

## MODERN INFORMATION TECHNOLOGIES IN THE LOGISTICS OF E-BUSINESS

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**Abstract:** Nowadays almost every action is accompanied by a constant haste. The goods, the information and the financial resources flow must be faster than ever before. A company success in distribution channels in current market is conditioned by a logistics and a quality of a provided services. All those actions are enabled with bearing the possible lowest own costs. Such functioning of the enterprise can be improved and become more effective by the development of IT system in logistics of the e-commerce, which is enabling unified way for the communication and the collaboration both inside and outside the enterprise. The scientific target of the article is to present to readers the meaning, the features, the possibilities and the changes in the supply chain of modern systems in e-logistics of distribution, by using an up-to-date IT. While writing this article, authors based on the available literature of the subject and on their own reflections and experiences. To the analysis were given the components such as description, functions and properties, application and evaluation.

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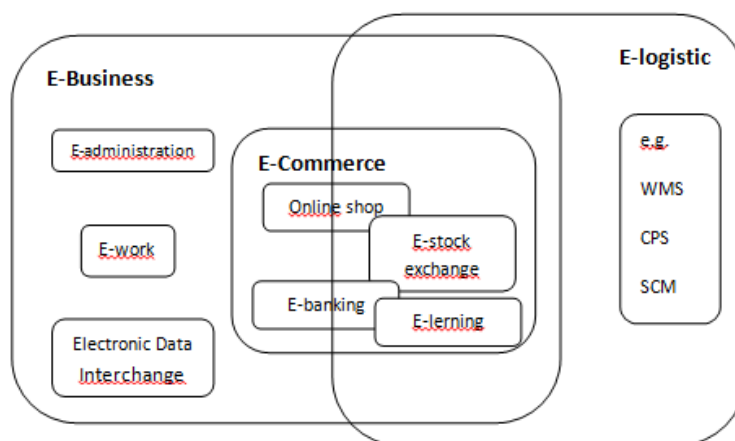
**Keywords:** Information technology, e-logistics of distribution, FMCG market, CEP market, clothing market, the Web

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## 1. INTRODUCTION

In the many areas modern economy is basing on the new technologies, which are evolving dynamically. The biggest development, and following it the biggest changes are noticed in a range of IT – starting from a software, a computing power and a hardware and ending with a development of a wireless Internet network. Devices miniaturization and their comprehensive usage thanks to mobility and access to the Internet contribute to develop e commerce (electronic trade). To develop, this new sales channel, had to evolve in area of distribution logistic. New opportunities in making orders to buy products and services, which customer got, lead to the creation of innovate solutions at a presentation of assortment, their sale and logistic, which links all actions in one cohesive unity.

E-commerce should be treated as a business venture, which is focused on the electronic transactions where Internet is a place for exchange of the information, the products and the services, including the company's relationship with its market environment (Brzozowska-Woś, 2014, p. 8). According to Wiczerzycki e commerce is a primal concept for e-business and that means the customers' access via Internet network to resources, which conduct to increasing of demand for the goods and the services (Wiczerzycki, 2012, pp. 43–47). The relationships between e-business, e-commerce and e-logistics by Wiczerzycki is presented by drawing number one.



**Fig. 1.** Diagram of relationships between e-business, e-commerce and e-logistic

Nowadays logistics, as resource of an interdisciplinary knowledge, very willingly use every innovation, which increase the profitability and the productivity of conducted operations and reduces costs. Distribution processes, which are components of the logistic, belong to area where using the newest achievements in modern technologies is the most noticeable. Thanks to that the distribution is more effective, makes less mistakes. Effectiveness of conducted actions and reducing own costs is much more improved. Innovations are used at the both sides – at the client side, where customer is using directly and actively those new possibilities for example through shopping on-line or virtual stores on the underground stations and at another side of logistic supply chain – side of vendors, which use a lot of new technologies and techniques in a places, where client doesn't have any access, but they impact on many other things such as an order completeness or a delivery time.

Experts estimate the global e-commerce market value on around 1.8 trillion USD and it is still increasing (Podjaki, 2016), therefore the techniques used in a range of logistics e commerce services will evolve into faster and more reliable methods.

The scientific target of the article is to present the meaning of occurring changes in the supply chain of modern systems in e-logistics of distribution by using an up-to-date IT. While writing this article, authors based on the available literature of the subject and on their own reflections and experiences. To the analysis were given the components such as description, functions and properties, application and evaluation.

## **2. E-LOGISTICS OF FAST-MOVING CONSUMER GOODS (FMCG) DISTRIBUTION**

One of the most innovate branches is the fast-moving consumers goods (FMCG). To be able to compete on this market the knowledge about customer preferences, the expectations and how people make shopping online is needed. Those information contain a number of variables and involves necessity of processing the large amounts of data. The data analysis process known as Big Data or Smart Data enables personalization of trade, basing on the customer feedback. The Big Data analysis not only allows to personalize offer for the customer, but also offers the most attractive forms of delivery or pick-up the ordered items. In addition this technology is able to analyze efficiency of system at every stage. Thanks to the feedback, which company received, this technology also enables to adapt the purchasing platform, the mobile application or the user interface to the customer expectations of the defined customer group.

Mostly the FMCG products are a first need, providing daily necessities as a food or the household chemicals products. Their character require a special approach. Without a continual monitoring of the FMCG market and all individual

products there is no ability to quick react and to work on a solution optimality. Good to notice is that nowadays the final consumers have a progressively wider knowledge about the products and its markets, which they are interested in. Changes at the customers behavior fluent on the steady improvement of the FMCG industry, on looking for the new distribution channels and on adapting the sales form to the customers' expectations. One of the most interesting technologies in e-logistics in FMCG market is using the Internet of Things (IoT). IoT can be defined as a system, where daily products can communicate between themselves and exchange the data by the various transmission technologies (for example: Internet, electric network, Bluetooth, GSM network, ZigBee, Z-Wave) with or without the human participation. This technology in conjunction with Big Data, for example, give opportunity to send information from smart-fridge to customer smartphone, which products he/she should buy or fridge can make an order by itself, after confirmation the date and the place to pick-up products by owner. IoT create many new possibilities to integrate the distribution channels with the purchasing platforms or with the logistic/warehouse systems.

According to "Building the business case for a unified commerce platform" research 53% of the sale managers respondents said, they understood there is a necessity to integrate all distribution channels and they DECLARED that they are going to implement the universal trade platform in coming years. In long-term perspective 86% of the answerers also declared that need (Podjacki, 2016).

### **3. INFORMATION SYSTEM IN THE WAREHOUSE ECONOMY – WMS**

As mentioned before an innovation is not only making a more modern buyer platform, but it has a large application in places, where the orders are being packed. The most common in logistics Warehouse Management Systems support the storage-logistics operations for example via easy finding each localization for every product on stock, by quick providing information about the availability on stock or making and reading the necessary products labels to signpost batch of goods (Książkiewicz, 2004, pp. 162–166). Norwegian chain stores Rema 1000, which supervise 582 shops (data: 2017), decided to upgrade its WMS. By cooperation with Consafe Logistics (one of the leaders in IT for logistics industry) Rema 1000 has implemented into WMS system more modern technologies, which were giving a new opportunity – since then warehouseman could complete the orders by 'pick by voice' (Figlerek, 2013, pp. 66–67). Next innovation were the introduced satellite forklifts, they were also managed by WMS system. Previous barcode scanners were changed for a voice communication – WMS system search the products localization from the automatic database and provides it to the user. System is telling places only for goods from the packing list. This solution is similar to the GPS

navigation, but it is limited to the warehouse area. Implementation of “pick by voice” system resulted in 15% increase of the efficiency and the significant improve of orders realization with accuracy close to 100%. As a result pick up mistakes were eliminated, what led to the company’s financial savings increase. Transport Rusing the satellite forklifts, integrated with WMS system contributed to such high effectiveness and efficiency. Satellite forklifts are a transport devices which are moving in the special satellite shelves, forming a half automatic or a fully automatic warehouse system, that is used for the goods pallet storing (Krzywonos & Nieoczym, 2015, pp. 2627–2633). Satellite forklifts system is responsible for 30% of goods release which, in connection with above-mentioned improvements, raised the efficiency of pallet release per working hour (Figlarek, 2013, pp. 66–67).

#### **4. ELECTRONIC TRADE – E-COMMERCE**

Development of Internet network and mobile devices made dynamic improvement of another sales way known as e-shop possible. Opportunity of the e-commerce was very quickly appreciated by the B2C sector (business-to-client), specially the retail sellers, who could decrease their costs by eliminating a traditional shop from their sales ways. Mainly e shop is a website, that presents the product range and contains the product specification, the price and the delivery terms. Similar to a traditional shop, client adds the ordered product to the virtual shopping basket, which can be checked before a payment form choosing or a possible order change. The evolution of market of multifunctional mobile devices such as the smartphones or the tablets caused dynamic boost and progress in e-shops dedicated for those devices. E-commerce is the most evolving market in Europe and North America. According to the researches led by RetailMeNot the value of on-line retail sale (excluding prepared food, restaurants, cars and fuels) for Great Britain, Germany, Netherlands, Sweden, Italy, Poland and Spain stood in 2015 year at 185.39 bln Euro (Retailresearch.org, 2016).

Taking into consideration that according to the researches led by We Are Social, Europe at the end of year 2015 numbered 838 mln residents, from that 616 mln were active Internet users including 305 mln that access the Internet by the mobile devices (Kemp, 2016, p. 16). It can be concluded that the Internet has become an another very important distribution channel. The particular industry leaders as well as the smaller sellers reacted to those trends very quick. Previous websites dedicated to stationary hardware, were adapted to be used on a mobile devices.

The responsive Internet website detects the kind of machine they are running on and automatically adapt to the device including a resolution or a screen size. The mobile websites are dedicated only for the mobile devices, they have separate ad-

dress for example starting by “m”. Difference in address WWW notation is shown below.



**Fig. 2.** Responsive WWW site vs. Mobile WWW site (foto E-Lign, LLC)

<http://www.domena.org>

<http://m.domena.org>

**Fig. 3.** Address of responsive website and mobile website

Additional facilitation for the customers is an ability to point out by mobile devices the nearest shop or any interesting services. Running of those opportunities at the website WWW is possible due to using the GPS network (this solution is not in use nowadays) or the transmitters and the Internet antennas network. By this expanded network the mobile devices can be localized with accuracy up to few meters.

The continually increasing possibilities of a mobile devices usage in on-line trade brought attention of either tradesman or programmer. In order to provide the maximum amount of information about chosen product to customer more and more often the sales managers are using the two-dimensional barcodes, named QR (Quick Response Code). Advantage of QR code over barcodes is an ability to save much more amount of data – in alphanumeric system it is 4296 signs. Despite that QR codes are well know for many years, in Europe they have not be used commonly so far (Żur, 2011, pp. 32–35). Nowadays they are implicated in the Western Europe virtual shops. Two-dimensional codes were developed by the Japanese company Denso-Wave in year 1994. Since year 1997 QR code are included into

USS (Uniform Symbol Specifications), and since year 2000 are also included into ISO standard as ISO/ICE18004.

Retail on-line trading has brought the application for QR codes in a connection with the mobile devices. First virtual shops, that were using two-dimensional codes was belonging to Tesco Group – the South Korean Home Plus chain. The role of shelves were taken by the posters in a showcases on the walls of Seoul subway. This solution has brought to Home Plus chain increase of sales of 130% in a retail channel (Žur, 2011, pp. 32–35; Creevy, 2011). The functioning rules of the shop is very simple and rely on downloading the proper program, that allow clients to buy particular products by scanning adequate QR code. After choosing goods, user choose the payment form and the delivery terms. Purchases can be picked up from one of the indicated places or be delivered to home. Shopping done before 1 pm has been delivered the same day, and that done later has been delivered the next day (Gębarowski, 2012, pp. 191–197). In Poland the first virtual shop has been created in Poznan in year 2012. Project has been fulfilled by the Logistics and Warehousing Institute, the Piotr i Paweł trade chain, Transferuj.pl and the AMS S.A. (Dyba, Marciniak, Rutecka & Skrobosz, 2012).



**Fig. 4.** Virtual shop based on QR codes (foto. retail-week.com)

Step in of the FMCG branch into the Internet age, has pulled also other branches that due to their specify attributes needed to create the selling and distribution systems that gives 100% satisfaction to the customer. Between others such challenge has been taken by the textile industry that previously was associated rather with the boutiques, the retail chains or the fashion shops than with the Internet. European leader of the electronic clothing trade Zalando, based its Internet business (except the website and the mobile platform) on a free deliveries and re-

turns of ordered goods, where for return client has even 100 days. Moreover Zalando basing on the researches is improving its mobile platform very rapidly. According to the company's data in year 2013 35% of opens of the selling platform was made using the mobile devices. In year 2014 this value increased to 48% and on the end of year 2015 reached 57%. Investments in the modern technologies aims to make the decisions of buying goods and services easier for the client. The advanced function "My Zalando" include client previous preferences and recommend the products that might be interesting for him or that suit to previous purchases. The "Photo Search" function allow to make a picture of a particular product to what, other suiting, available products will be added automatically. The newest mobile service is barcodes scanning of a chosen good in a traditional shop and checking if Zalando has it in its range. What is more Zalando noticed that the clients using the mobile platform are purchasing more, compared to the traditional website users (Gacki, 2015; Izakowski, 2016).

Capability of e-shops and purchases platforms services depend largely on the logistics centres, where orders are completed and prepared to the further dispatch. Efficient completion is minimizing the time needed for order preparation, it also fluent on decreasing the amount of order mistakes. In order to improve this process and at the same time reducing mistakes, Amazon implemented inside its logistics centre near Wroclaw Amazon Robotics system. In packing zone a robot is moving the shelves to the indicated place, on which are located the necessary products. After some time the robot is putting shelves back to right place in warehouse. Advanced information system is monitoring robot's work. Algorithm used in this system allow robots to choose the shortest way from its localization to needed shelf, it also help to put the most often used shelf back nearer to packing zone. Amazon logistics centre in Poland is the first distribution centre in Europe using described Robotics system. In USA robots are supporting packing work in 13 logistics centres (Libiszewska, 2015).

## **5. E-LOGISTICS OF DISTRIBUTION COURIER, EXPRESS AND PARCEL MARKET – CEPELECTRONIC TRADE – E-COMMERCE**

Transport – Shipping – Logistic industry is very much differentiated and orientated for various customers. In its range may be the distinct courier services, the express services and depend on literature sources: the post services or the parcel services (Kawa, 2011, pp. 74–81). Regardless of an amplification acronyms one of CEP component is an express service, it means parcel need to be delivered very fast to the final customer. On the market there are many CEP operators. The differences between operators are primarily result of their operation areas, the used transport, the additional services (like a levy payments, a return of attached documents, etc.) or the time, in which they had to deliver packages (Kawa, 2011,



pp. 74–81). Internet dynamic development led to a fast development in CEP industry. The electronic trade almost extorted on the CEP industry launching the distribution of the small parcels, caused a full truck load transportation stopped to be at the top. Therefore it can be expected that further development in e-commerce branch will be associated with the dynamic development of CEP industry (Olszewska, 2016, p. 40).

Internet of Things - in a customer perspective very interesting solution, was proposed in year 2013 by Volvo, this idea was continued by Audi cooperation with DHL and Amazon in year 2014. For this case those companies proposed a delivery of the small parcels and the courier dispatches directly into clients' car trunk, totally eliminating customer engagement in logistic process. Courier had been given special code on his mobile phone to open right customers' car trunk. Meaningful role had the localization technologies, which based on GPS system, allowed courier to trace a car. Package boxes are working on a similar rules, but with one difference – code to open the box is given to a customer (Kacperek, 2016, p. 42).

According to the PricewaterhouseCoopers International Limited (PwC) report CEP the services market in Poland were estimated at 5.1 billion PLN in year 2016 (Mazur & Urban, 2016, p. 4). Companies from CEP industry are aiming to attract the customers by a convenience and the technological news. They want to achieve a competitive advantage on the market by their own dedicated systems, which are continually evolving as the new innovated technologies appears.

The packages and a shipment tracking is already a standard service, but FedEx company offers it extended by a WWW website and a mobile platform FedEx Ship, that is monitoring the package in a real-time, using COSMOS system (Customer Operations Service Master On-line System). System supervise all the delivery stages so FedEx inform its clients about the status and the current location of every single package. It works with so high accuracy that the company guarantee covering the shipment cost if a client will not receive an answer within 30 minutes after asking where exactly his package is (Federal Expres, 2016, www). To ensure the fastest and a safe way for packages, regardless of the weather conditions, FedEx uses solutions of Command and Control system. This system bases on the satellites and the overland stations that analyze a route and a traffic information in the real-time terms. The usage of NASA weather data and an artificial intelligence allows to set the transport route which is: the fastest, the most safe and the most cost effective. Command and Control system is one of the most important company's high technology projects, allowing for the global logistics coordination (Federal Expres, 2016).

Nowadays the drones are associated with three branches – military, model-making and CEP. The global potentates as Amazon, DHL, Wal-Mart or Mearsk are doing the researches on this type of transport. The most sophisticated research has DHL company, since year 2013 it has worked on a delivery small parcels and packages by using these devices. Next DHL drone from third version is named

Paketkopter 3.0 and during three months period (January-March year 2016) drones were tested in the alpine conditions. Machines were mainly used to deliver the small parcels and the packages weighing up to 2kg – as its previous version. Innovation in third version was implemented using the full automatically package boxes – named Sky Port. Big advantage for the package boxes solution is allowed to charge a drone battery, what significantly increased a range of flights to 100km. The DHL company has not publicized the results of that examination. However DHL announced the information that the average delivery time at difficult alpine condition was 8 minutes. The same package transported by car would be provided in around 30 minutes (Olszewski, 2016, pp. 18–20).

CEP industry leaders are focused on servicing of entities which generate the biggest quantity of dispatch. Reaching to the average and the small enterprises with individual offer, which is adapted to their needs, mostly is not much profitable. Because of that those companies and other clients have an alternative way – aggregation of offers for courier dispatch. This possibility gives Furgonetka.pl, the website connect a few courier companies with the small entrepreneurial and individuals customers. Through this website or a mobile application client describes the package parameters, than he receives quotation from various companies. After analysing offers the customer chooses one offer and pay on-line. Benefit for WWW website customers is ten percent lower payment than in a traditional way. The innovation in that idea rely on a number of prepared solutions that distinguished the described website over other Internet prices comparison websites, which has shown customer to the service provider. The most important different feature is that Furgonetka.pl has the agreements with courier operators, thanks to that prices for the dispatches are much more attractive for an individual customer. Furgonetka.pl is a customer to the operator, so it is a payer to the courier, because of that making payments is much more easier. For example, the levy payment for the package is on the next day at the customer. By the availability of software, the customers can fully integrate with furgontka.pl system and the courier operators systems. Systems integration allows to automatically choose the right delivery operator basing on placed orders (the type of package, the weight or the delivery address). This type of package sending is used mostly by e-shops. The payments are automatically retrieved from the customers' accounts, on which clients are making a direct deposit at optional time for themselves. The cooperation with this web service does not require signing any agreements. Small and average companies do not declare a minimum quantity of the dispatches in month, what for many businesses is a huge advantage. The described above solution has brought its creators in year 2015 30 million PLN income. Although the service earns only a small margin on the resale of the transport services. The worked out margin achieved 10%, what on CEP market is a quite big achievement. Currently Furgonetka.pl service cooperate with nine the biggest courier operators from CEP industry – for example DPD, FedEx, InPost or Poczta Polska. It is worth to mention that the service already has more than 150 000 registered users (Krukowska, 2016).

## 6. CONCLUSION

The dynamic improvement and innovation of nowadays logistics is based on the multidimensionality and the interdisciplinary of science. Currently the main factor revolutionizing logistics are informatics, Internet and technology development, that made multifunctional and widespread mobile devices, touch panels and very fast transfer of big amount of data possible to exist.

The quantity and the quality of the collected data determines the solution adaptation to the customers' needs. Enable reducing the cost of operation at the manufacturer-receiver plain and saving time – so it provides access to resource, which normally do not have the ability to acquire or store.

The versatility and the increased capabilities of using IT directly affect reducing business costs of improving efficiency and the ability to integrate many distribution channels, which is immensely important in nowadays global market.

The target for e-business researchers should be to further develop the technological capabilities of using e-logistics to reach the customer by providing him the solutions he expects. Those new solutions should be customized to the individual preferences, taking into consideration the time that the customer has for the purchasing process and for receipting the ordered goods or services.

## REFERENCES

- Brzozowska-Woś M. (2014), Kierunki rozwoju handlu internetowego, *Przedsiębiorstwo we Współczesnej Gospodarce – Teoria i Praktyka*, no. 1.
- Wieczerzycki W. (2012), *E-logistyka*, PWE, Warszawa.
- Podjaski P. (2016), E-commerce: ile z 31 mld zł dla polskich e-sklepów?, *eHANDEL*, <https://ehandelmag.com/e-commerce-ile-z-31-mld-zl-dla-polskich-e-sklepow,1243#> (accessed 22.02.2017)
- Książkiewicz A. (2004), Rola Internetu w usługach logistycznych, W. Rydzkowski (ed.), *Usługi logistyczne*, Instytut Logistyki i Magazynowania, Poznań, pp. 162-166.
- Figlerek M. (2013), Klucz do sukcesu Rema 1000, *Eurologistics*, no. 77, pp. 66-67.
- Krzywonos L. & Nieoczym M. (2015), Charakterystyka transportowych wózków satelitarnych, *Logistyka*, no. 3, pp. 2627-2633.
- Consafe logistics (2014), Stamping down on prices through ramping up logistics. REMA's key to success, [http://www.consafelogistics.pl/in-practice/case%20studies/rema\\_1000](http://www.consafelogistics.pl/in-practice/case%20studies/rema_1000) (accessed 13.12.2016)
- Retailresearch.org, 2016, Online Retailing: Britain, Europe, US and Canada 2016, Centre for Retail Research, <http://www.retailresearch.org/onlineretailing.php> (accessed 09.01.2017)
- Kemp S. (2016), *Digital In 2016, report We Are Social Jan.*
- Żur Ł. (2011), Biznes ukryty w kodach QR – zeskanuj swoją firmę, *Nowoczesne zarządzanie*, no. 2, pp. 32-35.

- Creevy J. (2011), Tesco opens virtual store in South Korea, <https://www.retail-week.com/technology/tesco-opens-virtual-store-in-south-korea/5028571.article> (accessed 26.11.2016)
- Gębarowski M. (2012), Koncepcja wirtualnego sklepu a dystrybucja produktów żywnościowych, Waśkowski & Sznajder (eds.), Nowe trendy w dystrybucji produktów żywnościowych. Determinanty i kierunki rozwoju, wydawnictwo UEP, ZN 237, Poznań, pp. 191–197.
- Dyba, Marciniak, Rutecka & Skrobosz (2016), Innowacje w dystrybucji towarów – wirtualne sklepy, Materiały konferencyjne Interlog 2012, SKNL AELogic, <http://www.ilim.poznan.pl/aktualnosci/164-zakupy-przez-telefon-wprost-z-ulicy-startuje-projekt-mobilny-konsument> (accessed 18.12.2016)
- Gacki G. (2015), Zalando: Strategię dostosowujemy do lokalnych rynków, eGospodarka.pl, <http://www.egospodarka.pl/127520,Zalando-Strategie-dostosowujemy-do-lokalnych-rynkow,1,20,2.html> (accessed 18.12.2016)
- Izakowski Ł. (2016), Zalando inwestuje w rozwiązania usprawniające proces dostawy i zwrotu zakupów, <https://retailnet.pl/2016/04/04/112100-zalando-inwestuje-w-rozwiazania-usprawniajace-proces-dostawy-i-zwrotu-zakupow> (accessed 18.12.2016)
- Libiszewska M. (2015), Amazon robotics już w magazynie, WR03, Magazyn internetowy NOWOCZESNY MAGAZYN ONLINE, [http://nm.pl/z\\_wizyta\\_u/40/pierwszy\\_w\\_europie\\_magazyn\\_amazon\\_wykorzystujacy\\_roboty\\_miesci\\_sie\\_na\\_8230\\_bielanach\\_wroclawskich.html](http://nm.pl/z_wizyta_u/40/pierwszy_w_europie_magazyn_amazon_wykorzystujacy_roboty_miesci_sie_na_8230_bielanach_wroclawskich.html) (accessed 19.12.2016)
- Kawa A. (2011), The place and role of the CEP industry in Polish economy, Research Papers of Wrocław University of Economics issue: 235, pp. 74–81.
- Olszewska M. (2016), Czy liczymy się na świecie?, Biznes Raport – Rynek KEP, Gazeta Finansowa 12–25.08.
- Kacperek P. (2016), Technologiczna przyszłość rynku KEP, Biznes Raport – Rynek KEP, Gazeta Finansowa 12-25.08.
- Mazur M. & Urban G. (2016), Raport Perspektywy wzrostu rynku przesyłek kurierskich, ekspresowych i paczkowych (KEP) w Polsce do 2018 roku, PwC Polska Sp. z o.o.
- Federal Expres (2016), COSMOS® Śledzenie przesyłek w czasie rzeczywistym, <http://www.fedex.com/pl/about/overview/innovation.html> (accessed 21.12.2016)
- Federal Expres, 2016, Command & Control Dostawa niezależna od pogody, Command & Control Delivery independent of the weather, <http://www.fedex.com/pl/about/overview/innovation.html> (21.12.2016)
- Olszewski J. (2016), Przyszłość łańcuchów dostaw, Eurologistics nr1, pp. 18-20
- Krukowska M. (2016), Twórca Fotki ma pomysł: Uber dla towarów, Forbes, <http://pierzwymilion.forbes.pl/furgonetka-pl-uber-dla-towarow,artykuly,209675,1,3.html> (accessed 18.12.2016).

## BIOGRAPHICAL NOTES

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