



THE IMPACT OF E-COMMERCE ON WAREHOUSE OPERATIONS

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ABSTRACT. Background: We often encounter opinions concerning the unusual nature of warehouses used for the purposes of e-commerce, most often spread by providers of modern technological equipment and designers of such solutions. Of course, in the case of newly built facilities, it is advisable to consider innovative technologies, especially in terms of order picking. However, in many cases, the differences between "standard" warehouses, serving, for example, the vehicle spare parts market, and warehouses that are ready to handle retail orders placed electronically (defined as e-commerce) are negligible. The scale of the differences between the existing "standard" warehouses and those adapted to handle e-commerce is dependent on the industry and supported of customers' structure.

Methods: On the basis of experiences and on examples of enterprises two cases of the impact of a hypothetical e-commerce implementation for the warehouse organization and technology have been analysed.

Results: The introduction of e-commerce into warehouses entails respective changes to previously handled orders. Warehouses serving the retail market are in principle prepared to process electronic orders. In this case, the introduction of (direct) electronic sales is justified and feasible with relatively little effort.

Conclusions: It cannot be said with certainty that the introduction of e-commerce in the warehouse is a revolution for its employees and managers. It depends on the markets in which the company operates, and on customers served by the warehouse prior to the introduction of e-commerce.

Key words: e-commerce, e-trade, electronic trade, warehouse, store.

We often encounter opinions concerning the unusual nature of warehouses used for the purposes of e-commerce [Graves 2012], most often spread by providers of modern technological equipment and designers of such solutions. Of course, in the case of newly built facilities, it is advisable to consider innovative technologies, especially in terms of order picking. However, in many cases, the differences between "standard" warehouses, serving, for example, the vehicle spare parts market, and warehouses that are ready to handle retail orders placed electronically (defined as e-commerce) are negligible. The scale of the differences between the existing "standard" warehouses and those adapted to handle e-commerce is dependent on the industry and supported of customers' structure.

DEFINITION OF E-COMMERCE

First, you must determine what e-commerce is. E-commerce, electronic or online trade is defined in different ways - "Although the concept of e-commerce has functioned for many years, its single general and widely recognised definition has not been formulated," [Szymanski 2013]. Literature definitions cited in the publication are summarised in a concise definition reflecting the specific nature of the term: "handling, use and generation of commercial activities based on Internet technologies" [Szymanski 2013]. It is true that this definition excludes the use of other media for the exchange of

correspondence - a bit outdated fax or ordering via electronic mail are no longer treated as a tool for e-commerce - however, no importance is attached to dedicated ordering tools. The World Trade Organization [2013] defines e-commerce in a more comprehensive way: the sale or purchase of goods or services, carried out via a computer network using tools specially designed to place and receive orders [WTO 2013]. Payments do not have to be made electronically. Only the communication channels are the Internet, extranet and

electronic information exchange (EDI). Thus, according to this definition, e-commerce differs from traditional mail-ordering only by the method of placing orders - mail-order catalogues, which used to be commonly used for decades, have been replaced by another medium. The global availability of the Internet, regulations favourable to buyers and dissemination of courier parcel service have determined the extremely wide availability of electronic "mail-order catalogues."

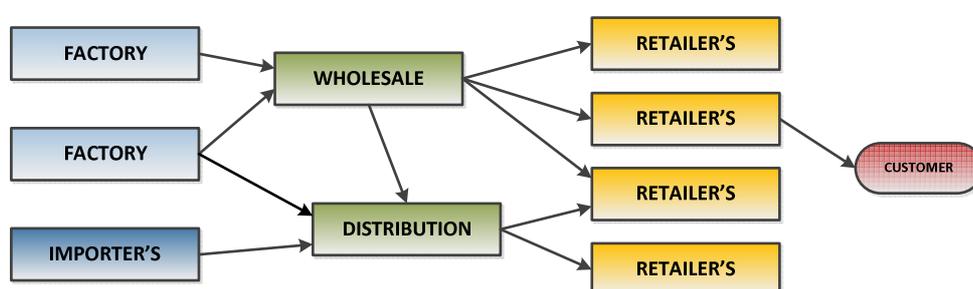


Fig. 1. Basic warehouses and their relationships in the distribution network of commercial products/goods
Rys. 1. Podstawowe magazyny i ich relacje w sieci dystrybucji wyrobów / towarów handlowych

THE IMPACT OF ELECTRONIC COMMERCE ON WAREHOUSE OPERATIONS

From the point of view of warehousing, e-commerce is not a homogeneous concept. Cooperation with existing customers in the B2B market on unchanged terms and conditions, only through the use of electronic forms of communication, in principle, does not change much. In fact, placing an order is less labour intensive, and the order arrives immediately to the supplier. This may reduce the size of orders and increase the frequency of their placement. However, it is the tendency not connected with electronic commerce that had also occurred before its emergence. It can be assumed that in principle in B2B relations, which are governed by the economic size of the order or limited by the economics of the cost of single shipment/transport, electronic media have not revolutionised warehousing.

There is no denying, however, that e-commerce is a tool (or perhaps an excuse) to take stock "higher" in the supply chain - this leads to a reduction in stock, bringing it "closer" to the end customer at the expense of stock held by the manufacturer or importer, while keeping the level of customer service (at least) unchanged. From the retailer's point of view, there are concepts assuming elimination of the warehouse, which is mistakenly interpreted as a (physically impossible) elimination of warehousing from the supply chain. Accumulation of stock in the higher levels of the supply chain can lead to their correct management and ultimately reduce the required total storage capacity throughout the supply chain.

If you try to skip one (or more) levels of distribution, the issue of e-commerce becomes more complicated, and a revolution occurs most often in B2C relations (Figure 2) - the so-called e-tailing ("electronic retailing"), as opposed to e-merchandising [Glinkowska,

2011]. Electronisation of retail trade leads to an increase in the quantity and fragmentation of orders handled by warehouses, and the need to deal with returns that the buyer is entitled to make in the case of distance sales. Returns

mean plenty of additional work for the warehouse staff. This applies particularly to the clothing industry, where the purchase of goods in the wrong size ends without consequences for the customer.

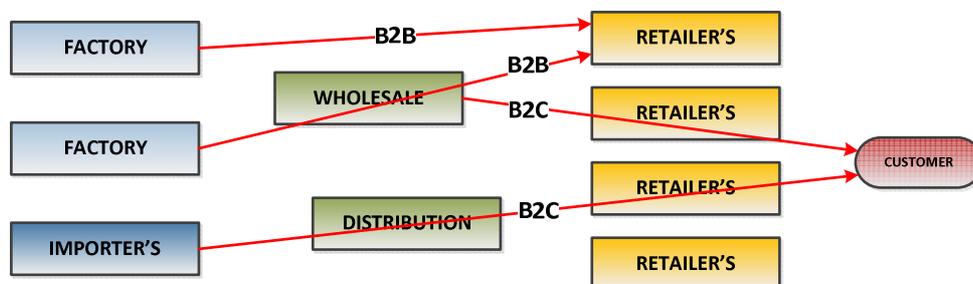


Fig. 2. Example directions for skipping warehouses in the commercial goods/products distribution network
 Rys. 2. Przykładowe kierunki pominięcia magazynów w sieci dystrybucji towarów handlowych / wyrobów

Another characteristic feature of the e-commerce market is also the significant irregularity of sales - seasonality [Graves 2012], particularly at the end of the year. This is illustrated by the data made public by amazon.com and presenting the sales of one of the largest online stores - see Figure 3. Significant differences between Q3 and Q1 of the following year compared to Q4 (Christmas) are a challenge for each warehouse, even the one that correctly forecasts its goods flows. In the case of poor forecasting, both performance of infrastructure and out-of-stocks may quickly spoil the store's opinion in the electronic market and lead to a collapse in sales - in the era of the Internet not only shopping but also negative feedback is extremely quick. "In terms of e-commerce, unpredictability is a constant factor" [Graves 2012]. Even correct forecasting with such a high proportion between seasonal and out-of-season sales requires the use of dedicated solutions - it is necessary to adjust technology and organisation to sale in the peak season, as out of season there is usually job reduction and technological equipment works at partial capacity.

Another requirement of customers is full transparency [Graves 2012] - information about availability of goods in the warehouse [Fechner 2010], and upon placing an order - information on its status at each stage of

processing must be available to the customer. It basically does not affect the operation of the warehouse, but requires the use of management information systems, transmission of online information about ongoing orders at each stage of processing.

In the case of the clothing industry, differences between e-commerce and sales via the (once) popular mail-order catalogues, are small from the point of view of organisation of the warehouse. It can therefore be concluded that there are sectors in which well-developed mail ordering somewhat prepared warehousing technologies for e-commerce. What has probably changed are expectations concerning order processing time in the warehouse (and the whole logistic chain). But not in all industries were (are) warehouses adapted to electronic commerce.

How, then, fragmentation of orders and a significant increase in the number of minor complaints influence the warehouse? The answer is in this case a "standard" one: it depends. Seemingly e-commerce does not bring anything new to warehouse management, as the total trading volume remains at the same level (of course, not taking into account seasonality and sales growth). What is important is that customers have access to goods/products directly at the distribution level, which depends on the decision of

the participants of the supply chain. The results of this access are: increased volumes and fragmentation of orders. Translating this into warehouse terminology, there is a need to

handle more documents with fewer lines in each of them. Also, the number of units of measure in the lines is less - the lines are "thinner".



Source: <http://www.statista.com/chart/1299/amazons-revenue-and-profit-growth/>

Fig. 3. Irregularity of revenues at amazon.com stores

Rys. 3. Nierównomierność przychodów sklepów amazon.com

EXAMPLES OF POTENTIAL IMPLEMENTATION OF E-COMMERCE IN WAREHOUSES

Differences compared to traditional methods of ordering are the greater, the "higher" an enterprise is located in the supply chain. In fact, the biggest change in the case of the introduction of e-commerce concern factory warehouses, and the smallest - retailers' warehouses. Hence the answer to the question of how electronic ordering will affect the warehousing operations depends (among other things) on the structure of existing customers. It is advisable to consider two extreme cases, for instance, a "mega" automotive wholesaler and a factory warehouse of a book publisher.

Characteristic features of the automotive market are significant amounts of returns and quick processing of orders. Small garages basically do not store spare parts. Cars left by customers in the morning are diagnosed, then

spare / ware parts and consumables are ordered. The ordered goods are delivered to garages within several hours or they are collected by their representatives. The idea behind such a system is to complete the repair/inspection, if possible, within one day, in order to minimise unproductive vehicle stoppage. It is worth noting that due to the considerable differentiation of spare / ware parts and consumables, mechanics often make mistakes that can be verified only during the installation of parts. Hence, many automotive wholesalers offer free return of unused parts, which in turn is used by their customers - they can buy without consequences several versions of a spare part and return those that are not appropriate. Currently, the level of retail returns in the automotive parts market reaches several percent.

In the automotive parts distribution system, central and wholesale warehouses usually function as retail stores in the region in which they are located, disregarding the economic justification and efficiency of this type of solution. So the distribution network includes

warehouses, where customers are wholesalers, retailers and garages, which generate a full range of order sizes.

Storage technologies and organisation of work in such warehouses are designed to handle orders of any size - if there are framework pallet racks, they are used primarily to store stocks. The picking operation is performed mostly from shelf slots. There are often (partially) automated solutions (for example, pick-by-light, automatic transport or sorting of picked goods), supporting employees in the performance of their tasks. Warehouse processes are carried out with the use of automatic identification, based on barcodes and terminals connected online to the warehouse management system, which is fully justified by the scale and structure of orders. This is done because there are dozens or even hundreds of issue documents a day. And each document usually covers from a few cartons (wholesale customers) to one piece (small garages).

For this type of warehouse, opening an online store does not involve a revolution. In the case of an increase in electronic sales, emphasis will be placed on orders whose size and frequency corresponds to those previously placed by garages. The storage technology (especially order picking) is suitable for this purpose or can be adapted with a relatively small degree of technological or organisational changes, allowing to appropriately adjust its performance. The warehouse is prepared to handle a significant amount of returns, their larger scale is associated only with increased effort in the use of the existing technology, as in the case of order picking. Thus a central or even regional warehouse distributing spare parts in the automotive market is basically technologically prepared to handle electronic commerce. With organisational changes, like the introduction of parallel picking of several small orders or limiting one line issues control (low error rate), it is possible handle increased flow, provided that performance is not exceeded.

A somewhat similar example is the pharmaceutical distribution market, where a pharmacy receives small-size deliveries even several times a day. However, there scale of

returns is not as big as in the case of garages. Thus, in this market barriers to possible introduction of retail electronic commerce (currently limited by law regulations) are relatively easy to cross.

The second example, a book publisher, is a completely different situation. Assuming that the publisher distributed finished products through two levels of intermediaries between it and the retail customer (through wholesale warehouses and retail stores), books were sold at least in bulk packaging, and a large portion of issues included mainly uniform loading units. The storage technology is adapted to this type of operations - only pallet racks are available in the warehouse. The picking operation is performed from the lowest pallet rack level, directly from the pallet. There are several issue documents per day, and each of them usually includes several pallet units. The picking operation is performed using paper documents. Barcodes are not used. If the warehouse management system has been implemented, it is usually limited in terms of functionality.

The decision to omit intermediaries and introduce sales via electronic channels directly to retail customers is in this case associated with a revolution. Firstly, in terms of the number of orders from customers, as their number will grow by several hundred percent. Secondly, in terms of employment, as the first step without technological changes, the storage process can be executed correctly only by increasing workload. Thirdly, in terms of the storage technology, as handling a few hundred orders per day using the described technology is reckless in the long-term. Fourthly, a revolution in terms of returns, which so far have generally been non-existent in the warehouse or existed in the "wholesale scale". Of course, changes aimed at adapting the technology to customer requirements can also be made in an evolutionary manner (which is preferred), through a gradual or only partial withdrawal from the current method of distribution. A revolutionary change can considerably interfere with the operation of the warehouse.

SUMMARY

Hence, the introduction of e-commerce into warehouses entails respective changes to previously handled orders. Warehouses serving the retail market (for example, warehouses functioning as supporting facilities for sales through mail-order catalogues, automotive wholesalers, pharmaceutical wholesalers) are in principle prepared to process electronic orders. In this case, the introduction of (direct) electronic sales is justified and feasible with relatively little effort.

Another thing is justification for the use of electronic commerce addressed to end retail customers by manufacturers or importers – a factory warehouse is usually not adapted to process orders (and returns) from retailers, and in this case the introduction of direct retail sales will require substantial outlays (and in the first stage - much effort). One of the requirements for an online store is a wide range of product items [Graves 2012], which the manufacturer/importer - in addition to its own finished products or commercial goods - cannot deliver. Hence the application of B2C solutions in the case of manufacturers or importers is also limited. A computer user usually requires access to more than one product to minimise the cost of delivery.

Therefore, you cannot say with certainty that the introduction of e-commerce in the warehouse is a revolution for its employees and managers. It depends on the markets in which the company operates, and on customers served by the warehouse prior to the introduction of e-commerce.

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WPŁYW E-COMMERCE NA FUNKCJONOWANIE MAGAZYNU

STRESZCZENIE. Wstęp: Często spotykane są opinie, dotyczące nietypowości magazynów przeznaczonych do obsługi handlu elektronicznego, najczęściej rozpowszechniane przez dostawców nowoczesnego wyposażenia technologicznego czy projektantów takich rozwiązań. Oczywiście w przypadku nowopowstających obiektów wskazane jest rozważenie innowacyjnych technologii, zwłaszcza w zakresie kompletacji. Jednak w wielu przypadkach różnice pomiędzy "standardowymi" magazynami, obsługującymi przykładowo rynek samochodowych części zamiennych, a magazynami, które są przygotowane do obsługi detalicznych zamówień składanych elektronicznie są pomijalne. Skala różnic pomiędzy istniejącymi "standardowymi" magazynami a magazynami przystosowanymi do obsługi e-commerce jest zależna od branży i obsługiwanego przekroju klientów.

Metody: Na podstawie doświadczeń oraz przykładowych przedsiębiorstw przeanalizowane zostały dwa przypadki wpływu hipotetycznego wdrożenia e-commerce na organizację i technologię magazynową.

Wyniki: Wprowadzenie e-commerce do magazynu będzie skutkowało zmianami odpowiednimi do poprzednio obsługiwanych zleceń. Uogólniając magazyny obsługujące rynek detaliczny są w zasadzie przygotowane do obsługi zamówień elektronicznych przeciwieństwie do magazynów przyprodukcyjnych. Wprowadzenie w tym przypadku bezpośredniej sprzedaży detalicznej będzie wiązało się ze znacznym nakładem środków.

Wnioski: Nie można jednoznacznie określić, że wprowadzenie e-commerce w magazynie to rewolucja dla jego pracowników i kierownictwa. Jest to zależne od rynków, na których operuje przedsiębiorstwo, oraz od klientów, których przed wprowadzeniem e-commerce magazyn obsługiwał.

Słowa kluczowe: e-commerce, e-handel, handel elektroniczny, magazyn

DER EINFLUSS VON E-COMMERCE AUF DAS FUNKTIONIEREN DES LAGERS

ZUSAMMENFASSUNG. Einleitung: Häufig sind Meinungen über die Ungewöhnlichkeit der Lager anzutreffen, die zur Handhabung des elektronischen Handels vorgesehen sind [Graves 2012], meistens werden sie von Lieferanten moderner technologischer Ausrüstungen oder von Entwicklern solcher Lösungen verbreitet. Natürlich ist es im Falle von neu zu errichtenden Objekten richtig, über innovative Technologien, insbesondere im Bereich der Komplettierung nachzudenken. In vielen Fällen können aber die Unterschiede zwischen den "Standardlagern", die Dienstleistungen z.B. für den Markt für Autoersatzteile erbringen, und den Lagern, die auf die Bearbeitung von Bestellungen im Einzelhandel, die elektronisch aufgegeben werden, ausgerichtet sind, außer Acht gelassen werden. Die Skala der Unterschiede zwischen den existierenden "Standardlagern" und den Lagern, die an die Handhabung des E-Commerce angepasst sind, hängt von der Branche und von der Art der zu betreuenden Kunden ab.

Methoden: Anhand von Erfahrungen und Beispielsunternehmen wurden zwei Fälle des Einflusses einer hypothetischen Einführung des E-Commerce auf die Lagerorganisation und -technologie analysiert.

Ergebnisse: Die Umsetzung des E-Commerce in einem Lager hat Änderungen zur Folge, die den Bestellungen entsprechen, die vorher bearbeitet wurden. Um es allgemein zu fassen, sind die Lager, die Dienstleistungen für den Einzelhandel-Markt erbringen, im Gegensatz zu den im Produktionsbereich tätigen Lagern, grundsätzlich auf die Bearbeitung von elektronischen Bestellungen vorbereitet. Die Einführung von direktem Einzelhandelsverkauf ist in diesem Fall mit einem erheblichen Mittelaufwand verbunden.

Fazit: Es lässt sich nicht eindeutig feststellen, ob die Einführung des E-Commerce in einem Lager eine Revolution für dessen Mitarbeiter und Führungskräfte bedeutet. Es hängt von den Märkten, auf denen das Unternehmen tätig ist, und von den Kunden, die das Lager vor der Einführung des E-Commerce betreut hat, ab.

Codewörter: E-Commerce, elektronischer Handel, Online-Handel, Lager

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