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## THE ANALYSIS OF LOGISTICAL AND INFORMATION FLOWS IN THE SELECTED ENTERPRISE RELATED TO THE IMPLEMENTATION OF PRODUCTION PROCESSES

**Summary.** The aim of the study presented in this paper is to analyze and evaluate the functioning of the internal transport and warehousing systems, in particular the flows of information in an enterprise and disturbances occurring during their implementation. The method of process mapping was used in order to conduct the study. The paper identifies the main entities (departments) active in the performance of the processes. The paper also presents the map of information flow processes and the dependencies occurring within it and discusses the information flow process map, as well. The solutions for identified problems during map processing were proposed.

**Keywords:** mapping process, information flows, transportation processes.

## ANALIZA PRZEPŁYWÓW LOGISTYCZNYCH INFORMACYJNYCH W WYBRANYM PRZEDSIĘBIORSTWIE ZWIĄZANYCH Z REALIZACJĄ PROCESÓW PRODUKCYJNYCH

**Streszczenie.** Celem przedstawionych w artykule badań jest analiza i ocena funkcjonowania systemów transportów wewnętrznego i magazynowego, a w szczególności realizowanych przepływów informacyjnych zachodzących w przedsiębiorstwie, jak również zakłóceń, które występują w trakcie ich realizacji. Do przeprowadzenia badań wykorzystano metodę mapowania procesów. W artykule zidentyfikowano główne podmioty (działy) występujące w realizacji procesów. W artykule przedstawiono również mapę procesu przepływów informacyjnych i występujące w niej zależności. Omówiono zaprezentowaną mapę procesu przepływów informacyjnych omówiono. Zaproponowano rozwiązanie procesów problemów zidentyfikowanych w trakcie mapowania.

**Słowa kluczowe:** mapa procesów, przepływ informacji, procesy transportowe.

## 1. Introduction

Logistical flows in an enterprise serve as the basis of its operation. Without the logistical flows, it is impossible to perform services and processes in the enterprise. Logistical processes are nothing but processes that rely on physical movement of goods and information related to them, during which the value of the product or service is enhanced [Grajewski P., 2007]. Process mapping methods result from the desire to present the organization within a process-oriented approach. This process approach aims to create processes and shape them in order to raise their effectiveness and efficiency as high as possible [Hramol A. 2002]. In the process approach, the process is considered a determinant of organizational effectiveness. When used in relation to the organization, the process approach assumes that the organization works on the principle of market relations taking place both inside the organization and in its environment. This approach establishes, thus, the existence of internal customer (e.g. production for a warehouse facility), which is as important as the external customer. In the process approach, it is the internal and external customers that decide what constitutes the value of a service or product. The main reason why processes are run in the organization is to achieve the requested effects, which are verified by the customer [P. Grajewski, 2007].

One can find many examples of analyses of logistical processes in the literature, in particular for manufacturing companies [Kaplan R., Murdock L., 1991; Bendkowski J., Kramarz M., 2006; Skowronek C., Sariusz-Wolski Z., 2008].

## 2. Method used – process mapping

The methods of mapping relations and processes make it possible to understand the processes occurring in the enterprise and thus serve as the basis for their optimization. Additionally, they help to determine the boundaries of the process [Tomala K., 2003]. Mapping relations and processes is the first step to understanding what opportunities lie in the activities performed by the enterprise [Ciesielski M., 2006]. The main objective for creating process maps is to describe business processes in order to simplify, eliminate or improve them so that the products and services are cheaper, better and more achievable [Bozarth C., Handfield R., 2007].

The map of relations is defined as a diagram showing the main organizational units involved in the process and their mutual interconnections in the flow of materials, information and funds [Bozarth C., Handfield R., 2007]. The map allows identifying the main actors in the process and is one of the most important steps in the mapping process. It constitutes the basis and the starting point for more detailed mapping technique – the process map.

The process map is defined as a graphical representation of subsequent stages and events that comprise the process. The process map identifies specific activities performed within a process. A properly drawn process map allows identifying the main connections in the process, determining the time required to perform activities in the process and identify illogical, unnecessary or wasteful activities [Dohn K., Kwiotkowska A., 2008].

The process map is in general a tool that allows visualizing a complex net of activities and evaluating the structure of each process and sub-processing at their present stage [Lisiecka K., 2002].

Process mapping is a tool that makes it possible to perfect the existing processes and implement the process-based structure in the organization and additionally makes it possible to better understand the current processes and eliminate or simplify ones that need to be modified [Ciesielski M., 2006].

### **3. The analysis of information flows in the selected company**

The analysis began with the presentation of the order completion process and visualization of the flows of information related thereto. These flows are presented in the form of a functional map of the process. Figure 1 shows the flow of information in the selected company.

The first stage, in which information flows emerge to support the production processes in the selected company, is the sales department, which reports interest in a tender initiated by the customer. As part of this interest, the manufacturer gains access to tender documents (ToR), where the elementary requirements for the product are specified (in this case – the shearer loader). Gaining access to the ToR is equivalent to initial acceptance of the order. The next step is to conduct design, technological, economic, timeframe and supply analyses. The design and technological departments analyze:

- the products necessary to achieve the target design parameters (dimensions, precision, etc.),
- the necessary input raw materials to be used and their technological characteristics (hardness, abrasability, etc.),
- the necessary technological operations to be performed as well as the capacity to perform certain operations by the available machinery stock (technological route),
- the necessary tools and instrumentation to be used.

The next step in the flow of information is the development of economic analysis of the order (its cost-effectiveness) by the department of cost analyses. Subsequently, the analyses and evaluations of existing materials, tools and the possibilities of purchasing them (price and

supply dates) are conducted and on this basis the ability to complete of the order fully and on time is evaluated and an initial production schedule is prepared.

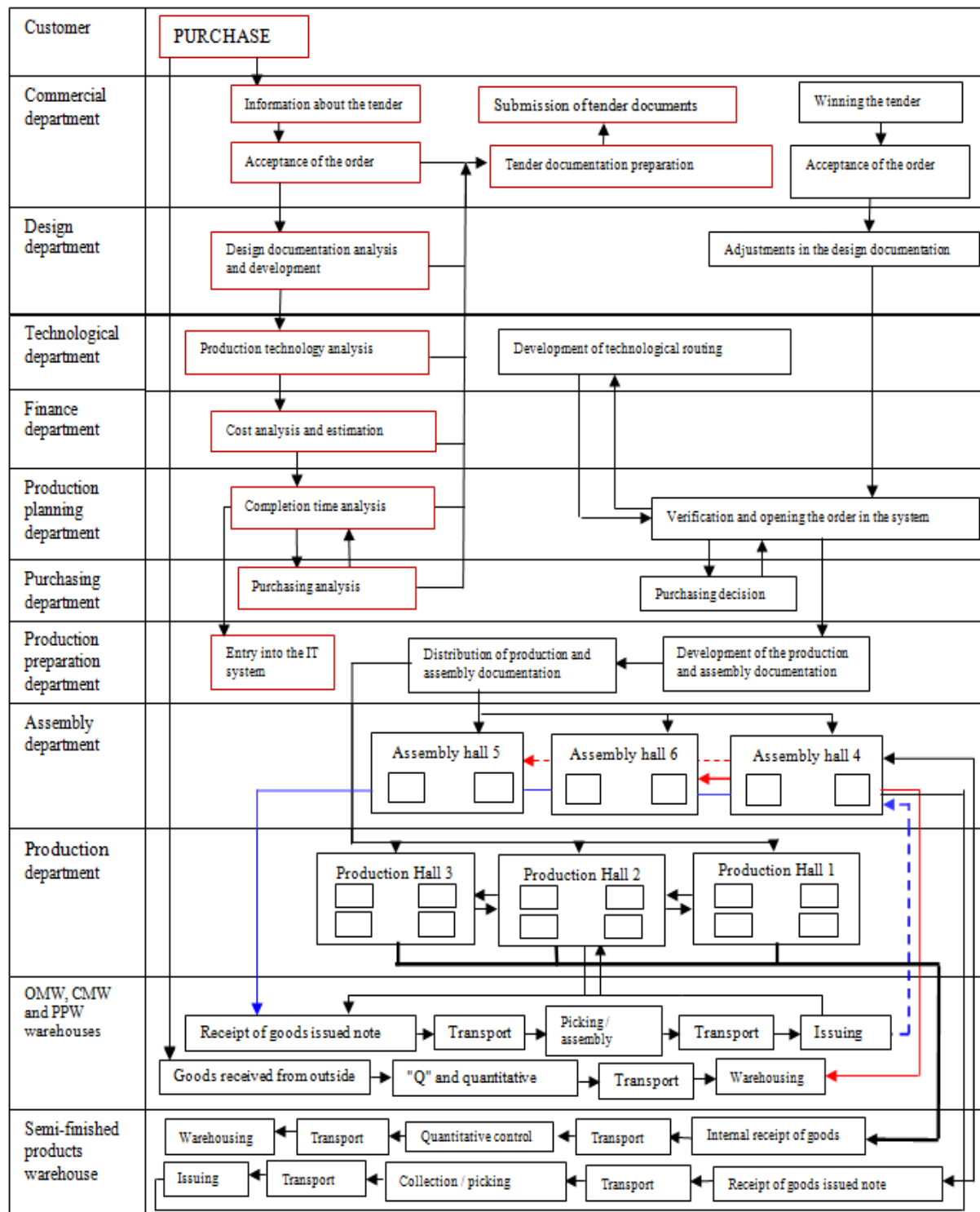


Fig. 1. Flow of information in the selected company

Rys. 1. Przepływy informacyjne w wybranym przedsiębiorstwie

Źródło: Opracowanie własne.

The tender documentation is prepared on the basis of these analyses. The next step is to enter the order data into the IT system and wait for it to be run. Pre-transaction information flows are marked in red.

After winning the tender, the order returns to the enterprise and is accepted and distributed to:

- the design department to make final adjustments and calculations,
- the production planning department to verify and open the order in the system,
- the technological department to develop the final technological routing,
- the production planning department to establish the production schedule,
- the purchasing department to determine the final purchase decisions,
- the production preparation department develops the manufacturing and assembly documentation and distributes it among various production and assembly workers.

The next step is to start the production. This activity starts the flow of goods issued notes (GINs). These notes are the basis for collection of raw materials, materials and semi-finished products by production and assembly workers. After obtaining goods issued notes, which must be delivered by hand to the warehouse workers, preparations start to issue or receive the load. In this case, an information process starts that is related to the analysis of the goods issued notes (GINs) and the entry of the data into the IT system about the collection of certain quantities and types of raw materials, materials or semi-finished products. Subsequently, information tags are printed describing the type and quantity of the goods issued. In the case of receipt of semi-finished products and goods ordered from suppliers, (for internal receipt of goods) the internal goods received notes and tags are analyzed and the warehousing location is identified by the computer system. In the case of receipt of goods from outside (from supplier), the received invoice and documentation confirming the quantity and quality of the goods as well as available storage are analyzed and appropriate storage location is allocated and Goods Received Note (GRN) is issued. While the warehousing tasks are being performed, materials are transferred on the basis of internal warehouse transfer documents. In accordance with the figure, one must identify the main information flows in the transaction part of the information flows that in particular support the transport and warehousing processes as well as the production processes. The most important flows include:

- the products necessary to achieve the target design parameters (dimensions, precision etc.),
- distribution of the production and assembly documentation to various production and assembly halls and on to individual workstations,
- the flow of documentation from the suppliers to the warehouse facilities:
  - the open warehouse for metallurgical raw materials (OMW),
  - the closed warehouse for metallurgical raw materials (CMW),
  - the purchasing warehouse for small parts and parts that do not require production machining (PPW),
  - the semi-finished products warehouse (SPW),

- the documentation flow between the production halls (1, 2, 3) and the assembly (4, 5, 6) halls,
- the documentation flow between the workstations in the production halls and the assembly halls,
- the flow of production and assembly notes to various warehouse facilities:
  - production hall 2 and the open and closed warehouses for metallurgical raw materials,
  - between the production halls (1, 2, 3) and the semi-finished products warehouse facility,
  - between the assembly halls (4, 5, 6) and the semi-finished finished products warehouse and PPW warehouse,
- the flow of material notes in the warehouse facilities.

For loads received from outside, one may specify documents, such as: invoice from supplier, information tag specifying the warehousing location and the description of the goods (printed from the IT system at the time of receiving the goods), goods received note (GRN).

For loads received internally in the semi-finished products warehouse, one may specify documents, such as: goods produced issued note, information tag specifying the warehousing location and the description of the goods (printed from the IT system at the time of receiving the goods), internal goods received note.

For goods issued internally from the OMW, CMW and SPW warehouses. PPW - the following documents are required: goods issue confirmation (it is printed at the time of picking the material by the warehouse employee) and the issuing tag specifying the material issued.

As a result of mapping the information flows and thanks to the observations and the analysis of the issuing documentation, the areas with the highest volume of information flows were identified. These areas are located at the point of contact between the internal transport with the semi-finished products warehouse facility (from the assembly halls and the production halls) and the internal transport from the semi-finished products warehouse facility to the assembly halls. The high volume of information flows is visible also in the point of contact between the supplier and the purchasing warehouse facility for parts not subjected to machining, which is marked with two exclamation signs. The double exclamation sign is placed also on the entry to semi-finished products warehouse facility, since the entry and exit from the facility are shared with the semi-finished products facility and the purchasing warehouse.

## 4. Summary

The information flows can be improved through implementation of a computer system in the pre-transaction stage that is in the stage of validating the manufacturing capacities in the departments of the enterprise (design, production planning, technological and production preparation departments). Currently, these documents are moved from one department to another in a paper form and eventually returned to the commercial department, where the decision is taken about the further fulfillment of the customer order.

All information flows in the product production stage are made on paper, which significantly increases the probability of making an error or losing the material notes. One solution to this problem is introduction of a barcode system for the management of warehouse facilities (receiving and issuing goods).

The need to manually enter data into the computer system, the preparation and printing of goods issued notes as well as their subsequent handling significantly reduces the completion times for production and assembly tasks. The introduction of barcode system has a considerable effect on the number of errors and the efficiency of the workers.

Implementation of barcodes is widely discussed and promoted in the literature as it makes it possible to primarily accelerate warehouse operations and reduce the number of errors made by warehouse workers. The basic benefits of the implementation of barcodes in the purchasing warehouse facility supporting the process of unit production within the enterprise analyzed include:

- reduction of the number of goods picking error (INDICATOR: number of errors in the deliveries for the production stage in the selected enterprise lower by 15%),
- shortening the duration of warehouse operations (INDICATOR: average duration of the warehouse operations reduced by 33%),
- automation of the operations,
- elimination of paper documents used for the circulation of information and goods.

This study determined that at the time the biggest accumulation, the time savings resulting from the use of the barcodes (automation of warehousing processes) would be 40%.

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## Omówienie

Celami artykułu są analiza i ocena funkcjonowania wewnętrznych systemów transportowych i magazynowych, w szczególności przepływów informacji w przedsiębiorstwie oraz zakłóceń występujących w trakcie ich realizacji. Pokazane są główne działy, aktywne w realizacji procesów. Przedstawiono również mapę procesów przepływu informacji i zależności występujące w tej mapie. W artykule omówiony został też, proces przepływu informacji, przedstawiono również sposób poprawy przepływów informacyjnych np.: przez wdrożenie systemu komputerowego w fazie pretransakcji, która znajduje się na etapie sprawdzania zdolności produkcyjnych w działach przedsiębiorstwa. W przeprowadzonym badaniu ustalono, że w największą oszczędność (w momencie największego nagromadzenia przepływów informacyjnych) można osiągnąć przez wykorzystanie kodów kreskowych i będzie ona wynosić 40%.