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Article

Optimization of e-commerce distribution center location

Reference: Kostikov, Eva/Jílkova, Petra et. al. (2021). Optimization of e-commerce distribution center location. In: Marketing i menedžment innovacij (2), S. 166 - 178.
https://mmi.fem.sumdu.edu.ua/sites/default/files/A510-2021-14_Kostikov%20et%20al.pdf.
doi:10.21272/mmi.2021.2-14.

Marketing and Management of Innovations
Issue 2, 2021

ISSN 2227-6718 (on-line)
ISSN 2218-4511 (print)

https://doi.org/10.21272/mmi.2021.2-14

JEL Classification: M31, O33, L86

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OPTIMIZATION OF E-COMMERCE DISTRIBUTION CENTER LOCATION

Abstract. *Since the COVID-19 pandemic hit last year, countries locked their borders. Thus, international shipping deteriorates drastically. Simultaneously, social distancing increased the need for immediate online consumption and fast home delivery. In the non-digital world, products still need to be shipped to their destination using trucks, trains, airplanes, and ships. Simultaneously, requirements for volumes of goods, transport costs, external limiting factors, etc., must be precisely defined. The article aims to find the optimal location selection solution based on the created mathematical model of the Modified Steiner-Weber Problem with restrictive conditions. The model allows for the central warehouse's optimal location and minimizes distribution costs from the central warehouse to sub-warehouses/branches located in individual EU countries. The mathematical model has been applied to a case study of a selected e-commerce dealing, which has established branches in capital cities but does not have an established central warehouse. Systematization of literature sources and approaches to solving the problem of e-commerce distribution center location showed that 86% of the studied companies plan to use on-demand warehousing in the next three to five years. Therefore, the need for warehousing would be preserved. The authors noted that they do not necessarily need to have it in-house. Consequently, fulfillment centers and warehouses would likely continue to be a significant component in the future logistics system. This research would like to stress how important the management of the effective optimization of e-commerce distribution center location is and how to achieve it. The success of Amazon in the US, Europe, and Alibaba in China has genuinely redefined consumer expectations. With the emergence of services like Amazon Prime, consumers now expect same-day delivery. The solution enabling this evolution has been a mix of manufacturing where the production costs are optimal, just-in-time shipping, highly automated fulfillment centers, and mobile connectivity growth. The proposed model results showed that the best location for a central location and storage center concerning the e-commerce environment, including minimum annual transport costs, is near Bristol in the United Kingdom. Eighty-six percent of the companies in the study plan to use on-demand warehousing in the next three to five years, and the solution enabling this evolution has been a combination of manufacturing where the production costs are optimal, just-in-time shipping, highly automated fulfillment centers, and, to a growing extent, mobile connectivity.*

Keywords: COVID-19 pandemic, distribution center, e-commerce, location-allocation selection, quality management.

Introduction. With the rapid development of digital technologies, the importance of online retailing has increased. Based on Victor et al. (2019), the spread of information technologies influenced changes in the e-commerce market. Belas et al. (2018) defined essential financial risks in the SME segment, and

Cite as: Kostikov, E., Jilkova, P., & Kotatkova Stranska, P. (2021). Optimization of E-Commerce Distribution Center Location. *Marketing and Management of Innovations*, 2, 166-178. http://doi.org/10.21272/mmi.2021.2-14

Received: 01 March 2021 **Accepted:** 04 June 2021 **Published:** 26 June 2021

Cepel et al. (2020) believed that the COVID-19 pandemic has significantly changed European enterprises. However, since the digital society has become so successful, consumers now expect fast access for their physical deliveries. Based on Oh and Teo (2010), Draskovic et al. (2017), Dzwigol and Wolniak (2018), Svecova (2020), and Hsu et al. (2021), customers preferred to consume safe, healthy, and sustainable products and services. The fundament of a successful logistic company is careful planning to select a cost-optimal customer solution. Due to new warehouse planning, defining the necessary factors harmonized within the future logistics system is essential. At the same time, requirements for volumes of goods, transport costs, external limiting factors, etc., must be precisely defined.

Digital technologies have spread worldwide. Besides, they could revolutionize entire businesses. In turn, e-customers are new economic growth sources (Lampropoulos et al., 2019). They are willing to pay, and the internet and social networks are tools for finding the needed information, product reviews, connecting with other customers or retailers. In many cases, digital technologies have boosted the retail trade to digital transformation (Caballero-Morales et al., 2020), the process of changing the business to operate in an ever-changing digital environment. Osman (2019) presented Smart City as an emerging concept aimed to mitigate challenges raised due to city smartening. Digital technologies, such as mobile phones, the fifth generation of mobile networks, big data connected with multi-cloud strategies, virtual reality, and omnichannel marketing could offer retailers new insights into their business (Petru et al., 2020). Fu et al. (2020) came up with the e-commerce explanation. Based on his definition, e-commerce combines the traditional business model and network technology and information technology in the information era, facing crucial opportunities and challenges. Raguseo (2018) added that companies currently have to deal with profound changes in how they manage their business, their customers, and their business face to the data-driven revolution in management. According to Svobodova and Hedvicakova (2018), customers share information about products, stores, events. McKinnon and Woodburn (1996) identified the main principles for traditional logistics: increasing control over the distribution through a distribution center, raising efficiency by reducing inventory, adapting the quick response system, reverse logistics, and improving overall supply chain management efficiency.

The logistics role in e-commerce is to reduce all risks in the relationship process among sellers and customers (Zyka and Drahotsky, 2019). It is necessary to deliver the right product at the right place at a specific time within the global market. Retailers would like to create a better competitive position, and the main challenge is to deliver smaller logistics units in different countries. According to Lekovic and Milicevic (2013), it is necessary to integrate all aspects of logistics management, such as implementing orders, inventory, warehousing, transportation and packaging, customer service, and development centers, which have new dimensions in connection with e-commerce. Warehouse centers for sending the ordered goods via e-commerce must have adequate storage space. They are usually located in the capital cities near the airport. A warehouse management system should enable easier tracking of products in the warehouse and quickly prepare and send the ordered products.

This paper aims to design the distribution of the central location and warehouse centers considering the e-commerce environment. The optimization is solved by using the Modified Steiner-Weber Problem with additional restrictive conditions. One of the problems might be the central distribution and warehouse center's optimal location, which supplies branches in all EU Member States. There were defined points (the capitals of all EU Member States) to examine the position of the central point of the distribution and warehouse center in connection with the expected annual transport volume. The center's optimal location must be situated within the optimal distance that allows minimum shipping costs.

The paper is structured as follows:

Section 2 presents the related literature review of location optimization in a decision-making process.

Section 3 describes the data and research methodology.

Section 4 shows the empirical results and discussions.

Section 5 concludes this paper with recommendations and further research possibilities.

Literature Review. Location optimization is a decision-making process and analysis. Besides, it is a part of strategic management (Dobrovic et al., 2019). According to Lu et al. (2012), the decision-making problem whose necessary information is geographical is called location decision and is now a part of operations research related to the location of new facilities among existing facilities to optimize them (Paul et al., 2020). According to Aikens (1985), there are basic location models (the capacitated facility location model, simple incapacitated facility location model, the dynamic and stochastic capacitated facility location models). The objective function minimizes transportation fixed investment costs. Transportation costs and customer responsiveness are critical considerations in locating production, distribution, marketing, and service facilities (Bhaskaran and Turnquist, 1990). In 1999 Holmberg investigated the facility location problem with the nonlinear function of the transportation costs. The other objective function parameters could be travel distance, costs, revenues, or the e-commerce level connected with internet use. Klose and Drexl (2005) reviewed some contributions to the current state of facility location models for the distribution system. Based on the research of Eiselt and Laporte (1987), Czyżewsk et al (2019), Farahani et al. (2010) or Ramezani et al. (2013), there were various models developed for the global logistics network design of an assembly system with rules of origin and to analyze how the changes of international relationships would affect logistics network design and evaluation functions. There are a lot of various objectives of optimization that are usually considered. For example, minimizing the longest distance from the central facilities, minimizing the total costs consists of fixed and annual operating costs, the average distance traveled, or the system responsiveness.

The e-service network location and the location choice for the online shop's case within an urban area were investigated by Arai and Sugizaki (2003). Burt and Sparks (2003) added how retailing processes are affected by e-commerce. Reynolds (2000) investigated e-commerce aspects, including consumer reaction and current eCommerce futures. E-commerce shopping is a complex problem with a multicriteria decision-making process. In the process of decision making a variety of factors could have an impact, including the well-being in the living environment (Bilan et al., 2020; Pająk et al., 2019), regional security (Putra et al., 2019) as well as satisfaction with life caused by regional infrastructure development (Kostiukevych et al., 2020), particularly B2C and B2B sectors development (Xuhua et al., 2019). Arbib et al. (2020) turned the question from the customer's point of view. After checking competing offers, customers make individual decisions trying to minimize costs that include both purchase and transportation. In the leading optimization characteristics, the location problem fulfills the possibilities to select the optimum location. Farahani et al. (2010) added that that logistic network design is the strategic issue. Besides, they are divided into multiobjective and multiattribute location optimization problems. Zhou et al. (2002) and Alcaraz et al. (2020) investigated the balanced allocation of customers to multiple distribution centers with a genetic algorithm approach.

Quality management widely discussed the supply chains, which is a platform for decision making and coordination (Tarí et al., 2020). Organizations are dependent on external resources and affected by resource utilization (Lu et al., 2019; Prasad et al., 2018; Kuznetsova & Pohorelenko, 2020). Another aspect of this fact is to design appropriate transport networks based on agile principles. Furthermore, quantitative evidence supporting the view (Tofighi et al., 2016; Abdel-Basset et al., 2020; Girchenko & Panchenko, 2020) of logistics network design problem involving central housing and local distribution centers based on a flexible approach is presented. Based on previous studies (Modgil et al., 2020; Yang et al., 2020; Shiripour and Mahdavi-Amiri, 2020), the paper develops a model applicable to emergency planning that connects multiple sources, including time and considering region-specific characteristics.

Dr. Ahmed M. W. Abdel-Latif (2007) from Saudi Arabia looked for locations for primary schools. The researcher applied the model based on P-median, i.e., by searching for a central point that will serve the given demand in a defined locality.

Methodology and research methods. The selection of the optimal e-supply chain design was conducted using the location-allocation modeling. Location-Allocation models are mathematical programming models based on operation research techniques such as Graph Theory (Teitz and Bart, 1968). The purpose of the objective function in this model is the distance between demand nodes and nearest facilities. The following model methodology is based on a model solving a discrete location problem. A P-distance model based on the known demand size aimed to minimize the level of transport costs between the depot and demand points. A mathematical model coordinates [xi,yi] as the set of points 1,2,...i,...,n and the transport volumes between a set of points and a central point Q1,Q2,...,Qi,...,Qn, where coordinates of the central point's X and Y do not know (Figure 1).

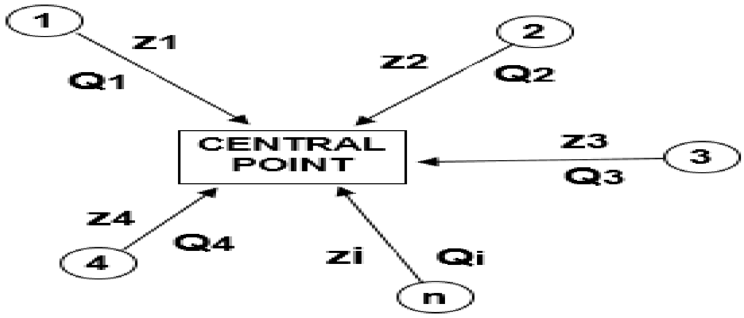

Figure 1. Description of the situation

Sources: developed by the authors.

Z_i is the distance from a central point to point i. The formula determines the distance is described as:

$$z_i = \sqrt{(X - x_i)^2 + (Y - y_i)^2} \qquad (1)$$

The problem is to find a location with minimal costs. This situation describes formula (2).

$$FF = \sum_{i=1}^{n} Q_i z_i = \sum_{i=1}^{n} Q_i \sqrt{(X - x_i)^2 + (Y - y_i)^2} \quad \ldots.minimalization \qquad (2)$$

The problem mentioned above is Steiner-Weber's problem, see in Fathali and Jamalian (2017). Steiner–Weber's problem would be modified through restrictive conditions. The restrictive condition for variables X and Y could be written by the formula (3).

$$[X, Y] \notin (a_1; a_2) \times (b_1; b_2) \qquad (3)$$

It could be assumed that the restricted area is defined as rectangle with coordinates [a_1, b_1], [a_1, b_2], [a_2, b_1], [a_2, b_2]. Then it calculates the values of a_s and b_s, where

$$a_s = \frac{a_1 + a_2}{2}, \qquad b_s = \frac{b_1 + b_2}{2}. \qquad (4)$$

It is also necessary to define a constants k_1 and k_2 as follows:

$$kk_1 = \frac{a_2 - a_1}{2}, \quad k_2 = \frac{b_2 - b_1}{2}. \qquad (5)$$

Figure 2 graphically represents the functioning mathematical model of Steiner–Weber's problem with the restrictive condition

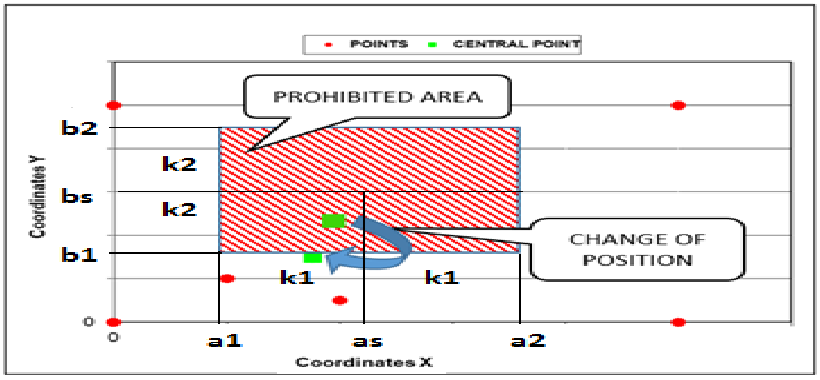

Figure 2. The restricted area is rectangular

Sources: developed by the authors on the basis of (Fathali and Jamalian, 2017).

When the distance *X* from the point *as* is more significant than *k1,* then the *Y* coordinate is arbitrary. Another situation occurs if the distance *X* from the point *as* is smaller than k_1, then the *Y* coordinate must be higher than b_2 or smaller than b_1 according to the following formula (6):

$$IF (X - a_S)^2 \leq {k_1}^2$$
$$THEN$$
$$(Y - b_S)^2 \ \geq \ {k_2}^2. \qquad (6)$$

The central question of this research is an optimization problem. This study aimed to design the location of the central distribution and warehouse center considering the e-commerce environment. It is known the set of points, in this case, there are capital cities of all EU member states ($S_1, S_2, \dots S_i, \dots S_n$), the transport volume ($Q_1, Q_2, \dots Q_i, \dots Q_n$), and the distance ($Z_1, Z_2, \dots Z_i, \dots Z_n$) from the distribution and warehouse center to point S_n.

Figure 3. Description of the solved problem

Sources: developed by the authors based on google maps.

The main aim is to minimize the total cost of transportation in connection with the fact that it is expected that the volume between the central point and each capital city would be different. Consequently, it is necessary to consider various transport volumes. Thus, the distance from the center to each distribution point would be different. The target position of the central point must comply with the restrictive conditions defined areas. Therefore, the solution must respect the constraints of designated areas and minimize the total costs of transport. In the case of the fulfilled requirements, the efficiency of the logistics system is expected. Formula (1, 2) describes the defined situation, where Z_i is the distance from a central point to point S_i. F is the function that would minimize transportation costs based on the Steiner-Weber problem. Besides, there is a restrictive condition for X_i and Y_i variables, based on the formula (2).

The input data to the model are as follows:

- geographical coordinates of branches, resp. Sub-warehouses located in the capitals of the EU Member States (28);
- geographical coordinates of selected main restrictions (e.g., mountains, national parks, airports, sea, etc.) – the area was adapted to the shape of a rectangle or square (the selection was only the most important or most extensive, from airports only the main large airports);
- the expected annual demand for transport (EATV).

The expected annual average transport demand (EATV) is determined according to formula (7).

$$median_{2010-2019}(POP_{tot} * USER_{int}) * w = EATV \quad (7)$$

where POP_{tot} is the number of persons having their usual residence in a country; $USER_{int}$ is the % of INT_{users} in the country in the period 2010-2019, w is weight of population (e.g. number of inhabitant divided number of inhabitant EU (28)).

The research focuses on collecting and interpreting secondary data concerning the position of each point (the capitals of all EU Member States). The mathematical model seeks to answer the question of where best to locate a central warehouse to respect the geographical location of individual states (represented by GPS coordinates of EU capitals) and the quantified annual average transport demand for e-commerce for 2010-2019 with minimal transaction costs incurred from the central warehouse to the sub-warehouses. The input data are GPS coordinates of the capitals of the following selected European countries as such: Belgium, Bulgaria, Czech Republic, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden, Norway, Switzerland, Turkey

Table 1. GPS coordinates of the capitals of the EU countries

State	GPS coordinates	
	North/South	East/West
Brussels	50°50'48"	4°21'9"
Sofia	42°41'50"	23°19'
Prague	50°5' 4"	14°25'16"
Copenhagen	55°40'34"	12°34'8"
Berlin	52°31'	13°23'
Tallinn	59°26'14"	24°44'42"
Dublin	53°20' 33"	6°15' 57"
Athens	53°57'	23°2' 27"
Madrid	40°25' 8"	3°41'31"
Paris	48°52'	2°20'
Zagreb	45°48'	15°57'
Rome	41°53'35"	12°28'58"

Continued Table 1

Nicosia	35°10'	33°21'
Riga	56°26'51"	24°6'25"
Vilnius	54°41'	25°17'
Luxembourg	49°36'41"	6°7'51"
Budapest	47°29'54"	19°2'27"
Valletta	35°54'	14°31'
Amsterdam	52°22'23"	4°53'35"
Vienna	48°12'26"	16°22'16"
Warszawa	52°14'59"	21°0'44"
Lisbon	38°43'	9°10'
Bucharest	44°24'	26°5'
Ljubljana	46°3'	14°31'
Bratislava	48°8'41"	17°6'46"
Helsinki	60°10'15"	24°56'15"
Stockholm	59°19'46"	18°4'7"
London	51°30'26"	0°7'39"

Sources: developed by the authors.

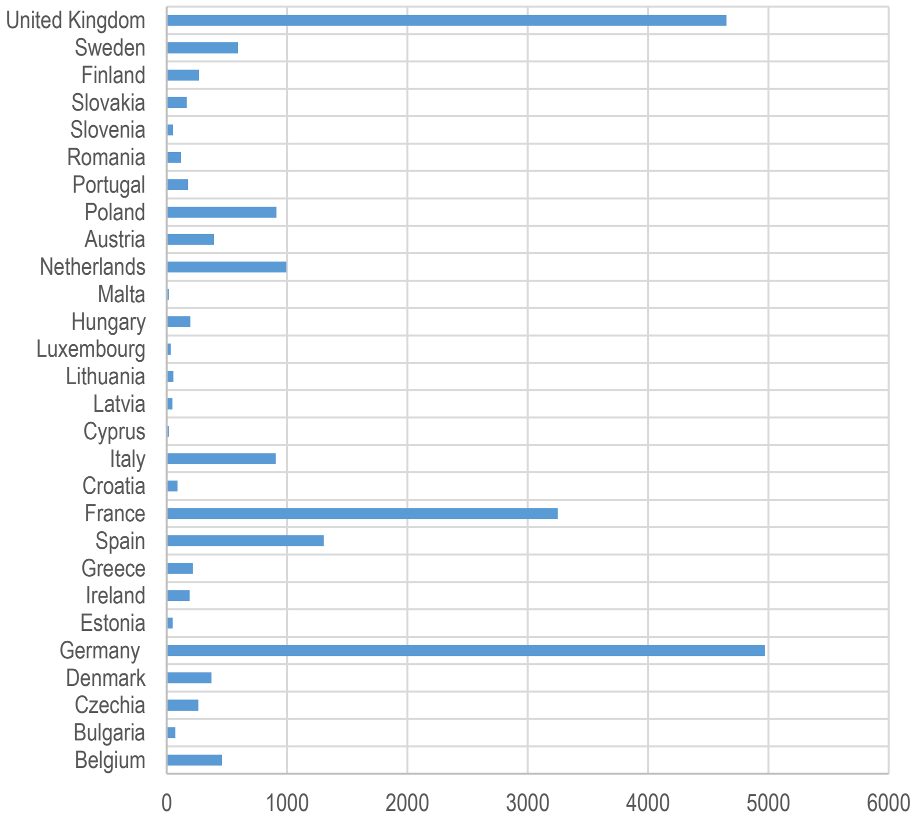

Figure 4. The expected annual average transport (in mil. population)

Sources: developed by the authors.

Results. Firstly, this mathematical model was applied without any constraints. Therefore, the input was the branches' geometric coordinates located in the capitals of each Member State and the expected traffic volume. The first model's output was geometric coordinates, which would place the central warehouse near Berlin in an area with greenery and historical monuments. Figure 4 demonstrates more details. Mathematical modeling took place in the Solver module in the MS Excel spreadsheet.

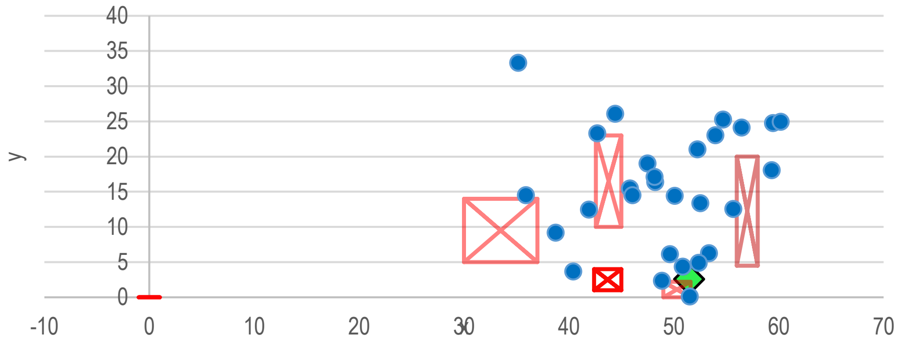

Figure 5. Location of point, central point, restricted area (x and y axes are the coordinates of the city positions)

Sources: developed by the authors.

Since it is impossible to build a distribution center in an area with historical monuments, it was necessary to include restrictive conditions in the model where this area was also excluded. As a result, the mathematical model was subsequently revised.

The restricted area is to define the space between the river Havel, Grunewald, and Zehlendorf. The central point's resulting coordinates are 51 ° 27' N and 2°35'E. These coordinates correspond to the location in the United Kingston, Bristol. Thus, the purpose function's value is 348,15 (expressed in several inhabitants * km (Formula 2). Figure 6 shows the finding the central point by a redpoint.

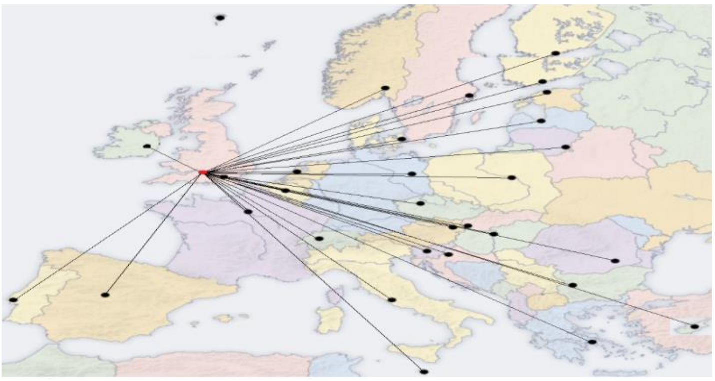

Figure 6. Location of central point on the real map

Sources: developed by the authors.

The optimization of the e-supply chain design was solved in the presented article. Based on literature review, relevant articles are classified under the following themes: 1) Quality management and optimization problem; 2) e-Supply chain management; 3) Global logistics network design; 4) Adequate goods and services processing; 5) E-commerce shopping as a complex problem with a multicriteria decision-making process.

This research aims to propose the optimal distribution of central location and storage centers concerning the environment of e-commerce. This modeling used the Modified Steiner-Weber Problem with additional constraints. The optimal placement of the center must be situated within the optimal distance, which allows minimum shipping costs. The research applied observations to the theory of location problems. Firstly, the study involved insights into location problem theory. The authors presented two different objectives: minimizing the opening and transportation costs if none of the facilities fails and reducing the expected transportation costs.

The model represents a real example of a central warehouse's location, minimizing distribution costs and respecting the main geographical and selected location problems (e.g., mountains, sea, airports, etc.). The relationship between geographical location and quantified annual demand for e-commerce ensures minimum transaction costs from the central warehouse to sub-warehouses. Eighty-six percent of the studied companies plan to use on-demand warehousing in the next three to five years. That showed that the need for warehousing would continue, while they do not necessarily need to have it in-house. Therefore, it is likely that fulfillment centers and warehouses would continue to be a significant component in the future logistics system. This research stresses how important the management of the effective optimization of e-commerce distribution center location is and how to achieve it. The success of Amazon in the US, Europe, and Alibaba in China has genuinely redefined consumer expectations. With the emergence of services like Amazon Prime, consumers now expect same-day delivery. The solution enabling this evolution has been a combination of manufacturing where the production costs are optimal, just-in-time shipping, highly automated fulfillment centers, and, to a growing extent, mobile connectivity.

Secondly, the solved problem is to have a central distribution and warehouse center considering the e-commerce environment in EU member states connected with the expected annual transport volume. The research aim is to obtain the most economical location. There are still significant differences among EU member states in connection with the use of the internet. According to the DISI index (Digital Economy and Society Index 2019), the most developed countries are Denmark, the Netherlands, Sweden, and Finland, followed by Luxembourg, Estonia, and Malta. Compared to the year 2018, Lithuania, Italy, Croatia, and Greece have the fastest improvement in this dimension (European Commission, 2019).

The global internet penetration rate is 59 percent among the population, with Northern Europe ranking first with 95%. Almost 4.54 billion people were using their mobile phones as of January 2020, encompassing 67% of the global population. There were 4.54 billion internet users (59% of the worldwide population). The regions with the highest internet penetration are Denmark, South Korea, and UAE. The region with the highest number of internet users in Asia, with 2 billion users, followed by Europe with almost 705 million internet users.

Finally, the paper describes the optimization problem with additional restrictive areas (mountains, forests, water areas, and none urbanized areas) given a set of locations where the central distribution and warehouse center could be installed. The ways to serve the customers are described. The proportion of internet users who bought or ordered goods or services for private use was in 2019, growing from 23% (in Romania) to 87% (in the United Kingdom). The most significant increases in the last five years, 15% or more, were recorded in Croatia, Czechia, Estonia, Hungary, Lithuania, Poland, Spain, and Slovenia. Besides, the share of e-customers is growing. The highest proportions are in two age groups of 25-54 (76%) and 16-24 (78%) (Eurostat, 2019). International business without the internet is unthinkable. Indeed, the internet connects billions of people worldwide, and it is a core pillar of modern business.

Conclusion. The role of logistics in e-commerce is to reduce all risks in relationships between sellers and customers. It is necessary to deliver the right product in the right place at a particular time in the global market. This research provides an overview of the optimization model designed to find the best location for service provision across a city or region, given the spatial distribution of demand for that service. This research particularly stressed the need to effectively optimize the distribution of central location and storage centers concerning the e-commerce distribution center location. Observations to the theory of location problems have been applied. The proposed model results showed that the best location for a central location and storage center concerning the e-commerce environment, including minimum annual transport costs, is near Bristol in United Kingston. Optimal reliability allocation techniques could be applied to series, parallel, and complex configurations such as bridge and series-parallel. However, the study limitation is in the number of system components and constraints. As they increase, the solutions become more complex, requiring the application of advanced programming methods. Problems are often solved using computer codes.

This paper shows that there is potential for a change in the business practices in retail e-commerce. The role of fulfillment centers and warehouses is likely to continue to evolve. One of the lessons learned from the ongoing COVID-19 pandemic is that critical goods and materials, whether fans, alcohol disinfectants or face masks, would also need local storage in the future. Besides, the achieved results from the given model could be linked to another model, which will include a regression function modeling the shape of e-commerce demand for the scarce commodity as medical goods are and how the EU coped with its distribution the previous year. That is the way where to move the current research next time.

Future studies should focus on the geographic modeling approach to identify the optimal locations for coronavirus disease 2019 testing sites, treatment sites, and food or resources distribution sites. The research should point out the decision-making tools for government leaders to ensure that those most in need have priority access to the care they will require during this crisis.

Author Contributions: conceptualization, P. J. and E. K.; methodology, P. K. S.; software, P. K. S..; validation, P. J., E. K. and P. K. S.; formal analysis, P. K. S.; investigation, E. K. and P. J.; resources, P. J., E. K. and P. K. S.; data curation, P. J., E. K. and P. K. S.; writing-original draft preparation, E. K. and P. J.; writing-review and editing, E. K. and P. J.; visualization, E. K. and P. J.; supervision, E. K. and P. J.; project administration, E. K. and P. J.; funding acquisition, P. J., E. K. and P. K. S.

Funding: This research received no external funding.

References

Abdel-Basset, M., Mohamed, R., Elhoseny, M., & Chang, V. (2020). Evaluation framework for smart disaster response systems in uncertainty environment. Mechanical Systems and Signal Processing, 145, 106941. [Google Scholar] [CrossRef]

Abdel-Latif, A. M. (2007). Combining GIS-Based Spatial Analysis and Optimization Techniques to Generate Optimum Facility Locations. Saudi Aramco. [Google Scholar]

Aikens, C. H. (1985). Facility location models for distribution planning. European journal of operational research, 22(3), 263-279. [Google Scholar] [CrossRef]

Alcaraz, J., Landete, M., Monge, J. F., & Sainz-Pardo, J. L. (2020). Multi-objective evolutionary algorithms for a reliability location problem. European Journal of Operational Research, 283(1), 83-93. [Google Scholar] [CrossRef]

Arai, Y., & Sugizaki, K. (2003). Concentration of call centres in peripheral areas: cases in Japan. NETCOM: Réseaux, communication et territoires/Networks and communication studies, 17(3), 187-202. [Google Scholar]

Arbib, C., Pınar, M. Ç., & Tonelli, M. (2020). Competitive location and pricing on a line with metric transportation costs. European journal of operational research, 282(1), 188-200. [Google Scholar] [CrossRef]

Belas, J., Dvorsky, J., Kubalek, J., & Smrcka, L. (2018). Important factors of financial risk in the SME segment. Journal of International Studies, 11(1). [Google Scholar]

Bhaskaran, S., & Turnquist, M. A. (1990). Multiobjective transportation considerations in multiple facility location. Transportation Research Part A: General, 24(2), 139-148. [Google Scholar] [CrossRef]

Bilan, S., Mishchuk, H., Bilan, Y., & Mishchuk, V. (2020). Empirical Study of Migration Caused by Well-being in Living and Working Environment. In Proceedings of the 34th International Business Information Management Association Conference, IBIMA (pp. 11159-11169). [Google Scholar]

Burt, S., & Sparks, L. (2003). E-commerce and the retail process: a review. Journal of Retailing and Consumer Services, 10(5), 275-286. [Google Scholar] [CrossRef]

Caballero-Morales, S. O., Guridi, J. D. J. C., Alvarez-Tamayo, R. I., & Cuautle-Gutiérrez, L. (2020). Education 4.0 To Support Entrepreneurship, Social Development And Education In Emerging Economies. International Journal of Entrepreneurial Knowledge, 8(2), 89-100. [Google Scholar] [CrossRef]

Cepel, M., Gavurova, B., Dvorsky, J., & Belas, J. (2020). The impact of the covid-19 crisis on the perception of business risk in the sme segment. Journal of International Studies, 13(3). [Google Scholar] [CrossRef]

Czyżewski, B., Matuszczak, A., & Miskiewicz, R. (2019). Public Goods Versus the Farm Price-Cost Squeeze: Shaping the Sustainability of the EU's Common Agricultural Policy. Technological and Economic Development of Economy, 25(1), 82-102. [CrossRef]

Dobrovic, J., Kmeco, Ľ., Gallo, P., & Gallo jr, P. (2019). Implications of the Model EFQM as a strategic management tool in practice: a case of Slovak tourism sector. Journal of Tourism and Services, 10(18), 47-62. [Google Scholar] [CrossRef]

Draskovic, M., Milica, D., Mladen, I., & Chigisheva, O. (2017). Preference of institutional changes in social and economic development. Journal of International Studies, 10(2). [Google Scholar] [CrossRef]

Dzwigol, H., & Wolniak, R. (2018). Controlling w procesie zarządzania chemicznym przedsiębiorstwem produkcyjnym [Controlling in the management process of a chemical industry production company]. Przemysl Chemiczny, 97(7), 1114-1116. [CrossRef]

Eiselt, H. A., & Laporte, G. (1987). Combinatorial optimization problems with soft and hard requirements. Journal of the Operational Research Society, 38(9), 785-795. [Google Scholar] [CrossRef]

European Commission. (2019). Digital Economy and Society Index (DESI). Retrieved from [Link]

Eurostat. (2019). Ageing Europe - statistics on population developments. Retrieved from [Link]

Farahani, R. Z., SteadieSeifi, M., & Asgari, N. (2010). Multiple criteria facility location problems: A survey. Applied mathematical modelling, 34(7), 1689-1709. [Google Scholar] [CrossRef]

Fathali, J., & Jamalian, A. (2017). Efficient methods for goal square Weber location problem. Iranian Journal of Numerical Analysis and Optimization, 7(1), 65-82. [Google Scholar] [CrossRef]

Fu, H., Manogaran, G., Wu, K., Cao, M., Jiang, S., & Yang, A. (2020). Intelligent decision-making of online shopping behavior based on internet of things. International Journal of Information Management, 50, 515-525. [Google Scholar] [CrossRef]

Girchenko, T. D., Panchenko, O.V. (2020). Research on the practical aspects of the providing efficiency of marketing communications' bank. Financial and credit activity-problems of theory and practice, 3. P. 13-22. [CrossRef]

Holmberg, K. (1999). Exact solution methods for uncapacitated location problems with convex transportation costs. European Journal of Operational Research, 114(1), 127-140. [Google Scholar] [CrossRef]

Hsu, P. F., Nguyen, T. K., & Huang, J. Y. (2021). Value co-creation and co-destruction in self-service technology: A customer's perspective. Electronic Commerce Research and Applications, 46, 101029. [Google Scholar] [CrossRef]

Klose, A., & Drexl, A. (2005). Facility location models for distribution system design. European journal of operational research, 162(1), 4-29. [Google Scholar] [CrossRef]

Kostiukevych, R., Mishchuk, H., Zhidebekkyzy, A., Nakonieczny, J., & Akimov, O. (2020). The impact of European integration processes on the investment potential and institutional maturity of rural communities. Economics & Sociology, 13(3), 46-63. [Google Scholar] [CrossRef]

Kuznetsova, A., Pohorelenko, N. (2020). Mechanism of providing financial stability of the banking system of Ukraine. Financial and credit activity-problems of theory and practice, 4. P. 37-47. [CrossRef

Lampropoulos, G., Siakas, K., & Anastasiadis, T. (2019). Internet of things in the context of industry 4.0: an overview. International Journal of Entrepreneurial Knowledge, 7(1), 4-19. [Google Scholar] [CrossRef]

Lekovic, S., & Milicevic, N. (2013). The importance and characteristics of logistics in electronic commerce. In 1st Logistics International Conference. Belgrade, Serbia (pp. 28-30). [Google Scholar]

Lu, Q., Wu, J., Goh, M., & De Souza, R. (2019). Agility and resource dependency in ramp-up process of humanitarian organizations. The International Journal of Logistics Management, 30(3), 845-862. [Google Scholar] [CrossRef]

Lu, Z., Wang, S., Li, X., Yang, L., Yang, D., & Wu, D. (2012). Online shop location optimization using a fuzzy multi-criteria decision model-case study on Taobao. com. Knowledge-Based Systems, 32, 76-83. [Google Scholar] [CrossRef]

McKinnon, A. C., & Woodburn, A. (1996). Logistical restructuring and road freight traffic growth. Transportation, 23(2), 141-161. [Google Scholar] [CrossRef]

Modgil, S., Singh, R. K., & Foropon, C. (2020). Quality management in humanitarian operations and disaster relief management: a review and future research directions. Annals of operations research, 1-54. [Google Scholar] [CrossRef]

Oh, L. B., & Teo, H. H. (2010). Consumer value co-creation in a hybrid commerce service-delivery system. International Journal of Electronic Commerce, 14(3), 35-62. [Google Scholar] [CrossRef]

Osman, A. M. S. (2019). A novel big data analytics framework for smart cities. Future Generation Computer Systems, 91, 620-633. [Google Scholar] [CrossRef]

Pająk, K., Kvilinskyi, O., Fasiecka, O., & Miskiewicz, R. (2017). Energy security in regional policy in Wielkopolska region of Poland. Economics and Environment, 2(61), 122-138. [Google Scholar]

Paul, J. A., & MacDonald, L. (2016). Location and capacity allocations decisions to mitigate the impacts of unexpected disasters. European Journal of Operational Research, 251(1), 252-263. [Google Scholar] [CrossRef]

Petru, N., KramoliS, J. & Stuchlík, P. (2020). Marketing Tools in the Era of Digitization and Their Use in Practice by Family and Other Businesses. Ekonomics and Management, 23(1), 197–212. [Google Scholar] [CrossRef]

Prasad, S., Zakaria, R., & Altay, N. (2018). Big data in humanitarian supply chain networks: A resource dependence perspective. Annals of Operations Research, 270(1), 383-413. [CrossRef] [Google Scholar]

Putra, B. A. (2019). ASEAN Political-Security Community: Challenges of establishing regional security in the Southeast Asia. Journal of International Studies, 12(1). [Google Scholar]

Raguseo, E. (2018). Big data technologies: An empirical investigation on their adoption, benefits and risks for companies. International Journal of Information Management, 38(1), 187-195. [Google Scholar] [CrossRef]

Ramezani, M., Bashiri, M., & Tavakkoli-Moghaddam, R. (2013). A new multi-objective stochastic model for a forward/reverse logistic network design with responsiveness and quality level. Applied Mathematical Modelling, 37(1-2), 328-344. [Google Scholar] [CrossRef]

Reynolds, J. (2000). E-Commerce: a critical review. International Journal of Retail & Distribution Management, 28(10), 417–444. [Google Scholar] [CrossRef]

Shiripour, S., & Mahdavi-Amiri, N. (2020). Disaster relief on destructive transportation networks using a circle-based approach. Transportation Letters, 1-23. [Google Scholar] [CrossRef]

Svecova, L., Ostapenko, G., & Veber, J. (2020). Impact of Global Trends and the Coronavirus Challenge on Consumer Behavior. In 2020 6th International Conference on Social Science and Higher Education (ICSSHE 2020) (pp. 1005-1009). Atlantis Press. [Google Scholar] [CrossRef]

Svobodova, L., & Hedvicakova, M. (2018). Shopping on the Internet and Use of the Technology. Advanced Science Letters, 24(4), 2953-2957. [Google Scholar] [CrossRef]

Tarí, J. J., Pereira-Moliner, J., Molina-Azorín, J. F., & López-Gamero, M. D. (2020). A Taxonomy of Quality Standard Adoption: Its Relationship with Quality Management and Performance in Tourism Organizations In Spain. Journal of Tourism & Services, 11(21). [Google Scholar] [CrossRef]

Teitz, M. B., & Bart, P. (1968). Heuristic methods for estimating the generalized vertex median of a weighted graph. Operations research, 16(5), 955-961. [Google Scholar] [CrossRef]

Tofighi, S., Torabi, S. A., & Mansouri, S. A. (2016). Humanitarian logistics network design under mixed uncertainty. European Journal of Operational Research, 250(1), 239-250. [Google Scholar] [CrossRef]

Victor, V., Thoppan, J. J., Fekete-Farkas, M., & Grabara, J. (2019). Pricing strategies in the era of digitalisation and the perceived shift in consumer behaviour of youth in Poland. Journal of International Studies, 12(3). [Google Scholar]

Xuhua, H., Elikem, O. C., Akaba, S., & Worwui-Brown, D. (2019). Effects of Business-To-Business E-Commerce Adoption on Competitive Advantage of Small and Medium-Sized Manufacturing Enterprises. Economics & sociology, 12(1), 80-366. [Google Scholar] [CrossRef]

Yang, J., Hou, H., Ju, Y., Gu, S., Qian, Z., & Wang, X. (2020). The Mechanism of Distribution Effectiveness of Territory Emergency Public Storage Materials. Sustainability, 12(21), 8940. [Google Scholar] [CrossRef]

Zhou, G., Min, H., & Gen, M. (2002). The balanced allocation of customers to multiple distribution centers in the supply chain network: a genetic algorithm approach. Computers & Industrial Engineering, 43(1-2), 251-261. [Google Scholar] [CrossRef]

Zyka, J., & Drahotsky, I. (2019). Methodology for Assessing the Impact of Workplace Ergonomic Factors on Airport Security Screener´ s Reliability and Performance. Journal of Tourism and Services, 10(18), 104-116. [Google Scholar] [CrossRef]

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Логістичні центри онлайн-торгівлі: пошук оптимального розташування

Закриття урядами країн міжнародних кордонів у відповідь на спалах пандемії COVID-19 спричинило значні збитки у міжнародному товароперевезенні та активізувало необхідність трансформації логістичних операцій з доставки товарів у системах електронної торгівлі. Метою статті є пошук оптимального місця розташування логістичних центрів онлайн-торгівлі. Для досягнення поставленої мети використано модифіковану модель Штейнера-Вебера, що дозволяє визначити оптимальне місце розташування центрального логістичного складу компанії та мінімізувати витрати при розподілі продукції від центрального складу до філій, розташованих в окремих країнах. Об'єктом дослідження обрано компанії у сфері онлайн-торгівлі. Встановлено, що 86% досліджуваних компаній планують використовувати складські приміщення протягом найближчих трьох-п'яти років та зосереджуватимуть свою діяльність на розбудові логістичної системи. Емпірично обґрунтовано ефективність менеджменту компаній Amazon у США та Європі, а також та Alibaba в Китаї з оптимального розташування їх логістичних центрів. Основним факторами ефективного перетворення товарообороту у логістичних центрах є оптимізація виробничих затрат, своєчасність доставки товарів, розвиток високоавтоматизованих центрів обробки замовлень (зокрема, сервіс Amazon Prime дозволяє споживачам отримати замовлений товар у той же день). Дослідження емпірично підтверджує та теоретично доводить необхідність і специфіку створення логістичних центрів онлайн-торгівлі в окремих містах країн Європейського Союзу. Результати проведеного дослідження можуть бути корисними для власників, менеджерів компанії, які надають послуги з вантажоперевезення автомобільним, залізничним, морським та авіатранспортом, де важливими базовими факторами ефективності функціонування є відповідність вимогам до обсягів товарів, мінімізація транспортних витрат, своєчасне врахування зовнішніх обмежувальних факторів тощо.

Ключові слова: пандемія COVID-19, розподільчий центр, електронна комерція, вибір місця розташування, управління якістю.