Economics and Organization of Logistics
5 (4), 2020, 21–30

DOI: 10.22630/EIOL.2020.5.4.26

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Identification and analysis of potential disruptions in warehouse processes in the distribution centre of the food industry

Identyfikacja i analiza potencjalnych zakłóceń w procesach magazynowych w centrum dystrybucyjnym branży spożywczej

Abstract. This paper is an attempt to identify and analyse disruptions that occur in the warehouse processes in the selected distribution centre of the food industry. The food sector has been briefly discussed and the distribution centre role within the distribution network as a link between suppliers, producers and consignees shown. Distribution centres play special role in the logistics and are the source of many benefits such as reduction of logistics costs, time cycles and stock as well as increase in the level of customer service quality. They also create value within the chain [Tomczak 2014]. In order to correctly implement the tasks put before a distribution centre, the warehouse processes taking place inside it should be performed efficiently and effectively. The performed A3 report has shown the potential disruptions that may affect the correctness of the warehouse processes implementation within the analysed distribution centre. The paper proposes improvements of the warehouse processes.

Key words: distribution, distribution networks, food industry, warehouse processes, A3 report, logistic indexes

Synopsis. W opracowaniu podjęto próbę identyfikacji i analizy zakłóceń, które występują w procesach magazynowych w wybranym centrum dystrybucji z branży spożywczej. Opisano branżę spożywczą w Polsce oraz ukazano rolę centrum dystrybucji w sieci dystrybucji jako łącznika dostawców i producentów z odbiorcami. Z badań wynika, że centra dystrybucyjne odgrywają szczególną rolę w logistyce, przynosząc tym samym wiele korzyści w postaci redukcji kosztów logistyki, cykli czasowych oraz zapasów, a także wzrostu poziomu obsługi klienta i tworzenie wartości w łańcuchu [Tomczak 2014]. Aby móc prawidłowo realizować zadania, jakie stoją przed centrum dystrybucji, procesy magazynowe w nim zachodzące powinny być wykonywane sprawnie i efektywnie. Przeprowadzony raport A3 ukazał potencjalne zakłócenia, jakie mogą wpływać na poprawność realizacji procesów

magazynowych w analizowanym centrum dystrybucji. W artykule zaproponowano usprawnienia procesów magazynowania.

Słowa kluczowe: dystrybucja, sieci dystrybucji, branża spożywcza, procesy magazynowe, raport A3, wskaźniki logistyczne

Introduction

The food industry in Poland can be characterized by relatively high stability therefore it should be included in the group of the least exposed sectors to the crisis, because the crises usually result from deviations of demand for durable goods, not for food. However, such drastic changes and results of these changes that took place within in the economy within the past year surely affected this sector also, to some extent. The impact of the pandemic can be seen among other things in the Statistics Poland data related to evaluation of the volume of purchase form foreign companies [FilaryBiznesu.pl 2020]. The food industry is one of the most important and strongly developing sectors in Poland. Figure 1 presents the value of food market in Poland. It is especially important to take a look at the stores operating within modern distribution channels because this is the channel that develops fastest from the value and quantity standpoint.

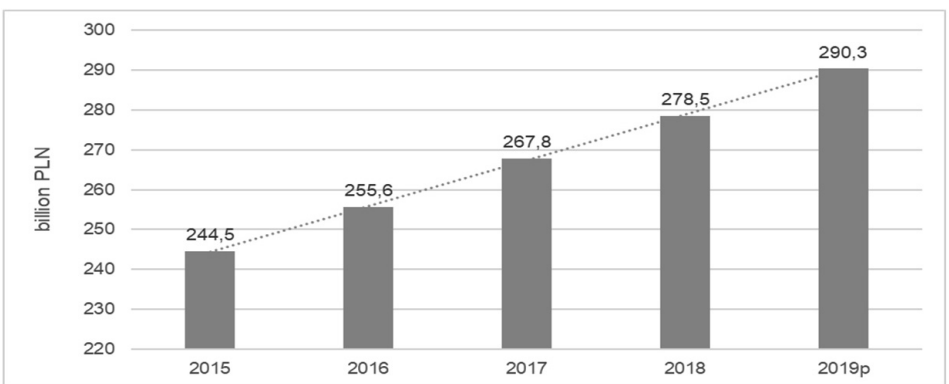


Figure 1. Value of food market in Poland [in billion PLN]
Rysunek 1. Wartość rynku żywności w Polsce [w miliardach PLN]
Source: developed based on [ZPP 2020, p. 11].

In order to deliver products to stores of the food industry, based on the 7W logistic principle, properly adapted, equipped and located distribution centres are needed. Distribution centres play the most important role within the distribution networks [Kozerska 2016]. In both these objects, the products are usually subject to picking process and dispatch to a consignee. The challenges put before the distribution centres are as follows [Kozerska 2016]: versatility, necessity of IT support, multimodality, creating added value related to the dispatched products, availability and integration option of many companies from various disciplines.

Distribution centres operate within networks. Network is a system composed of cooperating nodes in order to widen the range of impact and penetrate the consignee market [Kramarz 2008, Rushton 2014]. The essence of the network is implementation of the same or similar tasks, functions in different areas (geographic, market niches, disciplines, etc.) [Kramarz 2011]. Distribution centre within a distribution networks fulfils a role of a logistic node [Onstein 2018]. It consolidates cargo streams from a few suppliers to one consignee and distributes cargo streams, i.e. from one supplier to many clients; when dividing a cargo stream, clients are distributed at various locations and order products any time [Śliwczyński and Koliński 2013]. It provides the services of warehousing, temporary storage and distribution of products. The task of distribution networks is to maintain and preserve product quality that passes the distribution channels and to deliver it as fast as possible to a final client [Śliżewska and Zadrożna 2014]. In order to optimise the distribution network operations, it is necessary to analyse: currently possessed storage capacity, transport means, external and internal infrastructure, costs, improvement and provision of better distribution quality. To some extent, food market forces the design of various organizational forms of the distribution centres from companies that depend e.g. on the client service form and standards [Odlanicka-Poczobutt and Brodnicka 2015]. This necessitates skillful selection of logistic objects based on functions and tasks such objects should perform.

Objective and methodology of research

Based on the literature analysis within the fields of distribution, distribution centre and analysis of operational tasks taking place in warehouses, an attempt of disruption identification was made that occurred during acceptance, storage and delivery of goods from a distribution centre. A3 report was used in order to identify the root causes of disruption within the said processes. One also proposed the directions of improvements of the warehouse processes related to food products at a distribution centre. A3 report is based on its versatile implementation for different purposes. The most common include: solving problems, identifying persons responsible for a given project, its monitoring and tracking the status, more effective and efficient learning by an organization and employees, common development of good practices, continuous correction of reports = continuous improvement, presentation of a project or making decisions [Kołodziejczak nd, Richardson 2014]. The A3 report is an effective tool with which errors, problems and their causes can be clearly defined. In addition, you can put a sketch of a solution, new ideas and use supporting tools [Ćwiklicki 2009]. The following procedure was proposed as an action plan: Observation – the first step in any scientific inquiry is to observe a phenomenon in reality. Formulation of the model (cause-and-effect relationship using the A3 report). Looking for inconsistencies and defining the problem. Proposing a solution and its verification.

In conducting this research, the indicators were used that were calculated before the A3 analysis was carried out and after some solutions were proposed.

Tests results

The analysed distribution centre (DC) has a centralized distribution network that serves stores within Górny Śląsk area and performs a function of a consolidation point within the supply network. Utilization of this type of network is beneficial because it allows for keeping the minimum level of stock in a warehouse and minimizes transport costs based on the supplies consolidation. Advantageous location of the centre, close to main transport nodes and distance from clients allows for more frequent supplies to the stores. The analysed DC performs warehouse processes that include problems affecting effective functioning of the whole distribution network. Processes performed in the DC include:

- acceptance of deliveries – from a specified dispatcher together with quantitative and qualitative inspection,
- storage process – including acceptance from the acceptance zone and placement within the storage zone using the FEFO method,
- picking – includes acceptance from the products storage zone according to clients order,
- internal transport of goods using a forklift truck between warehouses and during unloading and loading,
- delivery of goods from the warehouse and its handing over to consignee,
- completion of client's order, i.e. completion of products based on the order from a consignee,
- inspection of warehouse inventory,
- organization of return of containers, boxes, pallets from clients to the distribution centre.

The process of accepting food products to the DC is as follows: The first task within the food products delivery acceptance at the cold store department is the control of the letter of advice by a warehouse administrator, who registers the delivery in the WMS (Warehouse Management System) system under appropriate number and then he / she hands it over to warehouse keepers in the cold store department. WMS is a program for managing products in warehouses. Warehouse Management System type solutions, coordinating warehouse works. These are specialized systems that improve all processes that take place in warehouses. They are of great importance, first of all, for the logistics warehouse (services), which support changes in the selection of shipments from multiple senders and directed to multiple recipients in their warehouses and terminals [Kownacka 2020]. Warehouse keepers at the acceptance department check the product temperature and then unload the delivery in the cold store buffer. The next task is the qualitative inspection which is very important because at the moment of finding potential products damage a delivery discrepancy protocol is made, the delivery is rejected and returned to supplier. After a successful quality control, quantitative inspection takes place through counting the goods on the pallets. In case of any discrepancies between the order and actual delivery, a delivery discrepancy protocol is made. In case of a surplus, warehouse keepers must contact the stock department in order to verify current stock status. If it is possible to accept the surplus of goods, another order is made related to the goods surplus

and the order is sent to the cold store department. In case of goods shortage, the delivery is accepted to the WMS system using a scanner. After the acceptance to the system, warehouse keepers perform another inspection of the accepted delivery, and then the External Acceptance document is created. The created document together with the copy of the External Delivery document are sent to the deliveries department where the documents are verified. If the documents are inconsistent, they are corrected. Another task is to issue a suitable document – invoice for the accepted goods – by the accounting department. Correctly accepted delivery is transported to the storage zone.

In order to quantify the occurring non-conformities in the warehouse, logistic indicators were used (quantitative warehouse compliance, warehouse utilization rate, delivery acceptance rate):

– quantitative warehouse compliance – the indicator informs about the compliance of the actual stock levels in the warehouse with those stored in the system. It is calculated according to the following formula:

  quantitative warehouse compliance = (number of items according to the system) / / (number of items physically converted in the warehouse) · 100 [%]

  $$\text{quantitative warehouse compliance} = \frac{10405}{11236} \cdot 100\ [\%] = 92.6\%$$

– the storage utilization index is calculated according to the following formula:

  warehouse utilization index = (number of occupied warehouse spaces) / (total number of warehouse spaces) · 100 [%]

  $$\text{warehouse utilization rate} = \frac{1480}{1620} \cdot 100\ [\%] = 91.36\%$$

– the correctness of the delivery acceptance is calculated according to the following formula:

  correctness of the delivery acceptance = (number of correctly accepted deliveries) / / (total number of deliveries) · 100 [%]

  $$\text{correctness of the delivery acceptance} = \frac{1456}{1499} \cdot 100\ [\%] = 97.13\%$$

The analysis of the above indicators shows that in the distribution centre there are differences between the stock levels in the system and the real stock levels. The warehouse utilization rate is within the normal range, but should aim at full utilization. There are numerous errors in accepting deliveries and completing orders, causing differences in stock levels and errors in deliveries to stores (recipients). In connection with the obtained results, it is necessary to propose an improvement that will improve the product distribution process as well as the efficiency and effectiveness of internal processes in the distribution centre.

Information about the order placement by a client is exported to the WMS system. Information about the order placement is sent to the deliveries implementation department that orders picking of the order to an external company. External company performs

picking of the delivery based on the order and its identification. The prepared delivery is transported to the delivery zone where it is additionally secured. Driver loads the goods on a truck and delivers them to a designated location. In the face of so many tasks to do in order to accept the goods to the DC and then send them to a consignee, there is a risk of many problems and inconsistencies within efficient implementation of these processes. Information about delays in deliveries received from clients and reports from the warehouse personnel concerning errors in the documents and the noticed quantitative and qualitative inconsistencies during the goods acceptance, necessitated detailed analysis of the occurring signals. A3 report was used to solve these problems and to find their root causes. The said report is used to analyse and solve problems of companies based on standardized scheme (Figure 2).

All causes mentioned in the A3 report directly or indirectly affect the problem of inconsistencies during acceptance of goods to the warehouse. This problem generates additional losses in the company, because the existing surplus in products generates costs related to disposal or resale of the products at lower value.

The objective of the preventive actions (corrective actions) proposed in the A3 report is to reduce the number of inconsistencies during goods acceptance, improve indexes identified in the report and specify the way of progress monitoring and define issues to solve. Of course, before any preventive actions can be implemented, it is necessary to answer the questions concerning problems with implementation of e.g. the Pick by voice system and what to do to prepare for them. It is necessary to specify concrete dates of implementation and completion of these actions and the form of their control to check if the results correspond with expectations.

The proposed solution – implementation of the Pick by voice [Złoch 2012] system, alike pick by light or pick by point, is an innovative technology employed in logistics and warehousing [Funk 2015, Bartczak and Barańska 2016, Dujmešić 2018]. One of the ways to increase the processing power of the warehouse is to strengthen the picking process through application of an intuitive voice technology. The WMS system, supported with the voice technology, significantly facilitates the work of operators in the warehouse. The support consists in substituting system messages transmitted to data collector with voice commands read to the operator's headset. Return communication is also very intuitive, namely based on voice commands said by an operator to a microphone integrated with the headset. Implementation of this technology frees the operators hands which is a very important thing when handling small or large-sized orders. Application of the intuitive technology, such as voice operation, affects also the increase of rate of warehouse flows and reduction of errors quantity.

In order to verify the correctness of the introduced improvements, the used logistic indicators were recalculated. The results of the indicators are definitely better.

$$\text{quantitative warehouse compliance} = \frac{14227}{14530} \cdot 100\ [\%] = 97.91\%$$

$$\text{the degree of utilization of the warehouse} = \frac{1580}{1620} \cdot 100\ [\%] = 97.53\%$$

$$\text{correctness of delivery} = \frac{1469}{1473} \cdot 100\ [\%] = 99.73\%$$

	A3 report	Problem: Inconsistencies during goods acceptance	Responsible Designated person	Date of preparation:	Report No.: 1	Status: P D A C

1. Problem description

During goods acceptance to the warehouse, qualitative and quantitative inconsistencies have been noticed and a problem related to the fact tha t employees "didn't know" where to put the goods.

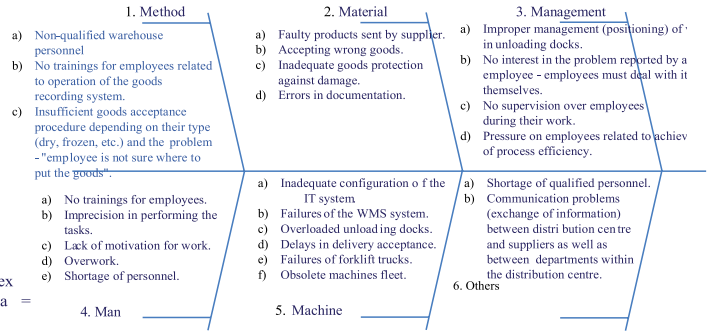
2. Current stat us, measur es, numbers

Quantitative measurement of warehouse conformity was performed - the index informs about co nformity of actual stock in the warehouse with the system data = 97.45%.
correctness of delivery acceptance = 97.67 %
The analysis of the aforementioned indexes show that there are differences between the warehouse inventory in the system and the actual n umbers. There are many er rors during acceptance of deliveries and picking of orders that cause the warehouse difference.

3. Target condition

Significant increase of warehouse quantitative conformity and delivery acceptance correctness indexes. The objective is to achieve the index at the l evel o 99% within six months.

4. Cause and effect anal ysis



5. Preventive measures

Proposals:

1. Accurately develop the path of development, training, raising professional competence. Pass the information and systematically monitor the development. Training for the employees.
2. Meeting of employee s with a superior in order to discuss the problems and the methods of their solving and preventing them in the future.
3. Developing goods acceptance procedures (SOP) depending on their types and passing them to the workstations.
4. More frequent insp ection of devices operation in the warehouse.
5. Substituting hardcopies with e -documentation.
6. Contractual penalties for failure to deliver the goods (from qualitative, quantitative and time standpoint).
7. Creating a "queue" system for vehicle s delivering goods to DC.
8. Implementing the Pick by voice system connected with the WMS system.

Figure 2. A3 report for solving the problems of inconsistencies during goods acceptance
Rysunek 2. Raport A3 dotyczący rozwiązywania problemów niezgodności podczas przyjęcia towaru

Source: own elaboration.

Summary and conclusions

Warehouse is of fundamental meaning in the distribution logistics, because it is a home for both operational phase processes (acceptance, storage and dispatch of goods) and management processes (predicting stock level, planning actions and tasks related to implementation of orders). In order to efficiently react on continuous changes within the distribution logistics, it is necessary to identify the most important challenges related to it. Continuous control of the implemented processes and planning their course allow to minimize the risk of downtime and identify areas to optimize. Because of the real-time access to all data on warehouse functioning and products circulation, the company is able to quickly react to any changes on the market or in the supply chain and smoothly adapt operations of an object to actual needs. Another task is to optimally use the available warehouse area. This may entail change of the warehouse logistic design, use of new storage solutions, including object automation or implementation of WMS system to manage all stages of the warehouse economy. Company should employ qualified employees and motivate them adequately. Experienced and properly trained personnel affects the acceleration of warehouse operations and minimizes costs and time necessary to train new employees. It is also important to ensure proper cooperation between transport, stock management, warehouse operations, administrative issues organization, etc. Only the full coordination would allow for obtaining the highest level of effectiveness both of the warehouse operations and the supply chain itself. However, the applied innovative solutions in the food industry logistics may be treated as one of the sources of gaining competitive edge through the search and implementation of new solutions that allows to overtake market competitors. Innovative technologies, organizational solutions and new distribution concepts may represent a key factor of a company success as well as the whole supply chain. When efficiently implemented, they increase effectiveness of logistics process and warehouse economy, decide about higher sale efficiency, reduction of distribution process costs and allow to expand the range of commercial service, including especially these that increase comfort or save time related to purchases made by clients [Ciechomski 2016]. For example, further automation of these processes and shortening the supply chain can be used to minimize disputes related to warehousing in a distribution center in a commercial link. Further research will develop on the continuous validation of the accepted receipts upon admission to the warehouse and its use.

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