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POSSIBILITIES OF USING THE FLEXSIM PROGRAM IN A MANUFACTURING COMPANY

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From the macroeconomic point of view, distribution is the process of goods relocation from producers to end customers. According to the microeconomic approach, distribution is more identified with the sales and delivery process, and the main tasks of the distribution centre include the storage of goods owned by suppliers and distributing them to recipients according to the specific instructions of the goods' owner. This article presents costs reduction and productivity improvement issues in warehouses and distribution centres. The objective of this article is to define order picking problems and to choose the best route for the operator using real simulation and optimisation.

Keywords: manufacturing company, warehouse management (WM), distribution centre, cost reduction, productivity

INTRODUCTION

Warehouse management (WM) is an important part of the company's operations, as it allows adjusting the amount of stored materials to the distribution needs. Material flows optimisation, information optimisation and optimisation of other factors related to the storage of goods in warehouses affect primarily the efficiency of management. Regardless of their location in the logistics system, warehouses must receive and provide a wide variety of information at the same time. This information may be data on the amount of available materials as well as demand for them. Therefore, it is important that the information provided reflects the actual inventory. Warehouse management tasks in the distribution area are storing finished products, picking and controlling flows of final products to recipients [1]. This area is an important link in the distribution processes that largely determine the company's competitiveness on the market [2]. In order for the warehouse process to be carried out, certain technical and organisational conditions must be met [3]:

- storage space where the activities will be performed,
- machines and devices used to perform the activities,
- personnel with specific tasks,
- a system for recording the inventories and flow of inventories through the warehouse.

A simple warehouse process in a company consists of eight steps:

- unloading means of external transport,
- relocation to the reception area,
- quantitative and qualitative acceptance,
- relocation to the storage area,
- storage,
- relocation to the dispatch area,
- quantitative and qualitative dispatch and shipment completion,
- loading onto a means of external transport.

Smooth operation of an enterprise depends not only on a well-organised production system, but also on the provision of parts and materials at the right time, place and quantity that is needed at a given moment [4].

OPTIMISATION TASKS

Modelling and simulation methods are used when obtaining a solution using analytical methods is too complicated or impossible, and carrying out direct experiments on a practical (physical) model is too laborious, dangerous and expensive. Modelling and simulation of the production process consists in creating a computer virtual model of a real production system on which a series of experiments are carried out. As a result of the simulation, sets of reports are obtained. With those reports, further actions are defined, and the tested model can be refined and further simulations can be carried out for various variants and settings [5]. FlexSim is an example of software, which allows for intuitive mapping and optimisation of advanced processes taking place in the industry analysed. With advanced algorithms and statistical tools, the natural variability of the process can be mapped [6]. With these tools, a large number of alternative scenarios can be analysed in order to find a solution, i.e. to confirm whether making strategic decisions, finding the optimal solution from hundreds of options or even creating the best production plan are legitimate. FlexSim also has a built-in

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mechanism for generating experiments and checking alternative scenarios [7].

PICKING TRANSFORMATION SIMULATION

The problem of the examined company was identified in terms of the key performance indicators - one of the two KPI levels Tasks implementation per hour - EPC\ FTE - Full Time Equivalent is a unit that indicates the workload of employees. An FTE of 1.0 is equivalent to a full time employee. KPI of the examined company is 75 %.

The company uses the WMS system, which records and monitors all warehouse events, from the receipt of goods (e.g. creating algorithms for distributing deliveries), through their storage (e.g. supervision of parameters of storage sites or inventory), picking (e.g. creating picking paths taking into account the distribution of goods in stock), verification (e.g. using verification panels that automate the process), and dispatch (e.g. register of shipments dispatched). Based on this, WMS generates picking lists by customer order, taking into account such constraints as weight, sequence, etc. The main goal is to minimise the overall operator route. The company's premise is that the total travel distance is the number of cases selected per hour per full-time basis. The solution to the problenijs to increase the efficiency ratio by 15 %. In order to do so, a simulation model of the analysed distribution centre was built:

1. Use of a preparation system.
2. Resources identification and modelling -tracks, racks, wrapping machine, operators, forklifts etc.
3. Addressing - hall, rack, shelf.
4. Importing a picking list from WMS.
5. Modelling the actual restocking.
6. Launching the first simulation model.
7. Model validation.
8. Defining decision variables.
9. Optimisation of the production process.

The simulation model was built using FlexSim. The main premise is to select the operator's best route based on a monthly list obtained from the WMS system. There are 687 addresses in the analysed area, and 227 addresses were taken for the examination due to skipped places -storage place, containers, pallets, etc.

Based on the picking list with the warehouse data, information was entered into the simulation model. Each command number was translated into the next number in FlexSim (starting with 1). In the second step, the storage container was translated to Row shelf and No. in a row. Based on this selection list, a simulation model was prepared. Several global tables were created in the simulation model (Figure 1).

The first Table is the 'Group' table, where information about the number of racks in each group (row) is stored. Values adopted gradually. With this table, we know that the racks in the D01 group start from 1 to 54 - so we have 53 racks, the D03 group starts from 55 to 99

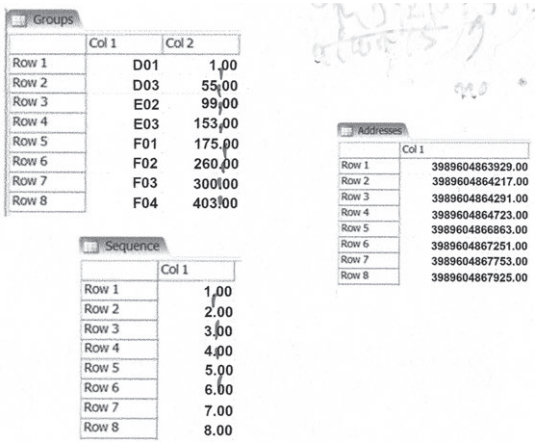

Figure 1 Global tables in simulation model.

- so we have 44 racks, etc. The 'Groups' table is linked to the 'Addresses' table. In the 'Addresses' table, the addresses of each rack in the model are stored based on the 'Groups' table. This means that rows 1 present the first rack in the D01 group. Rows 55 represent the first rack in the D03 group, etc. The next table is the 'Sequence' table. This table is related to the 'Addresses' table.

A number in each row of the 'Sequence' table shows a number in the 'Addresses' table. At the beginning, the 'Sequence' took a value from 1 to 227 - a real scenario. If we change a number in the 'Sequence' table, it will mean that we will change the location of the items in the warehouse. During the simulation, the values in each row of the 'Sequence' table were changed.

During the optimisation, the storage locations of the products were changed.

Products from the D group (D01 and D03) remained in this group, while other items may be stored in a different part of the warehouse - in a different group. There can only be one product in one cell at a time. Therefore, restrictions should be introduced and a simulation should be carried out for each group - first for from the D01 and D03 groups items, then for E02 - F04 groups items.

A simulation model was developed on the basis of 11 254 pickings to prepare 832 pallets (Figure 2).

The total distance covered by the operator in the basic variant is 220 126,5 meters.

The best result in the searched area is 210 651,5 meters. In this area, three simulation solutions have the same value of 783, 754 and 867. As a result of the initial simulations, the warehouse was optimised and the efficiency index was increased by 5 %.

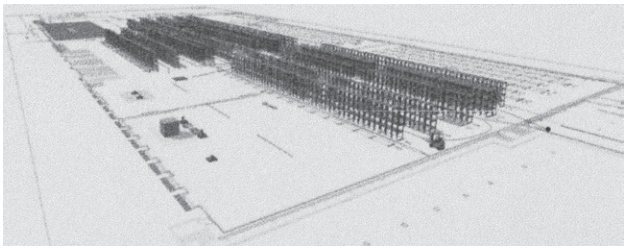

Figure 2 Warehouse simulation model.

SUMMARY

The results of the simulation experiment performed show that the model reflects the actual conditions that determine how the production system in the examined enterprise operates.

In the case analysed, with the computer simulation method, an effective model reflecting the operation of a company in the manufacturing industry could have been developed. The simulation experiment carried out using a model provided detailed data for an in-depth analysis of the production flow. As a result, order picking problems were identified and the operator's best route was identified. In the article, the results of operator distance optimisation in the picking area using simulation experiments were presented. FlexSim was used for optimisation. With the model used, the efficiency indicator increased by 5 %. The result obtained is not satisfactory, therefore more iterations should be used in the model. In order to improve it, the model can be accelerated by using software that removes any superficial objects or a metaheuristic optimal guarantee can be implemented.

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Note: Nowak P. is responsible for English language, Katowice, Poland