

USING LEAN MANUFACTURING TOOLS TO IMPROVE LOGISTICS PROCESSES – CASE STUDY

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Purpose: The aim of the presented investigations was to explore the possibilities of the effective use of the 8D method to improve the merchandise distribution processes.

Design/methodology/approach: The application of the 8D method involved the use of support tools, such as 5Why or ABC. These tools helped to identify and categorize problems involved in the distribution of goods. Next, major problems and their causes were identified. The 8D method enabled establishing improvement, corrective and remedial actions. The last stage of the analysis was verifying the effectiveness of the implemented actions, which proved that the application of the 8D method to improve distribution processes was justified.

Findings: The 8D method turned out to be an effective tool for solving problems identified in the distribution process, which proves its effective transfer from the automotive industry.

Research limitations/implications: The correct use of the 8D method, which guarantees obtaining reliable and useful results, is only possible if an interdisciplinary research team is appointed. Such a team should consist of a leader and specialists from organizational units responsible for the process correctness. Small and medium-size companies may have insufficient resources to conduct investigations and analyses in a proper way.

Practical implications: The discussed case study proves that it is possible to use advanced management methods in the company. Creating an efficient and experienced team should result in developing an effective mechanism for identifying the causes and solving problems in the company's logistic processes.

Originality/value: An original solution is implementation of the 8D method from the automotive industry to improve logistic processes.

Keywords: distribution, quality, management, 8D, 5 Whys

Category of the paper: case study

1. Introduction

The implementation of the enterprise's basic activities is not only related to the production of finished products or communication with customers, but also to delivering the right products to the right place at the right time. One of the basic requirements of consumers is the spatial and temporal availability of products. Meeting these conditions allows for the large increase in sales of many groups of goods. Meeting the requirements for ensuring the spatial and temporal availability of products makes it necessary to use a number of instruments in the broadly understood field of logistics. In some cases of production companies, the importance of distribution channels and processes is even greater than the products they produce (Karaxha, and Kristo, 2016).

Constantly progressing globalisation allows many manufacturing companies to offer their products in more and more markets. This trend is noticeable both in domestic production, part of which is intended for export, as well as in internal sales, in which many products are imported. In the era of globalisation, the progressive unification of many products, as well as the increase in their substitutability requires that many enterprises increase competitiveness in the area of distribution (Tosun, and Uysal, 2016). An efficiently functioning process of distribution of goods is currently one of several factors supporting the production process of these products, as opposed to the situation from a dozen or so years ago, when production propelled the entire distribution system.

The distribution process is also a key link between the producer and the recipient in the system of producing and delivering the product to the final customer, as well as in the complaint and returns handling system. Thanks to efficiently functioning distribution, it is possible to optimally distribute products on a given market and balance supply and demand. The distribution of goods is also an element of the system that allows the collection of information about the market, which allows better optimisation of production processes. The growing importance of distribution processes entails the need for their continuous improvement and adapting to both the production needs and customer requirements. Taking into account the ever-increasing competition in all areas of business operations, distribution is of strategic importance for companies and industries around the world. It is in the areas of distribution of goods, that innovative solutions are being implemented more and more often, allowing for a significant increase in the attractiveness of the offered product and to improve the brand image and market position of the company.

1.1. Distribution processes

In macroeconomic terms, distribution means the process and structure of moving manufactured products to final recipients. It is directed towards making a profit from the conducted activity, consisting primarily in planning, controlling and carrying out physical flow of goods from the place of their production to the place of their sale. The purpose of distribution is to properly manage the flow of values between suppliers and recipients of moved products. The distribution process contains two basic decision-making problems related to the definition and selection of distribution channels in the trading field and the organisation of physical movement of tangible goods (Gołemska, 2010; Wood et al., 2012). The primary goal of distribution processes is to provide consumers with desired products in places where they can be purchased. The whole process should be planned and carried out, so that the movement of products takes place in a timely manner, while maintaining the assumed level of costs. This process should not have any negative impact on the final values of the product, such as its price or form of sale. The implementation of such a task requires the manufacturer to design and create a number of distribution channels and procedures for the physical movement of products. Proper organisation of the distribution channels and product assortment transport allows the producer to reach a suitably wide group of consumers, as well as ensure the proper and required level of service (Czubala, 2001). Another purpose of distribution is to differentiate a given product from other competing products. The manner and location of sales and all the infrastructure organised around this process affect the perception of the brand and the product itself. Properly conducted distribution allows for concealing defects and exposing the advantages of a given product by stimulating the needs and awareness of final customers. Distribution also aims to provide producers with relative protection against companies wishing to enter a given market. Establishing strategic relations with partners, building an image by distributing own goods significantly hinders many new companies entering the market (Zarzycka, 2008; Bertazzi et al., 2009).

The process of distribution of goods is also aimed at taking all kinds of measures to overcome the spatial, financial and temporal barriers between customers and the producers of goods. Eliminating the aforementioned obstacles usually involves placing the product on the market in such a way, that final customers can make purchases on favourable terms (Frankowska, and Jedliński, 2011; Fugate et al., 2010). The distribution process is shaped by organising promotional, acquisition, communication and accounting processes. An important element of distribution is also forecasting future phenomena occurring within the activity market (Grądzki, and Sekieta, 2012).

From the perspective of the production company's operations, the process of distributing its products is often of strategic importance, due to the fact that it is a connection between the organisation itself and its customers. It is through distribution that it is possible to provide customers with additional profits related to the purchase of a given good. Such additional value for the customer can be not only the spatial and temporal accessibility, but, for example, the environment, in which the purchase transaction is made, the way the product is presented, the proximity of the service, delivery to the customer's home or installation and connection of the purchased product. The distribution process is also a kind of medium between the producer and their customers, which allows feedback of the product and the enterprise from consumers of the purchased item. The way in which customers respond to product availability and the whole related sales environment is analysed at every stage of the distribution process, which allows manufacturing companies to adapt their offer to a given market or group of recipients. An example of adapting the distribution to the needs of customers can be the sale of the same products of the company under different brands, as part of its own, separate sales network or in sets together with complementary products (Frankowska, and Jedliński, 2011).

Distribution covers a range of activities related to the flow of goods and services from the place of their production to the place of their sale. Its tasks include coordinating the activities of all entities involved in the process to provide customers with the appropriate product. This coordination is most often manifested in the integration of the activities of individual companies, which constitute links in the distribution channel (Śliwczyński, 2013).

Currently, the distribution process brings together many functions related to the organisation of transport, storage and shaping of inventories in one integrated management system. This system is geared for taking into account any changes arising in market processes. Distribution currently plays the role of coordinating the basic areas of their activity in many companies (Bendkowski, 2003). Due to the duration of the distribution process, three basic groups of functions affecting the implementation of its tasks can be distinguished. These are, respectively, pre-trade, transactional and post-trade functions. Within these groups, a number of activities are undertaken to achieve the final goal, which is to meet the customer's needs.

Pre-trade functions are fulfilled by all kinds of activities, consisting in the best possible preparation of goods for sale and, at the same time, assuring the final customer – in a decision favourable to the enterprise – to purchase the products of the company. One of the basic operations is market research and monitoring, as well as subsequent forwarding of these research conclusions to the manufacturer in order to optimise the offers and forms of sales. Another important task included in pre-trade operations is to conduct all kinds of promotional procedures that increase the prestige of a given product and the company that offers it. Subsequently, works are conducted on the search and implementation of sale and purchase transaction between the producer and intermediaries, such as wholesalers or retailers. In connection with this activity, an important task is also establishing partnerships with intermediaries and negotiating agreements that constitute the basis of the flow of goods and

property rights between the producer and the end customer. The main purpose of all operations included in pre-trade activities is to balance demand and supply by ensuring and controlling the proper capacity of distribution channels.

Transactional functions are functions directly related to the finalisation of the purchase and sale agreement. They cover all activities directly related to the physical flow of goods throughout the supply chain. These operations include, for example, handling orders from intermediaries, transport, maintaining an appropriate level of stocks, or transferring receivables within the supply chain. These activities are focused on the physical delivery of a given product assortment to the right place at the right time and at the right cost. The essence of this type of activities is to distribute the product assortment within the entire channel or distribution network in such a way, that the products are constantly available to final customers. However, the arrangement of products should be organised, so as not to generate unnecessary costs incurred for storing too much of the product assortment or additional and economically unjustified transport.

Post-trade functions are implemented through activities aimed at ensuring the appropriate level of customer service in the field of broadly understood after-sales service. These include, among others: handling complaints, direct delivery of purchased goods to the place indicated by the final customer, assembly and installation of purchased products or conducting all kinds of surveys examining the degree of customer satisfaction of services rendered to them. The information obtained thanks to this allows to specify the customers' requirements and to identify potential errors and discrepancies occurring during the distribution and sales process. Operations undertaken as part of after-sales activities are another level of data acquisition by manufacturers and distributors, which, in combination with information from previous distribution stages, allow comprehensive analysis of the entire process and its possible discrepancies. Thanks to this type of activities, it is possible to build long-term relationships with the customer, adapt the service, product and forms of its sales to the customer's needs, as well as influence the loyalty of recipients and their attachment to the brand. The distribution functions presented above can both be implemented by manufacturers under direct distribution, as well as in cooperation with intermediaries under indirect distribution (Czubala, 2001).

The distribution system can both be discussed as an element of the internal structure, but also as its external resource, which aims to integrate all organisations cooperating with a given manufacturer. Depending on many variables conditioning the activity of a production enterprise, a number of individual features and parameters of the used distribution system are modified. Factors affecting the selection and functioning of the distribution system are, among others: properties and characteristics of the market, size and structure of competition, features and parameters of the offered product, position and economic situation of the enterprise placing the product on the market, as well as predictions and tendencies forming in the environment of that enterprise. All these factors influence the change of individual aspects of the functioning of the distribution system, which include: price, quality, quantity, time and place of delivery or

e.g. the method of promotion and provision of after-sales services (Roszak, 2016; Midor, 2019; Molenda, 2019). In addition, the organisation and functioning of the distribution system is influenced by a number of external factors, independent of the manufacturer and its distributors, e.g. political and legal, climatic, social and cultural, economic and spatial and geographical conditions. All factors influencing the structure and functioning of distribution can be divided into many different categories, depending on their origin or the strength and type of influence exerted and the changes. However, the simplest and most readable is the division of these factors into five basic categories, in which there are a number of activities and operations that have a direct impact on the process of product distribution. The first category of such factors are purchasers of goods, i.e. final customers, as well as wholesale and retail intermediaries in further sales. Another important group of factors are operations and activities that allow the building of lasting relationships with customers. Subsequently, a number of factors related to the physical characteristics of the product have an impact on shaping the distribution process. It is around the product that distribution strategies are often built to achieve the best results, thereby using the properties of the product being sold. Another important group of factors is the enterprise's ability to properly shape its inventory level. Thanks to this, it is possible to offer customers goods in accordance with one of the basic objectives, which is to ensure the spatial and temporal accessibility of the distributed product. The fifth and last group of factors is the market environment and, therefore, all those factors, on which the manufacturer and its distributors do not have a direct impact (Krawczyk, 2001).

1.2. 8D Method

The method called the 8D Report – 8 Disciplines, is used in industry to solve problems related to the incorrect quality of products. Most often used in the automotive industry for quality problems with parts produced by cooperating parties (Łuczak, and Maćkiewicz, 2016; Stanek et al., 2011; Zarghami, and Benbow, 2017). The 8D method was developed in 1974 by the United States Department of Defence for the needs of the arms industry and Ford was the precursor of its use in the civil industry.

The 8D report comes down to answering the following questions:

- what was the cause of the problem?
- what actions to reduce or eliminate the problem should be implemented?

The 8D report using additional tools, such as, for example, the Pareto-Lorenz diagram, 5 Whys or the Ishikawa diagram (Wolniak, and Skotnicka-Zasadzień, 2011; Hąbek, and Villahoz, 2018) helps, in a logical and simple way, to systematise and determine the path of conduct when solving the problem by going from the first to the eighth step. The method is formalised, but the graphical form of the report is optional, however it should contain the following elements (1D-8D):

- appointment of an interdisciplinary team and leader,
- accurate description of the problem to be solved, understandable for all members of the group,
- development of actions with the task of ad hoc and immediate solution of the problem,
- conducting an analysis to find out the root cause of the problem using quality management tools,
- development of corrective actions, e.g. changes in the way individual procedures or operations are performed, introduction of additional actions etc.,
- development of preventive actions aimed at consolidating the introduced changes in the existing system, e.g. changes in the records of instructions and procedures, new elements of employee training etc.,
- implementation of corrective and preventive actions and verification of their operation in practice,
- final report on the team's activities.

It is recommended that the final form of the 8D report be in the form of a table with individual elements, clearly separated from each other. An example of the report layout is shown in Figure 1 (the 5 Whys tool was used to analyse the causes of the problem).

This method can be used successfully when solving moderately complex problems, in which finding the cause does not involve the engagement of senior management. It works in situations, where the cause of the problem is not difficult to identify and its solution lies within the competence of the enterprise's employees, implying minor changes in the production system.

In this study, it was decided to use the 8D method to improve a typical service process, which is the distribution of lighting items.

8D Evaluation Form

| | | | | |
|--|----------------|--------------------|-----------------------|--|
| D0. Recognize/Identify Problem – Identify the customer requirement and specify the nonconformance. Understand the difference between facts, and perceptions (how things <i>appear</i> to be). | | | | |
| | | | | |
| NPN / NC #: | Part #: | Job / PO #: | Project Owner: | Due Date: |
| | | | | |
| D1. Establish Team – Team should include persons who own the process, who are responsible for the affected areas / equipment / processing / personnel, who are considered to be subject matter experts, and/or who can help with the Root Cause Analysis / Corrective Action. Cross-functional teams work best. | | | | |
| <i>Name</i> | <i>Title</i> | <i>Dept.</i> | <i>Telephone#</i> | |
| | | | | |
| D2. Describe Problem - Define and quantify the problem to provide a starting point for solving it. An accurate problem description using terms understood by all helps in determining the correct root cause(s). Use pareto charts, histograms, check lists, tally sheets, control charts, etc. to illustrate the problem and attach to the last page of this form. | | | | |
| | | | | |
| D3. Contain Symptoms – Take immediate action to contain the problem at each point in the process (All stock locations, WIP, in-transit, & affected prior shipments) to ensure that the customer is isolated from the problem. Document quantities and condition found, as well as the individual responsible for containment. | | | | Containment Date: |
| | | | | |
| D4. Root Cause(s) - Identify potential causes with team brainstorming sessions, fishbone diagrams, 5-why analysis, etc. Attach all tools used to the last page of this form. | | | | |
| <i>Creation</i> | <i>Cause</i> | | | <i>Evidence / Notes</i> |
| <i>Escape</i> | | | | |
| D5. Select / Verify Corrective Actions - Identify potential solutions that address the root cause(s). Corrective actions to be evaluated for effectiveness using a decision-based analysis process such as a Process Failure Mode Effects Analysis (PFMEA). List corrective actions or dismissal reasoning for all root causes. | | | | Verification - Utilize the Action Item page to document action plans. |
| | | | | |
| D6. Implement / Validate Corrective Actions - Ensure that corrective action does "what it is supposed to do." Allows for the detection of any undesirable side effects. Utilize tools like error-proofing and process improvement, Poka-Yoke, natural mappings, visual factory, standard operating procedures (SOP), control charts (let the data illustrate process improvement), etc. If desired results were not achieved return to D4. | | | | Implementation Date: |
| | | | | |
| D7. Prevent Recurrence - Take the appropriate steps to ensure that the problem does not occur again by updating supporting engineering and quality documents (PFMEA, control plan, in-process masters, process flow charts, etc.), identify/implement changes to areas that allowed the problem to occur/escape (systems, practices, procedures, specifications, etc.), and identify/implement RCCA on any similar products that could exhibit a similar failure. | | | | Implementation Date: |
| | | | | |
| D8. Recognize Team - Acknowledge / recognize team, celebrate successful completion, ensure documentation/information storage is completed for easy retrieval, review metrics for identification of next opportunity. | | | | |
| <i>Name / Signature</i> | <i>Title</i> | <i>Telephone #</i> | <i>Closure Date</i> | |
| | | | | |

Figure 1. An example of an 8D report. Source: 8D Supplier Report, 2019.

2. Research context

This case study takes place in the Polish branch of an international concern that sells lighting items throughout the country. The change of the logistics operator by the enterprise brought about an increase in the number of complaints reported by customers. This forced improvement actions to limit negative phenomena or eliminate them completely. To achieve the intended goal, a decision was made to use the 8D method. A period of three months was analysed. In addition, data from the research period was compared with data from the previous quarter, in which the current goods distribution system operated. This made it possible to compare data covering the period of distribution of items of both logistics partners.

The distribution process is initiated upon delivery of the order to the customer service department, in the form of an appropriate form containing: customer data, together with the address of receipt of the goods, product code names and quantities ordered.

In the case of a correct and complete order, the so-called customer reservation is created in the ERP system, which contains all the data provided on the order. The reservation document prepared in this way is sent via email to the customer and to the appropriate sales representative representing the seller. Later in the process, the order is created in the SRM (Supplier Relationship Management) system, which is used at the company's headquarters. Thanks to the data entered into the system, central warehouse employees have the opportunity to obtain all the information necessary to prepare and complete the order. Saving the order in the system allows for the sending of all data to the central warehouse and central sales department located in the company's headquarters. Based on the data from the SRM system, warehouse workers proceed to complete orders for individual customers. The goods are transported from the company's central warehouse to the warehouse of the logistics operator dealing in the distribution of product assortment in Poland. After completing the order, the warehouse worker sends data to the system regarding the type of product and its quantity. Next, a document is printed containing a list of the completed product assortment and a waybill containing data on the place of delivery. Information about the product assortment prepared for release is then downloaded from the SAP system by sales employees, who issue an invoice for a given regional branch of the company. Purchase invoices are completed and sent collectively via email to the Polish branch of the company. After receiving purchase invoices from the headquarters, regional department employees enter them into the ERP system, which allows invoicing for individual contracting parties ordering goods. Along with the invoices, the Polish branch of the company receives a summary of items in individual customer orders. In addition, this summary contains data of individual contracting parties and the delivery number, as well as the dimensions and number of the unit load, in which the ordered products are transported. On the basis of this summary and thanks to previously created contracting party's booking documents, customer service employees proceed to issue invoices. After receiving the goods

from the central warehouse, the product is transported to the warehouse of the logistics operator cooperating with the Polish branch of the company. In the carrier's warehouse, located in Silesia, the delivery is divided into individual pallets and cardboard packaging, which were previously completed in the company's central warehouse. Logistic operator employees attach invoices to the packages prepared earlier by the customer service department. Load units prepared in this way are transported to appropriate means of transport that will move cargo to the transshipment point. Subsequently, after delivery of the pallets and packages to appropriate transshipment points throughout the country, the goods are again sorted inside each transshipment point and then assigned to a courier, who will deliver packages or pallets to the address on the waybill.

3. Improving the distribution process of the researched enterprise using the 8D Report

3.1. Defining problems

During the analysis, key problems affecting the malfunctioning of the distribution process were diagnosed and defined. This was done on the basis of reports from customers, who were the final recipients of goods offered by the researched enterprise, and logistics services provided by an external operator. The discrepancies concerned, among others, documentation attached to transported products, physical damage to the product, lack of timely delivery, as well as low frequency of receiving goods from customers' complaints.

Deficiencies and errors in documentation. One of the most frequently reported complaints was the lack of invoices or delivery documents in the delivered parcels. Due to customer requirements, one of the most important tasks of a logistics operator when handling parcels in their main sorting office was to attach to the packages or pallets a document confirming the sale or issue of goods. These documents were delivered daily by the Polish branch of the company in the form of a PDF file, which the warehouse employees of the logistics operator then had to print out and attach individually to the appropriate unit loads. An important problem that appeared systematically during distribution was the lack of any document attached to the delivered product assortment. This situation negatively affected the enterprise's relations with contracting parties and generated additional work to customer service employees, who were forced to devote more time to sending the required documents to contracting parties. The attachment of incorrect documents to individual unit loads was another important problem. This situation was unacceptable, because sensitive information about the size of rebates or other discounts was provided to economic entities that competed with each other on the market.

Damage to the product assortment delivered to customers. The distributed product assortment sold by the company, being the subject of research, is extremely susceptible to all kinds of mechanical damage. Glass shades that are part of lighting fittings are most often damaged. In addition, due to the specificity and construction, the light sources are also destroyed. This type of product is extremely fragile, which significantly hinders their protection against all types of damage. An important type of damage caused in the transport of goods are deformations of the lighting fixtures' construction. The metal skeletons of lamp structures undergo frequent deformations, which necessitates the delivery of a new light fixture as part of the replacement.

Each product complaint significantly increases the logistics costs. The customer expects the replacement of the damaged product for a new one, and the supplier, in addition to the cost of receiving the goods, must also bear the cost of sending new products as part of the exchange. Mechanical damage to goods forces the importer to take back any defective item and provide a new one as part of the exchange. All damage to the product generates the largest costs associated with handling complaints, because it is necessary to collect the goods from the customer, send it to the central warehouse and bring out a product free from defects.

Delayed delivery and collection of parcels. The delivery of goods ordered by the customer at the right time and to the right place is one of the key areas of assessment of the distribution system. Due to the fact that the company dealing in the distribution of lighting fittings on behalf of the described company also has transport orders from other entities, it was not possible to organise deliveries notifying the customer. The company's contracting parties could expect a delivery with the product assortment they ordered between 8:00 and 16:00. This led to many problems, because in some places of delivery couriers turned up outside of the recipient's working hours, which resulted in goods not being delivered. In this situation, the delivery attempt was repeated the next day, which prolonged the entire delivery process.

Delays in receiving complained goods from customers were another identified problem. Repeated delays in taking courier parcels from customers led to the weakening of business relationships with business partners. The fact that some of the employees of the logistics operator did not respond to calls for collection of goods caused the necessity to issue further orders and intervene with the logistics dispatcher. Failure to collect the faulty goods from the company's customers resulted in the suspension of the complaint handling process or product returns in general. The lengthiness of the activities described above, in many cases required the company's employees to order a new product assortment for exchange before receiving the product return from the customer. An additional disadvantage of this solution was the fact that, at that time, the company fully bore the risk of not being able to handle the complaint before sending the full value of the goods to the customer as an exchange.

3.2. Assessment of the significance of diagnosed problems

Based on the collected data on the identified problems, a table was prepared to illustrate, in a synthetic way, the scale of the described phenomena (Table 1). Based on the most important data from Table 1, a graph was prepared, showing the change in the problems discussed, broken down into the period before and after the start of cooperation with the new logistics operator (Fig. 2).

Table 1.
Level of identified problems

| | Number of parcels | Missing or incorrectly provided documents | Percentage of problems | Number of pallets and cartons sent | Number of damaged pallets and cartons | Percentage of problems | Quantity of delivered products | Quantity of damaged products | Percentage of problems | Number of parcels | Number of untimely deliveries | Percentage of problems | Number of complaint collection orders | Number of unrealised complaints received | Percentage of problems |
|--------------------|-------------------|---|------------------------|------------------------------------|---------------------------------------|------------------------|--------------------------------|------------------------------|------------------------|-------------------|-------------------------------|------------------------|---------------------------------------|--|------------------------|
| | [pcs.] | [pcs.] | [%] | [pcs.] | [pcs.] | [%] | [pcs.] | [pcs.] | [%] | [pcs.] | [pcs.] | [%] | [pcs.] | [pcs.] | [%] |
| 1st quarter | 6,849 | 15 | 0.22 | 48,359 | 3,744 | 7.74 | 43,203 | 3,744 | 8.67 | 6,849 | 78 | 1.14 | 591 | 78 | 13.20 |
| 2nd quarter | 5,098 | 870 | 17.07 | 41,509 | 774 | 1.86 | 54,973 | 774 | 1.41 | 5,098 | 332 | 6.51 | 786 | 355 | 45.17 |

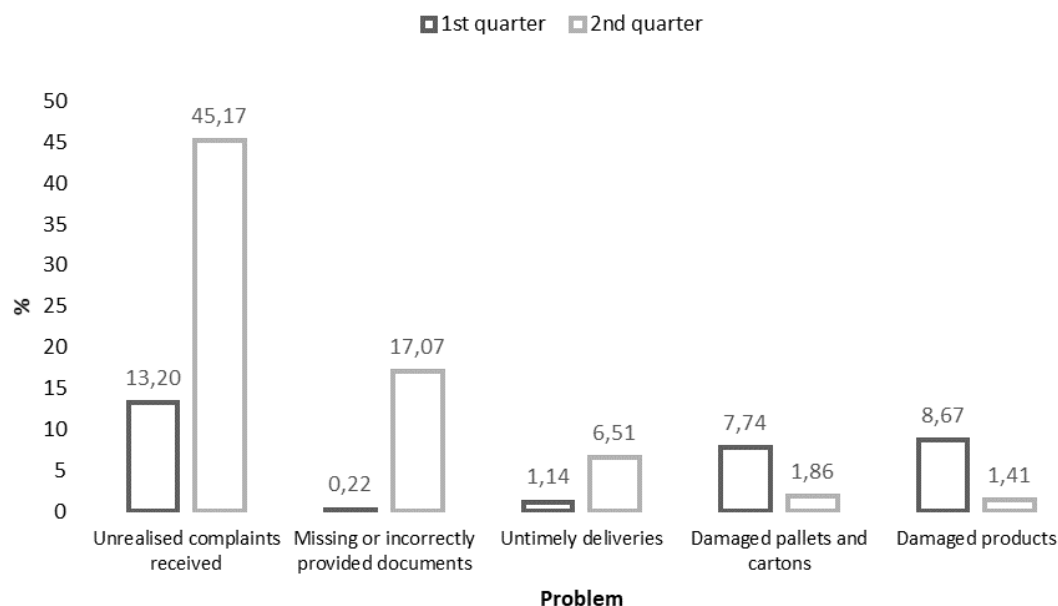


Figure 2. Changes in the number of problems examined before and after changing the logistics operator.

Based on the data contained in Table 1 and Figure 2, it can be seen that the change consisting in the exchange of many courier companies for one large logistics operator significantly affected the number and thereby the percentage of identified irregularities. The number of damaged parcels and products was reduced by approx. 6 and 7 percentage points, respectively. Unfortunately, the quality of services in the areas of complaint handling, parcel documentation and delivery timeliness deteriorated by approx. 32, 17 and 5 percentage points, respectively.

Based on the above information, it was decided that the most important problem requiring improvement is incorrectly attached documentation or lack of it. Other problems were at an acceptable level or constituted part of the area of cooperation between the importer and the courier company, which should be improved in a different way.

3.3. Introducing temporary corrective actions

In order to minimise, as soon as possible, the effects of errors in the documentation sent to customers along with the goods, it was decided to develop and implement temporary corrective actions, which is in line with the 8D methodology, specifically with point 3. The improvements introduced were primarily characterised by their short implementation time, so that at least partial improvement of most of the faulty areas of the distribution process was possible. The priority in the proposed solutions was to eliminate the most blatant errors until the development and implementation of final repair solutions.

The problem of incorrectly attached invoices and other documents missing in parcels has been partially corrected by individually issuing documents for each unit load. As a result, each package and pallet had to have its own document, which contained a list of the supplied product assortment. The documents attached to the packages were invoices or warehouse documents, which were closely related to the customer's order, so that contracting parties could specify the date and type. This did not completely solve the problem of the lack of invoices attached to packages; however, the number of unit loads containing relevant documents was increased, which accelerated, although some of the company's customers were able to accept a fragment of delivery. The next element was sending documents by email to all customers who agreed to it. This solution enabled some customers to download the document even before the physical delivery of the goods. In the event of lost paper versions of documents, customer service employees re-printed and signed documents and sent them via post/courier. The improvements introduced in this respect were only temporary and did not allow for long-term provision of the level of service required by customers. In addition, these solutions required increasing the amount of time spent on the process of creating and sending invoices to the company's contracting parties.

3.4. Identifying the root causes of the problem

One of the most important problems reported by customers was the lack of commercial or warehouse documents and their incorrect attachment to unit loads containing goods for individual contracting parties. From 15 errors made from August to October 2016, this value increased to 870 in the first quarter of the functioning of the new distribution system. As a result of a number of consultations with representatives of the logistics operator and the analysis of the causes of individual errors using the 5 Whys method, individual factors affecting the worsening of the process were identified. The list of all potential causes of errors is presented in Figure 3.

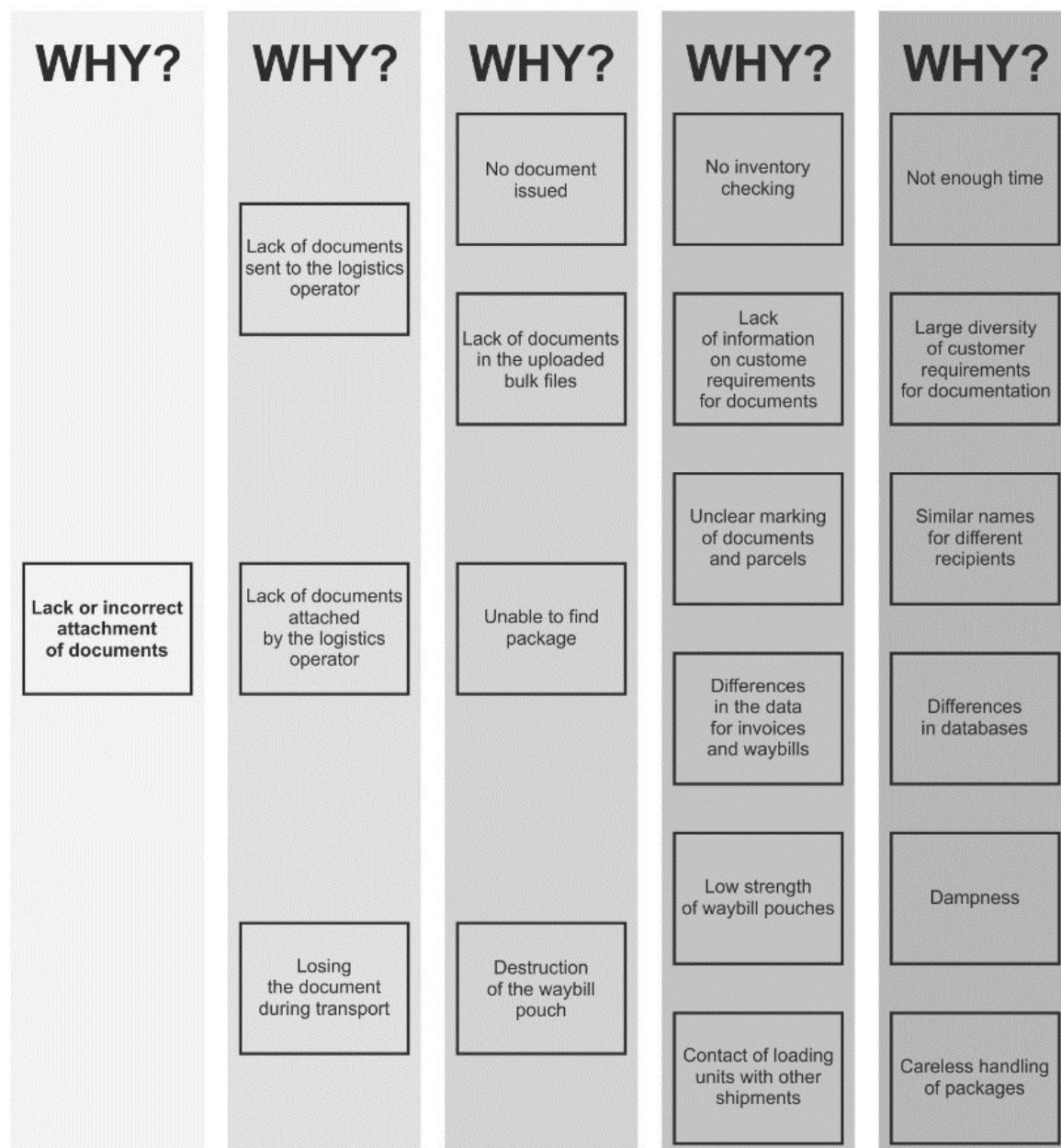


Figure 3. List of potential factors influencing the lack or incorrect attachment of documents.

The first group of reasons was related to the lack of documents sent to the logistics operator, which prevented the employees of the distribution company from attaching documents to shipments. The reasons for this situation were primarily deficiencies in issuing invoices and issue documents. After the document creation process, employees were required to check inventory to verify that the goods received based on purchase invoices were released from the warehouses.

Because the logistics operator collected goods from the central warehouse between 12:00 and 13:00, and the main sales department sent documents to the Polish branch between 12:00 and 15:00, customer service employees only had 2-3 hours before the goods appeared in the distribution company sorting office. This required those responsible for preparing documents to speed things up and to skip many checking operations in order to deliver documents on time. An important aspect was also the fact that some customers of the companies wished to deliver invoices by post only.

Due to the fact that the product assortment was delivered to different branches of the same contracting party, no documents containing business terms could be found on the unit loads agreed with the customer's central office. The problem was compounded by the lack of any information about this fact that would be visible in the system. Customer service employees had to constantly remember not to send documents to the logistics operator, to customers who did not want them.

Another group of reasons conditioning the occurrence of the described problem was the inability to locate relevant documents and assign unit loads to them. The specificity of the recipients of the company selling lighting fittings is characterised by the repetition of many names associated with lighting in various forms and varieties. This resulted in the frequent confusion of customer names attached on the address cards of pallets and packages with the names of contracting parties on the documentation. The occurrence of the error described above also had a great impact that the packages and pallets issued from the central warehouse had labels containing only the customer's code, their name, a series of bar codes along with information about the shipment and its destination, as well as the code names and quantities of products transported. The data on these labels and waybills was often insufficient to compare with the address data on invoices and warehouse documents issued by the Polish branch of the company. The Polish branch of the company used the ERP Comarch Optima software, which included a database containing all customer information necessary to issue commercial documents. The company's headquarters and its subordinate warehouse used the SAP SRM software, which included a database containing delivery addresses to individual customers. Table 2 presents the differences between individual systems.

Table 2.

Summary of the number of differences between the Comarch Optima and SAP SRM databases

| Category | Number of differences | |
|--|-----------------------|----------------|
| | SAP SRM | Comarch Optima |
| Number of records | 1248 | 748 |
| The number of records containing the data of current business customers | 722 | 722 |
| Number of records containing the data of current customers addresses | 617 | 719 |
| Number of records containing different names of the same business partners | 71 | |
| Number of records containing more than one delivery address | 0 | 46 |

The discrepancies presented in Table 2 meant that the invoices created in the Comarch Optima ERP system contained other information than on the waybills created in the SAP SRM system. This resulted in many difficulties for the logistics operator employees, related to determining the correctness and timeliness of individual data. The distribution company's warehouse employees who had to handle shipments had to collate and compare different data, which led to many discrepancies and mistakes, and in some cases to the total inability to correctly identify the owner of the document and the parcel assigned to it.

The last important factor that could affect document deficiencies was the foil wrapping the documents used to attach invoices and warehouse issue documents. The main problem arising from its use was the peeling of foil windows due to moisture or mechanical damage. In addition, tight packing of goods in the transport meant that during handling of the unit loads – during their loading and unloading – the label containing documents attached to a given shipment could have been torn or peeled off.

3.5. Development of corrective actions

The analysis using the 5 Whys method allowed to list all root causes of individual errors. Depending on the frequency of occurrence of source factors, several different scenarios of solutions, focusing on the most common causes reducing the quality of the process, can be developed. In order to validate the data, Pareto-Lorenz analysis was used to determine the frequency of occurrences of each factor and, thereby, the strength of its impact on the error in the process, which is the lack of appropriate documentation attached to shipments. Table 3 presents data on the frequency of occurrence of individual root causes, causing deficiencies in appropriate documentation. Information applies to, among others, moisture and physical damage collected largely from customers who reported any shortcomings when receiving the goods. Logistics operator employees provided all information regarding problems with locating relevant shipments to the corresponding documents. Members of the importer's customer service department pointed out the lack of time when issuing documents and the lack of information regarding customer requirements in terms of documentation. Data was collected from 02/01/2017 to 31/01/2017 and was used to develop targeted improvements to permanently eliminate the root causes diagnosed.

Table 3.

Summary of the number of occurrences of individual causes conditioning the lack of documentation

| No. | Type of error that occurs | Number of occurrences | Percentage of occurrence | Cumulative percentage of occurrence | Group |
|----------|---|-----------------------|--------------------------|-------------------------------------|-------|
| 1 | Differences in data found in documents and waybills | 61 | 42.66% | 42.66% | A |
| 2 | Unclear parcel and document markings | 37 | 25.87% | 68.53% | A |
| 3 | Rough handling of the goods | 16 | 11.19% | 79.72% | B |
| 4 | Lack of information on individual customer requirements for documentation | 13 | 9.09% | 88.81% | B |
| 5 | Too little time to prepare documentation | 9 | 6.29% | 95.10% | C |
| 6 | Moisture | 7 | 4.90% | 100.00% | C |
| In total | | 143 | 100% | 100% | |

Based on the data from Table 3, a Pareto-Lorenz diagram was prepared (Fig. 4) enabling a graphical representation of the scale of the diagnosed causes of problems. Due to the specificity of the examined reasons and the limited possibilities of the enterprise, the principle was adopted that in Group A these factors will be placed, which constitute a maximum of 70% of all occurrences. Similarly, group B was assigned factors in the range of 71% to 90% of the cumulative value of all errors. In the range from 91% to 100% there are factors classified into group C.

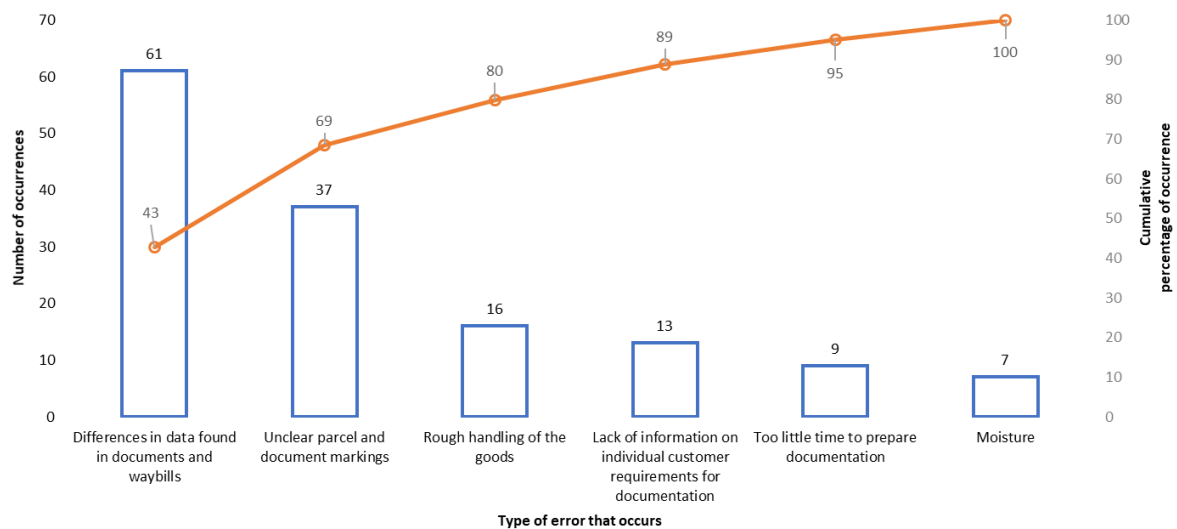


Figure 4. Pareto-Lorenz diagram for individual reasons determining the lack of documentation.

Figure 3 shows that 33% of the errors are responsible for less than 70% of the occurrences of all the discrepancies that affect the lack of documentation attached to the unit loads. For this reason, it was decided to first focus on developing solutions that eliminate two key factors contributing to errors.

With regard to the differences in the data contained on the documents issued by the Polish branch of the company and its headquarters, it was proposed to unify the information on individual clients in such a way, that the records in both systems have the same contact details in the same format, which will facilitate the comparison of information placed on the documents

generated under various systems. In addition, the recipient's exact data should be placed on the invoice or warehouse issue documents if the delivery address is different from the address of the invoice payer. In order to minimise the problems related to unclear marking of shipment documents, it has been proposed to place the number of the shipment to which the printout is to be assigned on each document. This number is individual for each unit load, which should eliminate the problem of finding the right shipment when attaching documentation.

3.6. Implementing corrective actions

The implementation of target solutions to improve the distribution system should be started by comparing all records in both systems and identifying those concerning the same customer. Next, find any differences that include: the customer's name, the addresses of their head office and branches to which the goods are delivered, as well as any additional identification and contact details, such as Tax ID Number or phone number. Subsequently, it was proposed to start ordering the data of individual contracting parties from the Comarch Optima ERP database system, because it is in this system that the most frequent changes are made, which means that the data there is most up to date. While organising the database, the formats of input data were unified, such as: postal codes, Tax ID Numbers or mobile and landline numbers. After updating all the company's contracting parties data, transfer the updated data to the SAP SRM system. Employees are required to correct any discrepancies in such a way, that the names and addresses of individual customers are identical in both databases.

At the same time as updating the data in the SAP system, the system administrator should permit customer service employees to place the parcel number on the documents to which the given document is assigned. The parcel number on the invoice or warehouse issue document will be the same as on the waybill attached to the product assortment when picking up the goods in the central warehouse. Thus, customer service employees will be able to associate documents with a parcel using the number on the waybill, commercial or warehouse document, and in the summary of the issued product assortment from the central warehouse. Thanks to this, employees of the logistics operator will be able to locate the appropriate unit load not only by using identical customer's address details, but also by using the specific shipment number that will appear on the documents.

3.7. Defining and implementing preventive measures

For subsequent maintenance of the quality of the distribution process, it is necessary for all customer and order data to be systematically updated in both systems used by the enterprise. All strategic information, necessary for the proper functioning of the enterprise and its subcontractors, must reflect the actual situation of the enterprise and its trading partners at a given time. Any data modifications made within one system should be immediately included in the other to ensure high quality information. In order to avoid losing documents correctly attached to the unit loads, it is recommended to use stronger document packaging and to store

the entire product assortment in places free of moisture. The risk of errors can also be minimised by providing customer service employees with sufficient time to prepare documents, which are then sent to the main logistics operator's sorting office. Goods invoices should therefore be sent to the Polish branch of the company, at the latest, when the goods are released from the central warehouse. Properly sending purchase documents will allow employees of the Polish branch of the enterprise to enter all data into the billing system and to prepare sales invoices for individual customers before the product assortment arrives at the logistics operator's sorting office.

A long-term way to avoid documentation related errors is to provide documents to all company customers via email. This solution will allow documents to be sent directly to the enterprise's customers, bypassing the employees of the logistics operator and physically attaching the documentation to the unit loads. Experienced customer service employees who know individual contracting parties will be able to deliver documents to the right business partners more accurately and more confidently. Regardless of the remedial solutions proposed, systematic monitoring of the process is recommended to detect undesirable habits early on. Rapid detection of errors and the reasons for their occurrence will allow for taking preventive reactions, thanks to which it will be possible to limit the escalation of the problem.

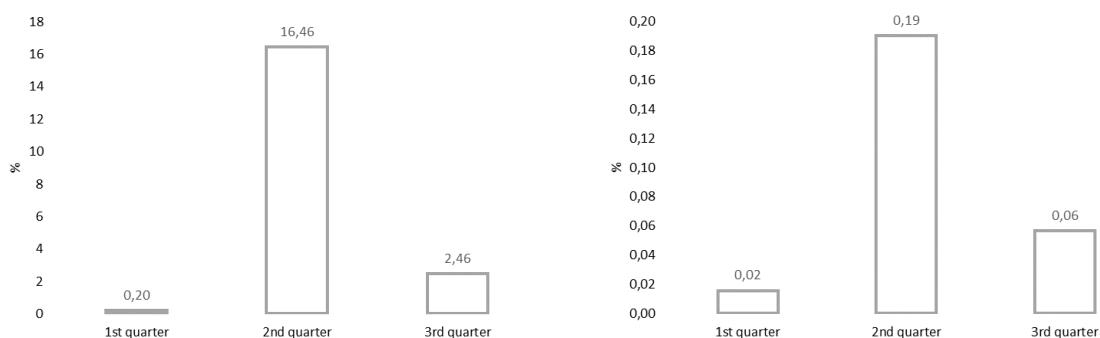
3.8. Verification of actions

After the completion of work related to the development and implementation of corrective and preventive actions, monitoring of the analysed process began over a period of three consecutive months. The results obtained at that time are presented in Table 4 and Figure 5.

Table 4.

Average values of problems related to documentation in the analysed time

| | Number of parcels | Number of parcels with missing documents | Percentage | Number of incorrectly attached documents | Percentage |
|-------------|-------------------|--|------------|--|------------|
| 1st quarter | 2283 | 4.67 | 0.20 | 0.33 | 0.02 |
| 2nd quarter | 1699 | 286.67 | 16.46 | 3.33 | 0.19 |
| 3rd quarter | 1135 | 28.00 | 2.46 | 0.67 | 0.06 |



a) deficiencies in documentation

b) incorrectly attached documents

Figure 5. Changes in the number of problems with parcel documentation in the three quarters analysed.

Actions obtained under the 8D method resulted in a reduction of the number of parcels with missing documentation by 14 percentage points and a result of approx. 2.5 percent was obtained. In the case of incorrectly attached documentation, the number of occurrences decreased from 0.19 to 0.06 percent. In the first case (Fig. 4a) there was more than a six-fold decrease in problems, and in the second (Fig. 4b) – a three-fold decrease. Unfortunately, it was not possible to achieve the value of indicators at the level of the 1st quarter, when the enterprise used the services of many courier companies.

After verifying the actions, it was possible to finalise the 8D report, the final form of which is presented in a synthetic approach in Figure 6.

| 8D REPORT |
|--|
| PROCESS NAME: distribution of goods |
| RECOGNIZE PROBLEM: problems with documents in the delivered parcels |
| 1D TEAM |
| Depending on the implemented activities: specialists from the Polish branch of the company, central warehouse and logistics operator. |
| 2D PROBLEM DEFINITION |
| <ol style="list-style-type: none"> 1. the lack of invoices or delivery documents in the delivered parcels, 2. incorrectly attached documentation. |
| 3D TEMPORARY CORRECTIVE ACTIONS |
| <ol style="list-style-type: none"> 1. individually issuing documents for each unit load, 2. sending documents by email to all customers, 3. creation of groups of products to form packs in consignments. |
| 4D THE ROOT CAUSES OF THE PROBLEM |
| <ol style="list-style-type: none"> 1. not enough time for proper preparation of documents, 2. large diversity of customer requirements for documentation, 3. similar names for different recipients, 4. differences in databases, 5. destruction of documents during transport. |
| 5D CORRECTIVE ACTIONS |
| <ol style="list-style-type: none"> 1. unify the information on clients, 2. entering additional information in the documentation. |
| 6D IMPLEMENTING CORRECTIVE ACTIONS |
| <ol style="list-style-type: none"> 1. unification of databases, 2. placing the payer's and recipient's data on documents, 3. placing loading unit numbers on the documents. |
| 7D DEFINING AND IMPLEMENTING PREVENTIVE MEASURES |
| <ol style="list-style-type: none"> 1. systematic updating of data in the system, 2. the use of more durable document frames, 3. reducing the amount of paper documentation. |
| 8D VERIFICATION OF ACTIONS |
| <ol style="list-style-type: none"> 1. reducing the number of missing documents from 16.46% to 2.46%, 2. reducing the number of incorrectly sent documents from 0.19% to 0.06%. |

Figure 6. Summary of the analysis in the form of a completed 8D report.

4. Conclusions

The 8D method used in the automotive industry proved effective in improving logistics processes and improving the company's functioning on the market in the described case.

Actions taken under the 8D method and the analysis of 5 Whys and ABC contained therein allowed for:

- identifying the most important problems in the distribution of goods,
- determining the significance of individual irregularities for the enterprise,
- determining the root causes of the problems,
- development and implementation of corrections, corrective and preventive actions aimed at minimising errors.

Using formal tools to improve logistics processes, many benefits can be obtained, the most important of which are:

1. Understanding the functioning of the process in the context of errors arising in it and learning the root causes of their occurrence.
2. Development of improvement actions by an interdisciplinary team aimed at minimising or eliminating problems.
3. Formulation of preventive actions, which are intended to prevent future irregularities.

Although the company is a Polish branch of the international concern and has sufficient resources in terms of tangible and intangible assets, it has been observed that the employees of the team dealing with work related to problem analysis by such an extensive research method lacked preparation, engagement and motivation. It should be assumed that further use of this method in the analysed enterprise will result in more effective work when applying formalized methods to improve the company's processes.

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