

**APPLICATION OF CLUSTER ANALYSIS IN THE STORAGE SYSTEM**

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**Keywords:** cluster analysis, storage system, dendrogram

**Abstract:** The paper will deal with the application of cluster analysis in the storage system of a selected manufacturing company from the automotive industry. The cluster analysis will be based on monthly business expedition data. The result will be dendrogram representation of clusters, from which we select the optimal number of clusters. These clusters will present a proposal for storage products. Cluster analysis belongs to multivariate mathematical-statistical methods. The aim of cluster analysis is to create clusters based on the similarity in compliance the conditions that the similarity of objects within the cluster is the largest, and similarity clusters as small as possible. Similarity is a fundamental idea in the formation of clusters of stocks.

## 1 Cluster analysis in storage system

### 1.1 Current warehouse system

Cluster analysis belongs to multivariate mathematical-statistical methods. The aim of cluster analysis is to create clusters based on the similarity in compliance the conditions that the similarity of objects within the cluster is the largest, and similarity clusters as small as possible [1]. Similarity is a fundamental idea in the formation of clusters of stocks [2].

The paper will deal with the application of cluster analysis in the storage system of a selected manufacturing company from the automotive industry. We have data on expedition of products for customer per calendar year. Monthly development of the dispatch of products per year for individual customers the company is graphically illustrated in Figure 1.

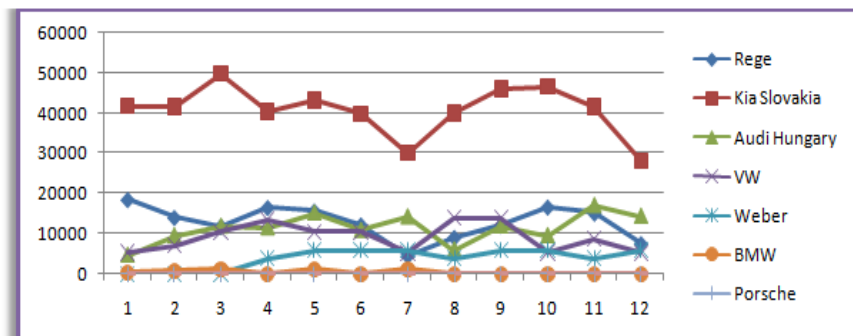


Figure 1 Development of product expedition

Percentage share on expedition of products to customers is shown graphically in Figure 2.

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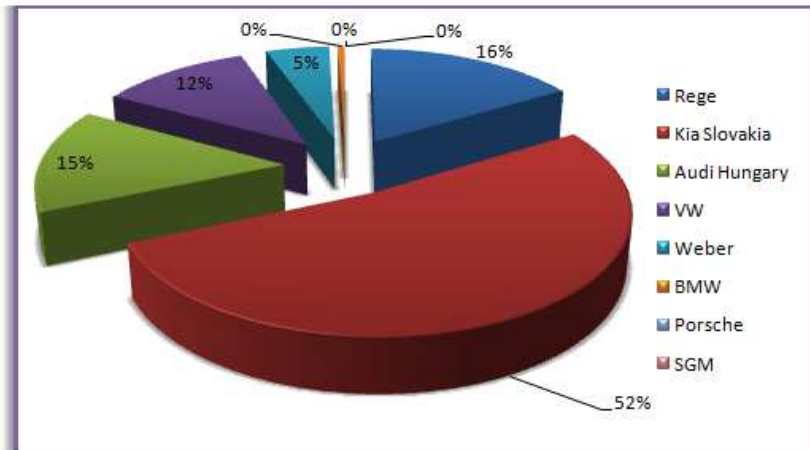


Figure 2 The share on expedition

The graphic representation on Figure 1, Figure 2 shows that the largest share of customers have Kia Slovakia (52%), Rege (16%), Audi Hungary (15%), VW (12%) of the total expedition.

The production company for storage of products in the warehouse of finished products using ABC analysis, based on which products are divided and arranged as shown in Figure 3.

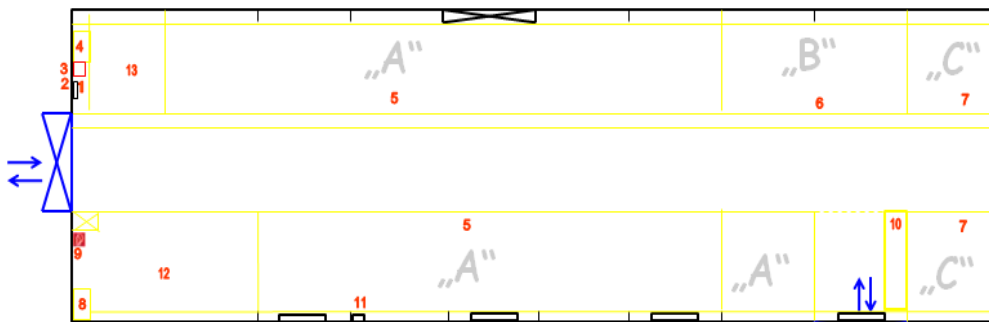


Figure 3 Partition in the warehouse by ABC analysis

The following figure shows graphically the percentage of expeditions of each product group by ABC analysis (Figure 4).

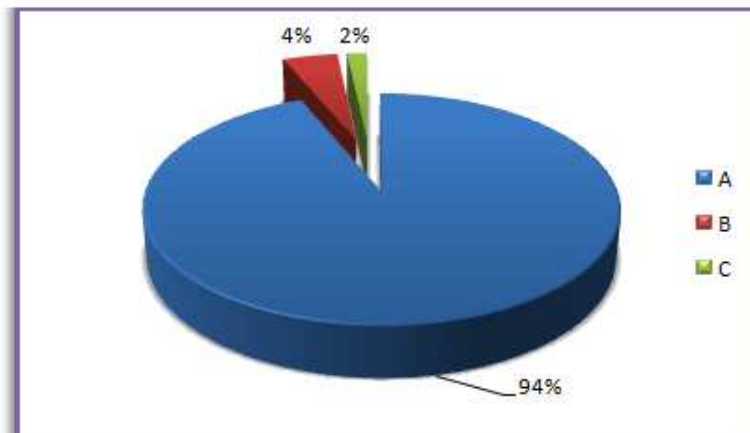


Figure 4 The share on expedition by ABC analysis

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We see that Group A products have the largest share of the expedition with a 94% share, so storage in the warehouse is closer to the expedition.

**1.2 Cluster analysis in the storage system**

When cluster analysis of the products we have not taken into account the current method of distribution of products

according to ABC analysis [3]. This division will be compared at the end of the article with the results of the cluster analysis and subsequent storage suggestions [4].

The first step in the clustering process of finished products is the creation of clusters based on input data of the expedition in the given year. The output of the cluster analysis is dendrogram shown in Figure 5.

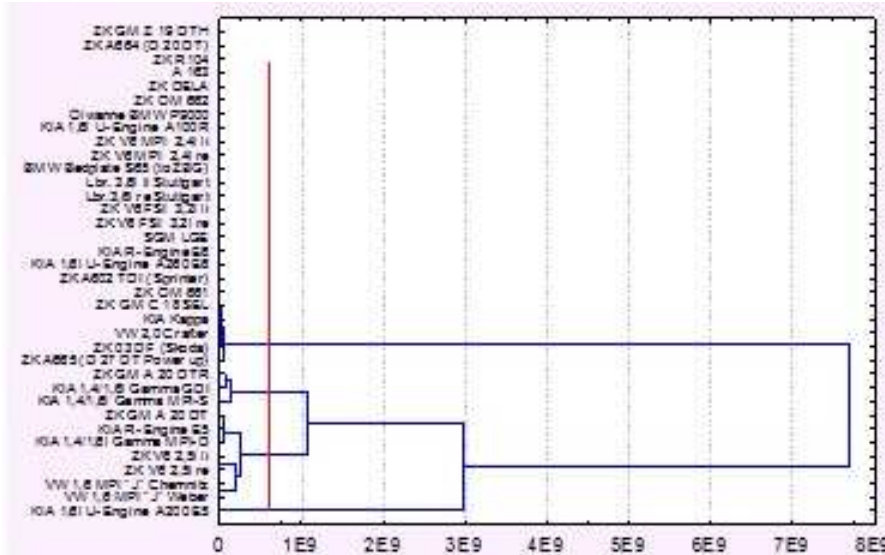


Figure 5 Dendrogram

Based on a heuristic approach to selection of clusters, there are optimal 4 clusters of products. Percentage of

individual clusters of products is graphically illustrated in Figure 6.

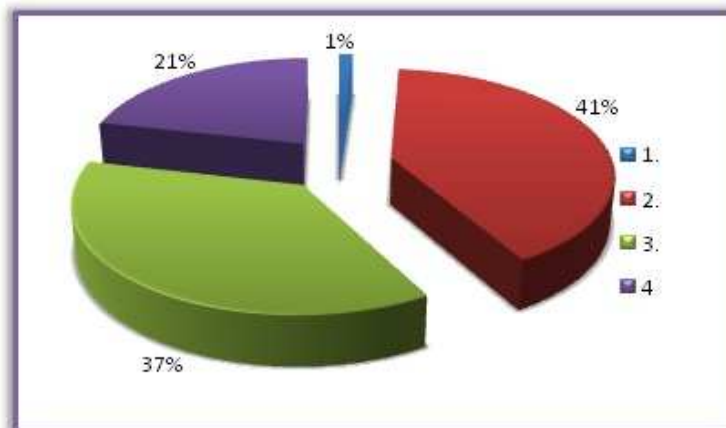


Figure 6 The share on expedition by cluster analysis

The most significant clusters by expeditions for customers are 2.cluster (768 497 pcs, 41% share) and 3.cluster (693 420 pcs, 37%). 4. cluster consists of the product to the customer Kia, United Kingdom, which is the biggest consumer of company, the percentage share those cluster is 21%, which is 405,830 units of products. The 1. and 2. cluster contain most types of products for different customers, but their expedition is low. Requirements of customer for production are one-off, so their percentage of

expedition is low. Requirements of customer for production are one-off, so their percentage of expedition is low.

**1.3 Layout of warehouse by clusters**

At the conclusion of the cluster analysis of the product stocks, it can be noted that the division of the products into groups (clusters) by cluster analysis is different from the original division of products by the ABC analysis.

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The result of cluster analysis of stock items in the form of clusters of finished products is taken into account in the

proposal of layout of the warehouse shows in Figure 7 in 2D and in Figure 8 is 3D forms.

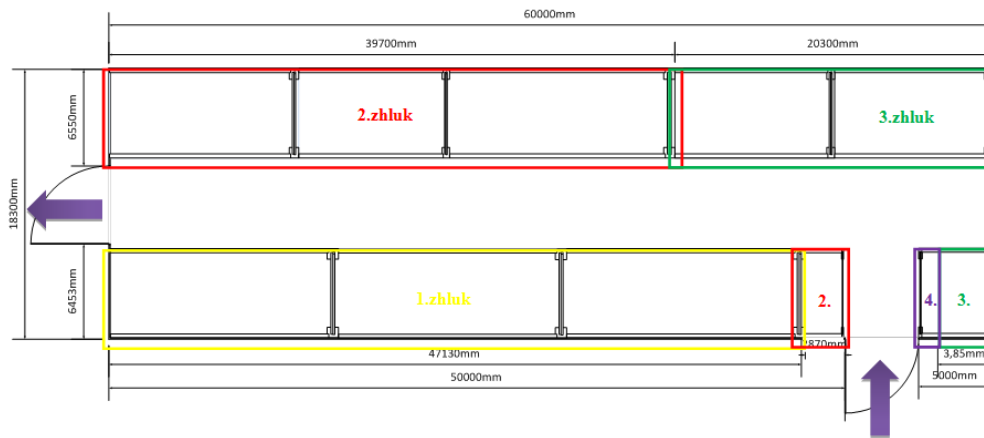


Figure 7 2D proposal of layout of warehouse



Figure 8 3D proposal of layout of warehouse

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