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Simulation study of a stocking system for consignment seller dietary supplement manufacturing company

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Abstract: Providing the supply chain for dietary supplement manufacturing companies plays a significant role in preserving the competitiveness of companies. We are looking at a special, but very important, supply chain that is based on commissioner sales. Continuous monitoring and efficiency enhancement of the inventory system of this type of supply chain is a major challenge for today's logistics professionals. In the processes to be examined, we have to examine a number of parameters, often with random effects, which in most cases require the use of a simulation test method. The dissertation describes the basic concept of a simulation test method that is suitable for defining optimal stocking mechanisms for the products of companies that produce dietary food supplements.

Keywords: Inventory system, simulation, food industry

1. Introduction

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Nowadays, the increase in the number of product types demanded by customers has an impact on the stocking and distribution logistics activities of consignment selling companies. It can be said that the number of types of raw materials to be procured and the quantity of products to be stored is also increasing, which can be explained by the fact that, following the expansion of the product structure, it is necessary to store a minimum set of products to satisfy customer needs [1].

Most dietary supplement manufacturing companies purchases the raw materials from China or United States of America [2], whose purchase lead times can be significant, up to several months. Suppliers in the region can deliver the raw materials at a higher cost, but with shorter lead times. Experience has shown that the quality of the raw material is also significantly different, since it is possible to obtain better quality raw materials from the surrounding countries, than from e.g. China [3]. It can be said that in the case of food supplement manufacturing companies, a certain product needs more raw material types to be stored, which makes the distribution logistics of companies more difficult. This has to be solved by taking into account several factors [4], i.e. the application of a decision making method. The literature does not or only minimally deal with this area, so we have set the objective of discussing the topic, as a proper stockpiling strategy can reduce operating costs and / or improve product quality [5].

2. The operation of the logistic system of consignment seller dietary supplement manufacturing company

Figure 1 shows the typical operation of the consignment seller dietary supplement manufacturing companies.

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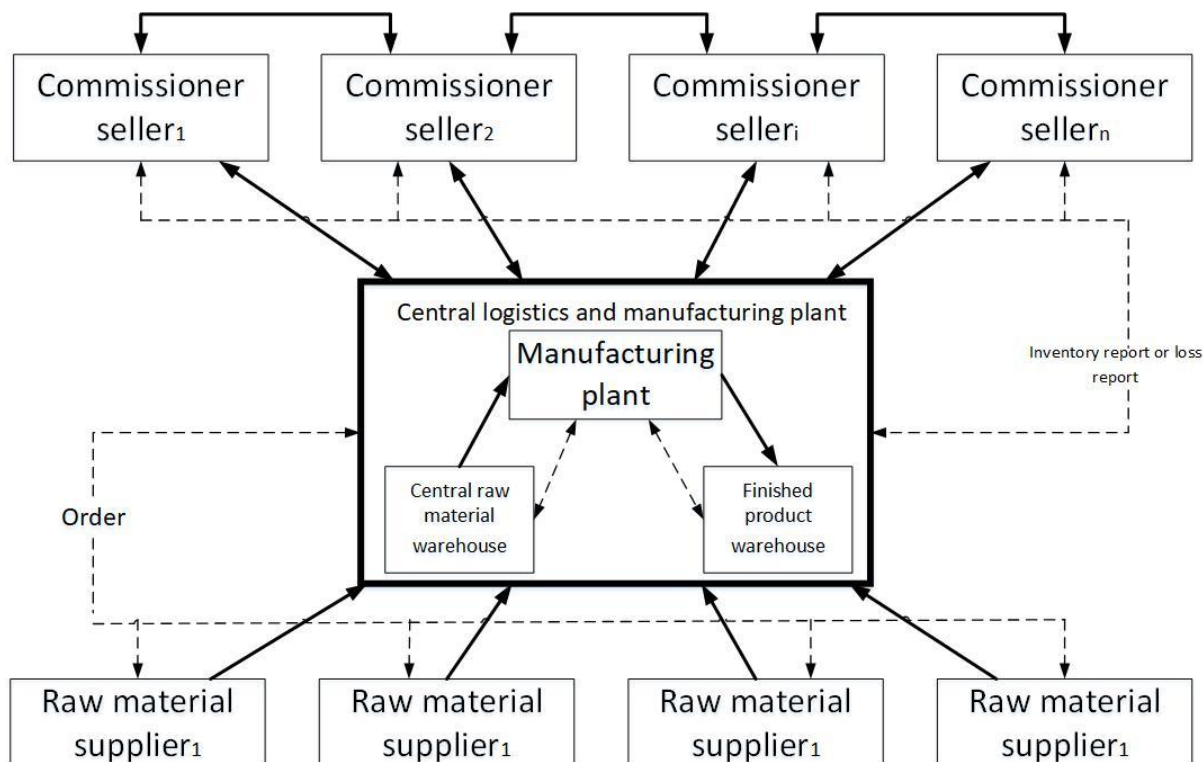


Figure 1. Material and information flow of the consignment seller dietary supplement manufacturing companies

System objects:

Suppliers: Companies that supply raw materials.

Central raw material warehouse: Warehouse for storing raw materials from suppliers.

Manufacturing plant: Capsule production is carried out at this location.

Finished Product Warehouse: In this warehouse the finished products (capsules) are stored.

Buyer: The buyer takes the product with a consignment contract and makes consumption reports to the central company on the quantity sold at certain intervals.

Flow:

In Figure 1, the continuous arrow is the material - the dashed arrow shows the flow of information. Suppliers deliver the raw material needed to make the finished product on a predetermined basis. Based on the experience of the past years, the production of such systems is in most cases carried out on the basis of a pressing principle. Pre-ordered raw

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materials from suppliers will be delivered to the central stock storage, where they will be stored until shipped to the capsule manufacturing department. Here, the FEFO principle is used in the storing and the releasing to the manufacturing plant. There, the homogenate products are prepared according to different recipes based, then the boxed and labeled by the manufacturer.

Once a full portion of a homogenized amount has been filled, boxed and labeled, it is handed over to the finished product warehouse. Storage in the finished product warehouse is also done on FIFO principle. This department must be kept at a certain product stock level, so the products can be shipped to the commissioners on demand. Here, after determining the number of items to be replaced, the products are picked, packed and sent individually. In practice, the operation of warehouse management systems (WMS) available for enterprise management (ERP) systems does not always meet the needs of the company. In many cases, many development opportunities remain unexploited (e.g. optimized material handling, system evaluation functions, etc.) [6]. The quantity to be shipped from the finished product warehouse is determined by the central logistic plant.

3. Possibilities of simulation testing of the storage system of companies producing dietary supplements

A prerequisite for creating an efficient process-specific simulation model is that the smooth operation and cost-effectiveness of inventory systems and processes can be quantified in each case. In the vast majority of cases, this is the way we want to achieve a minimum of all the costs associated with stockpiling in the most recent case of stock managing networks for companies that produce dietary supplements, so we want to set the probability of satisfying

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the needs of the system to a predefined value [7]. The companies' stocking method can be examined from a number of points of view, the most important of which are:

- Defining an optimal stocking policy: Depending on the size of the stock level, the operating costs of the system and the quality of the service are highly dependent, so determining when and how much to order is a key issue, often requires a simulation test.
- Defining the ideal product placement strategy: Material handling depends on the storage position of the products. By simulating future processes, the material handling process can be optimized to reduce operating costs.
- Determining storage capacity for future warehouses: Simulation testing may point to the need for storage capacity for future warehouses to avoid unwarranted investments.
- Definition of Warehouse Logistics System: Simulation testing of future processes can facilitate the selection of applicable storage and material handling systems.

4. Simulation testing model for a stocking system for companies producing dietary supplements

4.1. Forms of inventory appearance in the examined supply chain

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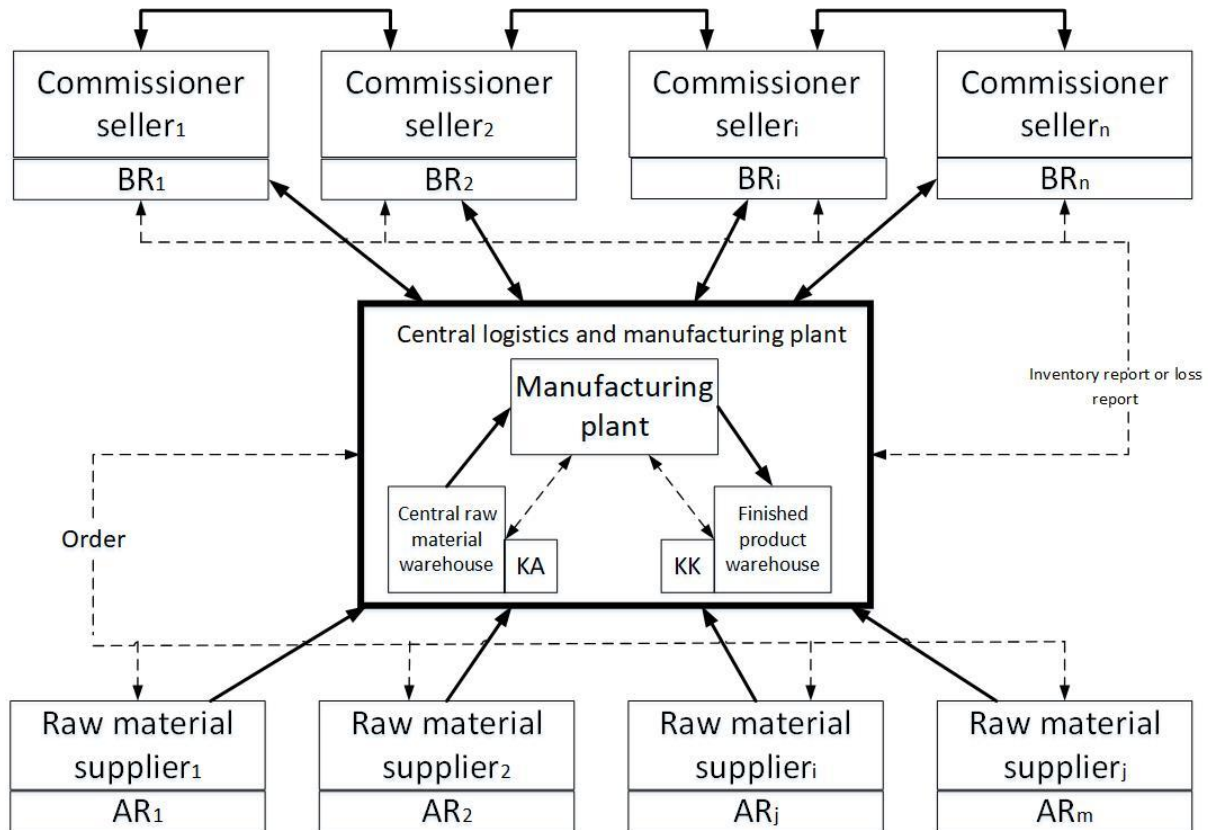


Figure 2. Stocking network of consignment seller dietary supplement manufacturing companies

Our goal is that the stocklevel for the whole system should be the smallest while still functional. This can be accomplished by determining the minimum and maximum stocking numbers for each raw material warehouse and finished product warehouse. This can define the principles of a stockpiling mechanism.

4.2. Simulation test model

For each warehouse, the minimum and maximum number of pieces per product should be set, which will be the decision variable. This process begins with the generation of a simulation test model, the next step of which is to build up the operating system operating variants. For each product in each warehouse, all possible stockholding mechanism value pairs must be

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trained and then used to determine the operational variations of the inventory system. The simulation then records the static data and records the data for the i -th variation. After these processes we run the simulation and determine the value of the target function. If $Opt_i > Opt$, then $Opt = i$. The next step is to test the simulation to see if all variations have been tested. If not, run the simulation again with $i := i + 1$. If so, you can specify the ID for the optimal version.

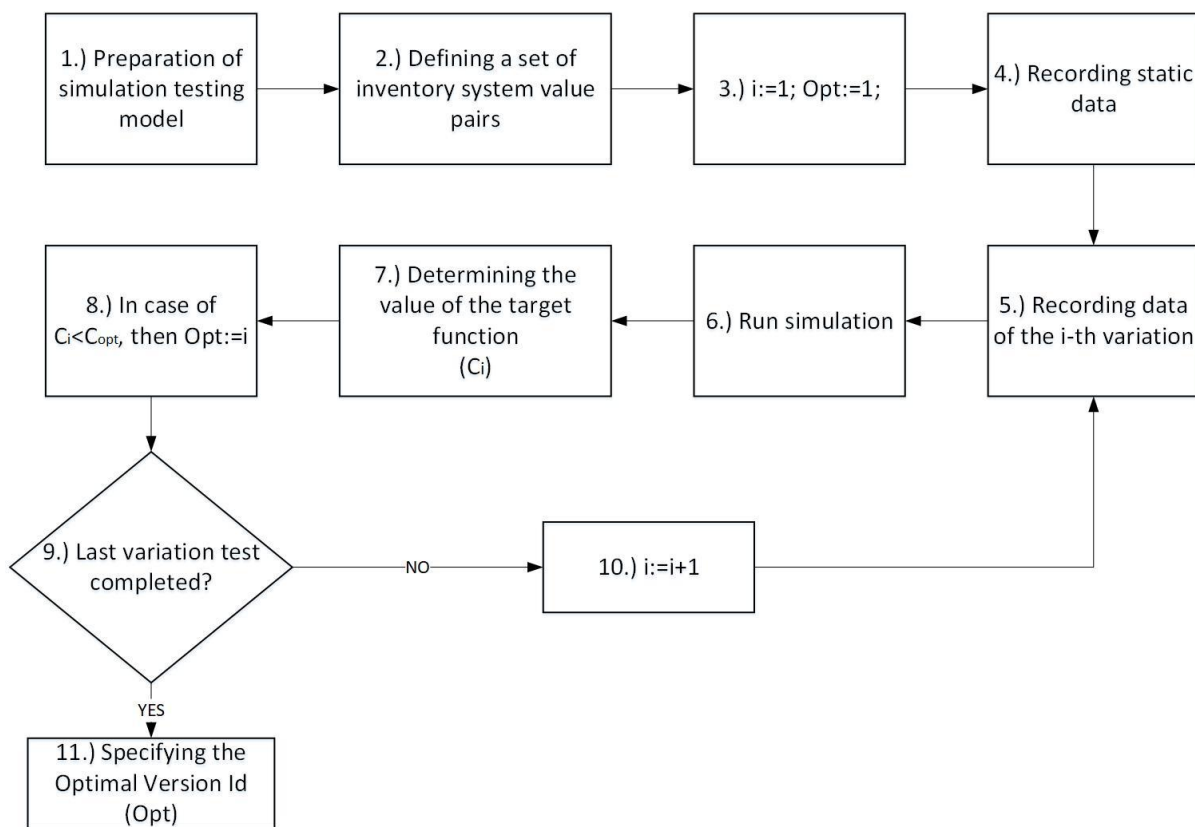


Figure 3. Simulation test model flow chart

Conditions for optimization:

- Avoiding stock shortages
- Exceeding storage capacity of warehouses,
- Minimum and maximum order quantity per product type.

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Target Function: Minimize logistic costs for a complete system.

5. Summary and conclusions

The dissertation presents the structure of supply chain for consignment selling dietary supplement manufacturing companies, as well as the simulation testing options applicable to the inventory system. The size of the optimal stock level has a significant impact on the company's cost of capital, and its precise definition is an important task. The simulation test method used to solve this kind of problem can help to solve the system's stockpiling problems. Applying this method can bring significant benefits to companies producing food supplements, as key logistics indicators are taken into account in the corporate interest. An experimental model that allows you to calculate a good enough value and standard deviation based on the statistics of the past and based on the statistics of each month, the value of our target function can produce optimal inventory levels for the company in terms of cost and inventory minimization.

6. Bibliographical references

- [1] R. Peres, E. Müller, V. Mahajan (2010): Innovation diffusion and new product growth models: A critical review and research directions, *International Journal of Research in Marketing*, Volume 27, Issue 2, June 2010, Pages 91-106
- [2] A. Behrens, S. Giljum, J. Kovanda, S. Niza (2007): The material basis of the global economy: worldwide patterns of natural resource extraction and their implications for sustainable resource use policies. *Ecol. Econ.* 64 (2), 444–453, Special Section—Ecosystem Services and Agriculture Ecosystem Services and Agriculture.
- [3] Sz. Szentesi, B. Illés, P. Tamás. (2017): Supply Chain Improvement Possibilities of Consignment Seller Dietary Supplements Manufacturing Companies In: Michael Schenk 10th International Doctoral Student Workshop on Logistics. 143 p.
- [4] Vörösmarty Gyöngyi (2002): A beszerzés információs kapcsolatai, PhD értekezés, Budapesti Corvinus Egyetem

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- [5] V. Arjan (2005): Purchasing and Supply Chain Management, 4th ed. Thomson Learning, London
- [6] TAMÁS P., ILLÉS B., (2016): Raktár-irányítási rendszerek hatékonyságnövelési lehetőségeinek vizsgálata, MŰSZAKI SZEMLE (EMT) 68: pp. 29-37.
- [7] D. F. Pyke, R. Petersen, E. A. Silver: Inventory management and Production Plannin and Scheduling (1998)

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