

## Sustainable logistics and passenger transport in smart cities

### **Olha Prokopenko**

Estonian Entrepreneurship University of Applied Sciences, 10a Suur-Sõjamäe, Tallinn 11415, Estonia, EU  
Sumy State Makarenko Pedagogical University, 87 Romanska Street, Sumy 40000, Sumy region, Ukraine,  
olha.prokopenko@eek.ee (corresponding author)

### **Gunnar Prause**

Wismar Business School, Wismar University, 14 Philipp-Müller-Straße, Wismar 23966, Germany, EU  
Tallinn University of Technology, 5 Ehitajate tee, Tallinn 12616, Estonia, EU, gunnar.prause@hs-wismar.de

### **Taliat Bielialov**

Kyiv National University of Technologies and Design, 2 Nemyrovycha-Danchenko Street, Kyiv 01011, Ukraine,  
bielialov.taliat.knutd23@gmail.com

### **Marina Jarvis**

Estonian Entrepreneurship University of Applied Sciences, 10a Suur-Sõjamäe, Tallinn 11415, Estonia, EU  
Tallinn University of Technology, 5 Ehitajate tee, Tallinn 12616, Estonia, EU, marina.jarvis@eek.ee

### **Mykola Holovanenko**

Taras Shevchenko National University of Kyiv, 60 Volodymyrska Street, Kyiv 01033, Ukraine,  
mykolaholovanenko47@gmail.com

### **Inna Kara**

Lviv Polytechnic National University, 14 Stepana Bandery Street, Lviv 79000, Ukraine,  
demchuk\_inna@ukr.net

**Keywords:** sustainable development, smart city, sustainable logistics, green logistics, ecology, e-commerce.

**Abstract:** The rapid growth of urban populations, coupled with the imperatives of decarbonization and the relentless march of urbanization, has thrust modern cities into a crucible of multifaceted challenges. In response, the Smart City concept has emerged as a shared paradigm for addressing these urban complexities. This transformative approach touches upon various facets of urban life, encompassing areas such as the economy, education, and governance. Among these, logistics stands out as a pivotal component of the Smart City framework, necessitating innovative and sustainable solutions. This article delves into the intricate nexus between sustainable logistics systems and the evolution of the Smart City concept. Drawing from both qualitative and quantitative research methodologies, including multivariate analysis, the study synthesizes data from primary sources collected during a series of European projects conducted from 2020 to 2023, in addition to secondary data sources. A central inquiry revolves around the symbiotic relationship between e-commerce dynamics and the sustainability of smart city logistics solutions. The findings of this investigation illuminate a compelling correlation between the profitability of logistics enterprises and the key indicators of logistics development underpinning smart cities. By unveiling these interdependencies, this research contributes to our understanding of how sustainable logistics and passenger transport systems are pivotal to the ongoing development of smart cities, offering valuable insights for urban planners, policymakers, and industry stakeholders alike.

## **1 Introduction**

An ever-increasing share of the world's population lives in cities, which creates new and deepens existing problems regarding the disposal of more significant waste amounts, aggravating the problems of traffic jams and environmental pollution. These processes are accompanied by reducing resources necessary for life, [1], and force to pay more and more attention to "green" issues in development decision-making, [2].

Experts in ecology, politics, and economics have concluded that the Smart City concept is a response to the growing number of problems, [3]. The city into a "smart" one is transformed by implementing innovations, regardless of the master plans of such cities, [4]. A smart city is defined not by an urban plan but by the ability to

adapt to the demands arising in the course of economic, technological, and cultural development, [5].

The Smart City concept applies to changes in the economy, education, management, mobility, the environment, and the lives of residents, [6]. Mobility is a critically important area — transport, passenger and cargo transportation, and logistics in general. Urban development decisions inevitably adapt to the necessary logistics solutions, [7].

The field of logistics serves all other areas of life, has a significant positive impact on solving the problems of modern cities, [8-10], and is a source of different problems, including harmful emissions, traffic jams, noise pollution, accidents, [11-13]. Meanwhile, scholars coined the concept of green logistics, focusing more on the environmental impact of logistics and the concept of sustainable logistics,

**Sustainable logistics and passenger transport in smart cities**

Olha Prokopenko, Gunnar Prause, Taliat Bielialov, Marina Jarvis, Mykola Holovanenko, Inna Kara

comprising environmental issues of logistics and social and economic aspects of logistics, [14,15]. Both concepts play a vital role in the context of the Smart City concept, [16].

The vector of sustainable logistics aims to ensure environmental friendliness and a socially and economically prospering orientation of supplies and transportation, [17]. Hence, sustainable logistics must ensure the needs of customers in quality goods and convenient methods of delivery and transportation with minimal damage to the environment, [18], realized through green transport technologies with low emissions and circular economy-oriented approaches in packaging and storing of goods by using information and communication technologies (ICT) and the introduction of the Smart Logistics concepts, [19]. The sustainable logistics system's development goes alongside the evolution of related fields comprising new ICT developments, abatement and automatization technologies, green energy concepts, circular economy implementations and e-commerce.

The study aims to determine the mutual influence of the logistics system development as a basis for the development of a smart city and related areas. The aim involved the fulfillment of the following research objectives:

- Outline the conceptual framework of the study.
- Assess the infrastructure and logistics of European countries and establish a link between the efficiency of logistics and related areas.
- Assess the influence of e-commerce development indicators on the profit of international logistics companies.

The research used the following methods: system-structural approach, cluster approach, correlation analysis, and economic and statistical analysis. The conceptual framework was built for the conducted research, which made it possible to describe the relationship between sustainable development, smart city, and sustainable logistics concepts. Correlation analysis was used to determine that the development of e-commerce is closely related to the development of logistics and infrastructure in European countries. It was determined that there is also a close correlation between the profit of some of the studied logistics companies and logistics development indicators. Future research should focus on identifying differences in the transformation of the logistics system based on sustainable development in the B2B, B2C and B2G sectors.

## 2 Literature review

The research is based on a clear understanding of the Smart City concept and current trends in logistics and passenger transportation within the Sustainable Logistics concept. The research problem is reflected in the work of authors, [20], which provides predictive results regarding the trend toward an increasing population living in cities. Therefore, cities will have to provide many residents with sufficient resources while issues of ensuring economic, ecological, and social sustainability come to the fore. The

researchers note that transforming the city into a Smart City requires solving several urgent problems, which necessitates close cooperation between the state and private participants.

The study's theoretical framework is based on the work of authors, [21], who distinguish areas related to the Smart City concept. In addition to the smart economy and providing jobs, a smart industry should be developed in a smart city, primarily related to ICT development. Moreover, the process of transforming the city into a Smart City should take into account modern transport technologies. In creating a list of aspects that should be improved in smart cities using ICT, researchers, [22], put smart mobility first.

Many researchers focus on ecological (green) and sustainable logistics issues. In work, [23], note that growing attention to the problems of mitigating the adverse effects of transport and increasing the productivity of supply chains. Researchers, [24], dwell on the analysis of existing definitions of sustainable logistics and conclude that most studies focus on ways to reduce the negative impact of logistics operations on the environment. Authors, [25], investigate energy efficiency and greenhouse gas emissions in logistics hubs.

In work, [26], deal with the issues of sustainable logistics in smart cities, formulating the primary goal of logistics management of a smart city — sustainable development through reducing the consumption of natural resources and optimizing the provision of services. This study (on the example of Brazil), as well as authors, [27], (2020) (China) and researchers, [28], (Australia), assigned a key role in the evolution of smart cities to urban logistics. Authors, [4], characterize urban logistics as an imperative mechanism of a smart city. Using the example of Smart City projects in the United States of America (USA) and the EU, Paskannaya and Shaban, [29], conclude that the goal of implementing such projects is to minimize damage to the environment, increase the efficiency of the use of material and technical resources and the process of making management decisions.

Another relevant direction is the study of the connection between the development of logistics and the e-commerce market. In turn, electronic commerce has a significant connection with the development of ICT, [30], which is the basis for the evolution of smart cities. In work, [31], note that the rapid growth of e-commerce creates new opportunities for global growth in the number of logistics service providers. Hoffmann and Prause, [32,33], point out the sustainability gains of autonomous delivery robots in e-commerce and tele-driving concepts in urban personnel transportation by highlighting the importance of the last-mile problem for logistics.

## 3 Methods and materials

The structure of the article consists of three consecutive stages. The first stage provided for defining a conceptual research framework using the system-structural approach that considers the concepts of sustainable development and

**Sustainable logistics and passenger transport in smart cities**

Olha Prokopenko, Gunnar Prause, Taliat Bielialov, Marina Jarvis, Mykola Holovanenko, Inna Kara

its goals, Smart City and logistics, the combination of which produces the definition of sustainable logistics.

The second stage involved a choice of a region for further analysis - the countries of Europe. The region was chosen by the location of most of the world's developed smart cities and the implementation of efficient logistics systems. The list of countries for analysis was determined - 37 European countries with the data on infrastructure and logistics freely available in the European E-commerce Report 2022, [34]. This Report provides information on rankings and indices regarding the infrastructure of European countries, so the results of using the ranking method were applied in the research. The following indices were used in the study: Logistics Performance Index (2018), Ease of Doing Business Index (2020), E-Government Development Index (2020), Inclusive Internet Index (2021), Universal Postal Union Reliability Score (2021), UNCTAD B2C E-commerce Index Ranking (2020), Environmental Performance Index Ranking (2020), Global Cybersecurity Index Ranking (2020).

The data of the European E-Commerce Report 2022 contributed to the research questions' solution by applying multivariate analysis methods. The focus of the methods was laid on hierarchical cluster analysis by using Ward's minimum variance method with Euclidian distance and correlation analysis by interpreting the values of the country vectors of the European E-Commerce Report 2022 as metric scaled. In addition to the European E-Commerce Report 2022 data set, other metric-scaled data from secondary sources complemented the study.

The cluster analysis was used to divide 37 European countries into three clusters according to the indices mentioned in the previous paragraph because this number of clusters was optimal through the analysis of average graphs.

The correlation analysis was conducted for the Logistics Efficiency Index and other above-mentioned indices. It was determined which indices are most closely

related to the Logistics Performance Index and, therefore, hypothetically influence the trends in the logistics industry. According to this analysis, the development of logistics in the world is most closely related to the development of electronic government, electronic commerce, and environmental indicators. The study of the relationship between the development of logistics and e-commerce indicators represents the highest interest among these indicators, which can be justified as follows:

- The first, there is a close correlation between the Logistics Performance Index and the UNCTAD B2C E-commerce Index.
- The second, the analysis of academic literature shows a high interest of researchers in the trends of logistics and e-commerce, and many studies note the mutual influence of these spheres.
- The third, e-commerce is one of the key current trends, as well as the development of the digital sphere in general, so logistics companies cannot fail to consider this influence in their activities. This influence extends not only to changes in user requirements but also to the need to introduce the latest technologies in logistics companies — for example, providing the ability to book/buy tickets for passenger transportation online, compare routes, choose alternative carriers, vehicles, travel time and others.

The third stage of the research provided for determining the dynamics of net profit and net income of logistics companies engaged in passenger transportation (GAL-VSESVIT LLC, East-European Travel Joint Ukrainian-English Company, GUNSEL LLC) using economic and statistical analysis. Ukraine is of high scientific interest in the context of the study, as the aspects of the post-war recovery of the country head the list of the most critical tasks for the Ukrainian government and international partners, given a large-scale invasion of the country and the urgent issue of granting Ukraine the EU member status. The post-war recovery could be most effective using Smart Cities and Sustainable Logistics concepts.

*Table 1 Indicators of net profit, net income of companies and e-commerce development indicators for correlation analysis*

UAH thousand	2019	2020	2021	2022
GAL-VSESVIT LLC (net income)	82,546.00	37,437	60,838	128,925
GAL-VSESVIT LLC (net profit)	-10,697	-11,037	1,276	16,715
East-European Travel Joint Ukrainian-English Company (net income)	26,852.7	12,443.4	17,468.4	20,042
East-European Travel Joint Ukrainian-English Company (net profit)	1,763.4	1,028.2	799.8	450.8
GUNSEL LLC (net income)	172,585.1	148,111.7	217,974.5	49,306.6
GUNSEL LLC (net profit)	-1,4165	-6,177	6,176.1	-9,176.2
Online buyers in Europe (% of total internet users)	69	74	73	75
Online buyers in Ukraine (% of the total number of Internet users)	35	40	44	48
The volume of the e-commerce market in Ukraine (USD milliard)	2.9	4.0	4.4	5.1
The share of e-commerce in Ukraine (% of the volume of retail trade)	6.9	8.8	9.2	9.7
Dynamics of global volumes of electronic retail sales (USD milliard)	3,535	4,206	4,927	5,695

Source: compiled by the authors according to [35].

The correlation analysis was also used to establish a connection between the net profit and net income of the above-mentioned companies on the one hand and the e-commerce indicators on the other. Hypothetically, companies' net profit, as the main result of their activity,

should reflect the current trends in the economy and the degree of their influence on the company's activities. Determining the correlation between net profit, company income, and e-commerce indicators is an important task considering that the development of e-commerce and the

**Sustainable logistics and passenger transport in smart cities**

Olha Prokopenko, Gunnar Prause, Taliat Bielialov, Marina Jarvis, Mykola Holovanenko, Inna Kara

scope of application of its tools by the company is one of the leading such trends and probably affects the activities of logistics companies. In other words, an attempt was made at this stage to identify close correlations between the net profit and net income of companies, on the one hand, and the following indicators of the development of e-commerce, on the other:

- The percentage of online buyers in Europe, the percentage of online buyers in Ukraine.
- The volume of the e-commerce market of commerce in Ukraine, the share of e-commerce in Ukraine.
- The dynamics of global volumes of electronic retail sales.

As a result, a rectangular correlation matrix was built with the determination of the strength of the correlation. Table 1 shows the indicators of net profit, net income of companies and e-commerce development indicators for analysis, all representing metric scaled values.

**4 Results**

**4.1 Conceptual framework of the research**

The Sustainable Development, Smart Cities, and Sustainable Logistics concepts are closely related and interdependent (Figure 1). The evolution of smart cities is inextricably linked with such Sustainable Development Goals (SDGs) as sustainable development of cities and communities, decent work and economic growth, quality education, industry, innovation and infrastructure. Sustainable logistics is a necessary prerequisite for developing a smart city and, in turn, concerns such SDGs as responsible consumption and production and mitigation of climate change.

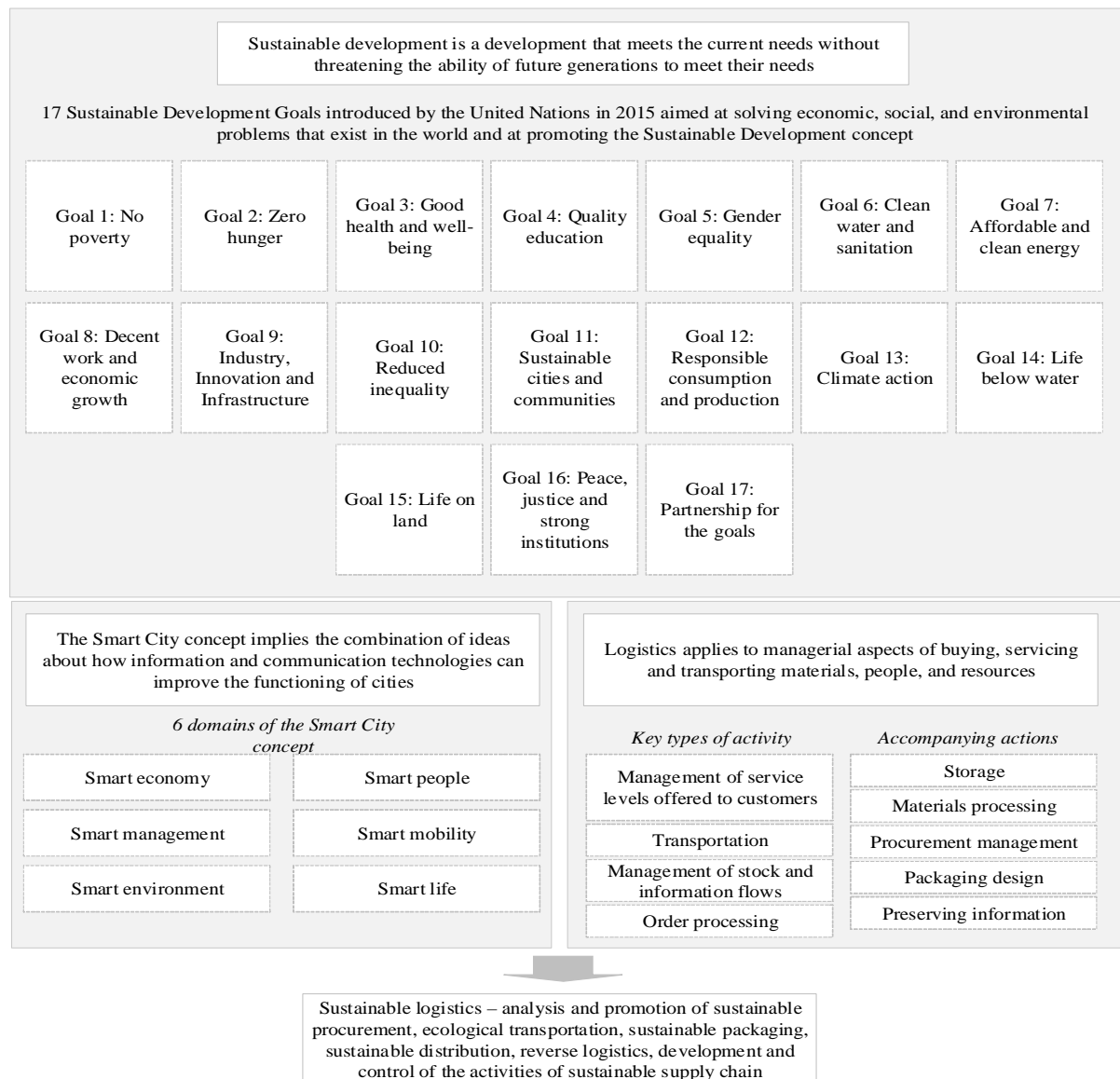


Figure 1 Conceptual framework of the research

Source: prepared and summarized by the authors based on [21,24].

The relationships in Figure 1 are interpreted as follows: smart cities must be developed with the unconditional consideration of the SDGs because of the defined domains of the Smart City concept. In turn, one of these domains is smart mobility, which primarily concerns the logistics system. At the same time, logistics must be sustainable in order to comply with the concept of sustainable development. So, modern logistics companies should care not only about profit maximization and market position but also about environmental friendliness and the social vector of activity.

#### 4.2 Infrastructure and logistics of European countries and establishing a link between logistics performance and related areas

To date, many indices and rankings are designed to evaluate logistics performance and related indicators. A comprehensive analysis of the 2022 European E-commerce Report, [34], is worth noting. The Report provides the values of indices and rankings related to infrastructure and logistics of 37 European countries, enabling the clustering of these countries according to the development of infrastructure and logistics. The cluster analysis determined that the optimal distribution is the clustering of the studied countries into three clusters, which is confirmed by evaluating the average graphs for each cluster (Figure 2).

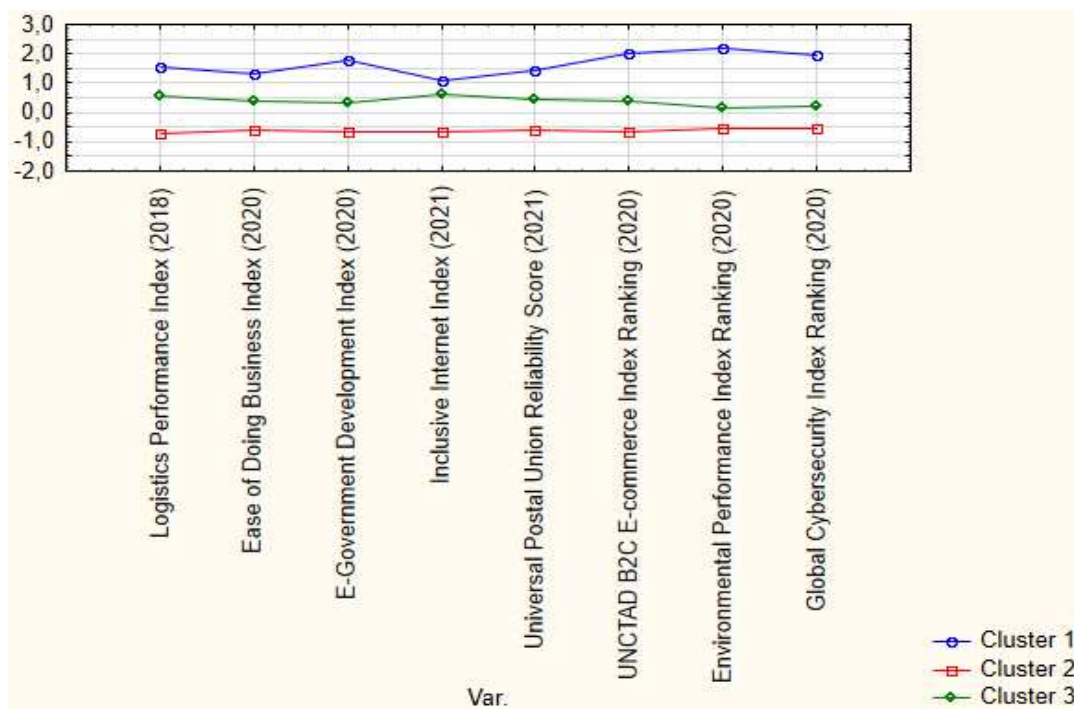


Figure 2 Averages graphs for clusters

The following clusters were identified as a result of the conducted cluster analysis:

Cluster 1 (Cluster with insufficiently developed infrastructure and logistics): Albania, Bosnia and Herzegovina, Montenegro, Ukraine;

Cluster 2 (Cluster with developed infrastructure and logistics): Belgium, France, Ireland, Netherlands, United Kingdom, Denmark, Germany, Estonia, Finland, Lithuania, Norway, Sweden, Austria, Czech Republic, Poland, Switzerland, Italy, Portugal, Spain;

Cluster 3 (Cluster with medium indicators of infrastructure and logistics): Luxembourg, Iceland, Latvia, Hungary, Slovakia, Slovenia, Bulgaria, Croatia, North Macedonia, Romania, Serbia, Cyprus, Greece, Malta.

The Cluster with developed infrastructure and logistics includes countries where individual cities belong to the most developed smart cities in the world. Such cities include London (United Kingdom), Amsterdam (Netherlands), Paris (France), Copenhagen (Denmark), Berlin (Germany), Vienna (Austria). Reykjavik, the capital of Iceland, which also belongs to the most developed smart cities, was included in the Cluster with medium indicators of infrastructure and logistics.

In the context of the study, the countries' Logistics Performance Index is of particular scientific interest among the above-mentioned indices. Table 2 shows how closely this index correlates with all other indices.

**Sustainable logistics and passenger transport in smart cities**

Olha Prokopenko, Gunnar Prause, Taliat Bielialov, Marina Jarvis, Mykola Holovanenko, Inna Kara

*Table 2 Results of the correlation analysis of the Logistics Performance Index with other indices*

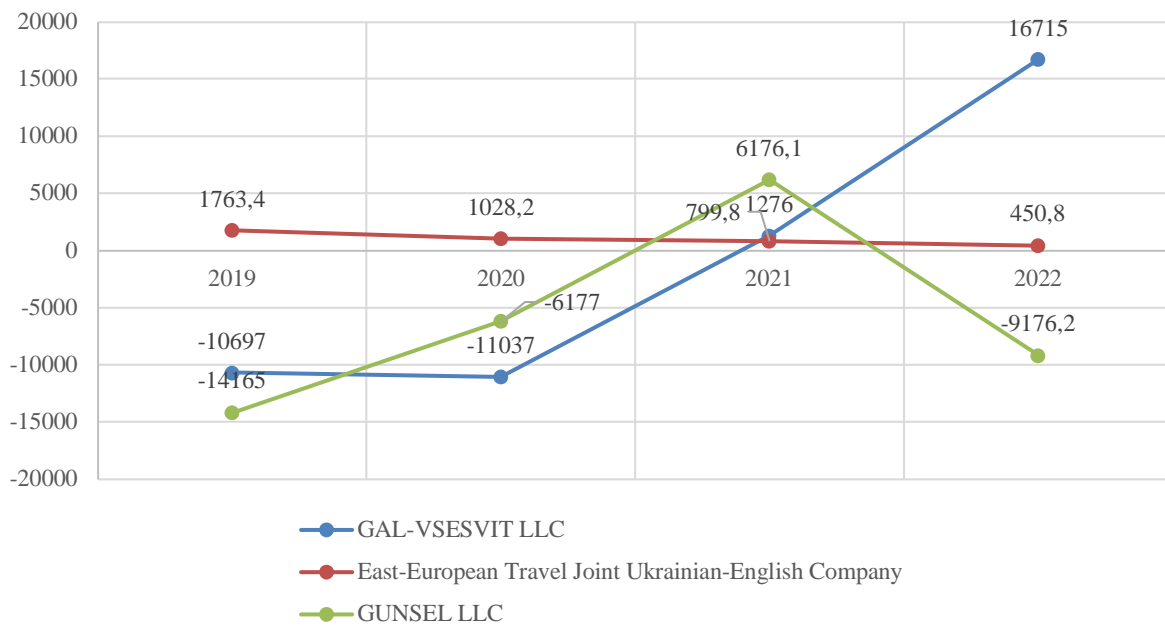
	Logistics Performance Index (2018)
Ease of Doing Business Index (2020)	0.461359
E-Government Development Index (2020)	0.733859
Inclusive Internet Index (2021)	0.637742
Universal Postal Union Reliability Score (2021)	0.652973
UNCTAD B2C E-commerce Index Ranking (2020)	0.834518
Environmental Performance Index Ranking (2020)	0.838396
Global Cybersecurity Index Ranking (2020)	0.571861

The results of the calculations give grounds to conclude that the closest correlation is observed between the Logistics Performance Index and the E-government Development Index, the UNCTAD B2C E-commerce Index, and the Environmental Performance Index.

in the context of the evolution of smart cities. It is proposed to analyze whether e-commerce indicators affect logistics companies' profit in passenger transportation. They include GAL-VSESVIT LLC, East-European Travel Joint Ukrainian-English Company and GUNSEL LLC. The dynamics of these companies' net profit (NP) and net income (NI) are shown in Figures 3 and 4, respectively.

**4.3 The impact of e-commerce development indicators on the profit of international logistics companies**

The literature review shows that e-commerce has the most significant impact on logistics processes, particularly



*Figure 3 Dynamics of net profit of the studied companies for 2019-2022*

Source: built by the authors based on [35].

**Sustainable logistics and passenger transport in smart cities**

Olha Prokopenko, Gunnar Prause, Taliat Bielialov, Marina Jarvis, Mykola Holovanenko, Inna Kara

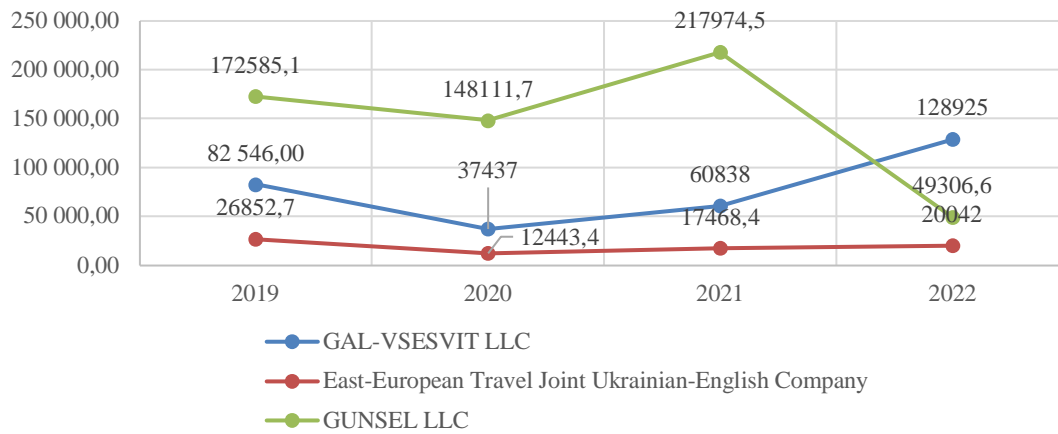


Figure 4 Dynamics of net income of the studied companies for 2019-2022  
Source: built by the authors based on [35].

Table 3 shows the results of the correlation analysis between, on the one hand, NP and NI of the studied companies and, on the other hand, e-commerce indicators.

Table 3 Results of the correlation analysis of the Logistics Performance Index with other indices

	Online buyers in Europe	Online buyers in Ukraine	The volume of the e-commerce market in Ukraine	The share of e-commerce	Dynamics of global volumes of electronic retail sales
GAL-VSESVIT LLC (NI)	0.138405	0.492397	0.412681	0.209775	0.563695
GAL-VSESVIT LLC (NP)	0.622232	0.910981	0.859204	0.735323	0.942840
East-European Travel Joint Ukrainian-English Company (NI)	-0.754016	-0.384464	-0.494366	-0.657519	-0.306671
East-European Travel Joint Ukrainian-English Company (NP)	-0.938956	-0.980955	-0.997059	-0.990541	-0.962165
GUNSEL LLC (NI)	-0.527521	-0.526190	-0.544983	-0.413473	-0.560480
GUNSEL LLC (NP)	0.384889	0.435950	0.430593	0.554566	0.383901

The obtained results give grounds to assert that NP of GAL-VSESVIT LLC, NI and NP of East-European Travel Joint Ukrainian-English Company are, to the greatest extent, related to the dynamics of e-commerce indicators — both in Ukraine, in Europe, and the world. No significant relationship was found between other indicators of the state of NP and NI of companies and the studied e-commerce indicators.

**5 Discussion**

The growing share of e-commerce and its high impact on logistics processes can contribute to the growth of many threats, particularly the natural environment. The response should be the introduction of new approaches and business models by logistics companies, which should focus on ensuring sustainability, environmental friendliness, and social orientation, which will correspond to the Sustainable Logistics in a Smart City concept.

Authors, [26], conclude that transportation and delivery of goods, public transport services, and traffic are crucial elements of a smart city. Researchers, [27], established a causal relationship between logistics performance and

economic development. So, in these works, the researchers, like the author of this article, identify logistics and passenger transport as one of the pillars on which a smart city is built.

Researchers, [22], note that the cities striving to become "smart" resort to applying ICT to improve their economy, transport system, traffic management, ecology and citizen welfare. This study is aimed at analyzing literature and, unlike the author's study, does not contain an analysis of actual indicators of logistics in smart cities. However, the researchers consider the impact of e-commerce, as in this study.

In work, [28], established that the use of ICT significantly affects the development of smart logistics, which, in turn, positively impacts the smart city environment, increasing social and economic indicators. The practical value of the study is to inform managers about the application of telematics-based smart logistics. At the same time, the author's research is focused on the need for practical implementation of e-commerce in logistics enterprises.

**Sustainable logistics and passenger transport in smart cities**

Olha Prokopenko, Gunnar Prause, Taliat Bielialov, Marina Jarvis, Mykola Holovanenko, Inna Kara

Some works reveal related aspects not explored in this article. Authors, [20], note that the city's evolution into a Smart City should primarily be based on considering various types of standards, including international ones. This research topic concerns the legal aspects of the problem, while the author's article is economic.

In work, [23], focus directly on the Sustainable Logistics concept. The researchers supplement their work with a list of harmful effects of logistics systems, which necessitate the transition to sustainability. Such effects include harmful emissions, traffic jams, accidents and noise. This study is a literature review, while the author's article quantifies the indicated effects by considering several indices related to the logistics performance in different countries.

Many studies aim to develop specific recommendations regarding the transformation of the logistics system. Researchers, [4], suggest increasing route planning efficiency, using environmentally safe vehicles, and implementing holistic strategic planning to transform the logistics system based on sustainability. As in the author's study, the researchers used a cluster analysis of the logistics performance of several European capitals, but e-commerce indicators were not considered. Authors, [24], note that the selection and determination of the method of transportation, the strategy of programming and routing vehicles, and the level of service can contribute to the effective transformation of the logistics system. In work, [25], propose the quantitative determination of greenhouse gas emissions by logistics centers to ensure their climate neutrality and sustainability, which will enable assessing the use of resources and increase the efficiency of operations.

Paskannaya and Shaban, [29], list directions for introducing green logistics into the Smart City concept: urban planning, reducing traffic jams, harmful emissions and noise and reducing transportation costs. In the mentioned studies, the researchers reach a common conclusion that sustainable logistics is, first, a forced necessity in the current conditions. Second, it should be aimed at ensuring environmental and social benefits. Third, it should be embedded into the Smart City concept as its integral part. Fourth, it should develop with the direct involvement of modern ICT. These conclusions are confirmed by the analysis results conducted in the author's article. This study differs by analyzing the mutual influence of the development of logistics and electronic commerce in quantitative terms, the study of the dependence of the profit and income of logistics companies on the e-commerce development indicators. This topic needs to be covered more in the studies. However, in the author's opinion, e-commerce is a crucial factor in the growth of demand for logistics services, particularly in the B2C sector. Authors, [31], reveal the challenges associated with the rapid development of the e-commerce market and supply chains, namely the sustainability and security aspects. Accordingly, researchers focus on the problem of transport routing in the B2B sector and by trying to tackle

the last-mile problem in urban logistics. A comparison of this study with the author's article gives grounds to propose the identification of differences in the transformation of the logistics system based on sustainable development in the B2B, B2C and B2G sectors as one of the potential directions of further research.

## 6 Conclusions

The analysis carried out in the article led to the conclusion that the Sustainable Logistics concept is closely related to the Sustainable Development and Smart City concepts. In many ways, the interrelation of these concepts is determined by the high impact of modern ICT. The analysis determined that the development of ICT causes an increase in the number of Internet buyers and the share of online trade in the total volume of retail trade. In turn, e-commerce significantly impacts logistics development, new logistics companies' emergence, and increased sales volume. The study found a significant correlation between the net profit and net income of the studied logistics companies engaged in passenger transportation and the dynamics of e-commerce indicators. The results obtained during the conducted correlation analysis give grounds to note that GAL-VSESVIT LLC's net profit and the net income of East-European Travel Joint Ukrainian-English Company are mostly related to the dynamics of e-commerce indicators. These indicators include the percentage of online buyers in Europe and the percentage of online buyers in Ukraine (from the total number of Internet users), the volume of the e-commerce market in Ukraine, the share of e-commerce in Ukraine and the dynamics of global e-retail sales.

## Acknowledgments

Research of Olha Prokopenko, Gunnar Prause, Taliat Bielialov and Marina Jarvis was performed within the framework of the international research project of the scientific and technical organization Teadmus OÜ (teadmus.org) "Exploring Sustainable Logistics and Passenger Transport in Smart Cities".

## References

- [1] CAMERO, A., ALBA, E.: Smart city and information technology: A review, *Cities*, Vol. 93, pp. 84-94, 2019. <https://doi.org/10.1016/j.cities.2019.04.014>
- [2] SHKOLA, V., PROKOPENKO, O., STOYKA, A., NERSESOV, V., SAPIŃSKI A.: Green project assessment within the advanced innovative development concept, *Estudios de Economía Aplicada*, Vol. 39, No. 5, pp. 1-15, 2021. <https://doi.org/10.25115/eea.v39i5.5135>
- [3] YIGITCANLAR, T., KANKANAMGE, N., VELLA, K.: How are smart city concepts and technologies perceived and utilized? A systematic Geo-twitter analysis of smart cities in Australia, *Journal of Urban Technology*, Vol. 28, No. 1-2, pp. 135-154, 2021. <https://doi.org/10.1080/10630732.2020.1753483>



- [4] ŠKULTÉTY, F., BEŇOVÁ, D., GNAP, J.: City logistics as an imperative smart city mechanism: Scrutiny of clustered EU27 capitals, *Sustainability*, Vol. 13, No. 7, Article 3641, 2021. <https://doi.org/10.3390/su13073641>
- [5] RUSSO, F., RINDONE, C., PANUCCIO, P.: European plans for the smart city: From theories and rules to logistics test case, *European Planning Studies*, Vol. 24, No. 9, pp. 1709-1726, 2016. <https://doi.org/10.1080/09654313.2016.1182120>
- [6] KIRIMTAT, A., KREJCAR, O., KERTESZ, A., TASGETIREN, M.F.: Future trends and current state of smart city concepts: A survey, *IEEE Access*, Vol. 8, pp. 86448-86467, 2020. <https://doi.org/10.1109/ACCESS.2020.2992441>
- [7] KRYKAVSKYY, Ye., PROKOPENKO, O., SHANDRIVSKA, O., VASYLTSIV, N., NYCZ-WOJTAN, S.: Innovations in management of the complementary development of the territories adjusted to the river cargo transportation, *Marketing and Management of Innovations*, Vol. 3, pp. 257-275, 2020. <http://doi.org/10.21272/mmi.2020.3-19>
- [8] NAUMENKO, M., VALIAVSKA, N., SAIENSUS, M., PTASHCHENKO, O., NIKITIUK, V., SALIUK, A.: Optimization model of the enterprise logistics system using information technologies, *International Journal of Management*, Vol. 11, No. 5, pp. 54-64, 2020.
- [9] PROKOPENKO, O., KICHUK, YA., PTASHCHENKO, O., YURKO, I., CHERKASHYNA, M.: Logistics concepts to optimise business processes, *Estudios de Economia Aplicada*, Vol. 39, No. 3, Article 4712, 2021. <http://dx.doi.org/10.25115/eea.v39i3.4712>
- [10] SAIENSUS, M.: *Trends and prospects for the development of the cold logistics market in Ukraine*, Proceedings of the 32<sup>nd</sup> international business information management association conference, IBIMA 2018 - Vision 2020, Sustainable Economic Development and Application of Innovation Management from Regional expansion to Global Growth, pp. 7222-7235, [Online], Available: <https://ibima.org/accepted-paper/trends-and-prospects-for-the-development-of-the-cold-logistics-market-in-ukraine/> [17 May 2023], 2018.
- [11] ÖZBEKLER, T.M., KARAMAN AKGÜL, A.: Last mile logistics in the framework of smart cities: A typology of city logistics schemes, *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Vol. 44, pp. 335-337, 2020. <https://doi.org/10.5194/isprs-archives-XLIV-4-W3-2020-335-2020>
- [12] PARFINENKO, A., SOKOLENKO, L., BIELIALOV, T., KARPENKO, N.G., TOLUBYAK, V.: Sustainable development of world tourism based on the strategic management, *Academy of Strategic Management Journal*, Vol. 18, No. Special Issue 1, pp. 1-7, 2019.
- [13] KELEŞ, A.E., GÜNGÖR, G.: Overview of environmental problems caused by logistics transportation: Example of European Union Countries, *Tehnički Glasnik*, Vol. 15, No. 4, pp. 569-573, 2021. <https://doi.org/10.31803/tg-20190308110830>
- [14] PRAUSE, G.: A green corridor balanced scorecard, *Transport and Telecommunication Journal*, Vol. 15, No. 4, pp. 299-307, 2014. <https://doi.org/10.2478/ttj-2014-0026>
- [15] SCHRÖDER, M., PRAUSE, G.: Risk management for green transport corridors, *Journal of Security and Sustainability Issues*, Vol. 5, No. 2, pp. 229-239, 2015.
- [16] CHUNG, S.H.: Applications of smart technologies in logistics and transport: A review, *Transportation Research Part E: Logistics and Transportation Review*, Vol. 153, Article 102455, 2021. <https://doi.org/10.1016/j.tre.2021.102455>
- [17] MATUSIEWICZ, M., ROLBIECKI, R., FOLTYŃSKI, M.: The tendency of urban stakeholders to adopt sustainable logistics measures on the example of a Polish metropolis, *Sustainability*, Vol. 11, No. 21, Article 5909, 2019. <https://doi.org/10.3390/su11215909>
- [18] PROKOPENKO, O., MIŚKIEWICZ, R.: Perception of "Green shipping" in the contemporary conditions, *Entrepreneurship and Sustainability Issues*, Vol. 8, No. 2, pp. 269-284, 2020. [https://doi.org/10.9770/jesi.2020.8.2\(16\)](https://doi.org/10.9770/jesi.2020.8.2(16))
- [19] RASHIDI, K., CULLINANE, K.: Evaluating the sustainability of national logistics performance using data envelopment analysis, *Transport Policy*, Vol. 74, pp. 35-46, 2019. <https://doi.org/10.1016/j.tranpol.2018.11.014>
- [20] LAI, C.S., JIA, Y., DONG, Z., WANG, D., TAO, Y., LAI, Q.H., WONG, R.T.K., ZOBAA, A.F., WU, R., LAI, L.L.: A review of technical standards for smart cities, *Clean Technologies*, Vol. 2, No. 3, pp. 290-310, 2020. <https://doi.org/10.3390/cleantechnol2030019>
- [21] GIFFINGER, R., FERTNER, C., KRAMAR, H., KALASEK, R., PICHLER-MILANOVIC, N., MEIJERS, E.J.: *Smart cities. Ranking of European medium-sized cities. Final report*, 2007. <https://doi.org/10.34726/3565>
- [22] ISMAGILOVA, E., HUGHES, L., DWIVEDI, Y.K., RAMAN, K.R.: Smart cities: Advances in research - An information systems perspective, *International Journal of Information Management*, Vol. 47, pp. 88-100, 2019. <https://doi.org/10.1016/j.ijinfomgt.2019.01.004>
- [23] REN, R., HU, W., DONG, J., SUN, B., CHEN, Y., CHEN, Z.: A systematic literature review of green and sustainable logistics: Bibliometric analysis, research trend and knowledge taxonomy,

**Sustainable logistics and passenger transport in smart cities**

Olha Prokopenko, Gunnar Prause, Taliat Bielialov, Marina Jarvis, Mykola Holovanenko, Inna Kara

- International Journal of Environmental Research and Public Health*, Vol. 17, No. 1, 2020. <https://doi.org/10.3390/ijerph17010261>
- [24] MARTINS, V.W., ANHOLON, R., QUELHAS, O.L., LEAL FILHO, W.: Sustainable practices in logistics systems: An overview of companies in Brazil, *Sustainability*, Vol. 11, No. 15, Article 4140, 2019. <https://doi.org/10.3390/su11154140>
- [25] DOBERS, K., PEROTTI, S., WILMSMEIER, G., MAUER, G., JARMER, J., SPAGGIARI, L., HERING, M., ROMANO, S., SKALSKI, M.: *Sustainable logistics hubs: Greenhouse gas emissions as one sustainability key performance indicator*, Proceedings of the Transport Research Arena (TRA) Conference, Portugal, Lisbon, pp. 1-8, [Online], Available: <https://hdl.handle.net/11311/1228467> [05 May 2023], 2022.
- [26] PAN, S., ZHOU, W., PIRAMUTHU, S., GIANNIKAS, V., CHEN, C.: Smart city for sustainable urban freight logistics, *International Journal of Production Research*, Vol. 59, No. 7, pp. 2079-2089, 2021. <https://doi.org/10.1080/00207543.2021.1893970>
- [27] LAN, S., TSENG, M.L., YANG, C., HUISINGH, D.: Trends in sustainable logistics in major cities in China, *Science of the Total Environment*, Vol. 712, Article 136381, 2020. <https://doi.org/10.1016/j.scitotenv.2019.136381>
- [28] SHEE, H.K., MIAH, S.J., DE VASS, T.: Impact of smart logistics on smart city sustainable performance: An empirical investigation, *The International Journal of Logistics Management*, Vol. 32, No. 3, 2021. <https://doi.org/10.1108/IJLM-07-2020-0282>
- [29] PASKANNAYA, T., SHABAN, G.: Innovations in green logistics in smart cities: USA and EU experience, *Marketing and Management of Innovations*, No. 1, pp. 173-181, 2019. <https://doi.org/10.21272/mmi.2019.1-14>
- [30] HALKIV, L., KULYNIK, I., SHEVCHUK, N., KUCHER, L., HORBENKO, T.: *Information and technological support of enterprise management: Diagnostics of crisis situations*, Proceedings of the 11th International Conference on Advanced Computer Information Technologies, ACIT 2021, pp. 309-312, Deggendorf, Germany, 2021. <https://doi.org/10.1109/ACIT52158.2021.9548354>
- [31] PRAJAPATI, D., KUMAR, M.M., PRATAP, S., CHELLADURAI, H., ZUHAIR, M.: Sustainable logistics network design for delivery operations with time horizons in B2B E-commerce platform, *Logistics*, Vol. 5, No. 3, pp. 1-12, 2021. <https://doi.org/10.3390/logistics5030061>
- [32] HOFFMANN, T., PRAUSE, G.: On the legal and economic implications of tele-driving, *Machines*, Vol. 11, No. 3, pp. 1-16, 2023. <https://doi.org/10.3390/machines11030331>
- [33] HOFFMANN, T., PRAUSE, G.: On the regulatory framework for last-mile delivery robots, *Machines*, Vol. 6, No. 3, pp. 1-16, 2018. <https://doi.org/10.3390/machines6030033>
- [34] LONE, S., WELTEVREDEN, J.W.J.: *European e-commerce report*, Amsterdam/Brussels: Amsterdam university of applied sciences & ecommerce Europe, [Online], Available: [https://ecommerce-europe.eu/wp-content/uploads/2022/06/CM12022\\_FullVersion\\_LI\\_GHT\\_v2.pdf](https://ecommerce-europe.eu/wp-content/uploads/2022/06/CM12022_FullVersion_LI_GHT_v2.pdf) [16 May 2023], 2022.
- [35] CLARITY PROJECT, [Online], Available: <https://clarity-project.info/> [06 May 2023], 2023.

**Review process**

Single-blind peer review process.