The Application of ABC Analysis in the Logistic Warehousing Processes

T. Kučera[1], A. Suk[2]

[1] *University of Pardubice, Faculty of Transport Engineering, Studentská 95, 532 10, Pardubice, Czech Republic, E-mail:* tomas.kucera@upce.cz
[2] *University of Pardubice, Faculty of Transport Engineering, Studentská 95, 532 10, Pardubice, Czech Republic, E-mail:* antonin.suk@student.upce.cz

Abstract

Each company asks how to reduce costs and waste while maintaining profit growth in a free market environment. Logistics can partly answer this question. Logistics opens the way to a wide range of methods and tools to optimize business. Warehousing and inventory management are one of the company's most important activities in logistics. It is important to ensure that the business is optimally sourced. A number of methods are used for the inventory management and one of them is ABC analysis. ABC analysis is one of the traditional scientific methods used in case studies. If a company has an unnecessary amount of inventory that it is not able to consume, it must spend unnecessary resources to store it. Otherwise, when a company has insufficient inventory, it loses profits from a missed order that can lead to customer losses. ABC analysis is used to inventory management in logistics especially in warehousing. This analysis is one of the methods of differentiated inventory management. The goal of ABC analysis is to divide stock items into three categories according to the classification criteria. ABC analysis is based on the Pareto principle, which means that by controlling 20% of the most important stored items, 80% of the total volume of stored items can be affected. The aim of this article is the application of ABC analysis in a selected company with a view to rationalization of logistic warehousing processes. The article is also based on research of world-renowned literature from the Web of Science database.

KEY WORDS: *ABC analysis, inventory management, logistic warehousing processes*

1. Introduction

Every company asks how to reduce costs and waste while maintaining profit growth in a free market environment. This question is partly answered by logistics, which also opens the way to a wide range of methods and tools to optimize business. However, not only the business sector that somehow interacts with the external environment (e.g. transport and distribution or purchase itself), but also the in-house system and its logistic chain, in particular for manufacturing companies, should be solved. It is needed to find and eliminate bottlenecks and wastage processes. It is necessary to thoroughly control business methods, which must not be obsolete and must be kept up to date at the same time. Inventory management is one of the company's most important activities, so it is important to ensure that the business is optimally sourced. A number of methods are used for this and one of them is ABC analysis. If a company has an unnecessary amount of inventory that it is not able to consume, it must spend unnecessary resources to store it. Otherwise, when a company has insufficient inventory, it loses lost profits from a missed order, which can lead to loss of customers. The main goal of each business is to optimize all of logistic operations to minimize errors and gain competitive advantage over other businesses in the industry.

The aim of this article is the application of ABC analysis in a selected company with a view to rationalization of logistic warehousing processes. The article is based on research of world-renowned literature from the Web of Science database.

2. Theoretical Background

Inventory and warehousing logistics is an actual topic that has been spoken about in recent years [1]. Effective inventory control can help businesses improve competitiveness [2]. Every business is looking for ways to save money. The current financial crisis puts pressure on companies to reduce costs and optimize inventory [3]. Warehousing solves many critical issues such as inventory, order cycles, warehousing facilities and their spatial distribution, warehouse management and inventory management [4]. Inventory management was a well-known problem in operational research. A large number of authors have solved this problem [5, 6, 7, 8, 9] and several models have been developed to solve inventory problems [10]. Business companies have hundreds of different types of materials. It is therefore easy to lose control over material management. Inventory is a tool that is used to manage and control the ordering, warehousing, and use of machines in companies, as most manufacturing companies apply policies to reduce their investment in fixed assets, such as jobs, warehouses, equipment and machines, emphasizing the consequences of reducing inventory. A business inventory is one of its main assets and represents the investment that is associated with the time the item is sold, as well as the costs of warehousing, tracking, and inventory security [11]. Inventory management is a continuing process of inventory planning, organizing and controlling to minimize inventory investment while balancing supply and demand. The stocks, expressed as the number of days of sale, at each moment determine the time needed to launch a new product on the market [12]. Inventory classification using ABC analysis is one of the most widely used techniques in organizations [13]. Inventory concepts and benefits of ABC classification were analysed and various steps implemented using ABC analysis for the analysis of the original case were discussed. Appropriate measures have also been proposed to show that ABC inventory analysis has a significant value in theory and practice [14]. Inventory management practices of various companies and institutions have been studied and compared with the necessary suggestions for improvement by ABC inventory analysis. ABC analysis has been found useful for most companies that already use this tool either manually or through company resource planning [15, 16, 17]. The study was conducted with ABC analysis in the automotive industry using the maximum cost-saving effect. A proposal has been proposed to reduce the costs associated with company inventories through research and statistical calculations. The new inventory management system has enabled companies to use the saved money in another way and achieve further process optimization [3, 18]. The basic methodology is ABC analysis widely used to manage a number of inventory items in organizations [19]. ABC analysis was a hot topic in many studies in inventory management. First Flores and Whybark [20, 21] emphasizing the importance of considering multiple criteria in ABC analysis, various approaches to solving ABC have been proposed in the literature. Most management and oversight is spent on managing A items, C items get the least attention and B items are between. The purpose of grouping items is to determine the appropriate level of control over each item [22, 23, 24].

3. Methodology

The basis of the ABC analysis can be found in the Pareto rule (also the 20/80 rule, the Pareto diagram or the Pareto principle) which states that 20% of the causes are responsible for 80% of the consequences. This means, for example, that 80% of the plant's profits will be only 20% of the product models. It is thus evident that not all product models have the same effect on the production profitability. It is precisely to analyse the influence of individual items on the problem solved by ABC analysis [25, 26]. Figure 1 shows graphical representation of ABC analysis. According to the share of the total value of the parameter (turnover, purchase price, earnings…). A more general approach is the so-called ABC analysis, which divides the data set into three discontinuous sets A, B and C, while the set A should contain important few, while set C contains trivial many [27, 28]. The items are then grouped into the following groups [25, 26, 29]:

- Group A - 70-80% of total parameter value and 10-15% of total item value.
- Group B - 15-20% share of total parameter value and 15-20% of total item value.
- Group C - 5-10% of total parameter value and 60-80% of total item value.

The procedure for compiling ABC analysis:

- Formulation of the goal - in the first step it is necessary to determine which quantity will be analysed by ABC analysis.
- Data collection - in the second step, it is necessary to ensure a sufficient amount of information about the quantity.
- Distribution of stocks into individual categories - in this step it works with data of a given quantity. According to the accumulated annual turnover, it is classified individual items into categories.
- Checking the execution of ABC analysis - the next step is to check whether the analysis was performed correctly.
- Periodic data update - in the last step, the period is set, in which the analysis should be performed again in order to update the inventory allocation to each category.

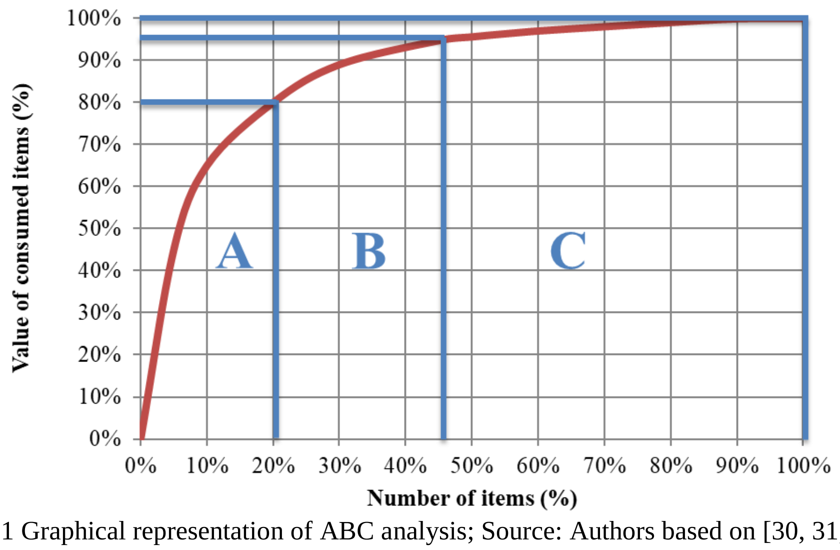

Fig. 1 Graphical representation of ABC analysis; Source: Authors based on [30, 31, 32]

In the case of simultaneous double analysis, two separate ABC analyses are actually obtained, the results of which are combined according to the item code to extract the final categorization [33, 34]. It is recommended that the period should be 12 to 24 months. Shorter period may be distorted by, for example, seasonal demand, or if the company's production program changes over a longer period of time and its reporting capacity may be lost [35]. However, the traditional ABC classification considers only one criterion to classify stocks. This criterion is the annual cost recovery very often. It is obtained by multiplying the annual requirements and the unit price of the part or position (item in stock). Other criteria, in addition to annual costs are delivery time, item criticality, availability, unit price and sanction costs [36].

4. Results and Discussion

The ABC analysis is applied in a selected company with a view to rationalization of logistic warehousing processes. The amount of material is measured in 6 units by type. In metres, in kilograms, in feet, in grams, in rolls and in pieces. The production itself is divided into 51 workplaces, which are identified by the alphanumeric code W01-W51. Some workplaces are not located in the surveyed plant, but in other halls. For this reason, only the W01-W10, W12, W19-W25 and W49-W51 workplaces are described in more detail. Workplaces W09, W49 and W50 make the transition between production and dispatch, as it is an assembly site (W09) where individual products are assembled with others to form a separate unit in subsequent distribution. W50 is labelled as the packing station and the last workplace (W49) is the distribution itself. An approximate overview of the processed volumes are displayed in the tables. Table 1 shows the average quantities transported to individual workplaces within one working day. Table 2 shows the amount of material transferred by milk run technology to individual sites throughout the year. This is 312 working days. The data bars show the relative distribution of the total number of units per workstation in both tables (e.g. the most material measured in pieces, was transported to W02 and then to W08).

Table 1

Average amount of material transferred to production during one day; Source: Authors

	Workplace										
	Total	**W01**	**W02**	**W03**	**W04**	**W05**	**W06**	**W07**	**W08**	**W09**	**W10**
Pieces	95 948,859	2 102,224	18 141,01	3 203,644	197,362	629,455	1 057,221	635,785	16 126,314	8 704,083	3 304,603
Metres	17 343,927	0,535	36,617	0,742	x	33,549	0,231	9 047,864	4 157,825	2 622,716	0,003
Kilogram	786,36	1,22	2,004	0,062	x	x	x	118,423	57,961	x	1,073
Feet	5,545	x	x	x	x	x	x	5,256	x	0,288	x
Grams	0,897	x	x	x	x	x	x	x	0,897	x	x
Roll	0,24	x	x	x	x	x	x	x	x	x	x
	W12	**W19**	**W20**	**W21**	**W22**	**W23**	**W24**	**W25**	**W49**	**W50**	**W51**
Pieces	882,526	10 808,282	1 305,885	6 293,074	334,910	964,833	8 407,788	9 506,606	26,420	3 316,833	x
Metres	x	0,013	13,686	0,253	0,006	1,653	0,026	1 415,336	12,821	0,052	x
Kilogram	x	0,0001	1,309	71,096	0,01	2,308	x	19,613	x	x	511,282
Feet	x	x	x	x	x	x	x	x	x	x	x
Grams	x	x	x	x	x	x	x	x	x	x	x
Roll	x	x	x	x	x	x	x	0,24	x	x	x

Table 2

Total amount of material transferred to production in one year; Source: Authors

	Workplace										
	Total	**W01**	**W02**	**W03**	**W04**	**W05**	**W06**	**W07**	**W08**	**W09**	**W10**
Pieces	29 936 044	655 894	5 659 995	999 537	61 577	196 390	329 853	198 365	5 031 410	2 715 674	1 031 036
Metres	5 411 305,227	166,92	11 424,395	231,63	x	10 467,2	72	2 822 933,552	1 297 241,311	818 287,252	1
Kilogram	245 344,263	380,494	625,235	19,2	x	x	x	36 947,853	18 083,954	x	334,815
Feet	1 730	x	x	x	x	x	x	1 640	x	90	x
Grams	280	x	x	x	x	x	x	x	280	x	x
Roll	75	x	x	x	x	x	x	x	x	x	x
	W12	**W19**	**W20**	**W21**	**W22**	**W23**	**W24**	**W25**	**W49**	**W50**	**W51**
Pieces	275 348	3 372 184	407 436	1 963 439	104 492	301 028	2 623 230	2 966 061	8 243	1 034 852	x
Metres	x	4	4 270	79,09	2	515,7	8	441 584,927	4 000	16,25	x
Kilogram	x	0,024	408,451	22 182,037	3	720	x	6 119,251	x	x	159 519,949
Feet	x	x	x	x	x	x	x	x	x	x	x
Grams	x	x	x	x	x	x	x	x	x	x	x
Roll	x	x	x	x	x	x	x	75	x	x	x

It was possible to apply the ABC analysis based on individual transport data thanks to the information system, which is in the company. These data include the transport number, time and date when the request for the material was specified, and when it met numeric or alphanumeric code. The code identifies the material, description and quantity of the material, the target site and, if it is a material for Kanban, the associated location in the shelf, and last but not least, from what warehouse and from which specific location the material was removed. The W49 site is excluded from the ABC analysis itself, as the distribution section is not part of the milk circuit run. Tables 1 and 2 show the material measured in feet, grams, and rolls can be neglected due to low outputs, and the analysis only addresses the material measured in pieces, metres, and kilograms, and the number of transports per site. The results of ABC analysis were plotted on the Pareto diagram and each workstation on the graph was assigned the letter A, B or C according to its evaluation in the analysis itself. Five items of group B have always been designated as the impact zone between items A and C. Figure 2 shows a diagram for transports. The A level was set at 70%, and 7 workplaces fall into this category.

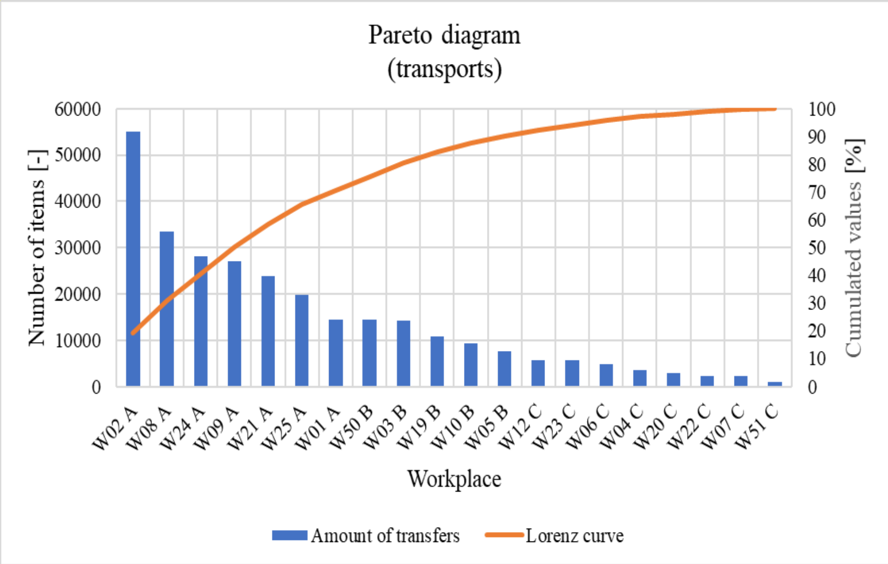

Fig. 2 Pareto diagram (transports); Source: Authors

Figure 3 shows the Pareto diagram for the material measured in pieces. Here, the cut-off value for item A was set to 81%. Category A consists of 7 workplaces.

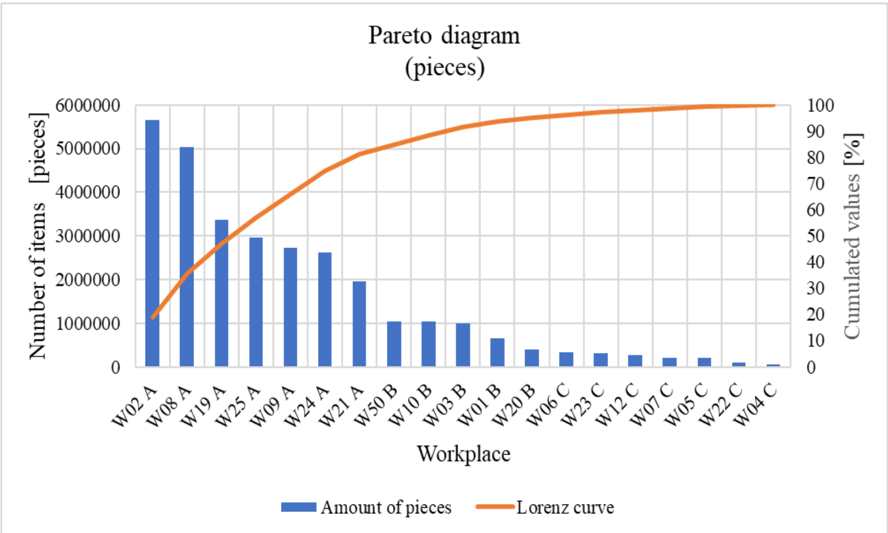

Fig. 3 Pareto diagram (pieces); Source: Authors

Figure 4 shows the Pareto diagram for the material measured in metres. For this material, the value for category A items was set at 76%. Thus, category A includes 2 workplaces.

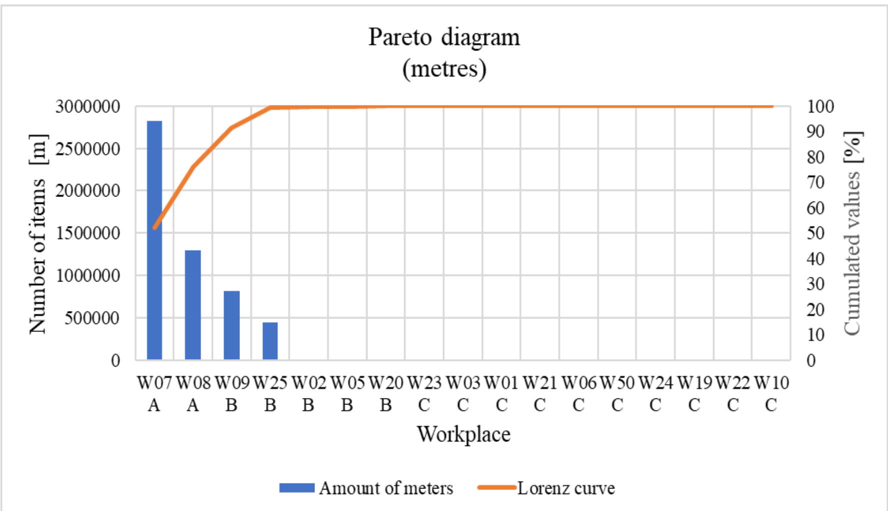

Fig. 4 Pareto diagram (metres); Source: Authors

Figure 5 shows the Pareto diagram for the material measured in kilograms. In this case, the level for item A was set to 80% and this category thus constitutes 2 workplaces.

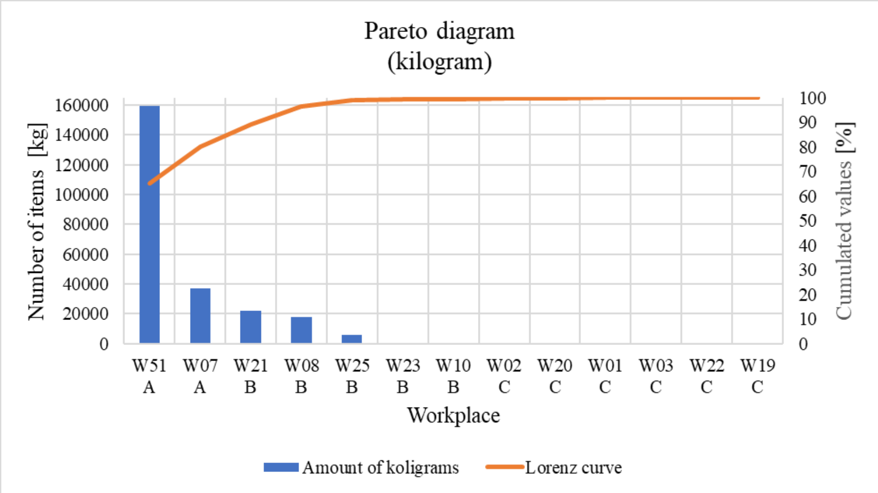

Fig. 5 Pareto diagram (kilogram); Source: Authors

Especially the W01 workplace appears to be problematic from this analysis. Despite the fact that in terms of supplies of material in kilograms and metres it was placed only in category C and for material in pieces in category B there were 14 349 transports (corresponding to category A in ABC analysis).

5. Conclusions

There is increased pressure in the area of optimization of logistic processes at the manufacturing and trading companies. As the logistic processes follow and interact with each other, it is very important that the entire cycle already work properly from purchase to final distribution to the customer. Warehousing is one of the most important elements of the logistic chain in goods manufacturing companies. Warehousing is necessary to hold stocks in any form. Therefore, it is very important that this process be constantly improved, while keeping costs as low as possible. Warehousing processes are the most important part of the logistic system, helping to maintain customer service levels and quality at the lowest cost. The introduction and shaping of the structure of individual logistic processes is becoming increasingly important nowadays as it is a series of mutually influencing and consecutive cycles, the proper functioning of which is a necessary condition for a prosperous business. The aim of this article was the application of ABC analysis in a selected company with a view to rationalization of logistic warehousing processes. It was possible to apply the ABC analysis based on individual transport data thanks to the information system. The ABC analysis shows that it is necessary to track the items such as W01, W02, W07, W08, W09, W19, W21, W24, W25 and W51. The next step could be to apply XYZ analysis as a complement to ABC analysis.

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