Proceedings of the 2017 Winter Simulation Conference
W. K. V. Chan, A. D'Ambrogio, G. Zacharewicz, N. Mustafee, G. Wainer, and E. Page, eds.

SIMULATION RESULTS OF OPTIMAL SOLUTION FOR A MULTIECHELON INVENTORY SYSTEM

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ABSTRACT

In this paper we present the preliminary results provided by the simulation from a multiechelon inventory system. Real data is taken from a chemical Spanish company with the factory located in the south of Spain. This supply chain includes distribution centers in different locations in Spain as well as in other European countries. Inventory optimization is applied to the scenario focuses in the main product. Therefore, a optimization model provided by the literature for multiechelon inventory systems is implemented in order to provide the replacement point. Using the output of the model, a simulation, based on the data of stochastic demands, determines the cost of inventory.

1 INTRODUCTION

The scenario of this paper is a supply chain of a chemical company with a facility in Spain, where products are manufactured, and different distribution centers in Spain and Europe. This supply chain can be modelled as a multiechelon inventory system with three levels. Figure 1 shows the structure of this multiechelon system. The first level is the main warehouse (the facility in Spain), denoted WH. The second level is formed by R1, a retailer located in Spain, and R2-R5, retailers located in different countries in Europe. He third level is formed by R6 and R7, retailers located in Spain served by R1.

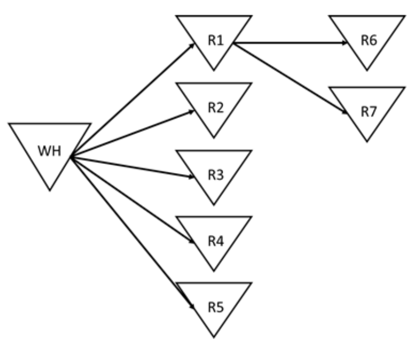

Figure 1. Multiechelon system of the modelled scenario.

2 MATHEMATICAL MODEL

The mathematical model for multiechelon inventory systems with two levels is proposed by (Axsäter, 2003), including an extension for more than two levels. In this paper, customer demand at the retailers is approximated to a discrete compound Poisson process, and we assume this distribution for our data from the company. The model considers as data the batch size: Q_0 for the WH, and Q_i, i=1,…,7 for the retailers. The variables to be determined are the reorder point of each node (R_i, i=0,…7), optimizing the expected total costs per unit of time, C. This cost is computed as the sum of the expected warehouse holding costs per unit of time, $C_0(R_0)$ plus the expected holding and shortage costs at retailer i per time unit, $C_i(R_j,R_i)$, where j is the index for the node provider of node i. Due to space issue, the model is omitted. The detailed model can be consulted in (Axsäter, 2003).

3 SIMULATION

The optimization model provides the optimal values R_i, considering the data on average: daily demand of customers for each node (mean and standard deviation, St. Dev.), and the batch sizes, Q_i, stablished by the company for the specific product with the highest volume of annual demand in the company. Table 1 shows the data used for the optimization model, and the values of R_i provided by the model. The optimal cost (based on mean) obtained is 3876 €.

However, considering these R_i values, the cost values generated by the real demands of the systems can be different. Therefore, a simulation model has been constructed using excel. We simulate the behavior of the system, and it has been run for 30 days with real demand data of a specific period. Due to the variability of the system, it can be observed that the total cost of the system varies from less of 1300 € to more of 10000€.

	WH	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**
Mean	985	16	28	126	425	390	8	8
St. Dev.	128	15	2	11	23	16	1	1
Values of Q_i	500	28	20	200	146	146	24	18
Value of R_i	735	2	0	0	281	281	0	0

Table 1 Simulation data used considering the values of R provided by the model.

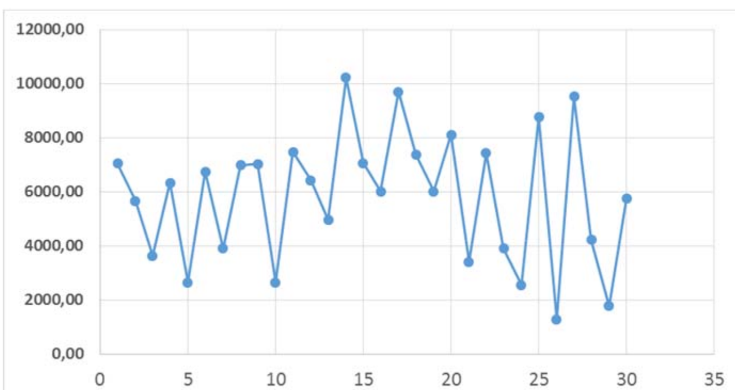

Figure 2. Simulation results.

4 CONCLUSION

Our model provides a preliminary conclusion about the difference between the cost results of an optimization model and those obtained in real periods for the inventory reorder point in a supply chain multiechelon.

REFERENCES

Axsäter, S. (2003). Approximate optimization of a two-level distribution inventory system. *International Journal of Production Economics*, *81*, 545–553. http://doi.org/http://dx.doi.org/10.1016/S0925-5273(02)00270-0