

# ANALYSIS OF INVENTORY MANAGEMENT ON THE EXAMPLE OF A SELECTED COMPANY – RESULTS OF AN EMPIRICAL

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**Introduction/background:** This paper presents the possibilities offered by ABC analysis by number of releases for solving complex problems in the area under study. The use of appropriate inventory management methods makes it possible to support decisions on flows in the company's logistics system. This contributes to quick action leading to the optimisation or transformation of ongoing logistics processes and the reduction of the associated risks.

**Aim of the paper:** The aim of the article is to present the dysfunctions in the area of inventory management in a selected company, to identify their negative impact on the implemented processes and to propose corrective actions. In addition, the importance of inventory, problems and challenges of the company based on the storage of goods is highlighted. An evaluation and recommendation of the described company is also made

**Materials and methods:** A literature study was carried out to identify key dysfunctions in the area of stock management. In addition, a detailed analysis of stock levels and their management in the warehouse of the company "GUSPOL" was carried out using the ABC method.

**Results and conclusions:** Based on the data provided by the company, an ABC analysis was carried out. Thanks to this, each assortment item was characterised and assigned to the corresponding ABC group. A change to the conceptual design of the warehouse was proposed, involving a change in the storage locations of the technical gas cylinders and the addition of shelving, making the floor space more functional and employee-friendly.

**Keywords:** logistics, inventory management, warehousing, ABC analysis.

## 1. Introduction

Inventory management is an important element in the logistics supply chain. Despite a number of publications have been produced in recent years on topics related to inventory stocking, there is still a research and publication gap related to inventory management in the warehouse. In particular, gaps have been observed in the area of minimizing storage costs through optimal distribution of assortment in the warehouse.

The purpose of the article is to present the dysfunctions in the area of inventory management in a selected enterprise, to identify their negative impact on the implemented processes and to propose corrective measures. It is worth emphasizing that when an enterprise decides to build up inventory, it must expect continuous monitoring and improvement of warehouse processes.

Without a properly functioning warehouse, it is difficult to imagine a successful company. This is why knowing the types of stock and their functions is so important. With this knowledge, it is possible to clearly determine whether holding stock in a company is necessary. If inventory is unavoidable, the focus should be on choosing the right management method. The chosen method should be tailored to the company in question. Introducing an inventory management method that is too sophisticated may not be viable for small businesses. Resulting in high introduction and maintenance costs. Therefore, the question to be answered is whether there is a need to improve inventory management in the warehouse and what benefits it can bring. A well-organised warehouse space reduces the occurrence of errors and reduces the time spent in handling it.

## **2. Review of the Literature**

Inventory is the amount of physical goods stored and used for consumption or resale to satisfy the normal operation of a business (Slawinska, 2004, p. 103). According to the definition of H.K. Compton and D. Jessop, inventories are "the collection of all materials, goods and services used in an enterprise whether they have been purchased externally, supplied from another branch of the enterprise or produced locally" (Compton, Jessop, 1989, p. 135). J. Sobótka, on the other hand, defined inventories "as a specific quantity of goods that is located in a specific logistics enterprise not used on an ongoing basis for later processing or sale. Inventory has a specific location, place of storage, and its size can be distinguished in quantitative and value measures" (Koliński, Konecka, p. 119). A. Niemczyk defined them as "tangible goods physically and documented accepted into a warehouse, inventoried there and stored for later release for appropriate use example production or distribution" (Niemczyk et al., 2013, p. 19). We can also call stocks the goods held in the various stages of the supply chain. An integral part of the operation of manufacturing, trading and service companies is the maintenance of inventories. When individuals and permanent premises with equipment are involved in the storage of materials, as well as financial resources allocated for their accumulation, these goods become stocks (Krawczyk, 2001, p. 81). The impact of random events on the development of demand is one of the main reasons for stockpiling. The lack of synchronisation of supply and sales is the main reason for stockpiling inventory. In this situation, inventory plays the role of a kind of shock absorber between demand and sales. Manufacturing companies are therefore forced to secure the stock necessary to satisfy

production and the stock of finished goods and merchandise (in trading companies) to satisfy the needs of the end customer. They are also expected to minimise the cost of lost sales. Other reasons for building up inventories include: delayed deliveries, reducing transport costs (Coyle et al., 2001, pp. 211-212), negotiating a lower purchase price, seasonality of supply of goods, hedging against price changes and against unforeseen events (Kempny, 1995, p. 125). Nevertheless, excessive and unnecessary inventories should not exist in the enterprise. Optimal management of them in relation to needs prevents losses in quantity and quality (Munyaka et al., 2022).

Some companies try to introduce solutions that completely eliminate the need to hold stock. However, not in every company, this is a rational solution. It requires viewing the entire supply chain holistically, where the starting point is the customer having a sense of satisfaction with the transaction (Kaczorowska-Spychalska, 2016).

## **2.1. Decision dilemmas in stock management**

Decisions are an integral part of our lives. The results from the research on decision-making issues carried out so far are ambiguous. We often do not have enough knowledge to make the right choices. However, on the other hand, it is easier to decide between two options while having residual information and thus reducing the costs used in problem exploration. The use of decision theory methods is helpful in solving dilemmas. They are used where, for various reasons, it is difficult to make the right decision. Many fields of science deal with this issue, especially the analysis and support of the decision-making process. These fields of science include mathematics, economics, psychology, sociology, statistics, computer science, management, philosophy, medicine, cognitive science. The decision-making methods they have developed have been brought together and organised to create a single decision-making process. However, the interdisciplinarity of decision theory results in it being seen only as a reference point, due to the circumstances under which a decision is chosen (Scibiorek, 2021, pp. 85-87). There are two basic models of decision-making, the classical model and the managerial model.

The classical model is based on the belief that decision-making can be optimised. Full information is used for this purpose. Managers identify ideal benefits and reject variations. This method usually uses mathematics, statistics or economics. In this model, the decision maker should:

- gather reliable and comprehensive information,
- eliminate uncertainty,
- judge everything rationally and logically,
- make the most advantageous (loss-minimising) decision for the organisation.

In reality, however, the assumptions of this model are rarely met. Complete and reliable information is hard to come by and there are errors in the manager's behaviour. Often their actions are illogical and irrational. In contrast, the managerial model is otherwise known as

behavioural or administrative. It means that the person making decisions, does so in an illogical manner. It tends towards self-satisfaction rather than optimisation. Often managers are not aware of their limitations in terms of values and skills. They are also limited by incomplete information and knowledge. These difficulties leave the decision-maker without the opportunity to make rational decisions. As a result, they settle for minimal benefits. The decision-maker in the managerial model:

- uses unreliable and incomplete information,
- is limited in its logical thinking,
- is willing to settle for the first better decision allowed,
- makes decisions that do not always bring benefits to the organisation (Malewska, 2014, pp. 128-133).

It should be emphasised that the moment information about the problem reaches the manager, the decision-making process is triggered. Based on the information received, the decision-maker outlines the decision problem for which he or she will seek solutions. The beginning of the decision-making stage is the identification of the problem, and the starting point is decision-making and evaluation of its effects (Scibiorek, 2021, p. 88). It consists of six consecutive stages:

Stage 1 - at the initial stage, the decision-maker needs to assess; where the problem has arisen, whether it is new or fixed, whether the situation is dependent only on the decision-maker, etc. This characterisation of the problem will allow the manager to determine the next steps in the decision-making process.

Stage 2 - once the problem has been formulated, the decision-maker focuses on finding the information needed to solve it. Based on the data collected and his or her knowledge, he or she can determine the cause of the problem.

Stage 3 - the decision maker creates possible solutions to the problem and ways to fix it. This requires creative ingenuity on the part of the manager.

Stage 4 - this stage is based on the evaluation of the decision-maker's proposed solutions. This uses mathematical techniques, listing the 'for and against' relationships and identifying possible benefits.

Stage 5 - based on the knowledge and information gained, the decision-maker chooses the best form of solution to the problem, i.e. makes a decision.

Stage 6 - when a solution has been selected, implementation takes place. After its implementation, the manager evaluates his decision. If the problem has been fully solved or partially reduced, this signals that the decision-making process has been successful. In cases where the problem has not been solved, the process must be restarted.

The integration of the presented factors formulates several different decision criteria in shaping the quantitative level of inventory as well as its replenishment time (Musiałek, 2018). For each of these, an appropriate inventory management method and system should be selected. Examples of inventory management solutions, including these decision criteria presented above, can be classified as shown in table number 1.

**Table 1.***Fundamental factors shaping inventory management issues*

The nature of the demand	Independent (primary)		Dependent (secondary)	
Determining the demand	Deterministic	Stochastic		Subjective
Delivery time	Unknown		Known	
Stock value	Group A	Group B		Group C
Stock consumption	Group X	Group Y		Group Z
Stock replenishment	Instant		Gradual	
Stock shortages	Unacceptable		Acceptable	
Out of stock	Not Transferred		Transferred	
Price discounts	Do not occur		Appear	
Inflation factors	Not included		Included	
Group ordering	Applied		Not applicable	
Planning periods	One		Many	

Source: Balter, 2008, p. 87.

This classification attributes the methods presented to the inventory management process, divided into planning and control phases. It is noteworthy that, as development and IT capabilities increase, these methods will evolve to satisfy the basic logistical principle of 7W (right: product, quantity, condition, place, time, consumer, cost), by adding a forecasting phase and establishing more accurately the quantity and time requirements for product circulation. Beginning with standard 'just-in-time' JIT inventory control systems, to DRP (Distribution Resource Planning) or OPT (Optimized Production Technology) distribution requirements planning systems or narrow section management, facilitating accurate quantity and time determinations of inventory at the time required by the user (Balter et al., 2008, pp. 88-89).

Inventory handling costs are also an integral element of management decision-making. This is the most significant element, along with transport costs, of logistics expenditure. A good inventory management strategy is based on an accurate estimation of inventory handling costs and pricing. These calculations have a positive impact on customer service levels. A situation should be sought where customer demand is met from current stock.

### 3. Research methodology

To this end, the following techniques were used:

- direct observation supported by the opinion of experts involved in the preparation and implementation of the non-normative transport process (expert group),
- analysis and evaluation of documentation related to the preparation and implementation of selected stock management processes,
- literature review.

The article aims to examine the possibilities of optimizing the space in the warehouse and reducing the costs of inventory management using the ABC method in the warehouse on the example of a selected micro-enterprise.

In addition, based on the conducted research, it was proposed to change the storage places for individual goods and to equip the warehouse with appropriate racks, thanks to which the usable area will be optimized and more functional.

#### **4. Research results**

Company "GUSPOL" provides comprehensive services in the field of Occupational Health and Safety and sales of fire-fighting equipment. The company was founded on 10 April 1992 in Bolesławiec (Poland). Then, in response to the growing private business sector, the company's owner expanded his activities to include the provision of training services. After a few years, he added to his offer, also servicing of fire-fighting equipment, maintenance and regeneration of extinguishers and trade in technical gases such as carbon dioxide (CO<sub>2</sub>), argon, mixon (mixture of argon + carbon dioxide), oxygen, acetylene, balloon helium, freshmix T30, mixon, nitrogen, HNMIX-5.

The company currently has four employees. Two employees deal with administrative and customer service matters. One employee for storage and maintenance of equipment, whose duties include taking care of storage space, receiving deliveries, delivery and installation of fire equipment at the customer's premises, together with maintenance of this equipment. One person is also employed who is responsible for the training and preparation of fire safety instructions for the plants.

The company's services are used by private individuals as well as small local companies such as car repair shops, clinics, shops or public institutions such as schools, theatres, museums and hospitals. The company cooperates with production plants such as: Toyota Boshoku Poland in Wykroty, BPW printing house, IBF building materials warehouse or TechnoNICOL-Insulation producing mineral wool.

As the company's stock management is structured and carried out according to the principle of fixed storage locations and the application of the 5S method, the focus should be on improving the stock management of the powder extinguisher and technical gas cylinder store. P.H.U. "GUSPOL" is a micro-enterprise, so the proposed improvements should be commensurate with the available financial resources the company can spend on this.

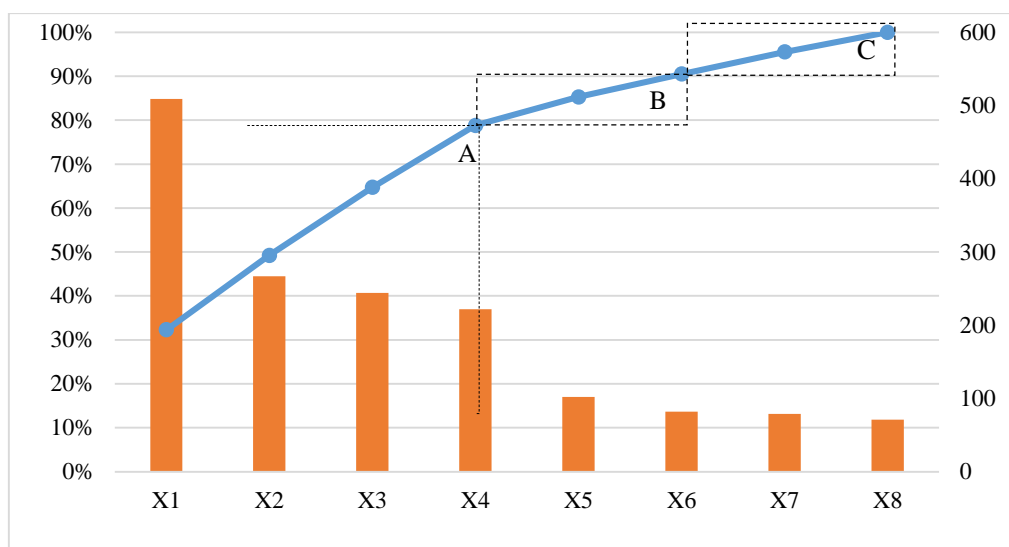
The first step to be taken to optimise stock management in the warehouse is to carry out an ABC analysis according to the number of releases in order to allocate the products in the warehouse as favourably as possible. To do this, it is necessary to compile the number of releases of all the stock items recorded on the stock records.

The ABC method in stock management helps logisticians to focus on those types of stock (Asana et al., 2020), whose deliveries represent the most important point in the total value of the stock and in the total turnover of the company. The results achieved in this way show the validity of treating each of the three classified groups of stocks differently. According to the ABC method, inventories are divided into the following groups:

1. Group A - representing the group of materials with the highest value and/or the largest share of total material costs - should be treated with special attention to:
  - Market, price and cost structure analysis;
  - Meticulous preparation of commercial orders;
  - Adequate management of stock levels;
  - Reliable determination of safety stock.
2. For group B articles - representing a range of materials of medium value and/or medium contribution to total inventory costs - an intermediate route between group a and group C procedures should be followed.
3. For group C items - representing a range of materials with low value and/or low contribution to total stock costs - simple procedures and maximum reduction of inputs are recommended. With the largest assortment and low value, the aim should be to reduce supply and trade order costs by focusing on facilitating dispatching procedures and emergency ordering from regular suppliers (Gubala et al., 2005, p. 75; Nosko et al., 2020).

The ABC method is also used to rationally distribute the assortment, consisting of differentiated goods, in storage areas. In practice, the ABC analysis is performed in conjunction with the XYZ analysis, as it provides information on the regularity of wear (Krzyżaniak, 2008). In the XYZ method, the classification criterion is the amount of consumption, the regularity of future demand, the possibility and quality of future forecasts (Krzyżaniak, Cyplik, 2007).

The data made available by the company covers the period from 1 January 2021 to 30 November 2021. On this basis, a Pareto-Lornz chart was drawn up (Fig. 1).



**Figure 1.** ABC analysis with Lorenz curve.

Source: own analysis based on data made available.

The Pareto Principle says that most results come from only 20% of efforts or causes in any system. Based on Pareto's 80/20 rule, ABC analysis identifies the 20% of goods that deliver about 80% of the value (www.netsuite.com).

The list of goods was ranked in descending order of the number of releases and the total was calculated. The percentage share of the goods in the releases was then calculated (formula 1). The sum of the shares, in the column department of releases, should equal 100%.

$$\frac{\text{Number of editions of a given assortment}}{\text{Total value of releasesm}} \times 100 \% = \text{Percentage share of goods} \quad (1)$$

The next step is to calculate the share of releases cumulatively and to calculate the cumulative value. The final step is to divide the goods into groups A, B and C. The results of the Pareto analysis carried out and the allocation of goods to each group are shown in Table 2.

**Table 2.**

*Results of ABC analysis by volume of releases*

Symbol	Name of the product	Number of releases [pcs.]	Share of releases [%]	Cumulative share of releases [%]	Grade
X <sub>1</sub>	Powder fire extinguisher 6 kg	509	32,30	32,30	A
X <sub>2</sub>	Gas cylinder CO <sub>2</sub> 26 kg	267	16,94	49,24	A
X <sub>3</sub>	Technical gas cylinder T8 Mix 8 L	244	15,48	64,72	A
X <sub>4</sub>	Powder fire extinguisher 2 kg	222	14,09	78,81	A
X <sub>5</sub>	Gas cylinder ARGON T40 40 L	102	6,47	85,28	B
X <sub>6</sub>	Powder fire extinguisher 1 kg	82	5,20	90,48	B
X <sub>7</sub>	Powder fire extinguisher 12 kg	79	5,01	95,49	C
X <sub>8</sub>	Gas cylinder ARGON T50 40 L	71	4,51	100,00	C
	Total	1576	100		

Source: own analysis.



After conducting the analysis according to the ABC method, it can be concluded that goods from group A should be placed closest to the warehouse gate, then goods from group B, and finally goods from group C. However, it should be remembered that in the warehouse of the "GUSPOL" there are not only goods for sale, but also utility items of the company, for which they occupy a certain space in the warehouse. In the case of car tires, you can purchase two racks for tires, type ART-886, which will reduce the space needed for their storage. For the storage of 6 and 12 kg powder extinguishers and empty 6 kg extinguishers, the ideal solution would be to purchase a new rack with three shelves (Fig. 2).

Empty fire extinguishers 6 kg, 26 pieces		<b>C</b>
Full fire extinguishers 6 kg, 32 pieces		<b>A</b>
Full fire extinguishers 6 kg, 9 pieces	Full fire extinguishers 12 kg, 8 pieces	<b>B</b>

**Figure 2.** Graphical representation of the distribution of stocks on the rack.

Source: own analysis.

According to the calculations, one rack is able to hold the entire stock of 6 kg and 12 kg fire extinguishers together with empty 6 kg fire extinguishers (Fig. 3).



**Figure 3.** Storage shelf rack.

Source: own analysis.

Pallet racks (Fig. 3) are a commonly used solution for the storage and storage of various types of products. The presented storage racks perfectly manage and systematize the storage space that we have at our disposal. Extremely durable construction, based on steel elements, ensures safety and functionality of storage racks.

Thanks to the proposed solution, the free space in the warehouse would increase, and the employee would gain additional space. For such a carefully planned warehouse space, an XYZ analysis could be performed in the future.

## 5. Discussion

Dynamic market changes, the speed of information flow and a number of random events often make it difficult to make optimal decisions and manage rationally. As a result, modern management requires solutions to optimise the inventory management process so that it becomes possible to achieve cost advantages and increase the existing level of flexibility.

The presented inventory management according to the ABC method in the company "GUSPOL" requires low financial expenditure. It should also be borne in mind that if the implementation of changes in the warehouse is carried out after working hours or at the weekend, additional costs will be associated with it. It is also possible that difficulties may arise in the form of opposition from a warehouse employee who may not be convinced or opposed to the introduction of innovative solutions in the warehouse. To this end, the advantages and benefits of the changes should be clearly presented. However, it should be emphasised that introducing changes in the warehouse can optimise the work in the warehouse and minimise the costs associated with inventory management.

## 6. Conclusions

The main benefit of the proposed changes is the optimization of warehouse employees' working time. This is due to the correct setting of goods in the ABC group. Goods are most often and in larger quantities located near the entrance to the warehouse, which shortens the time needed to transport the goods. Another advantage is obtaining additional free space in the warehouse, which makes it easier to manipulate stocks.

In addition, it can be concluded that the use of the method of permanent storage places eliminates the probability of errors when completing the order for the customer. Summing up all the advantages and disadvantages of the proposed solutions, they generate a low cost of implementation for micro-enterprises, including the "GUSPOL" enterprise.

It should be emphasized that this article concerned only one warehouse in one micro-enterprise, further research should be carried out to confirm that ABC can also be applied to warehouses of other enterprises.

Choosing the right inventory management method focuses on improving the efficiency of warehouse operations while keeping input costs low. These solutions are used not only in large-scale warehouses, but also in small private warehouses. Implementing the right method to improve the spatial organization of the warehouse, by defining inventories into different categories and locating them in warehouses in such a way as to eliminate errors and reduce the time spent handling them, including the elimination of unnecessary inventory. However, the implementation of an appropriate inventory management method is extremely difficult due to the fluctuating demand, which affects the nature of cooperation with suppliers. The presented method of inventory management can be used not only in the production and warehouse spheres of the enterprise, but also in office areas, making it one of the most versatile methods of inventory management.

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