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ANALIZA ZAKŁÓCEŃ W PRZEPLYWACH LOGISTYCZNYCH W PRZEDSIĘBIORSTWIE BRANŻY MASZYN GÓRNICZYCH

Streszczenie. W artykule zidentyfikowano i przeanalizowano zakłócenia, które występują w trakcie realizacji zadań transportowych i magazynowych. Wybrano zakłócenia występujące najczęściej w realizowanych procesach transportowych i magazynowych. W pracy przedstawiono także możliwe sposoby usprawnień występujących zakłóceń. Artykuł ma charakter praktyczny.

Słowa kluczowe: Przepływy logistyczne, analiza zakłóceń, procesy transportowo-magazynowe.

ANALYSIS OF DISTURBANCES IN LOGISTIC FLOWS IN MINING MACHINERY COMPANY

Summary. Disturbances that occur in the course of transportation and storage tasks has been identified and analyzed. Disturbances occurring the most frequently in the ongoing processes of transport and storage have been selected. The article also shows possible ways of improvements of occurring disturbances. The article is of a practical nature.

Keywords: Logistics flows, analysis of disturbances, transportation and warehousing processes.

1. INTRODUCTION

The internal warehouse transport plays an important role in manufacturing companies (unit and small series production) operating in the machine industry, as it is directly related to the manufacturing logistics. This transport, in particular, involves movement of products over small distances that are dependent on the spatial distribution of the company as well as the so-called components of the infrastructure of the production process and their locations. This transport includes movements both within the area of warehouse facilities and between various facilities located on the premises of the production plant.

The main elements of the transport process in a warehouse facility and outside of the warehouse facilities that support the production process include:

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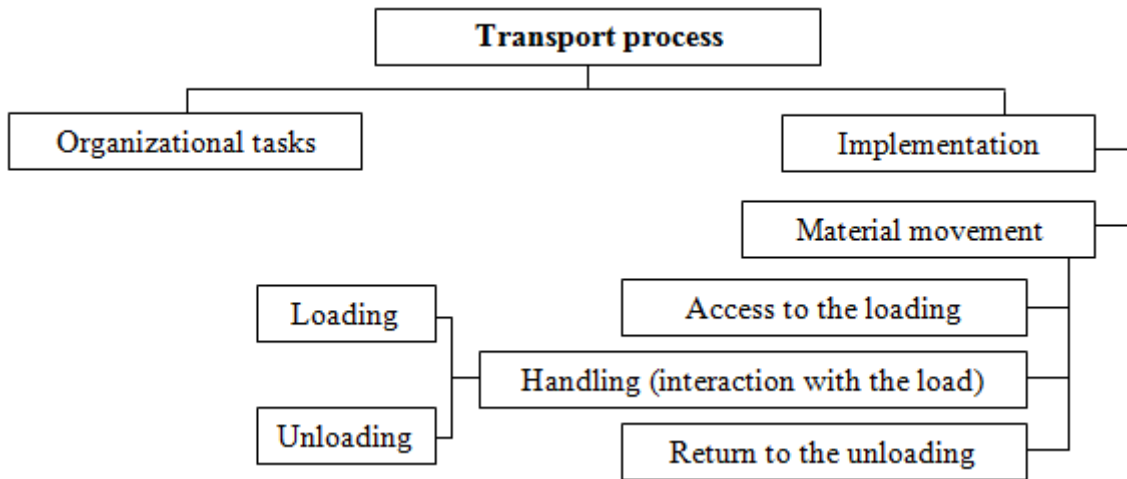


Fig. 1. Major components of the transport process
 Rys. 1. Główne składowe procesu transportowego
 Source: Own study based on [5].

The concept of transport processes (internal) is meant as a transportation process from one place of the company to another (production site, warehouse) [4,7].

Internal transport is closely related to the flow paths of raw materials, finished products within a specific organizational unit [6].

The shaping and selection of the transport solution constitutes the key element of the management-related issues, since the internal transport process within a company is one of the main processes of logistical activity [1, 2]. Internal transport system [ITS] is thus a binder that keeps together all the logistical processes in the warehouse facility. Should such a system lose efficiency, the warehouse can be paralyzed (stock shortages, delays, congestions, etc.), which may lead to a shutdown of the entire supply chain. Therefore this system must be properly designed and then monitored and evaluated. To that end, it is necessary to develop appropriate ITS assessment methods in the warehouse facilities that support production processes.

The internal transport is one of the most important additional processes in all the companies (service, manufacturing and production as well) Internal transport in all of these companies is responsible for the implementation of information and material flow. The implementation of information and material flows may be hindered by an interruption. The analysis of the interruptions in the implementation of the flows within production plants is a complex process consisting of several stages. It includes, among others, the identification of [3]:

- the location where the interrupting factor appears (e.g. the production line, a particular workstation, a supplier, the transport system),
- the elements which cause interruptions (e.g. an employee, transport equipment, machinery),
- the sources of interruption (e.g. shortages in the personnel or equipment, a malfunction, shortages of materials, missing information, new urgent orders, late receipt of materials),
- the deviations as the results of the interruptions,
- the losses related to the occurrence of the deviation (e.g. the lengthening of the production cycle, excessive stock amounts).

The interrupting factors also include all the unexpected events that have a destructive influence on the implementation of the flows and which cause the balance or the goal of the production plant activity to change. In order to identify interruptions in the flows, one can take advantage of daily flow examinations within the company using sheets in which the

employees make notes about the interruptions on the daily basis or e.g. the fish-bone diagram. For the search of the root causes of the identified interruptions, one can use the 5Why approach.

2. IDENTIFICATION OF INTERRUPTIONS IN THE SELECTED COMPANY – DESCRIPTION OF THE METHOD

As a result of ongoing research based on observation, interviews and interruption sheets, information on the interruptions in the internal transport and warehousing systems were obtained. For this reason, field studies aimed at identification of the most significant interruptions were conducted in the selected company. The study used interruption measurement sheets. The deviations in material flows were categorized on a 3-step scale:

- group 1: occurs rarely (once every a few months),
- group 2: occurs occasionally (at least once a month),
- group 3: occurs frequently (at least once a week).

The study was conducted over the period of 3 months. Every day the internal transport and warehousing employees got interruption measurement sheets, in which they took notes on the interruptions. At the end of the shift, a researcher collected the sheets.

The interruption measurement sheet is shown in table 1.

Table 1

Interruption measurement sheet

Date:	Equipment utilization level during the shift		
Factors No.	Name of a factor	Was there an interruption? (if yes, put X)	Number of occurrences (put an X whenever there was an interruption)
1			
2			
3			
4			
5			
N			

Source: Own elaboration

Two types of interruption measurement sheets were developed. The first sheet applied to the interruptions that occur in the transport between the warehouse facilities and the production / assembly halls as well as between the production halls and the assembly halls), while the other applied to the transport directly in the warehouse. Throughout the period of the study, 420 measurement sheets were handed out for warehouse transport equipment and 480 measurement sheets were handed out for the equipment used in transport outside of the warehouse.

3. IDENTIFICATION OF INTERRUPTIONS IN THE SELECTED COMPANY

Based on the observation and interviews, groups of interruption factors were identified. For warehouse transport, such a group consists of 44 factors that may influence the transport in the warehouse facilities.

For the system of transport between the company facilities, 38 transport interruptions were identified.

As a result of the research, the key bottlenecks (interruptions) were identified in the internal and warehouse transport process. The major bottlenecks were selected on the basis of an analysis of the interruption measurement sheets. The major interruptions were the ones that are most frequently mentioned, that is to say the ones that were categorized within group 3 (interruptions that occur at least once a week). The major interruptions that occur in the internal transport within a warehouse facility include the interruptions presented in Table 2.

Table 2

The major interruptions that occur in the internal transport in a warehouse facility

Interruption type	Interruptions
Human related	Late notification about the demand for a load unit leading to material handling equipment being occupied and the incapacity to perform the order on time.
Organizational	Lack of planning for supplier arrivals. It is only agreed that deliveries are to be performed before 12 noon.
	The necessity to wait for an MHE that performs transport to the production or assembly hall.
	No direct access to a single load unit (moving or unpacking)
Technical and technological	Lack of regularity in the warehousing tasks (leading to accumulation of orders) as a result of the lack of regularity in the production,
	Production cycle variability that causes the completed orders to not be received.
	The need to use a ladder to retrieve small-sized load units.
	The necessity to manually enter data into a computer system

Source: own elaboration

These interruptions belong to group 3, so they occur frequently – at least once a week.

Identical studies were conducted for the internal transport outside of the warehouse facilities. The findings of the studies are as follows. The most frequent interruptions (bottlenecks) are the interruptions presented in Table 3.

Table 3

The major interruptions that occur in the internal transport of the warehouse facilities

Interruption type	Interruptions
Organizational	Excessive number of routes from the initial part assembly hall to semi-finished product warehouse facility for the purpose of transporting into the unit assembly hall.
	Waiting with the material for a warehouse MHE.
Technical and technological	The production cycle variability
	Lack of regularity in the warehousing tasks (leading to accumulation of orders) as a result of the lack of regularity in the production
	The size of the load makes unloading the material more difficult, which causes waiting for the material handling equipment
	The weight or dimension that makes it impossible to transport more than one load unit at a time
	Exhausted transport infrastructure

Source: own elaboration

As can be seen, a large number of interruptions are the same for both warehousing and internal transport tasks. The employees of the company pointed to the same factors. The study also determined the average utilization level for the internal transport and warehousing equipment, which was 83% and 85% for warehouse transport and internal transport, respectively.

4. SUMMARY

As part of the study based on the interruption measurement sheets, the most frequent interruptions were identified, which were then discussed among experts in order to attempt to address the identified problems. The final rationalization and improvements applied to these interruptions that can be considered controllable from the point of view of internal and warehouse transport and do not entail production changes.

Some of the identified interruptions are closely related to the nature of the company, more specifically to the characteristics of the production process that takes place in it. The timing and parameters of the internal / warehouse transport process are results of the type of production. Unit and small series production is characterized by a high level of randomness, thus it is impossible to eliminate interruptions, such as:

- lack of regularity in the warehousing tasks as a result of the irregularity in the production,
- production cycle variability that causes the completed orders to not be received,
- late notification about the demand for a load unit leading to material handling equipment being occupied and the incapacity to perform the order on time.

Additionally, due to the character of the devices produced in the studied company, it is similarly impossible to eliminate the following interruption: weight or dimension that makes it impossible to transport more than one load unit at a time.

The last of the most frequent interruptions for which no improvements were attempted to be made is the exhausted transport infrastructure. The current state of the transport equipment, according to the maintenance department, does not constitute a major issue that could cause the bottlenecks to appear in the process. Any malfunction that takes place in the equipment is repaired very quickly. Furthermore, the plant has some additional transport equipment, which can be used to replace the existing equipment in the event of a major failure that could render a quick repair impossible. In the current situation, the investment in a new transport infrastructure is not supported by a business necessity and the profitability of the investment. The company plans to replace the transport infrastructure in the future, though, in line with the adopted strategy and performance supervision plan for these devices. All the interruptions that were not discussed are very poorly controllable from the viewpoint of the internal and warehouse transport.

The following was proposed to help resolve the existing interruptions:

- elimination of the manual data insertion into the IT system during the goods-in or goods-out process in the warehouse facilities through application of bar codes,
- elimination of the manual labor during the warehousing tasks (a ladder in the closed purchasing warehouse facility),
- implementation of the Kanban system for warehousing processes for the standard products of the company (universal – without the implemented structural and technological changes of the product),
- introduction of appointments for suppliers in order to eliminate the accumulation of the warehousing tasks,
- authorizations for internal transport operators in the semi-products warehousing facility to unload semi-products in the goods-in area,
- installation of a hoist in the production halls to enable unloading of heavy items without waiting for overhead cranes.

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