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CONCEPTION FOR SELECTION OF ADEQUATE WAREHOUSE MATERIAL HANDLING STRATEGY

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Abstract: Warehousing has been traditionally viewed as non-value-added activity but the identification and elimination of losses in logistics have a great importance for the production companies, because mostly this determines their competitiveness. So far decreasing of lead time in logistics processes have been in focus mainly just in production fields, at the same time the adequate selection of warehouse storage material handling strategies has gained a significant importance in the interest of smooth and effective supply of production processes. This thesis focuses specifically on presently applied warehouse storage material handling strategies and their adequate selection concept, which will be presented in this publication.
Keywords: storage, warehouse strategies, optimal material handling

1. Introduction

Due to the extending customer orientation and the forth industrial revolution promptness, flexibility and increased self-tailoring have initiated a launch in product diversity. This process gives intense challenges for production and supply chain management operating in mass production. Increase in number of product variety required by customers, decrease of product lifecycles, seasonally changing customer requirements have leaded to an increase in material stock level and/or to an increasing uncertainty in production planning [1] (Figure 1). The costumers would like to receive the ordered products as soon as possible. For that reason decrease in production lead time means serious market advantage for the companies. Production lead time can be defined as a sum of the following components:

- lead time of material purchasing,
- lead time of material handling into the warehouse,
- lead time of material handling out of the warehouse, commissioning of materials and delivery to the technological containers,
- lead time of the technological operations of products and lead time of storage between two operations,
- lead time of packaging, making unit loads and shipment to the costumers.

Decrease of production lead time come to material storage-in, -out and relocation is important by the materials with increased product spectrum, means short life cycle and small amount of order. This can be ensured by adequate selection of material handling strategies and optimized conducting of material handling tasks [2, 9-10]. Presently applied storage-in, storage-out and relocation strategies and their optimal selection concept will be presented in the thesis.

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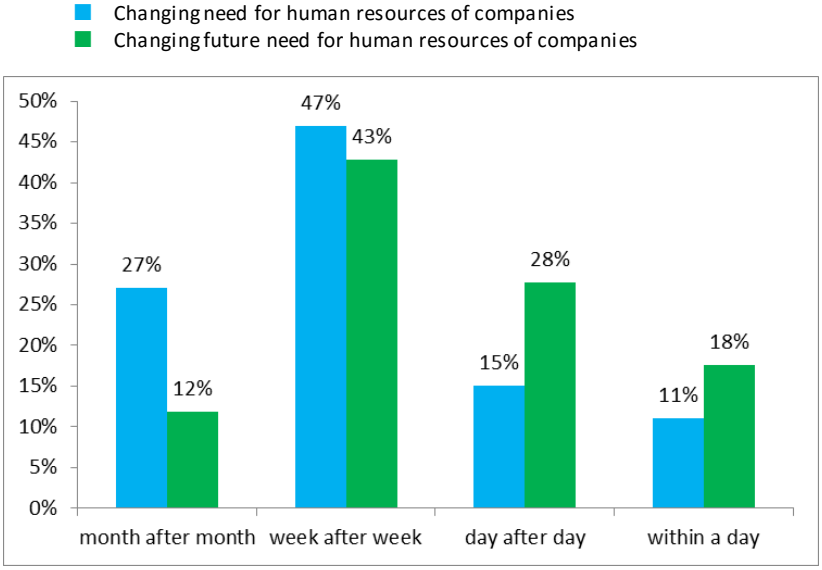

Figure 1. Changing need of human resources demanded by the market requirements

2. Presently applied warehouse storage material handling strategies

This part contains a certain overview in professional literature and material handling strategies presently applied in practice (Figure 2) and the possible relations can be defined between them (Figure 3).

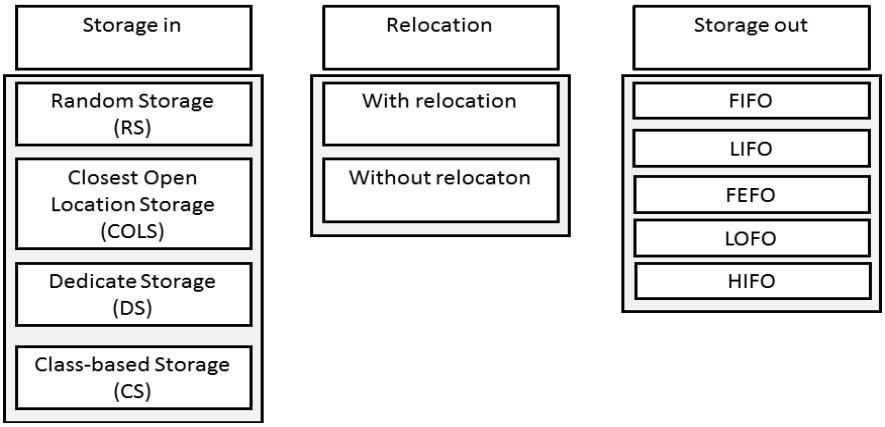

Figure 2. Material handling strategies

Introduction of storage-in strategies:

- *Random storage:* Materials to be stored in are placed to the empty warehouse places on a random way [3].

- *Closest open location storage:* Materials are placed to the nearest empty warehouse place [3].
- *Dedicate storage:* Materials to be stored in are placed to dedicated warehouse places according to product types. In case of constantly changing environment, this model can be applied only with heavy losses [6].
- *Class-based storage:* Stored materials are grouped in ABC categories based on a chosen aspect and the possible warehouse zones are defined in groups. (Figure 4).

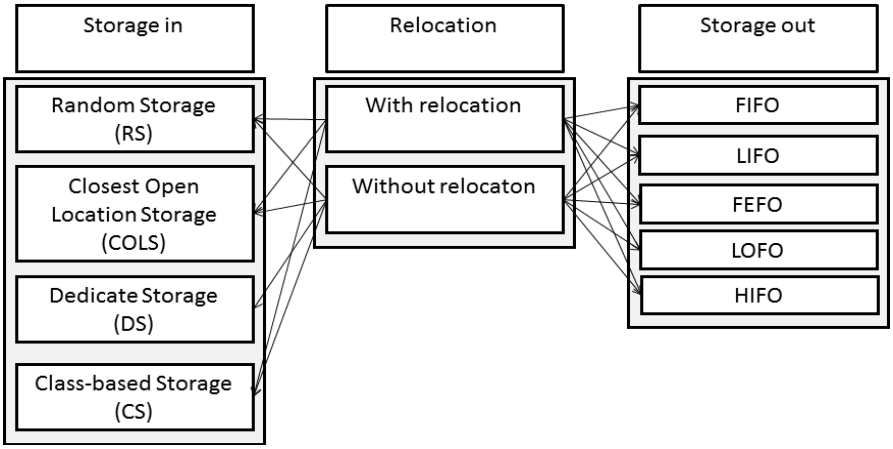

Figure 3. Relation possibilities of material handling strategies

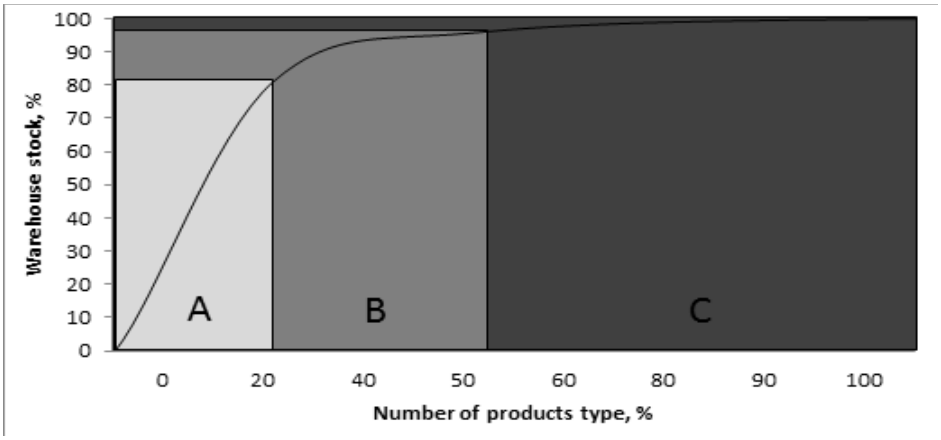

Figure 4. ABC grouping [5]

Formation of groups can happen:

- Popularity: it is based on the frequency analysis of usage, storage place check of materials.
- Turnover: analysis of the total incoming product quantity within a determined time-period.

- Volume: volumetrically analysis belonging to the total incoming product quantity within a determined time-period.
- Pick Density: analysis of the connection between the product consumption frequency and quantity
- Cube per Order Index (COI): analysis of the connection between the product volume and the product consumption frequency. In case of low product index, it will be stored in far away from the storage-out point [4].

Introduction of storage-out strategies:

- *FIFO (First In First Out):* the first incoming product will be the first picked out in the case of a product type.
- *LIFO (Last In First Out):* the first incoming product will be the latest picked out in the case of a product type. .
- *FEFO (First Expired First Out):* product with the shortest expiry will be the first picked out in the case of a product type. .
- *LOFO (Low First Out):* the product purchased on the lowest price will be the first picked out in the case of a product type.
- *HIFO (High First Out):* the product purchased on the highest price will be the first picked out in the case of a product type.

Introduction of relocation strategies:

- *Without relocation:* materials are not moved from one place to another place while they are in the warehouse waiting.
- *With relocation:* In a dynamic stock environment, it is possible to move materials among warehouse places while they are in the warehouse waiting. The goal of the relocation is to have the materials closer to the storage-out point, which results to a decrease in the distance of material moving routes. (ensures opportunity to take away material moving tasks from the peak times) [6-8].

Commissioning of materials according to ordered units can be done based on different strategies. However, due to the extension limit, this thesis deals just with material handling strategies for whole unit load.

3. Concept for selection of optimal warehouse material handling strategy

Warehouse material handling strategies introduced in previous part and their related material handling systems are working in the practice usually based on intuition, simple – considering just a few aspects – calculations. This causes remarkable losses for most of the companies. In the interest of minimizing these losses there is a need to develop a system able to select adequate operation strategy (storage-in, -out and relocation) and optimize real-time material handling tasks. This part introduces concept to select the adequate material handling strategy (Figure 5).

The adequate concept of material handling strategy selection consists of the following steps:

1. step: Creation of possible warehouse material handling strategy versions (can be created according to different combinations of pick-in, -out and relocation strategies, based on Figure 5).
2. step: Initiating of variables. Variable *i.* contains the presently analysed material handling strategy version, while *Opt* contains the optimal material handling strategy version identification.
3. step: Material handling, product and warehouse place data recording needed for the analysis within a defined time period (determination of exact data structure is a topic for a research later).

- Material handling data:
  - number of material handling machines,
  - acceleration, working velocity of material handling machines,
  - fuel consumption and refill of material handling machines,
  - maintenance of material handling machines,
  - transport capacity of material handling machines,
  - product storage-in and –out time of material handling machines,
  - material handling routes,
  - limitation of applied routes of material handling equipment.
- Product data:
  - built-in matrix of parts,
  - overall dimensions, filling quantity of UL (unit load) per product type,
  - storage-out deadlines per product type.
- Warehouse places data:
  - size data of warehouse systems (overall dimensions, size of warehouse bins, size of corridors for transportation, etc.),
  - rate of occupied warehouse places, empty warehouse places,
  - type of the materials are on warehouse places,
  - distance among warehouse places and the storage-in and –out points.

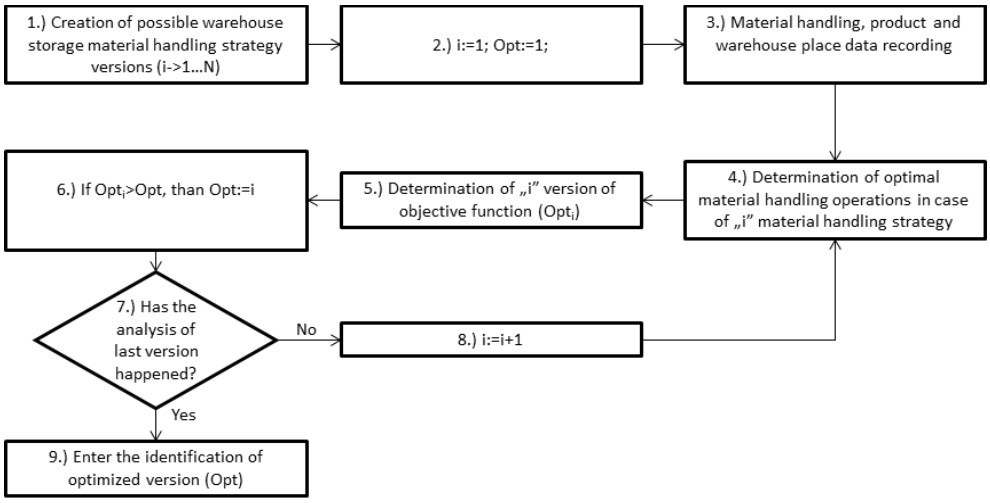

Figure 5. Selection concept for optimal material handling strategy

4. step: Determination of optimal material handling operations regarding „*i*" material handling strategy. Determination of material handling operations based on information described in point 3. is done based on a simulation analysis model optimizing material handling operations (simulation analysis model needs to be worked out in a research to be done later).
5. step: Determination of „*i*" version of objective function result based on optimal material handling strategy (determination of objective function is the topic of a research later).
6. step: Examination whether the objective function result of „*i*" material handling strategy version is preferred to the one determined by previous strategy. If yes, the reference number of this variable will be stored in *Opt* variable.
7. step: Examination whether the analysis of the last material handling strategy has happened.
8. step: In case the analysis of last material handling strategy did not happen, the variable „i" shall be incremented and therefore steps 4-7 have to be done in case of next material handling strategy version.
9. step: In case even the last material handling strategy has been analysed, optimal storage-in, -out and relocation strategies can be determined based on the best objective function result.

4. Summary

Selection and running of adequate warehouse material handling strategy have a major influence on companies' competitiveness by efficiency increase in conducting internal warehouse storage material handling tasks and serving production. In the thesis, the presently applied storage-in, -out and relocation material handling strategies have been presented. For adequate selection of strategies, the professional literature does not provide investigational system worked out on a detailed way. In this publication, a concept was presented how to select adequate warehouse material handling strategy, which is the base of our research for the future.

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