution of daily quantities that exits the system

Observing the time between inventory replenishments, 72% of products are determined to follow the exponential distribution. Normal distribution is determined in a small number of items (16%), while for the rest of the items uniform distribution is found to be appropriate one.

The main problem in determination of the probability distribution of the replenishment quantities was that for some products the sample was small (less than 60 data) and therefore it was not sufficient number to determine the probability with required accuracy. Moreover, for products that have had sufficiently large sample to form a probability distribution, distributions did not match any known distribution pattern. The (figure 5) shows the probability distribution of replenishment quantities of product 3, and for other products distribution is similar to this. One amount appears with much higher probability. However, this amount is not the maximal, and is even lower than the average amount. For these reasons, the amount of the entrance is calculated as the product of the average time between the entry and the average demand.

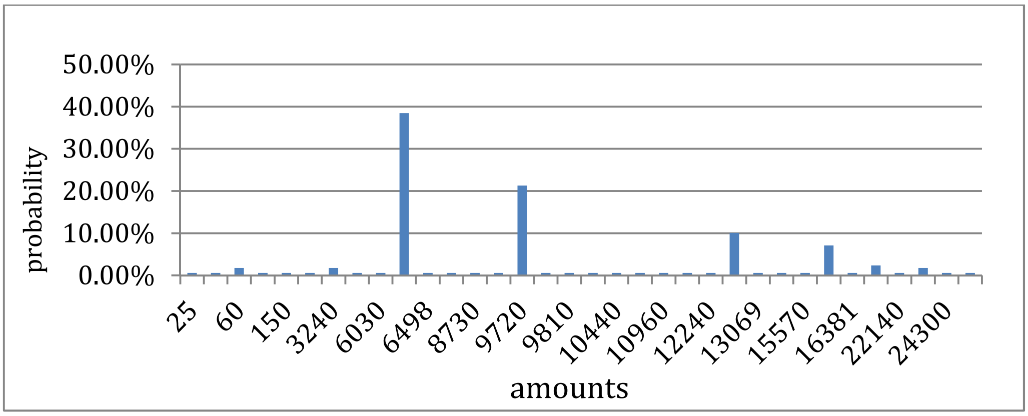

Figure 5. Probability distribution amounts at the entrance of the product 3

The probability distribution of daily quantities that exits the system turned out to follow the gamma and log logistics distributions. Data were processed in the program Minitab. This program gives loglogistic distribution parameters that cannot be implemented in the program FlexSim. Therefore, all products were determined by the gamma distribution with the most appropriate parameters.

According to the data obtained by the simulation model inventories of product 1 ranged from 0 to over 150 000, while product 16 inventory level moved in a different way. Inventories of product 1 are represented on figure 6, and inventories of product 16 are represented on figure 7.

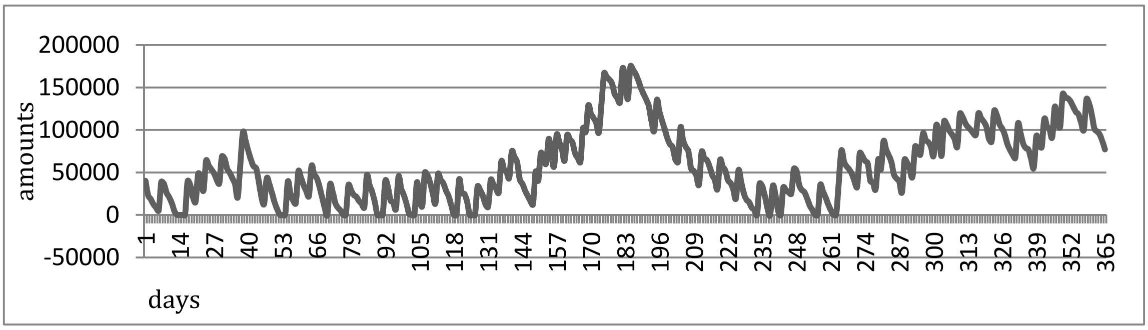

Figure 6. Inventories of product 1

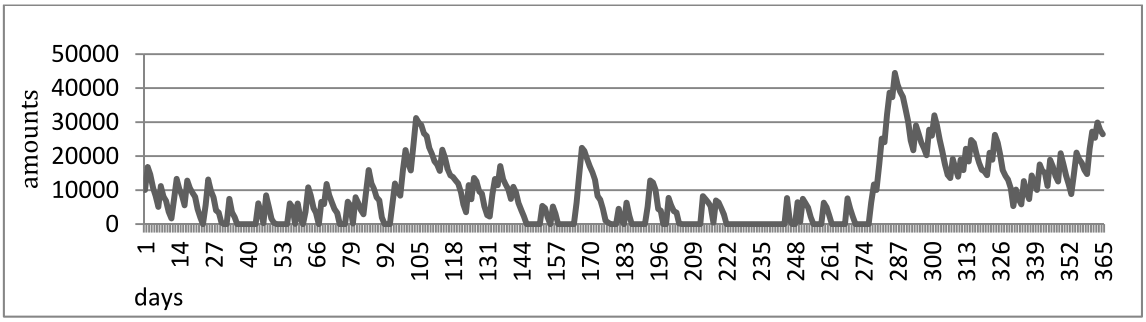

Figure 7. Inventories of product 16

On the inventory level graph of figure 8, each products are determined by the number on the end of the days when inventories were equal to zero. Only two products (36 and 56) at the end of each day were at the stocks, while product 16 at the end of 99 days wasn't in stock.

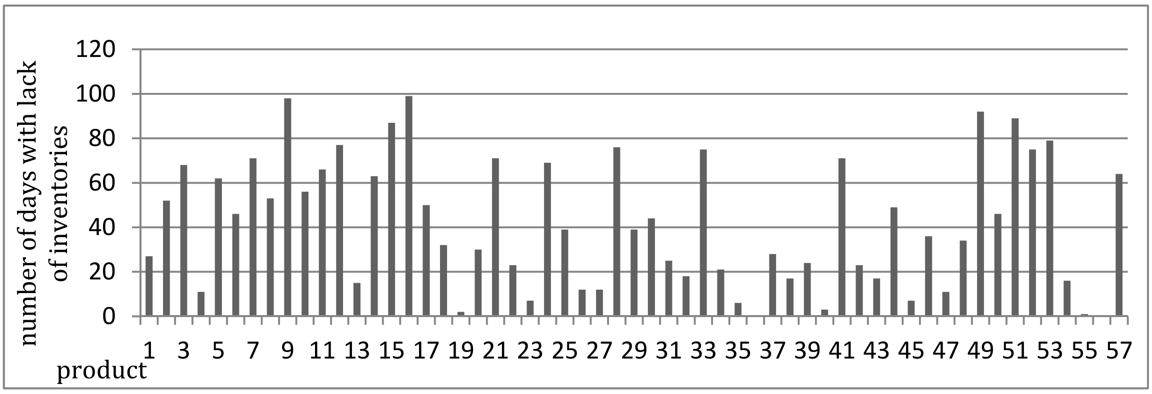

Figure 8. number of days when inventory were equal to zero

If user requests the amount of goods that is larger than the state of the stocks, he gets an available quantity of goods. Amount that was missing (the difference between the required and delivered quantities) is calculated and only product 56 is always supplied in the required quantity (picture 9).

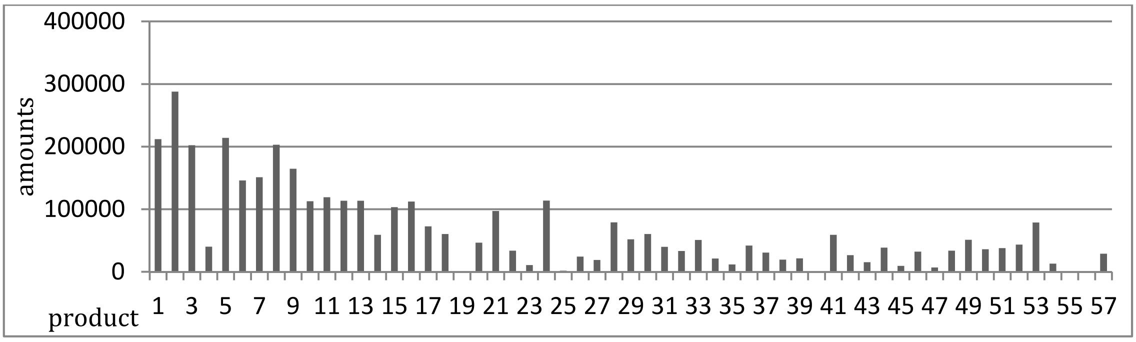

Figure 9. The quantities of the products that have been missing in the formation of the required orders for a period of one year

5. CONCLUSION

If company wants to manage inventory in a future period, it would be necessary to make as much precise history data analysis as it is possible. The data should be related to a longer period of time, because, the larger sample gives greater chance of accurately determining the probability distribution. Also, it is necessary to know the delivery time and cost to order that the company could implement a strategy of inventory management. With all this improvements the simulation results would be much more realistic (lack of stock would be lower, so instead of one, most of the products would always be supplied in the required quantity).

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