sciendo

PRODUCTION ENGINEERING ARCHIVES 2022, 28(3), 217-224

PRODUCTION ENGINEERING ARCHIVES

ISSN 2353-5156 (print)
ISSN 2353-7779 (online)

Exist since 4th quarter 2013
Available online at https://pea-journal.eu

E-commerce and last mile delivery technologies in the European countries

Tatiana Corejova[1,*], Peter Jucha[1], Anna Padourova[1], Mariana Strenitzerova[1], Katarina Stalmachova[1], Alexandra Valicova[1]

[1] University of Zilina, Univerzitna 1, 01026 Zilina, Slovakia; peter.jucha@fpedas.uniza.sk (PJ); anna.padourova@fpedas.uniza.sk (AP); mariana.strenitzerova@fpedas.uniza.sk (MS); katarina.stalmachova@fpedas.uniza.sk (KS); alexandra.valicova@fpedas.uniza.sk (AV)
*Correspondence: tatiana.corejova@fpedas.uniza.sk

Article history
Received 11.03.2022
Accepted 24.05.2022
Available online 16.08.2022

Keywords
e-commerce
last mile delivery
out of home delivery
automated parcel machine
pick-up and drop-off delivery

Abstract
Society, companies and institutions are involved in a digital transformation that can be pervaded in various industries or sectors, and this also applies to communication, sales and distribution channels. The possibilities of e-commerce have also increased and world trade has been further developed. In 2020, more than two billion people bought goods or services over the Internet. Customer satisfaction depends on the solution of the last mile process, the method of picking up shipments as well as the time and place of picking up the shipment. The most common forms of off-premises delivery are automated parcel locker or machine (APM) and pick-up and drop-off delivery (PUDO). The aim of the paper is to analyse the level of the PUDO and APM network in European countries and in the V4 countries with regard to the size of the country and the population. For this purpose, it was necessary to focus on determining the population per 1 PUDO and the number of inhabitants per 1 APM in individual European countries and subsequently in the V4 countries. The obtained data were processed and recalculated in Excel. The results showed that within European countries the best values were achieved by Finland with 526 inhabitants per 1 PUDO and Spain with 188 inhabitants per 1 APM. Regarding the V4 countries, the Czech Republic achieved the best value in the case of inhabitants on PUDO with 729 inhabitants per 1 PUDO and in the case of APM Poland with 3,184 inhabitants per 1 APM.

DOI: 10.30657/pea.2022.28.26 JEL: L23, M11

1. Introduction

At present, society and organizations are engaged in digital transformation, which can be perceived in various industries, and this also applies to communication, sales, and distribution channels (Kawa, 2020). Thanks to the development of information technologies (IT) such as laptops, tablets and smartphones, and globalization, over the last few years, e-commerce has become increasingly common and an indispensable part of the global retail framework (Morganti et al., 2014; Dobroselskyi et al., 2021). It has increased the possibilities of e-commerce and allowed further development of world trade. As Internet access and adoption are rapidly increasing worldwide, the number of digital buyers keeps climbing every year (Eurostat, 2021; Kvasnicova et al., 2016).

Nowadays, companies use a combination of stone stores and online stores, with the aim of e-commerce in particular to improve the usability of websites. The combination of these two distribution channels can give the organizations a competitive advantage (Garbarova et al., 2017). Currently, e-commerce is the most widespread form of commerce and is expected to be the main sales strategy for both retailers and wholesalers in the near future. The growing popularity and global success of e-commerce have also meant a transformation in existing support and distribution structures. Traditional distribution processes are also changing to suit this new business model (Madlenak and Madlenakova, 2020). Thanks to e-commerce, the postal sector is characterized by the existence of a highly competitive environment (Madlenakova et al., 2017). These changes in the structure and volume of postal items distributed by the universal service provider, therefore, create a need for innovation of postal transportation network (Madlenak et al.,

2015). New network architectures are required for flexible service provisioning (Keil et al., 2015). Slovakia has the 54th largest e-commerce market with revenues of 1 billion USD in 2020. With an increase of 32%, the Slovak e-commerce market contributed to a global growth rate of 29% in 2020. Revenues for e-commerce are constantly increasing, new markets are emerging and existing markets also have the potential for further development (Ecommerce DB, 2021).

2. Literature review

Nowadays, almost all products that can be bought in brick-and-mortar stores are sold through the Internet and also from a geographical point of view, the possibilities for buying and selling are even greater. This trend can also be linked to the development of information technology and mobile applications, which have caused significant growth in e-commerce (Sitek and Wikarek, 2019; Abraham, 2020). If consumers buy products online, they cannot physically check their quality. This gives the seller, i.e. companies and e-shops, the opportunity to hide low quality products. The consumer may receive a product that does not meet the required quality. However, consumer reviews and a larger market size can increase the quality of products in the online market (Chen et al., 2015). According the Eurostat data in 2020, over two billion people purchased goods or services online. The COVID-19 pandemic also has a major impact on e-commerce growth. Since the outbreak of the pandemic, e-commerce has become the preferred choice for any type of purchase (Lakshmi, 2021). This is also because many people have been forced to change their way of shopping and decided to shop online, even though they had not used it before. Especially at the beginning of a pandemic, many products would not have been able to obtain in other ways, so several consumers decided shop over the internet things that they used to buy mostly in a classic store. In some cases, the limitations are language and local regulations, but above all logistics, especially the delivery of the product to the customer, because not all sellers offer the possibility to deliver the product to every location. On the other hand, it represents a huge potential for the sector of logistics and postal services (Turska and Madlenakova, 2019). Due to the lack of geographical restrictions, there are opportunities to buy and sell even bigger because almost anyone can be a customer. But it is not always possible to deliver products to every location, as not all retailers offer such an option. Thanks to online shopping, customers have become accustomed to convenience and want to decide for themselves where and when to pick up their electronic purchases. The phenomenon of the present postal services is the fact that customers expect the lowest price while maintaining the availability, security, and on-time delivery of mail items (Drozdiel et al., 2017). It can be stated that they require flexibility, especially for the current active lifestyle and ever-longer working hours. For this reason, e-commerce also has an impact on logistics services (Kawa, 2020).

Today's world is characterized by the need for speed and an ever-increasing level of services. Customers have the opportunity to shop through the e-shop in a matter of minutes at any time of the day or night without leaving their home or office, and they can also order products (goods) from the other side of the world, which can be delivered within a few days. Before buying, they also have the opportunity to read reviews and ratings of the product from other customers who have already bought the product. The popularity of the e-commerce sector is growing dramatically, it results in a steadily increasing number of packages sent and the delivery of a package is becoming a challenge, as it is necessary to reconcile the delivery of goods on the part of the carrier and their acceptance on the part of the recipient/customer/ addressee (Faugere and Montreuil, 2016). Often customers have to adjust their daily schedule to the wide delivery time window and wait for the shipment at home. Often used is sending information to the customers about the preliminary delivery time. A common solution to this problem on the part of customers is delivery to work (certainty that the customer will take over the package), but this may not meet the understanding of the employer (Kawa, 2020).

The connection between the recipient and the end point of the service or product provider, is called the last mile. The last mile, often referred to as the most important part of the supply chain, is the last part in the supply chain where the goods are delivered from the last point of delivery to the end point. This is usually represented by recipient. The recipient receives the goods at home, at a pre-determined place or at a designated place to pick up the goods. The recipient can be a private person or a company (Lu et al., 2020; Gnap and Benova, 2021; Janjevič and Winkenbach, 2020).

The main goal of last mile logistics has recently been to deliver goods to customers. In order to easily purchase product alternatives, retailers and their supply chain partners must be exceptional and have services from competitors to gain market share and build brand loyalty. Especially in highly competitive markets, great attention is paid to customer satisfaction in the service sector and improving service quality and maintaining customer loyalty. Delivery within the last mile is becoming more important than before as a result of making online orders (Datex, 2021; Strenitzerova and Gana, 2018). Many customers are currently looking for the widest possible selection of delivery options directly to them within the last mile.

From the companies' point of view, last mile delivery appears to be part of the whole delivery process, which has the lowest efficiency and highest costs. The reason is, for example, the required level of service, which is difficult to achieve, the small size of the order or the dispersion of destinations over a large area. The last mile represents the most expensive and problematic part of the entire supply chain process and usually has a negative impact on the profits of companies as well as the customer experience. It represents more than 30% of the total logistics costs and part of the last mile is many of the challenges that logistics managers have to face in their day-to-day operations (KO et al., 2020; Honorato, 2016). The problem can be in situation when the customer has the goods delivered to his home by courier and he is somewhere else all day. The courier must return the next day, which also increases the cost of delivery. The issues of enhancing the deliverability of consignments have become the main topic of the wide dis-

cussion among national and international organizations involved in last-mile logistics (Turska and Madlenakova, 2019). According to some authors, however, it is necessary to focus and improve the processes of the first mile, because it is beginning to appear as another narrow place in the logistics processes (Koncova et al., 2021).

Several years ago, products ordered over the Internet were delivered mainly by courier companies and postal operators. The short delivery time and the door-to-door delivery system are a great advantage when delivered by courier companies. On the other hand, delivery by courier companies is more expensive, the customer does not have information about the exact time of delivery. There can often be problems with an incorrect address or the absence of a recipient, which is a major disadvantage of this type of delivery (Kawa, 2020). Another problem is that recipients do not have time to take delivery by courier or postman, so consignments remain stored at the post office or other contact delivery points Bachanova et al., 2009; Last Mile Experts, 2021).

The solution to the delivery problems related to the door-to-door system is out-of-home delivery. Out-of-home delivery (hereinafter referred to as "OOH") consists of the delivery of the consignment to the place or to the machine which is in a suitable place for the customers. The customers are involved in the last mile process, so they can pick up the shipment at any time for several days, for example, on the way to work and the like at a time that the customer chooses within the set time frame for picking up the shipment (Kawa, 2020 and Faugere and Montreuil, 2016). The most common forms of OOH are parcel locker (APM) and PUDO (pick-up and drop-off delivery). Out-of-home delivery is provided by various players, for example national postal operators, CEP (courier, express and parcel) companies, e-commerce giants, such as Amazon or AliExpress, retail point owners, infrastructure owners or IT platforms (Last Mile Experts, 2021).

As mentioned above, in an era of strong e-commerce growth, resellers and recipients are looking for additional forms of sales, delivery, shipping, and collection, but also return options, and customer satisfaction, among others, depends on these processes. The presented article offers a look at the PUDO and APM network in European countries, where it compares the development of this network in terms of population and area. The result is the identification of countries where it can be stated that the PUDO and APM network is sufficiently developed here (in terms of population per 1 PUDO and APM and in terms of km^2 per 1 PUDO and APM) and therefore higher customer satisfaction with the delivery processes can be expected in these countries. In particular, the article points to the situation in the V4 countries, where it also analyses the population and km^2 per 1 PUDO and APM and identifies countries with a less developed PUDO and APM network, where lower customer satisfaction with the delivery process can be expected. The contribution of the article and the novelty of the presented research is mainly a concrete view of the PUDO and APM network in European countries, especially in the V4 countries. The submitted information can be a basis for stakeholders in building a network of PUDO and APM in the specific country analysed.

The aim of the paper is to analyse the level of the PUDO and APM network in European countries and in the V4 countries with regard to the size of the country and the population.

3. Experimental framework

The purpose of the study is to analyze key technologies in securing the delivery of e-commerce shipments to the addressee outside his/her address and to compare the level of use and supply on the part of companies providing last mile delivery within European and Visegrad countries (V4) that include Poland, Hungary, Czech Republic ans Slovakia.

Approaches to evaluating and comparing the technologies used in the delivery of shipments in e-commerce include:

a) characteristics of the most used technologies in the last-mile delivery process
b) indicators definition for comparing the state of used technologies in individual EU and V4 countries
c) statistical analysis of indicators in terms of their desired trend and finding a correlation between e-commerce revenues and delivery solutions.

The most used technologies in last-mile delivery in e-commerce are:

- parcel lockers or automated parcel machine (APM) and
- pick-up and drop-off (PUDO).

Automated parcel machine (APM) is a parcel collection service that allows customers to have their parcels delivered to service point and pick them up at any time of day using digital pickup codes (Orenstein et al., 2019). It is a form of self-service technology that is used for autonomous customer pick up and drop off parcels (Kawa, 2020; Vakulenko et al., 2019). In recent years, parcel lockers became very interesting and popular solution as the efficient last mile delivery system (McKinsey Company, 2016). These lockers are usually located in convenient and public locations in living neighbourhoods, easily accessible places and highly frequented areas, such as train stations, malls, shopping areas, gas stations, or other public locations, storing packages for all customers for a certain amount of time (Kawa, 2020; Faugere and Montreuil, 2016). Customers can choose the most suitable time for them to pick up the shipment. They need to log in to the smart terminal, which is connected to the delivery company's system via the Internet of Things, using a code sent by e-mail, text message, or otherwise. This type of takeover has an advantage for delivery companies, which are able to consolidate parcel deliveries, reduce congestion and increase efficiency (Faugere and Montreuil, 2016). Their great advantage is especially that they are self-service, and thus they are available to the customer 24 hours, 7 days a week (Orenstein et al., 2019; McKinsey Company 2016). Nevertheless, according to McKinsey Company, delivery to parcel lockers does not really appeal to consumers despite the possibility of picking up their parcel 24/7, but if home delivery were to cost more than a pickup at the parcel locker, customers would prefer to use parcel lockers (McKinsey Company 2016).

A pick-up and drop-off point (PUDO) is a location that offers a parcel pick-up and drop-off service as part of a wider network of PUDO points. These points are located in places

that are relatively easy to access and that are regularly visited by customers. It might be a local shop or retail outlet. As was mentioned before, a door-to-door delivery system can have a problem with an incorrect delivery address or the absence of a recipient. In this case, PUDO eliminates problems related to determining the correct address or the recipient's absence from home (Kawa, 2020). The growth of the e-commerce market has resulted in an increase in the importance of last-mile deliveries. It has an impact on the growing demand for last mile delivery, which could in turn create traffic problems and cause congestion (Iwan et al., 2015). The way to reduce the number of deliveries realized by traditional transportation systems, includes alternative methods (Iwan et al., 2016) such as APM and PUDO. Out-of-home delivery using PUDO and APM is today the best solution to the last mile problem-related to the door-to-door delivery. According to Last Mile Experts (2021):

- the out-of-home delivery benefits include, in particular, flexibility in picking up the shipment, time flexibility (especially extended opening hours for PUDO and 24/7 for APM availability), speed of delivery, cheap and easy return, operationally and cost-effective delivery method, and the like.
- the need for a dense network is 1 point per 10,000 inhabitants. This is not an optimal network but represents the minimum density that has any chance of success.

The study subsequently set indicators for comparing the development of the PUDO and APM network within individual countries, by determining the population per 1 PUDO and 1 APM and the area per 1 PUDO and 1 APM in a given country. The same procedure was chosen when comparing the V4 countries.

The evaluated and compared indicators have a minimizing character, which follows from the assumption that a higher penetration of PUDO and APM in the country, or lower population and territory per unit of PUDO and APM is preferred. A smaller area per PUDO and APM unit presupposes better accessibility for the inhabitants, as well as a smaller number of inhabitants per PUDO and APM unit is associated with an increase in the use of technologies in the last mile delivery process.

The study used data from the Last Mile Experts, Out-of-home delivery in Europe 2021 study as well as the data of e-commerce revenues in 2020 from www.statista.com and Eurostat 2021. All figures are the result of own data processing from the above mentioned study and statistics.

The obtained data were processed and recalculated for the needs of analysis and comparison in Microsoft Excel. Subsequently, the correlation dependence between the volume of e-commerce revenues and solutions for the delivery was investigated.

4. Results and discussion

To achieve the main goal of the study, it is necessary to focus on determining the number of inhabitants per 1 PUDO and the number of inhabitants per 1 APM in individual European countries and subsequently in the V4 countries.

The results of European countries are shown in the following figures (see Figure 1-5) and we can state the following:

- the minimum in the number of inhabitants per 1 PUDO in individual European countries is Finland, where there are 526 inhabitants per 1 PUDO. At the bottom of the ranking is Malta, where there are 6,703 inhabitants per 1 PUDO. In Slovakia, there are a total of 1,441 inhabitants per 1 PUDO (Fig 1).

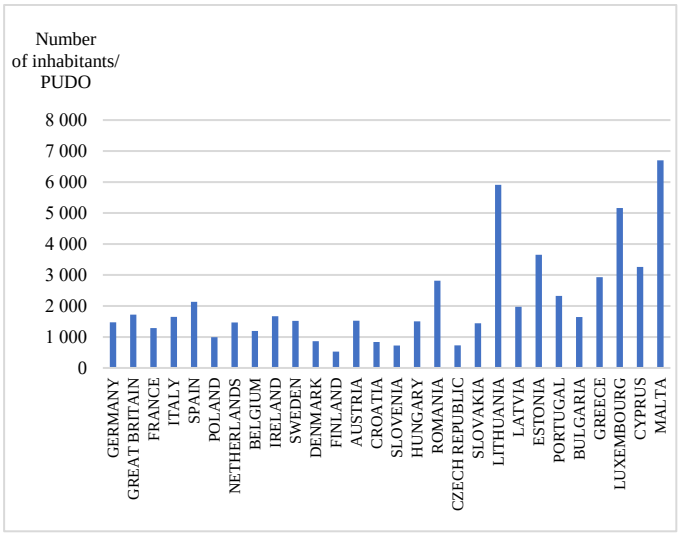

Fig. 1. Number of inhabitants per 1 PUDO

- the minimum in the area per 1 PUDO in the European countries is Belgium where there are 3.15 km² per 1 PUDO. At the bottom of the ranking is Lithuania, where there is 1 PUDO per 138.03 km². In Slovakia, there is 1 PUDO per 12.94 km². (Fig. 2)

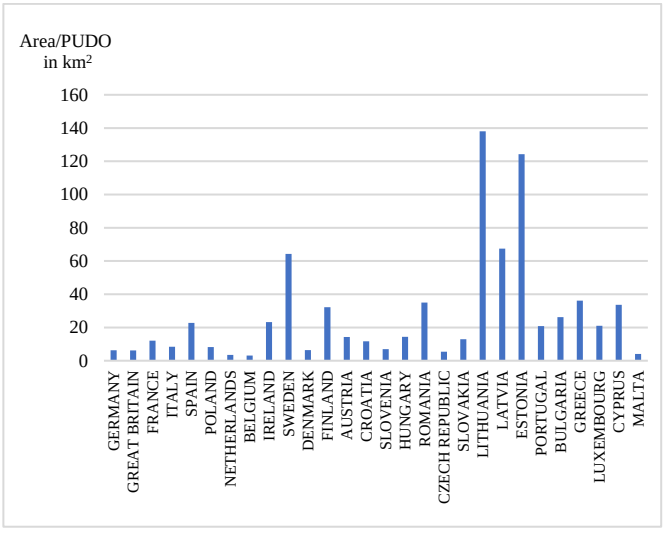

Fig. 2. Number of square kilometres per 1 PUDO

- the minimum in the number of inhabitants per 1 APM in individual European countries is Spain where there are 1,188 inhabitants per 1 APM. At the bottom of the ranking is Greece, where there are 712,170 inhabitants per 1 APM.

In Slovakia, there are a total of 47,477 inhabitants per 1 APM (Fig. 3).

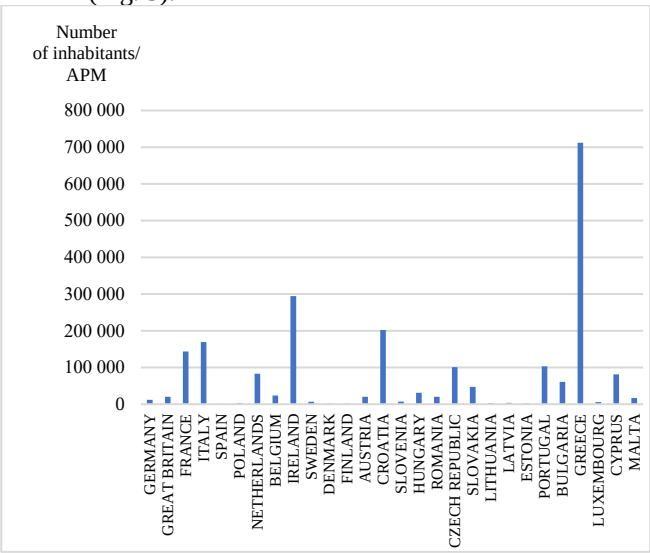

Fig. 3. Number of inhabitants per 1 APM

- the minimum in the area per 1 APM of the European countries is Denmark where there is 9.96 km² per 1 APM. At the bottom of the ranking is Greece, where there is 1 APM per 8,803.27 km². In Slovakia, there is 1 APM per 426.39 km² (Fig. 4).

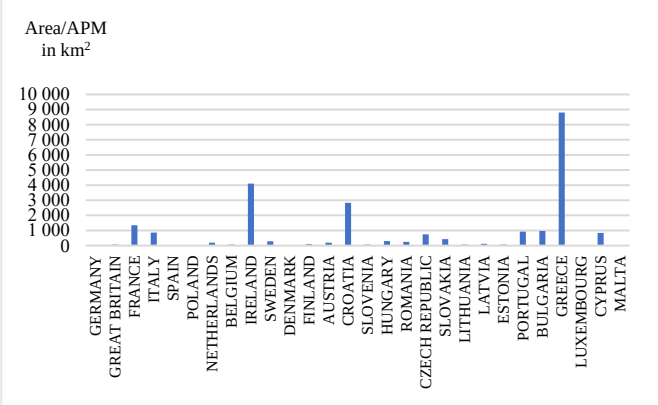

Fig. 4. Number of square kilometres per 1 APM

The obtained results indicate significant differences between individual countries in the facilities of PUDO and APM, both within the EU28 comparison and within the V4 countries. The differences between the lowest and highest values according to the monitored indicators are shown in Table 1.

In terms of comparing the Visegrad countries (V4), the following can be stated:

- the minimum in number of inhabitants per 1 PUDO in V4 countries is Czech Republic where there are 729 inhabitants per 1 PUDO. The second is Poland where there are 993 inhabitants per 1 PUDO and third is Slovakia where there are 1,441 inhabitants per 1 PUDO. At the bottom of the ranking is Hungary, where there are 1,506 inhabitants per 1 PUDO (Fig. 5).

Table 1. Minimum and maximum value of inhabitants and area size per PUDO and APM in EU28 countries

	min	max	difference
Number of inhabitants per 1 PUDO	526	6,703	6,177
Number of square kilometres per 1 PUDO	3.15	138.03	134.53
Number of inhabitants per 1 APM	1,188	712,170	710,982
Number of square kilometres per 1 APM	9.96	8803.27	8793.31

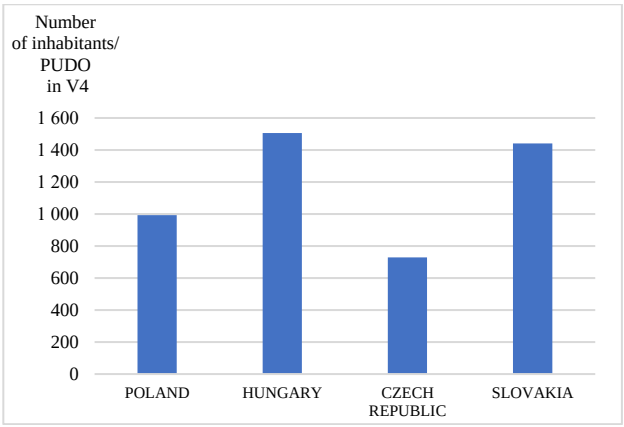

Fig. 5. Number of inhabitants per PUDO in V4 countries

- the minimum in area per 1 PUDO of the V4 countries is Czech Republic where there is 1 PUDO per 5.37 km². The second is Poland where there is 1 PUDO per 8.21 km² and third is Slovakia where there is 1 PUDO per 12.94 km². At the bottom of the ranking is Hungary where there is 1 PUDO per 14.40 km² (Fig. 6).

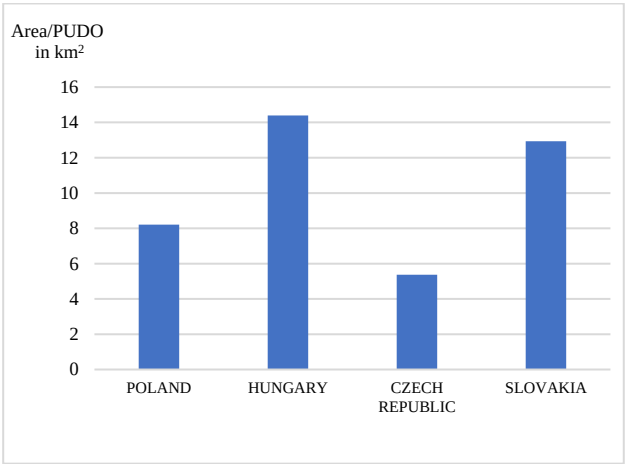

Fig. 6. Number of square kilometres per 1 PUDO in V4 countries

- the minimum in number of inhabitants per 1 APM in V4 countries is Poland where there are 3,184 inhabitants per 1 APM. The second is Hungary where there are 31,189 inhabitants per 1 APM and third is Slovakia where there are 47,477 inhabitants per 1 APM. At the bottom of the

ranking is Czech Republic, where there are 100,961 inhabitants per 1 APM (Fig. 7).

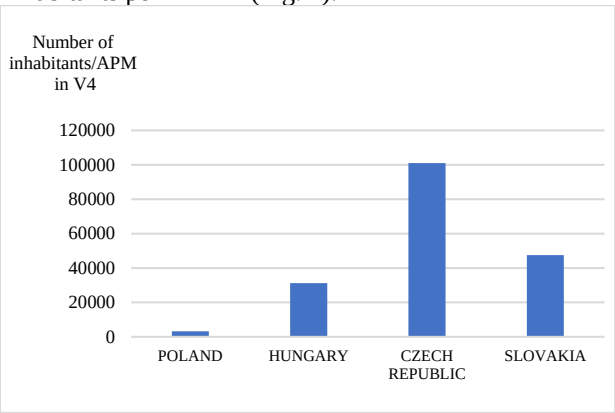

Fig. 7. Number of inhabitants per 1 APM in V4 countries

- the minimum in area per 1 PUDO of the V4 countries is Poland where there is 1 APM per 26.31 km². The second is Hungary where there is 1 APM per 298.11 km² and third is Slovakia where there is 1 APM per 426.39 km². At the bottom of the ranking is Czech Republic where there is 1 APM per 744,040 km² (Fig. 8).

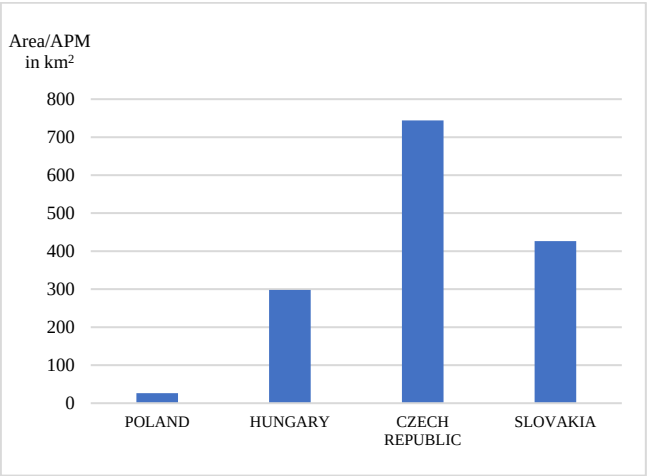

Fig. 8. Number of square kilometres per 1 APM in V4 countries

As in the case of the EU28, differences were also recorded in the V4 countries, while the situation in the density of PUDO and APM is always in the opposite ratio. The technological solutions and strategies that have been chosen in the area of securing the last mile in individual countries determine the position of these countries in the context of comparability. Both technological solutions represent new elements in the business models of postal and courier service providers in the V4 countries. They are related to elements of a shared economy, when several providers use APM together.

In 2020, there was a significant growth in the field of e-commerce. Within Europe, it represents an increase of up to 26.7% compared to 2019. Of the European countries, Spain recorded the fastest overall growth, namely 36%. In second place was the United Kingdom with a gain of 34.7%. The importance of e-commerce is also a matter of increased shopping on e-shops, which represents how important this way of shopping is for customers. The importance of e-commerce in 2020 increased by 12% and progress was recorded in all European countries. For comparison, in 2019 the increase in the importance of e-commerce was at the level of 9% and in 2018 it was 8.5%. In addition to more and more regular customers, a large number of new customers have been added in the field of e-commerce, with a total of up to 15 million e-shoppers across Europe. The absolute number of e-shop customers thus reached a value of up to 381.6 million (Macko, 2021). The volume of revenues from e-commerce in 2020 per 1000 inhabitants is shown in Fig. 9 and in comparison with Fig. 1, it can be assumed that these indicators will interact.

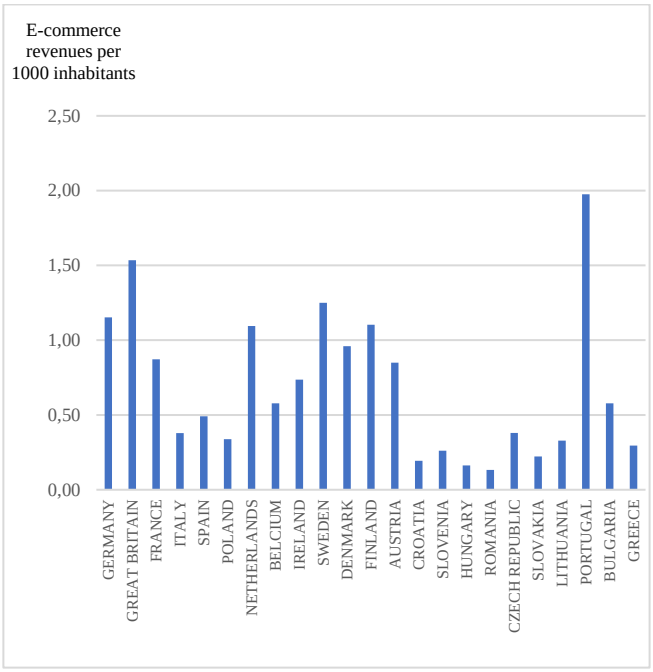

Fig. 9. e-commerce revenues per 1000 inhabitants by countries in 2020

Based on the determination of the correlation dependence between the volume of e-commerce revenues and new technological solutions for the delivery of shipments, it can be stated that:

- the correlation coefficient between the volume of e-commerce revenues and the number of PUDO was at the level of R = 0.836, which indicates a strong dependence
- the correlation coefficient between the volume of e-commerce revenues and the number of APM was at the level of R = 0.165
- the correlation coefficient between the number of PUDO and APM was at the level R = 0.301

It follows from the above that securing the last mile in e-commerce logistics is predominantly addressed through PUDO, but due to the growth in e-commerce volume, APM is also growing, as these two technologies show a certain degree of substitution and complementarity. In terms of business models in securing the last mile, with the current significant

growth in the volume of e-commerce, both technologies can be considered as complementary solutions.

5. Summary and conclusion

Some e-commerce operators and deliverers are now moving away from traditional business models. Delivery strategies are thus increasingly creative in response to more demanding and specific customer requirements and expectations, but also the emergence of new technologies in the delivery process (Uzzaman, 2019). In this way, traders form partnerships with innovative start-ups or association companies in order to deliver goods to customers as efficiently as possible. According to Lebaron, 2021 these delivery companies subsequently provide the specific traders with whom they have a partnership with the delivery of goods made through their own vehicles to the customers of a particular e-commerce. Some make their facilities for delivering goods to customers available to partners upon request, others operate on the basis of predetermined agreements.

The logistics industry is coping with many challenges and problems at the same time, forcing the industry, in addition to developing innovations, to address things in new ways. Logistics service innovations apply to basic as well as complex logistics services. Specific examples of logistics innovations in recent decades include: electronic data interchange (EDI), cross-docking, radio frequency identification (RFID) and joint planning, prediction and implementation (CPFR). However, new innovations, models and concepts are also being implemented specifically within the last mile. Rapid growth and urban development are forcing the optimization of goods distribution processes through efficient last mile models.

The growing trend of e-commerce and the associated growth in orders that need to be delivered to end customers every day has meant that several new last mile solutions have been implemented in recent years. However, the trend of increasing the number of orders also has its negative consequences in the context of environmental protection and the safety of shipments while securing the last mile to the customer.

The result of the article is the identification of countries with more and less developed PUDO and APM networks and at the same time, our research assumes that customers in countries with more developed PUDO and APM networks are more satisfied with the delivery processes than customers in countries where PUDO and APM are not sufficiently developed. However, the present article did not address the identification of the relationship between the PUDO network and APM and customer satisfaction, which can be considered the main limitation of the submitted research, but also the possibility for further research and direction of scientific work in this area.

Acknowledgements

The research was supported by project VEGA 1/0011/21 Research on the interactions among new emerging technologies, the performance of enterprises and industries based on network technology infrastructure, the application of new business models and the institutional regulatory, environmental, and social environment and the project ITMS2014+ 313011AUX Identification and possibilities of implementation of new technological measures in transport to achieve safe mobility during a pandemic caused by COVID-19.

Reference

Abraham, Aji., 2020. How Technology is Improving Last-Mile Delivery in 2020. Available online: https://yourstory.com/mystory/technology-improving-last-mile-delivery-2020 (Accessed 6th September 2021).

Bachanova, P., Corejova, T., Rostasova, M., 2009. The green issues of postal industry in Europe. 3rd Central European Conference in Regional Science - CERS, 2009, 901-905.

Coppola, D., 2021. E-commerce worldwide - statistics & facts. Available on: https://www.statista.com/search/?q=by+country&qKat=newSearchFilter&sortMethod=idrelevance&isRegionPref=1&groupA=1&branchreports=1&countryreports=1&cityreports=1&ecommercedbreports=1&xmo=1&accuracy=and&isoregion=0&isocountrySearch=&category=0&interval=0&archive=1

Datex, 2021. What is Last Mile Delivery? Part 1: How Omnichannel Retail is Affecting Transportation & Logistics. Available online: https://www.datexcorp.com/last-mile-delivery-part-1-omni-channel-retail-affecting-transportation-logistics/ (Accessed on 4th September 2021).

Dobroselskyi, M., Madlenak, R., Laitkep, D., 2021. Analysis of return logistics in e-commerce companies on the example of the Slovak Republic. Transportation Research Procedia: 14th International Scientific Conference on Sustainable, Modern and Safe Transport, TRANSCOM 2021, 55, 318-325, DOI: 10.1016/j.trpro.2021.06.037.

Droździel, P., Wińska M., Madlenak, R., Szumski, P., 2017. Optimization of the position of the local distribution centre of the regional post logistics network. Transport Problems, 2017, 12(3), 43-50. DOI: 10.20858/tp.2017.12.3.4.

Ecommerce, D.B., 2021. E-commerce market analysis: The eCommerce market in Slovakia, Available online: https://ecommercedb.com/en/markets/sk/all (Accessed on 3th September 2021).

Eurostat, 2021. E-commerce statistics, 2021. Available online: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=E-commerce_statistics#E-sales_record_a_slight_increase_over_the_recent_years (Accessed on 3th September 2021).

Faugère, L., Montreuil, B., 2016. Hyperconnected City Logistics: Smart Lockers Terminals & Last Mile Delivery Networks. Proceedings of the 3rd International Physical Internet Conference, 2016.

Garbarova, M., Bachanova, P.H., Vartiak, L., 2017. Purchasing behaviour of e-commerce customers. Global Scientific Conference on Management and Economics in Manufacturing: Management and economics in manufacturing, 160-165.

Gnap, J., Benova, D., 2018. Logistika poslednej míle. Available online: http://www.svetdopravy.sk/logistika-poslednej-mile/ (Accessed on 4th September 2021).

Honorato, M., 2016. What No One Tells You About Last Mile Delivery. 2016. Available online: https://www.beetrack.com/en/blog/what-no-one-tells-you-about-last-mile-delivery (Accessed on 4th September 2021).

Chen, P., Chen, YJ., Hu, XT., Li, SX., 2015. Can online markets attract high-guality products? Economic Modelling, 51, 65-71. DOI: 10.1016/j.econmod.2015.07.010

Iwan, S., Kijewska, K., Lemke, J., 2016. Analysis of parcel lockers' efficiency as the last mile delivery solution - the results of the research in Poland. Transportation Research Procedia: The 9th International Conference on City Logistics, 12, 644-655, DOI: 10.1016/j.trpro.2016.02.018.

Janjevic, M., Winkenbach, M., 2020. Characterizing urban last-mile distribution strategies in mature and emerging e-commerce markets. Transportation Research Part A: Policy and Practice, 133, 164-196, DOI: 10.1016/j.tra.2020.01.003.

Kawa, A., 2020. Out-of-Home Delivery as a Solution of the Last Mile Problem in E-commerce. In book: Smart and Sustainable Supply Chain and Logistics - Trends, Challenges, Methods and Best Practices (Chapter 2), DOI: 10.1007/978-3-030-61947-3_2.

Keil, R., Krone, D., Kremenova, I., Madlenak, R., 2015. Communication networks as base for mobility - Trend development of network architectures. Communications - Scientific Letters of University of Zilina, 17(2), 80-85.

Ko, S.Y., Sari, R.P., Makhmudov, M., Ko, CH. S. 2020. Collaboration Model for Service Clustering in Last-Mile Delivery. Sustainability, 12(14), 5844, 1-18, DOI: 10.3390/su12145844.

Koncova, D., Kremenova, I., Fabus, J., 2021. Proposal for a change in the type of devices used for submitting of postal items by using the Saaty's method, a case study for the postal sector. Transportation Research Procedia: 14th International scientific conference on sustainable, modern and safe transport, TRANSCOM, 55, 236-243, DOI: 10.1016/j.trpro. 2021.06.027.

Kvasnicova, T., Kremenova, I., Fabus, J., Babusiak, B., 2016. E-commerce user experience: do we feel under pressure during online shopping? WMSCI 2016 - 20th World Multi-Conference on Systemics, Cybernetics and Informatics, Proceedings, 2, 41-44, ISBN 978-194176343-8.

Lakshmi, D., 2021. Pick-Up and Drop-Off Services: How PUDOs Can Redefine Delivery Efficiency and Convenience? Locus Blog, Available online: https://blog.locus.sh/will-pick-up-and-drop-off-network-improve-deliveries-efficiency/ (Accessed on 3th September 2021).

Last Mile Experts, Out-of-home delivery in Europe 2021: PUDO and parcel lockers. Last Mile Experts Sp. z o.o., Warszawa, Polska.

Lebaron, J., 2021. Ecommerce Trends for 2021. Available on: https://pattern.com/blog/ecommerce-trends-for-2021/

Lone, S., Harboul, N., Weltevreden, J.W.J., 2021. European E-commerce Report. Amsterdam/Brussels: Amsterdam University of Applied

Sciences & Ecommerce Europe.Lu, S.H. et al., 2020. The Last Mile: Managing Driver Helper Dispatching for Package Delivery Services. Journal of Business Logistics, 41(3), 206-221, DOI: 10.1111/jbl.12242.

Macko, O., 2021. Ako nakupovali zákazníci internetových obchodov v pandemickom roku. [online]. Available on: https://touchit.sk/ako-nakupovali-zakaznici-internetovych-obchodov-v-pandemickom-roku-2020/346384

Madlenak, R., Madlenakova, L., 2020. Multi-criteria evaluation of e-shop methods of delivery from the customer's perspective. Transport problems, 2020, 15(1), 5-14, DOI: 10.21307/TP-2020-001.

Madlenak, R., Madlenakova, L., Stefunko, J., 2015. The variant approach to the optimization of the postal transportation network in the conditions of the Slovak Republic. Transport and Telecommunication, 2015, 16(3), 237-245, DOI: 10.1515/ttj-2015-0022.

Madlenak, R., Madlenakova, L., 2015. Comparison of regional postal transportation networks in Zilina Region. Transport Means - Proceedings of the Internationational Conference: 19st International Scientific Conference Transport Means, 2015-January, 277-280.

Madlenakova, L., Madlenak, R., Rudawska, A., Droździel, P., 2017. On the problem of quantitative analysis of the concentration on the postal and logistics market, Transport Means - Proceedings of the Internationational Conference: 21st International Scientific Conference Transport Means, 2017-September, 693-698.

McKinsey&Company, 2016. Parcel delivery: The future of last mile. Travel, Transport and Logistics, Available online: https://www.mckinsey.com/~/media/mckinsey/industries/travel%20transport%20and%20logistics/our%20insights/how%20customer%20demands%20are%20reshaping%20last%20mile%20delivery/parcel_delivery_the_future_of_last_mile.ashx (Accessed 5th September 2021).

Morganti, E., Dablanc, L., Fortin, F., 2014. Final deliveries for online shopping: The deployment of pickup point networks in urban and suburban areas. Research in Transportation Business & Management, 11, 23-31. DOI: 10.1016/j.rtbm.2014.03.002.

Orenstein, I., Raviv, T., Sadan, E., 2019. Flexible parcel delivery to automated parcel lockers: models, solution methods and analysis. EURO Journal on Transportation and Logistics, 8, 683-711, DOI: 10.1007/s13676-019-00144-7.

Sitek, P., Wikarek, J., 2019. Capacitated vehicle routing problem with pick-up and alternative delivery (CVRPPAD): model and implementation using hybrid approach. Annals of Operations Research, 273, 257-277, DOI: 10.1007/s10479-017-2722-x.

Strenitzerova, M., Gana, J., 2018. Customer Satisfaction and Loyalty as a Part of Customer-Based Corporate Sustainability in the Sector of Mobile Communications Services. Sustainability, 10, 5, 1567, DOI: 10.3390/su10051657.

Turska, S., Madlenakova, L., 2019. Concept of smart postal mailbox. Transport Research Procedia: 13th International Scientific Conference on Sustainable, Modern and Safe Transport, TRANSCOM 2019, 40, 1199-1207. DOI: 10.1016/j.trpro.2019.07.167.

Uzzaman, A., 2019. 10 technology trends that will impact our lives in 2020. Available online: https://venturebeat.com/2019/12/30/10-technology-trends-that-will-impact-our-lives-in-2020/ (Accessed 6th September 2021).

Vakulenko, Y., Shams, P., Hellström, D., Hjort, K., 2019. Service innovation in e-commerce last mile delivery: Mapping the e-customer journey. Journal of Business Research, 101, 461-468. DOI: 10.1016/j.jbusres.2019.01.016.

欧洲国家的电子商务和最后一英里交付技术

關鍵詞
电子商务
最后一英里交付
送货上门
自动包裹机
接送服务

摘要
社会、公司和机构都参与了可以渗透到各个行业或领域的数字化转型，这也适用于通信、销售和分销渠道。电子商务的可能性也增加了，世界贸易得到了进一步发展。 2020 年，超过 20 亿人通过互联网购买商品或服务。客户满意度取决于最后一公里流程的解决方案、提货方式以及提货时间和地点。最常见的场外递送形式是自动包裹储物柜或机器 (APM) 以及取件和投递 (PUDO)。本文的目的是分析欧洲国家和 V4 国家的 PUDO 和 APM 网络在国家规模和人口方面的水平。为此，有必要重点确定每个欧洲国家以及随后在 V4 国家中每 1 PUDO 的人口和每 1 APM 的居民数量。获得的数据在 Excel 中进行处理和重新计算。结果表明，在欧洲国家中，芬兰达到了最佳值，每 1 PUDO 有 526 名居民，西班牙每 1 APM 有 188 名居民。关于 V4 国家，捷克共和国在 PUDO 居民的情况下实现了最高价值，每 1 PUDO 有 729 名居民，而在 APM 波兰的情况下，每 1 APM 有 3,184 名居民。