

order fulfillment, bulky loads, Ishikawa's diagram

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## **CHOSEN ASPECTS OF THE ANALYSIS AND IDENTIFICATION OF DISTURBANCES IN PREPARING BULKY STEEL LOADS TO TRANSPORTATION**

**Summary.** The paper presents an analysis of order fulfillment for bulky loads in terms of preparing those goods for transportation. It presents key considerations for the fulfillment of the order in relation to specifics of bulky load transportation. It describes customer's order fulfillment, focusing on preparing those products to carriage from manufacturer's view. Ishikawa's diagram, was used in own research to identify critical problems, which are causing disturbances while preparing bulky loads for transportation. As a result of identification and analysis of existing disturbances, suggestions of improvement were propounded.

## **WYBRANE ASPEKTY ANALIZY I IDENTYFIKACJI ZAKŁÓCEŃ W PRZYGOTOWANIU WYROBÓW WIELKOGABARYTOWYCH STALOWYCH DO TRANSPORTU**

**Streszczenie.** W pracy podjęto próbę analizy realizacji zamówienia dla wyrobów wielkogabarytowych z punktu widzenia problemu przygotowania tego produktu do transportu. Przedstawiono kluczowe rozważania dotyczące realizacji zamówienia w odniesieniu do specyfiki przewozu wyrobów wielkogabarytowych. Omówiono realizację zamówienia klienta, skupiając się nad przygotowaniem procesu transportu wyrobu od strony przedsiębiorstwa produkcyjnego. W badaniach własnych wykorzystano diagram Ishikawy do identyfikacji problemów krytycznych, powodujących zakłócenia na etapie przygotowania wyrobów wielkogabarytowych do transportu. W wyniku identyfikacji i analizy występujących problemów w procesie przygotowania do transportu, wysunięto propozycje usprawnień.

### **1. INTRODUCTION**

Analysis of order fulfillment shows that there are many ways of dividing this process into phases . What is more it also could be taken under consideration regarding such aspects like time, date or quality. Diversity of this cycle not only depends on the type of product, which is ordered, but also from the client. That is why an order fulfillment will be effective if customer service is on high level. In this aspects, customer service in customer order execution can be divided into [7]:

- pre-transaction elements,
- transaction elements,
- post- transaction elements.

What is more an order fulfillment is associated with adaptation to market requirements, control and flow of materials and information from suppliers to customers that is why this process can be implemented in three different forms: make to order, make to stock, finish to order [9]. That is why the main objective customer order is to guarantee the punctual and efficient execution. It is possible with good scheduling which can be achieved by formulating [10]:

- sourcing strategies,
- time strategies,
- allocation strategies,
- inventory strategies.

An order fulfillment process starts when workers receive an order and ends after delivering goods to final customers [1]. Order fulfillment can be divided into phases, presented on fig.1.



Fig. 1. Customer's order fulfillment – phases  
Rys. 1. Fazy realizacji zamówienia klienta

Phase 1 is an order acceptance. Nowadays companies tend to use information technologies to improve communication with clients for example EDI (*Electronic Data Interchange*), which presents the actual information about location of transport units [8], CRM (*Customer Relationship Management*). It leads to shorten the time of sending an order. What is more it provides clear understanding of an order and decreases number of errors. The main target of Phase 2 is to enter the order into enterprise's logistics system and then to check the stock level and technical and technological possibilities. Compiling and dispatching mean that certain details must be composed together due to complete an order. It's also very important to prepare goods properly for transportation [2]. It means that products should be prepared in a physical way but also lots of documents required during transportation need to be created (and attached) in the last phase of the process. From this point of view phase 3, as an order processing is connected with collecting, checking the product and exchanging an information between departments in enterprise and departments-customers [11].

According to phase 3 specification of products like bulky loads should be considered. In this aspects an order processing in meaning preparation for transportation and second transportation, indeed are in a group of most important order fulfillment components. Above-mentioned two elements exist as integral part of logistics activities which are presented on fig. 2 [11].

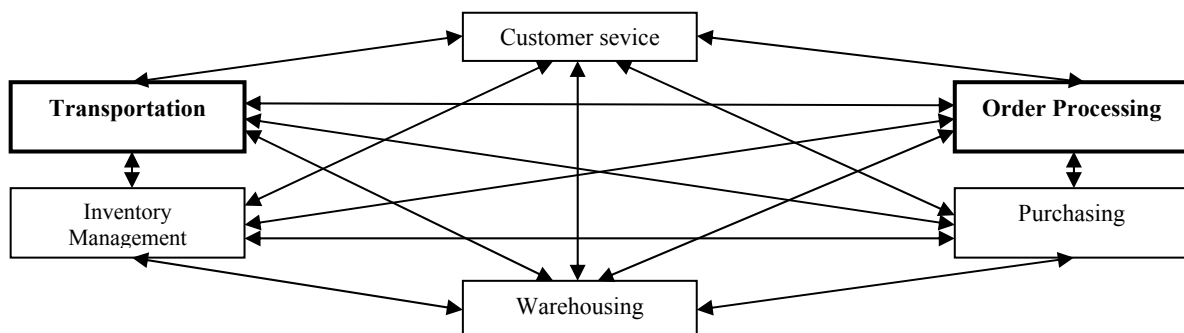


Fig. 2. Logistics activities  
Rys. 2. Czynności logistyczne

Unfortunately in customer order executive are likely to be the bottlenecks, they may cause delays in customer's order fulfillment. Also time of a cycle should be deeply considered as a parameter which prolong its duration. It is necessary to monitor key points of this process in order to prevent it from being extended [3].

## 2. PREPARATION BULKY LOADS FOR TRANSPORTATION IN A STEEL CONSTRUCTION COMPANY

To understand the main issues of bulky loads is to focus on its definition, which relates directly to transportation. Transportation is one of the most important points in abnormal loads order fulfilment process. However any errors committed in a preparation for transportation phase may contribute to delays in delivering goods to recipients. Cargo that is classified as a bulky load is characterized by parameters which dimensions exceed [4]:

- 13,6 m length,
- or 2,55 m width,
- or 2,90 m height,
- or weight of 26 t.

It is also worth considering that abnormal loads may differ significantly in aspects of dimensions, weight or technical and constructional parameters. Therefore, the individualized approach to preparing every bulky load to transportation process is indispensable. Setting up transportation for goods created in a production plant is a very important and complexed decision. Unfortunately, the transport of large-size product is associated with high costs. In case of road transport, costs of semitrailer can reach up to several hundred Euros. Therefore, for manufacturing companies it is unprofitable to maintain of transport equipment [12]. What is more taking on account high requirements and procedures necessary to fulfil during transportation, hiring a shipping company is the most appropriate decision to fulfill them. Regardless, of the chosen shipping operator, a manufacturer needs to ensure proper preparation of the goods for shipment.

In own research Steel Construction Company (SCC) has been analysed. SCC that is being analysed in this paper has created a list of qualified suppliers which are cooperating with them. It should be also highlighted that company is in contact with its suppliers also before and during order fulfillment. It's important because, analysis shown, that process of preparation for transportation is often longer than duration of production phase indeed.

Activities which are considered as a preparation for transportation are all those taken by a company, in order to ensure that goods will be delivered to a customer in a safe way. Of course actions made by a manufacturer sometimes overlap with activities done by a shipping company. That's why clear cooperation between them should ensure avoiding the potential disturbances.

Preparing a product for transportation in a Steel Construction Company was divided into :

- physical preparation,
- informational and documentational preparation.

The own research allow to define the tasks and activities in preparation for the transportation of the product.

In analysed SCC, it is Transportation Department (TD) that is responsible for preparing loads for dispatch. In case of abnormal loads, actions needed for this phase takes place before the production process starts.

TD employees are responsible for identifying information such as:

price,  
type of goods,  
delivery time

or dimensions and weight, parameters that influence on choosing means of transport.

All documents are sent to Technical & Technological Department (TTD), where instructions and requirements for packing, conservation and transportation are defined. Documents prepared by TTD include detailed description and drawings of all actions needed to protect goods. In table 1 some of instructions and requirements for physical preparation are shown.

Copy of this documentation is given to manufacturing department. The original one is sent to Transportation Department (TD). Preparation, protection and loading related activities are made by TD employees after the manufacturing process is finished.

Table 1

Exemplary instructions and requirements for physical preparation of a product for transportation

Product's elements	Procedures and requirements
Connectors	Fulfill with a silicon sweeper
Internally and externally threaded bars	Do not protect
Hole	Stick with a textile self-adhesive tape
Mechanically worked surfaces	Use anticorrosion protective grease
Mechanically worked threads	Use tamping plug made from foamed material

There is a close cooperation between TD and Expedition and Customs Clearance Department (ECCD). In ECCD indispensable documentation needed during transportation is prepared and provided to a shipping company. ECCD is responsible for creating:

- specification created in polish and foreign language (defined with a recipient),
- waybill
- transportation certificate - EUR,
- invoice,
- customs inspection record
- quality control record before and after loading.

Documentation circulation between TD, TTD, ECCD and manufacturing department takes place in a paper way. However, the documentation is created in both: an electronic and paper form and its copies are sent to the client.

Loading process takes place according to defined schedule of arrival and loading. Due to the schedules, control and final acceptance are activities that are undertaken in the first place. They are led by Quality Control Department (QCD). Those processes include following actions:

- product's record checking,
- evaluation of control scope in comparison to requirements set in a contract,
- visual inspections of product quality,
- verification of protections, which were made, in comparison to the data contained in the technical and technological specification.

As a result of control made by QCD, products are classified as possible for transportation or not. If a product was prepared properly, it's transported from manufacturing department to a transporter. During this process, load is specially fastened and moved by a gantry. Four workers are participating in this action and it takes up to 2 hours.

### 3. ANALYSIS AND IDENTIFICATION OF DISTURBANCES IN PREPARING FOR TRANSPORTATION PHASE

In order to identify and analyze problems occurring in the preparation of bulky loads for transportation the Ishikawa diagram, called also as a fish diagram, was chosen. This tool is one of the most popular method used to conduct the analysis of cause-effect. The essence of the method is the links that produces a specific problem. A general outline of the method is specified:

- fish head – analyzed problem,
- bones - causes,
- backbone– combines causes together [5].

Reasons for the creation of a diagram are generated during the brainstorming. Problems are divided into categories relating to: human resources, applied methods, measuring instruments, materials and equipment. Methodology of cause and effect diagram is based on a rule “from general to specific”, which means by searching for the reasons outlined in general to their specific sources.

Ishikawa diagram is the graphical presentation of the various factors that causes a specific problem. This form of presentation of the problem makes it easier to find the most important reasons that have implications for the considered phenomenon.

Causes identification of the problem by using a cause and effect diagram, puts the emphasis on detailed classification of elements having the negative impact on considered phenomenon and selecting those that have the greatest impact. That is why this tool is so useful and widely used [6].

In own research the SCC Ishikawa diagram was used to identify problems that affects the occurrence of delays during order fulfillment for customers, which imply to incur additional financial costs. Example of using the method of cause-effect diagram in the SCC was shown on fig.3.

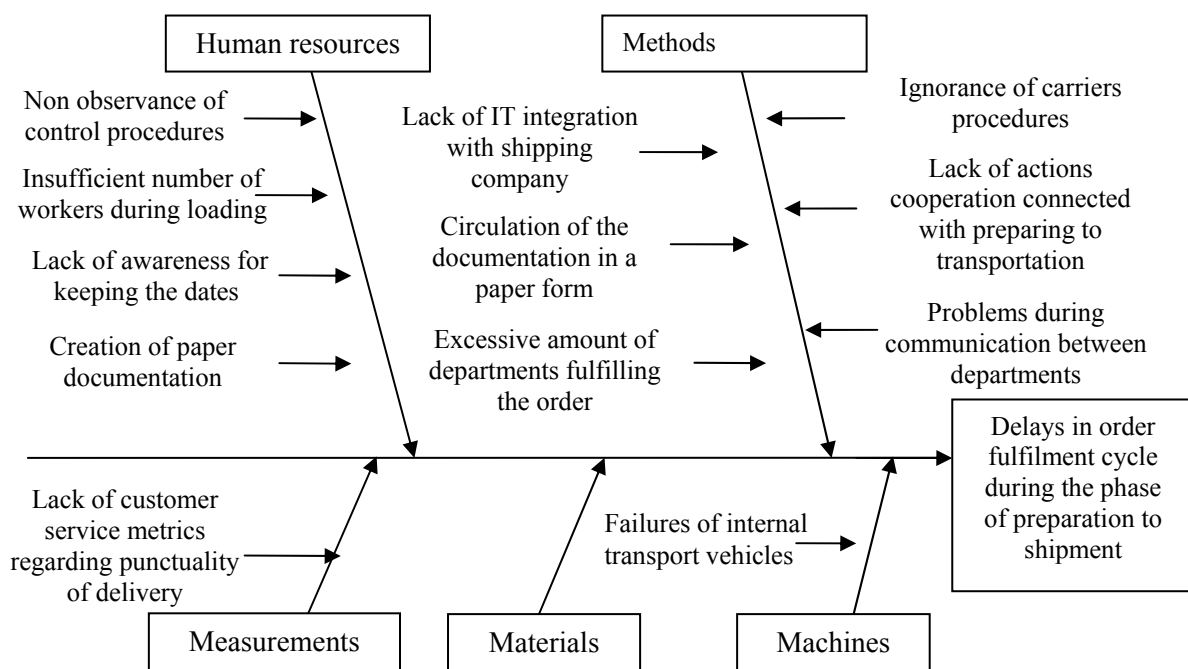


Fig. 3. Ishikawa diagram for the phase of preparation for the transportation of the product in SCC

Rys. 3. Diagram Ishikawy dla etapu przygotowania wyrobu do transportu w Przedsiębiorstwie Konstrukcji Stalowych

Research results have shown that causes of disturbances, which occur during the execution of the contract while preparing bulky loads to transportation, include mainly the problems related to human resources and working methods.

Measurements, materials and machines are problems that have smaller share in generating delays in preparation process. Therefore, SCC should firstly pay special attention to the identification, reduction and solution of problems existing in the field of human resources and working methods. After analyzing the selected diagram, the main elements, which may cause delays in the phase of preparation product for transportation, were selected. It is shown in tab. 2.

Disturbances that are mentioned, significantly impede the proper order fulfilment in a company. They particularly affect on order servicing time and on the company assesment by its customers. In addition, lack of understanding of the need for careful control of abnormal loads may affect on the product quality or even may result in lack of possibility to deliver product to a client. Therefore, the analyzed company should pay attention to emerging problems and their causes.

Table 2

The main factors which causes the emergence of delays in preparing products for shipment

Reasons	Justification
Circulation of documentation in a paper form	Lack of the possibility to update documentation simultaneously in different departments and faculties of company
Excessive amount of departments fulfilling the order	Lack of coordination in preparing a product for shipment. Documentation is transferred between departments, which lengthens the time of service an order
Problems during communication between departments	Lack of fully implemented information system. The use of paper documents elongate the time of preparing an order.
Insufficient number of workers during loading	Inability to provide complete control during the loading process
Non observance of control procedures	Running inspections are done often very cursorily and final product acceptance is carried on while the transport vehicle is awaiting.

As a result of own research the main directions for improvements have been developed. Improvement of order fulfillment in the phase of preparing loads to transportation in the analyzed steel company can be achieved by:

- Creating a common department responsible for operating and maintaining the orders,
- Implementation of information system allowing to eliminate circulation of paper documentation, simplifying and reducing the time duration of documents' transmission and giving opportunity to members of different departments to work simultaneously on the documentation. In addition, it will also simplifies communication between departments.
- Increasing the number of people working during the loading in order to improve the efficiency of the process and reduce the amount of damage formed during these processes.
- Increasing the importance of control activities – it can be achieved by lean management training in order to broaden staff awareness of the relevance of control tasks.

#### 4. CONCLUSIONS

The article attempts to analyze the bulky loads order fulfillment from preparing the product to transportation process. Disturbances analysis has been undertaken from the perspective of manufacturing company. Preparing a product for transportation in a SCC can be divided into physical, informational and documentation preparation. The chosen analytical method of logistics management, called cause-effect diagram, was presented and used in own research. Based on information, documents and own research in SCC the causes of disturbances to the phase of preparing the product to transportation have been identified. The main causes generating delays are related to human resources and working methods. As a result of own research improvements were presented. In order to

improve preparing bulky loads to transportation, first of all, the steps in field of human resources and informational system must be taken. Due to suggested improvements, analyzed SCC is able to achieve higher efficiency in preparation goods to transportation process and prevent delays in it.

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