

IT Systems Supporting Warehouse Management in the Supply Chain

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Abstract: In the present-day situation, various IT systems are used for the management of storage area, location of goods and registration of warehouse turnover. Customers want to receive their goods in a faster and faster manner, and the number of orders is increasing together with the development of the e-commerce industry. IT systems undergo a constant makeover. Owing to the development of information technology and process automation, it is possible to handle a larger number of warehouse transactions without the need for increasing the number of staff. This study aims to present the role and importance of IT systems supporting warehouse management in the supply chain. We analyze in detail the role and place of a warehouse in the logistics supply chain, factors shaping changes in the storage area market in Poland, major IT systems facilitating communication within the warehouse and its environment. The final section of the study indicates the directions of changes in the scope of warehouse processes computerization and automation. Owing to automation, robotics, artificial intelligence and other advanced technologies, a modern WMS is the software which is capable of handling the majority of distribution operations. It makes inventories visible and it integrates with transport management systems and with other solutions to streamline the movement of goods from a producer to a warehouse, and then to a retailer and finally to an end-customer.

Keywords: IT system, warehouse management, supply chain, e-commerce industry, automation warehouse processes

Introduction

In the present-day situation, various IT systems are used for the management of storage areas, the location of goods and the registration of warehouse

turnover. They provide information about stock levels and facilitate the completion and preparation for shipment of a new batch of goods. The development of IT systems follows the evolution taking place within the supply chain (Adamczewski, 2001). Customers want to receive their goods in an ever-faster manner, and the number of orders is increasing together with the development of the e-commerce industry.

Contemporary businesses need to catalogue a diversified range of products. In many warehouses the number of warehouse units identifiable with a unique code dedicated to a given product amount to tens of thousands. Without efficient warehouse management systems, this would be an impossible task (Długosz, 2009).

IT systems are undergoing a constant makeover. Servicing multi-stage processes which occur during warehouse operation time requires the systems to display versatile functions. As a result, these systems support the management of further phases of warehouse processes such as the logistics of incoming and outgoing materials, the logistics of returns and claims, or the management of stocks and storage area. Additionally, IT systems managing the work of a warehouse need to have the ability to communicate and cooperate constantly with the company supply, the production and distribution systems, and to have convenient tools to manage personnel productivity. Owing to the development of information technology and process automation, it is possible to handle a larger number of warehouse transactions without the need for increasing the number of staff (Skowronek, Sarjusz-Wolski, 2012).

This study aims to present the role and importance of IT systems supporting warehouse management in the supply chain. We analyze in detail the role and place of a warehouse in the logistics supply chain, factors shaping changes in the storage area market in Poland, the major IT systems facilitating communication within the warehouse and its environment. The final section of the study indicates the directions of changes in the scope of warehouse processes in terms of computerization and automation.

The position of a warehouse in the supply chain

A warehouse represents an important component of the supply chain. It is described as a functional and organizational unit designated for the storing of material goods (inventories) in the designated area of a storage structure; storing inventories, raw materials, semi-finished products and goods which are

temporarily not in demand (Bendkowski, Radziszewska, 2011). Material goods need to be stored using appropriate methods and kept in proper storage conditions depending on individual physical and chemical characteristics of specific goods.

In the supply chain, a warehouse constitutes the key link combining the purchasing activity with the production and the market (Ciesielski, 2009). Its function is taking temporary storage and the transfer of goods momentarily, not moving to further links of the trade. Irrespective of its location within the organizational structure of an enterprise, we may distinguish two main functions which a warehouse performs: the inventory protection function, which is static, and the manipulative function, referring to the time of entries and withdrawals of the goods, the waiting time in loading. The time it takes to perform these actions affects warehouse efficiency. This is because the manipulative functions are characterized by high dynamics.

Logistic processes aim to guarantee the highest possible level of customer service at the lowest possible costs (Grzybowska, 2010). That is where various types of modern stock management strategies directed at reducing company costs through the cutting of inventory levels, without decreasing the standards of customer service, come into play. However, fast-changing demand and costs, which companies are exposed to as a result of lack of stocks, make it impossible to eliminate the storage process (Ciesielski, Długosz, 2010). Thus, storage areas remain one of the major links in the logistic process for each business entity.

To meet the constantly changing requirements of the market, production, trade and service enterprises are forced to maintain stocks which will ensure an uninterrupted production process and the appropriate level of customer service. In this area, functions relating to warehouse management and proper stock management are of key importance (Fertsch, 2006). To this end,, the realization of activities performed in the logistic process: the organization of storage tasks, the warehouse staff management as well as supervision over storage tasks, becomes particularly important. The efficient functioning of a warehouse within the enterprise structure has a significant effect on the level of costs, the number of stocks held, the efficiency of material flow, as well as the level of organization of the enterprise.

The market for the modern warehouse storage area in Poland

Poland holds the third position in the list of European locations most frequently chosen to set up or to transfer to a warehouse. Only the Netherlands and the largest European market of Germany are ahead. of Poland. Further positions are taken by France, Russia, Spain and Italy, respectively. Every tenth metre square of storage space in Europe is rented in Poland (Olszewski, 2019).

The development of modern storage facilities is occurring in Poland at a faster pace than that seen in other Central and East European countries. The first facilities of this type started to appear as early as in the first half of the 90s. Then, developers and investors focused on Warsaw and its nearest regions. The situation changed in 2004-2005 when Poland's accession to the EU triggered a sudden growth of industrial investments. When the demand was growing, developers were more willing to start investments also outside Warsaw. After Lehman Brothers went bankrupt, the supply of new storage space slowed down. Then, developers limited their speculative investments and started to opt for the hedging of earlier rent agreements. As early as in 2010 there was again stable growth, and starting from 2014 we have been witnessing spectacular increases in the supply.

As at the end of March 2019, the total storage space in Poland amounted to 16.3 sqm. 2.14 sqm of storage space is still under construction as part of 72 projects (Marketbeat - Polski rynek magazynowy - I kw. 2019, a record high in developer activity recorded as at the end of the first quarter. We may distinguish four markets in terms of the scale of new investments. These are Upper Silesia (568,000 sqm, 13 projects), Central Poland (454,000 sqm, 10 projects), Wrocław (221,000 sqm, 8 projects) and Warsaw- the neighbourhood (197,000 sqm, 9 projects). It is also worth noting that there has been an increase in developer activity in Eastern Poland in the area of Lublin, Rzeszów and Kielce (in total 167,000 sqm, 4 projects)

The scope of development of infrastructure has had a decisive influence over the location of warehouses. The biggest concentration of large-sized storage facilities may be found at the intersections of A1 and A2, as well as the A1 and A4 motorways. Also, the areas with express roads are gaining in importance. As a result of the still-present regional diversification, prospective hirers operating in the storage space market in Poland have a wide range of options available to them (Raport - Rynek magazynowy w Polsce. Maj 2019).

An important advantage favouring the location of a storage facility is Poland's geographical situation. Our country is located in Central Europe, at the intersection of North-South and East-West trade trails. For the logistics industry, it constitutes an enormous advantage, especially for enterprises which have their distribution centres in Eastern and Central Europe. It is also significant that the Polish market is characterised by the high standard of their storage facilities coupled with their state-of-the-art equipment.

The key investors in the storage space in Poland are foreign investors. In the last three years, 70% of the capital invested in Poland has come from investors based in USA, the Republic of South Africa, Germany and Great Britain. The activity of the Polish capital remains marginal not only as compared to Western European economies but also to the neighbouring countries of Central and Eastern European.

Against the background of the Central and Eastern European countries, in terms of storage space, Poland offers one of the lowest rents in the region. Current base rents for the big-box space are still lower than in Czech (EUR 4.25 /sqm/month), Slovakia (EUR 3.90 /sqm/month), Hungary (EUR 4.50 /sqm/month) or Romania (EUR 4.0 /sqm/month). The difference in effective rents is also clear, and here Poland's competitive advantage becomes even stronger. It is also important that the cost of acquiring land is relatively low and the administrative procedures for obtaining permits necessary for this type of investments are faster (Raport - Rynek magazynowy w 2018 r. w Polsce).

The dynamic development of e-commerce remains the factor stimulating the growth of demand for modern storage space. It is estimated that in 2019 Poles will spend PLN 50 bn on internet shopping (Raport Interaktywnie.com: e-commerce 2019). This translates into an increase in the volume of logistic space needed for the servicing of both the domestic e-commerce market and foreign orders. The e-commerce industry has specific needs relating to space and the entire storage infrastructure. New challenges result from the necessity to quickly take orders and make goods available for sale, to efficiently complete goods; and from the fact that there are large fluctuations in the volume depending on the season, as well as holiday and sales periods. So as to meet these requirements, it is necessary to equip storage facilities with efficiently operating IT systems, also useful in warehouses servicing industries other than e-commerce.

The ERP system as the most common IT solution streamlining communication with the warehouse

It turns out that the most frequently used IT solutions including warehouse management are ERP (Enterprise Resource Planning) systems. They are applied in their basic version or in a version extended with a warehouse module. In 2014, when the Panel of Polish Logistics Managers together with Logisys published a report, 47% of those surveyed claimed to use an ERP system for the managing of their inventory levels (Raport Systemy informatyczne w polskich magazynach, 2014).

The ERP system is a collection of collaborating modules. They include such areas of operations as production planning, sales, accounting and controlling, human resources management and storage. Within the warehouse module, it is possible, among other things, to register entries and withdrawals, to prepare orders based on the analysis of production plans, to gather information on orders from customers and suppliers.

The main objective of ERP systems is the integration of all departments and functions within an enterprise. It supports the management of the entity in the scope of planning, production and distribution which directly affects the day-to-day operations of warehouses. The integration means using a shared database within one system. Owing to such an approach, the company uses only one set of data.

Data in the ERP systems are available in real-time immediately after they have been entered. This also means that all incorrect entries are instantly visible. As a result, users need to exercise caution while entering the data. It is of key importance that the system contains only correct data (Jakimowicz, Saniuk, Saniuk, 2015).

IT solutions applied within the ERP systems may perform the following functions:

- initiating functions - the processing of orders and preparation of documents,
- planning functions – the forecasting of dependent and independent demand,
- control functions – the comparing of results with the assumed customer service standards,

- coordinating functions – planning of sales, preparation of production schedules, planning of material requirements,
- integrating functions – combining the systems of an enterprise with external systems of customers, service providers (Majewski, 2006).

These integrated ERP information systems are by nature planning systems. Their comprehensive functionality refers to both the operating and strategic management levels. However, there are situations when it is necessary to reach for more advanced IT solutions.

WMS as a specialized tool for stock management

The specificity of storage processes means that, especially when it comes to larger business entities, there is also the need to apply an appropriate additional system apart from the ERP system. Then, the WMS (Warehouse Management System) becomes such a system. This comprehensive IT solution gathers detailed information on the place of storage, characteristics of the goods stored (such as best before dates, storage conditions, etc.) and also a number of other data necessary for the proper functioning of a warehouse (Matulewski, Konecka, Fajfer, Wojciechowski, 2007).

The Warehouse Management System (WMS) makes it possible to manage warehouses both in terms of inventory levels, the location of individual goods and in terms of the management and supervision over processes carried out within the warehouse and at the interface of production, entries, forwarding and other processes. The functional scope of the WMS is very broad. Its functionality includes:

- hierarchical division of the warehouse structure,
- spatial division of storage spaces,
- defining of logistic parameters for items,
- control of quality and quantity of goods delivered,
- automated identification,
- returns management,
- inventorying,
- management of returnable packaging,
- management of lots and best before dates,
- tracking of storage lots and drivers,
- work in a wireless data exchange mode (Kanicki, 2011).

The application of the WMS speeds up order processing, reduces losses related to past "best before" date product, streamlines the flow of materials, minimizes inventories levels and increases the precision of deliveries. The main advantages of a warehouse IT system include compatibility with external systems, increasing of the quality of deliveries and customer service levels, the tracking of storage drivers and dates, ordering of processes and resources, the reduction of logistic costs, the streamlining of distribution processes, and control over the logistic chain. Flexibility also allows it to be used in any type of a warehouse, increasing work efficiency. An additional benefit is also the option allowing for preparation and analysis of reports for individual customers, carrying out of complex settlements of logistic services, compatibility with warehouse automation devices and mobile devices, and data exchange with external systems.

The WMS is a kind of visualization of warehouse operations. It provides real-time information on the state of key hardware components, at the same time notifying the staff if any irregularities occur. The system gathers information referring to types, quantities and division of storage spaces, data concerning items, their best before dates, batches, indicating the manner of storage. It is a specialized tool supporting all operations carried out in a warehouse and relating to the physical process of placing goods in a warehouse. It allows the business to manage any number of warehouses, enabling a division into storage areas and spaces.

The key players in the present global WMS market are SAP, Oracle, Manhattan Associates, HighJump, Synergy, Tecsys, Reply, Epicor Software Corporation, PSI Logistics, IBM and PTC. Warehouse systems are most frequently used in the distribution industry (i.e. where the massive movement of goods occurs). Another market segment intensely investing in the WMS are large production companies supplying their goods from their warehouses.

While implementing the system, you need to consider high costs and a long deployment time. The number of individual modifications is also limited.

Directions of change in the scope of computerization and automation of warehouse processes in the future

The constantly changing needs of customers and enterprises create new challenges that IT systems handling warehouse operations need to face. The

e-commerce industry is becoming an arena of exceptional challenges. Customers in this sector expect faster and faster deliveries and larger and larger numbers of products. A modern facility that lessees selling on-line will use should also be automated. Only then, is it possible to cope with numerous industry-specific challenges regarding among other things human resources, fluctuations of sales volumes and time pressure (Berlowski, 2019).

So as to shorten the completion time and to avoid errors, more and more often businesses implement pick-by-voice, pick-by-light, pick-by-vision solutions, or combined options, which allow an employee to faster pick a product from a shelving unit and to confirm the operation with a voice command. The pick-by-vision systems consist in the completion of orders by a person moving around on a warehouse trolley or pulling a completion trolley and equipped with special goggles with an extension visualizing the next step in the process. Then, the next warehouse locations and the number of items to be collected will appear on the display. The process becomes intuitive, and the number of errors is reduced because the goggles display shows the exact location and the assigned volume (Raport Magazyn idealny dla e-commerce).

Although bar codes remain the most standard solutions used for tracking goods in warehouses, RFID (Radio Frequency Identification) is constantly gaining in importance. RFID technology is one of the methods used in a warehouse. Solutions based on RFID chips used for the identification of goods in correlation with readers receiving signals from RFID chips limit the risk of error occurrence. Gates or conveyor belts in warehouses are equipped with such readers so that every item that passes through them is correctly identified. Such solutions combined with the warehouse system allow for the automation of storage transactions recorded in the software. They allow an organization to carry out many system transactions without human interference, e.g. the automated issuance of documents, movements in stocks, purchase entries.

The need for meeting customers' expectations resulting from the growth in e-commerce industry speeds up the development of the market for WMS software. According to the Grand View Research report, the global market for these systems will show an average annual growth of 16.3% until 2025 measured using CAGR (Compound Annual Growth Rate). The value of the market for these systems as at the end of the projection period will amount to USD 5.25 bn (Report Grand View Research), of which more than half of the revenue (55%) will be generated by cloud-based WMSs.

Compared to traditional local systems, cloud-based WMSs offer more functions, and most importantly, the initial implementation costs are low (what is crucial especially for smaller enterprises). A cloud-based WMS is a good solution for businesses characterized by simple warehouse processes, unautomated manual operations, and a lower numbers of operations. Larger organizations with complex automation should rather consider hybrid solutions combining a stationary component with a component placed in the cloud (Meissner, 2019).

The arguments for the implementation of cloud-based solutions include a fast implementation process and lower maintenance costs. A client does not need to have his own IT infrastructure or a team responsible for its maintenance. Also, cloud-based solutions enable a quick increase in hardware efficiency for the system when there is a peak sale period. Before making a final decision on the version of the WMS, we should consider issues relating to data security and their real-time availability.

Additionally, robotics enters warehouses on a larger and larger scale. Producers collaborate with the suppliers of systems for warehouse management, developing customized software and intelligent robots, which help manage the movement, storage and sorting of warehouse resources. The Internet-of-Things (IoT) is another new trend in warehouse operations. Detectors and data transfer technology may be built-in warehouse components such as conveyors and forklifts which allow organizations to track, coordinate and control both physical facilities in the warehouse and the entire supply chain.

Owing to the development of technology and the concept of IoT, the process automation enables handling larger numbers of warehouse transactions without increasing the number of employees. Autonomous shelving units may, on their own, put aside and release specific goods based on received orders. The number of autonomous robots is also on the increase. In 2016 Amazon had 4,500 robots, in 2017 the number increased to 45,000, whereas in May 2019 it was more than 100,000. As the management of the company claims, full automation of storage and completion processes will be possible not earlier than in 10-12 years.

Conclusions

Up to now, an investment in storage space was affected by such factors as location, road infrastructure, the availability of international links, and personnel issues. Taking into account the present conditions, the availability of labour has become a key factor. Low unemployment levels and the aging of society have forced investments, especially those from the e-commerce and light production sectors, to move in search of locations offering available staff. An important direction for the development of storage space in the coming years is the further computerization and automation of warehouse processes. Also, the application of IT systems in buildings supports both owners and lessees, combining the work of machines and humans using applications, detectors and wireless communication networks.

While choosing IT systems for the management of warehouse processes, a dilemma arises. Businesses are wondering whether to purchase a separate WMS or an advanced warehouse module for the ERP system. The experience demonstrates that both solutions are in use and here the market is equally divided.

In Poland businesses owning storage space of not more than 5,000 sqm tend to use the ERP module. Companies with larger needs manage their warehouses with the use of WMSs as they are believed to be more flexible and better suited for warehouses than the ERP systems. Owing to automation, robotics, artificial intelligence and other advanced technologies, a modern WMS is a software considered capable of handling the majority of distribution operations. It makes inventories visible and it integrates with transport management systems; and with other solutions to streamline the movement of goods from a producer to a warehouse, and then to the retailer and finally to the end-customer.